EMPIR EURAMET
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# Aerial Unmanned Spectrometric (HPGe) System

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JRP Consortium:

# EMPIR Project Preparedness

Aim of the ***Metrology for mobile detection of ionising radiation following a nuclear or radiological incident*** project is to develop new measurement techniques and traceable calibration methods for mobile detection


Partial outcome:

## Unmanned airborne spectrometric (HPGe) system

### SWISSDRONES SDO 50 helicopter

- long endurance (1-3 hours)
- payload up to 40 kg


### + ORTEC IDM-200 HPGe detector

- mechanically cooled HPGe detector
- keeping the detector powered up is crucial:
  - during the flight the detector can be powered either from the helicopter or from the internal battery (2 hours)
  - during transport one can use an external battery or car's 12V outlet

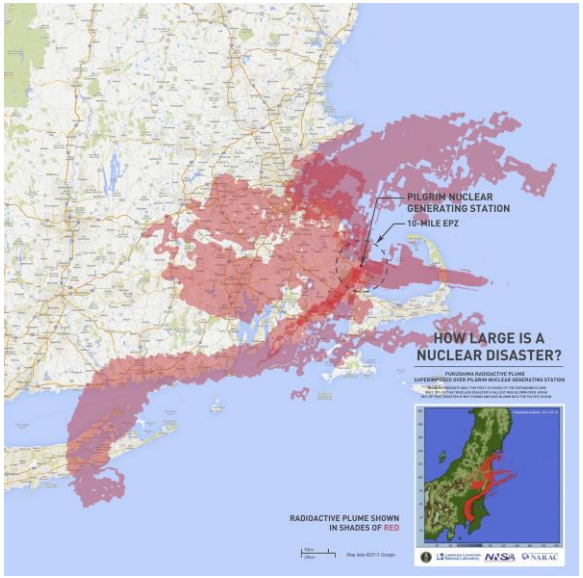
# Why Spectrometric Detector?

**Urgent emergency response phase:**

- Real time monitoring of the accident site (small area)
- Depending on the number of barriers breached, different radionuclides will be present

**Early emergency response phase:**

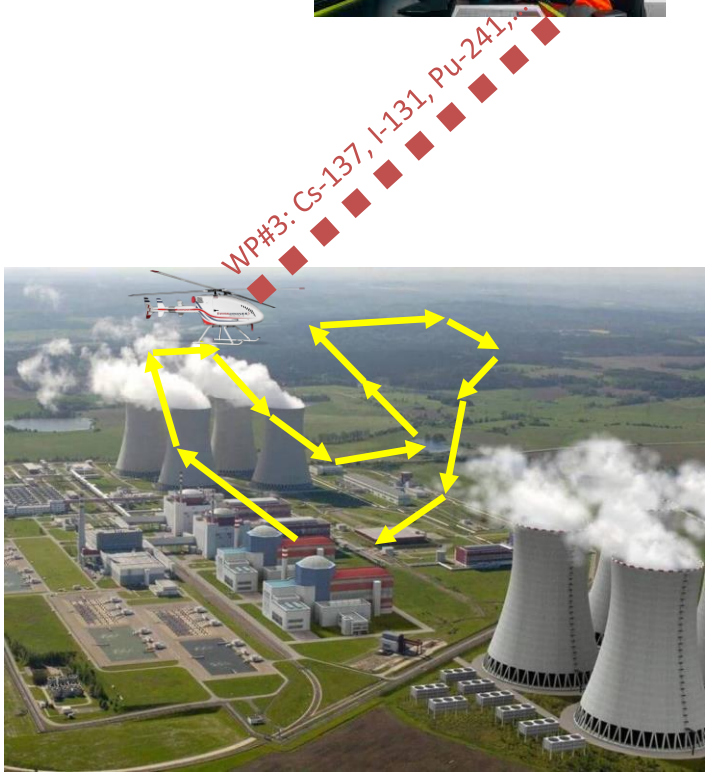
- Monitoring of the radioactive plume over surrounding area
- Different radionuclides possess different radiotoxicity and may require specific countermeasures



