LOST RADIOACTIVE SOURCE EXPLORATION TRAINING CAPABILITIES AT THE CENTRE FOR ENERGY RESEARCH (EK)

ELVESZETT RADIOAKTÍV FORRÁS FELKUTATÁSI GYAKORLATOZÁSI LEHETŐSÉG AZ ENERGIATUDOMÁNYI KUTATÓKÖZPONTBAN (EK)

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Abstract

The article presents the training and practical opportunities of the FOSTER (**F**irst resp**O**nder**S** cen**T**er at the Center for **E**nergy **R**esearch) courses at the Centre for Energy Research (EK) for the first responders. At a CBRNe (Chemical, Biological, Radiological, Nuclear, explosive) event to handle properly the situation several organizations must work together. This can be a difficult task, since the first responders of different organisations have to practice together based on a common procedure [2]. To study radioactive and nuclear materials infield, the Nuclear Security Department (SBL) of EK established both an indoor and an outdoor training site (FOSTER) at the campus of the EK, where several training events have already been held.

Keywords

radiation protection, FOSTER, training site, CBRNe event, orphan source, RCSM

Absztrakt

A cikk bemutatja az Energiatudományi Kutatóközpontban (EK) az első beavatkozó szervek számára kialakított tanpályákon (FOSTER, **F**irst resp**O**nder**S** cen**T**er at Centre for **E**nergy **R**esearch) végezhető képzési és gyakorlatozási lehetőségeket. Egy CBRNe (Kémiai, Biológiai, Radiológiai, Nukleáris, robbanó anyag) esemény kapcsán több szervezetnek kell együtt működnie az esemény megfelelő lebonyolítása érdekében. Ez nehéz feladat, mivel a különböző szervezetektől jövő első beavatkozóknak közösen kell gyakorolniuk, egy közös eljárásrend alapján [2]. A radioaktív és nukleáris anyagok terepi vizsgálat érdekében az EK Sugárbiztonsági Laboratóriuma (SBL) beltéri és kültéri tanpályákat (FOSTER) hozott létre az Energiatudományi Kutatóközpontban, melyeken azóta több tréninget is tartottunk.

Kulcsszavak

sugárvédelem, FOSTER, tanpálya, CBRNe esemény, elhagyott forrás, RCSM

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INTRODUCTION

One of the main tasks of the Nuclear Security Department (SBL) of EK is to explore, collect, identify, and store the lost orphan nuclear sources and materials in Hungary as delegated in the 490/2015. (XII.30.) governmental decree to EK [1]. Also, this decree describes the required relevant intervention procedures and the steps of the intervention in such cases (which organization has to act and when).

The EK has the following technical capabilities to meet among others, the tasks delegated by the decree:

- The EK is the Collaborating Centre of the International Atomic Energy Agency (IAEA) in Nuclear Forensics.
- Nuclear forensic laboratory with ICP-MS laboratory for the destructive analysis of the nuclear materials.
- Test laboratory for the testing of radiation monitoring devices in dynamic, static and pulsed radiation fields.
- Gamma spectrometry laboratory for the non-destructive analysis of the nuclear materials;
- Mobile Expert Support Team (MEST), i.e., a trained human resources for the exploration of nuclear materials.
- Mobile laboratory for exploring, collecting, and transporting the nuclear materials.
- Storage facility for the orphan nuclear materials, and for the other radioactive sources.
- Recently developed indoor and outdoor FOSTER (**F**irst resp**O**nder**S** cen**T**er at the Center for **E**nergy **R**esearch) training sites.

The Centre for Energy Research is the Technical Support Organization of the Hungarian Atomic Energy Authority (HAEA) and has also got cooperation programs with the following organizations:

- National Directorate for Disaster Management (NDDM)
- Counter Terrorism Centre (CTC)
- Hungarian Defence Forces (HDF)
- Hungarian Defence Forces "Görgei Artúr" Chemical Biological Radiological Nuclear Area Information Centre (HDF CBRN ACC)
- Hungarian National Police, National Bureau of Investigation
- National Tax and Customs Administration (NTCA)

EXERCISES, DEMONSTRATIONS WITH THE MOBILE EXPERT SUPPORT TEAM (MEST)

The organized EK MEST demonstrations for the Police, the ITWG (International Technical Working Group) and the GICNT (Global Initiative to Combat Nuclear Terrorism) conference participants are shown on Figure 1.:

Figure 1: MEST demonstrations, [own construction]

The EK participated at a joint action with the National Directorate for Disaster Management (Figure 2).:

Figure 2: NDDM and EK joint action, [own construction]

EK participated at the Horizont 2020 „C-BORD" EU project together with the NTCA. The testing of the new instruments and procedures developed in the frame of the project was performed at the Hungarian-Serbian border control point (BCP) at Röszke. These devices included the newly developed HVCM portable X-ray machine of Smith Detection, the

sniffer equipment developed by Manchester University and Bonn-Rhein_Sieg University and the radiation portal monitor developed by Symmetrica Co. Ltd. (Figure 3.):

Figure 3: The C-BORD test at Röszke BCP, [own construction]

Most of these practices had difficulties, e.g. it was often time consuming to coordinate the needs of the field practice (required place, radioactive sources, equipment, accessories etc.), also it is a requirement to get the license from the HAEA which is strictly necessary.