# Example scenario

**Urgent emergency response phase monitoring**

1. An accident happens.
2. The UAS is prepared for flight in a safe distance (e.g. 30 km away).
3. The UAS flights to the place of the accident (beyond visual control).
4. The UAS starts to follow the preplanned path with several way-points at key locations. This ensures repeatability of the measurement.
5. At each waypoint the HPGe detector starts to measure the energy spectrum for a given period of time.
6. The spectrum is analyzed and radionuclides identified using the onboard computer.
7. The list of radionuclides together with the coordinates is immediately sent to the operators/emergency responders.
8. The emergency responders can take a proper action.




*The analogous procedure can be applied in the second scenario, i.e. survey of the close vicinity during **early response emergency phase** (zoning).*

# Detector Holder Test (March 2019)

- The UAV detector holder was designed and produced
- It was successfully tested in Buchs in March 2019
- A mass model of the detector was used for these tests

# High-lift Platform Tests (April 2019)

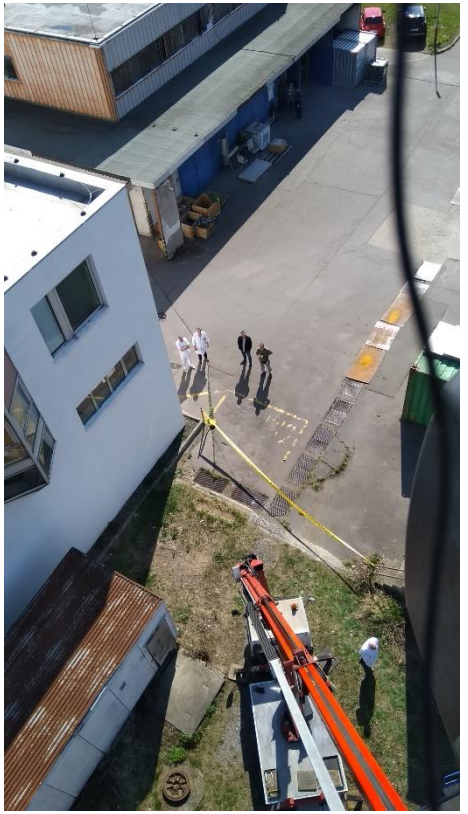
## Validation of the MC model

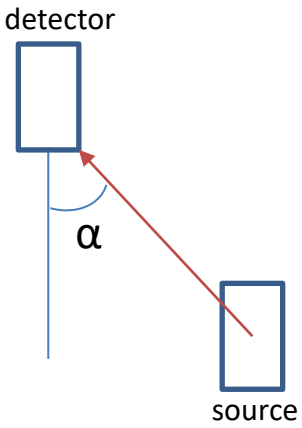
Measurements performed for:

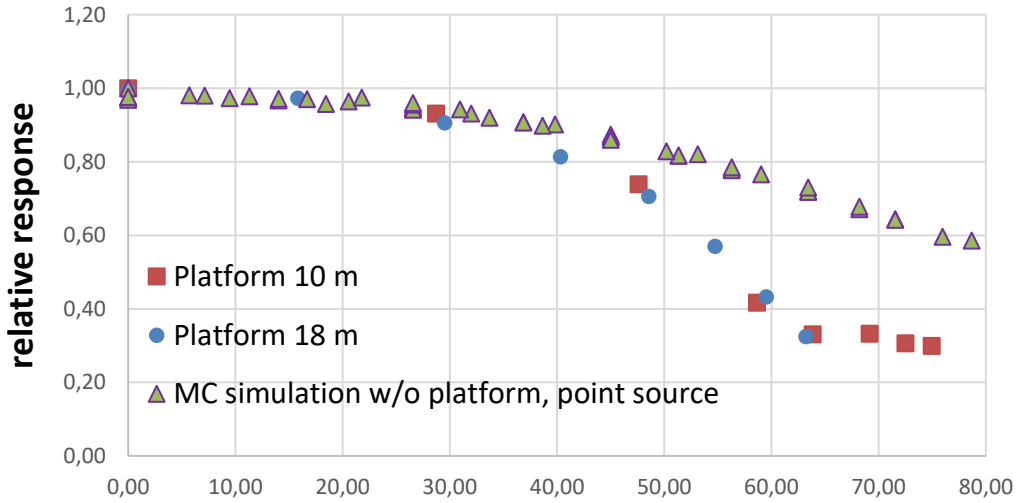
- two heights (10 & 18 m)
- two sources (Cs137, 0.5 & 2 GBq)
- different angles