The EK made a full demonstration in Vienna at the International Atomic Energy Agency (IAEA) Headquarters together with the Hungarian National Police, National Bureau of Investigation. At the demonstration the common procedure at a crime scene with radioactive contamination was showed. (Figure 4.).

Figure 4: MEST+Police demonstration at IAEA [own construction, Contesy of Index and Police.hu, 7, 8]

PREPARATIONS FOR THE JOINT INTERVENTION WITH RELEVANT ORGANISATIONS

The EK made cooperations with several Hungarian stakeholders, such as the CTC, NDDM, Hungarian National Police, National Bureau of Investigation, HDF CBRN ACC). The EK created a common procedure and training material with the Hungarian Police, National Bureau of Investigation in the frame of the Internal Security Fund project for the joint management of radiological crime scenes [2].

The test laboratory of EK has capabilities to test different types of measurement devices under various ionizing radiation conditions.

With the radiation risk assessment supporting VR DOSE code [3], several simulations can be done. The code can simulate and calculate the absorbed dose of the first responder persons (avatars) and visualize the location. The EK SBL tested this code and participated at the calibration and verification procedure [4].

In Figure 5. the VR DOSE code was used, two ^{241}Am and one ^{239}Pu sources were placed in the created location of the indoor training site. The route of the orphan source researcher (avatar) is shown.

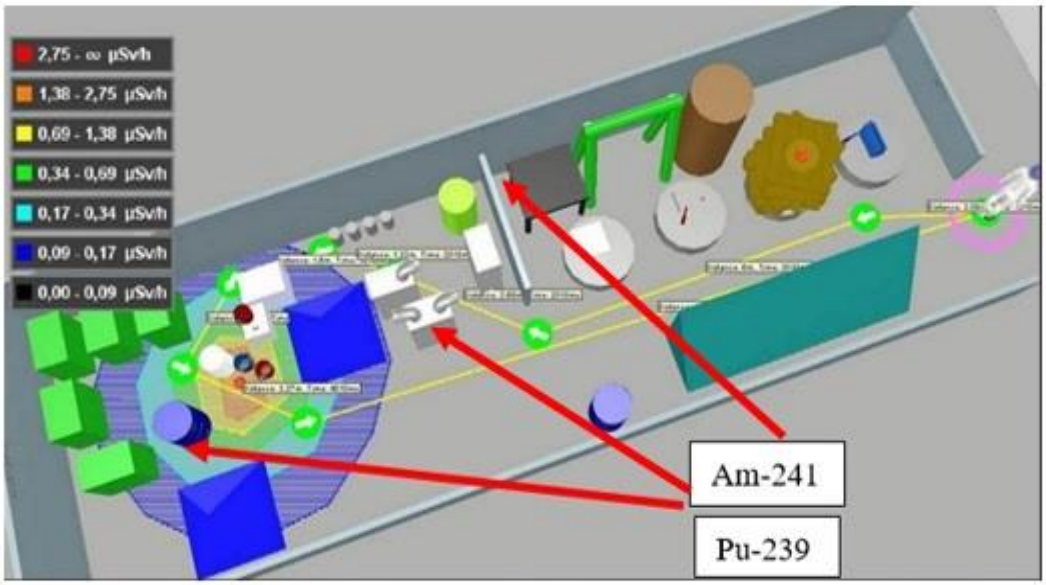

Figure 5: A created location for the simulation, [own construction]

The avatar made two interventions. First, a slowly moving beginner's movement was simulated, who did not keep distance from the sources. In the second run an advanced first responder's route was simulated. In Figure 6. the calculated dose rate field, and dose rate isocurves by the VR DOSE can be seen.