MC model did not include the platform sides

- this caused discrepancies for larger angles
- otherwise the MC model works flawlessly

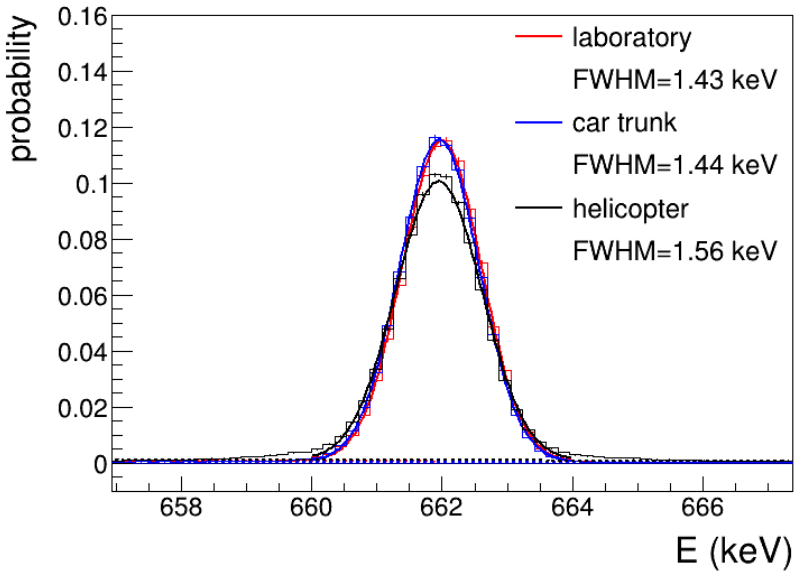




# Manned Helicopter Test (May 2019)

- Cs137 source was placed close to the detector
- the detector was then run in laboratory, during transport by car and on board of helicopter “Sokol” (“Falcon”)
- decrease of resolution due to vibrations and EM noise is negligible



# Manned Helicopter Test II (September 2019)

- First test of the whole system: detector + telemetry + data transfer + data acquisition software
- Detector was placed on board of Robinson R44 helicopter
- Mixed source: Cs137, Co57, Co60, Eu152
- Measurements in different altitudes

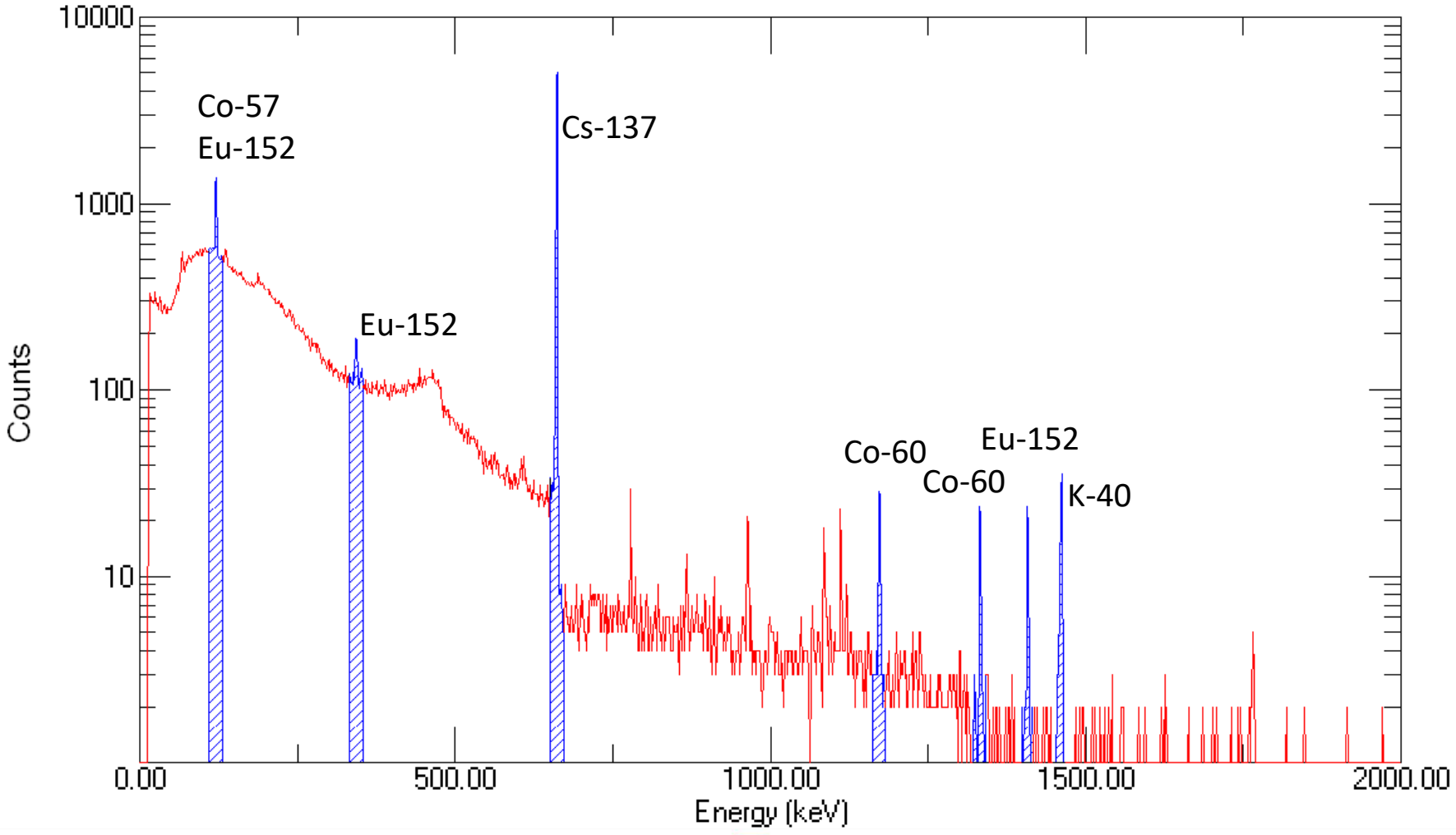
| nuclide | Co-57 | Eu-152 | Eu-152 | Cs-137 | Co-60 | Co-60 |
|---|---|---|---|---|---|---|
| energy [keV] | 136.5 | 244.7 | 344.3 | 661.7 | 1173.2 | 1332.5 |
| MDA in 20 m [MBq] | 3.3 | 3.8 | 1.6 | 0.7 | 0.6 | 0.5 |

# Unmanned Helicopter Test II (November 2019)

- November 2019 – flight test with SDO 50 in Spiez, Switzerland, using several radionuclide sources (Ba-133, Cs-137, Co-60, Am-241)
- Radionuclide identification and activity measurement was performed in several altitudes
- Helicopter proved to be very stable during the flight, 25kg mass of the detector and holder seems to be no issue – except the limited flight time (≤ 1 hour)
- Detector worked well, no significant change in resolution was observed
- Data from the detector were sent to the ground operator in real time

# Example of measured spectrum

## Measurement of a mixed source (Cs137, Co57, Co60, Eu152) in 30 m for 6 minutes



# See you soon on …

## Preparedness Airshow

- measurement campaign within the Preparedness project
- presentation of several unmaned airborne radiation detection systems

**Venue:** Vyskov military area, Czech Republic (transportation from Prague and Brno will be provided)

**Date:** 5-6 May 2020

**Program:**

- Swissdrones SDO 50 + IDM 200 will be presented
- Presentation of BfS, NUVIA's UAVs and much more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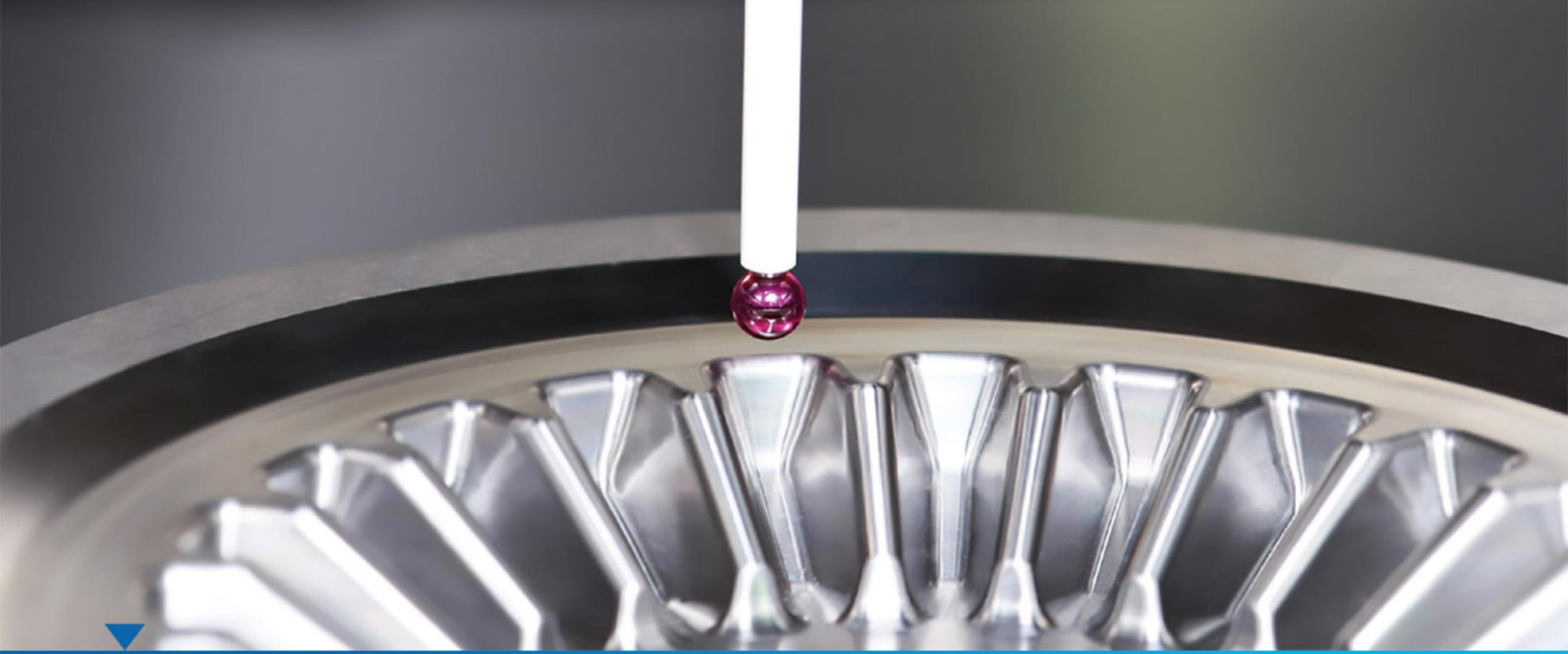
## Conclusion

- A reliable, robust, unmanned airborne spectrometric system equipped with HPGe semiconductor detector
- Novel system providing the emergency responders with valuable, easy to interpret data
- Based on the radionuclide content of the released material the level of technology disruption can be determined
- Identification of radionuclides causing ground contamination is available for quick determination of emergency zones, where urgent protective actions are needed



# THANK YOU FOR YOUR ATTENTION

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