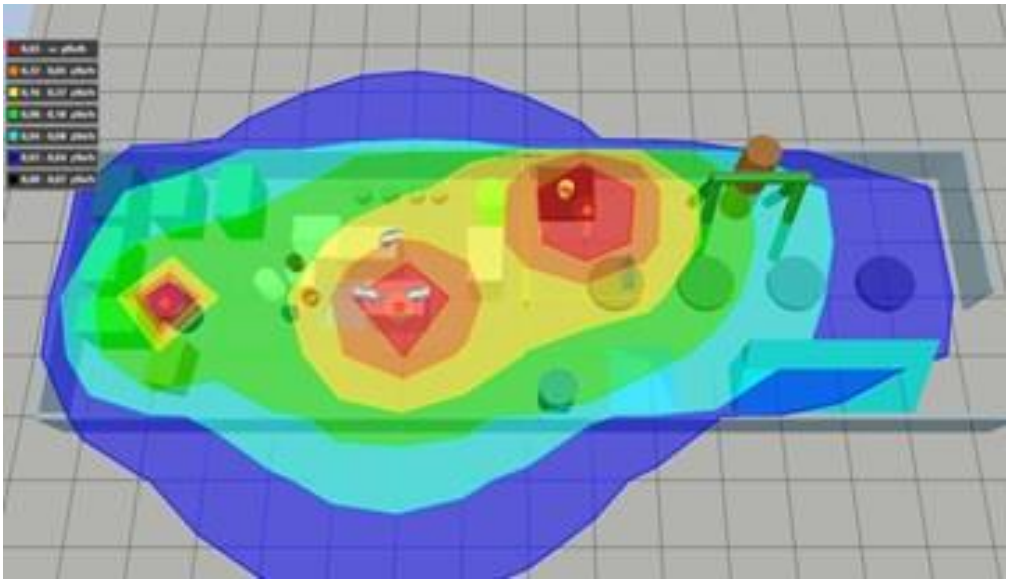

Figure 6: The dose rate fields of the sources, [own construction]

In Figure 7. the dose difference accummulated in the beginner and the advanced first responder is shown. Also it can be seen that the beginner often receives high dose rates.

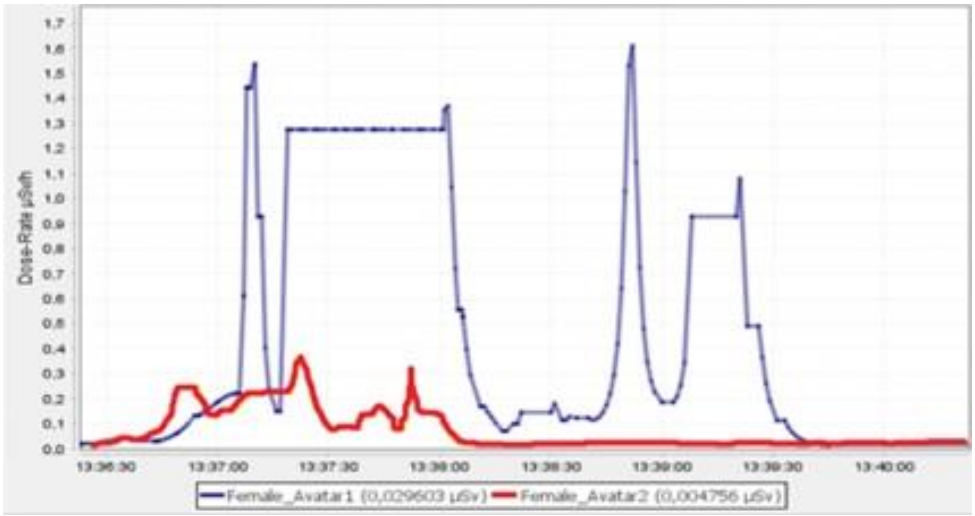

Figure 7: The absorbed dose of the beginner (avatar 1) and the advanced (avatar 2) intervener, [own construction]

The accummulated dose is much lower if the advanced first responder scans the location due to lower dose rates.

This is the reason why it is really important, beyond the theoretical knowledge, to make physical trainings to achieve real experiences.

INTERNATIONAL EXPERIENCES ABOUT THE EXPLORATIONS OF ORPHAN SOURCES

The INCLUDING [5] project seeks to provide a fully fledged and comprehensive training in the RN security sector at European level. Starting from the existing training resources of the Partners in the Consortium, - mostly developed in the framework of EC projects - INCLUDING aims are the enhancement of practical knowledge and to boost an European sustainable training and development framework for practitioners in the RN security sector. Far from being a simple aggregation of entities separated geographically and with complementary expertise, INCLUDING is intended to be a cluster of facilities and resources pursuing a Federated Model in which individual components will cooperate together to provide a common framework for optimizing the exploitation of all the potentialities available in the Cluster [5]. The aim of the INCLUDING project is to assess the knowledge and technical skills of different EU countries in the orphan source exploration. The EK participated at several joint actions (JA) in Athens, Greece; Mikkeli, Finland and Paris, France. At the JAs different scenarios were presented and the orphan source exploration was in the focus, and also in parallel brand new, freshly developed techniques were performed.

After the JAs the observing group made an immediate evaluation about the demonstration, where the proper practices and the development possibilities were identified. From the JA in Athens, a typical example for a possibility for development was the collection of an orphan source localized in a sea container hours after its localization.

A few other development possibilities were also found at the JA in Athens. This fact highlights how important is a well written and well-trained common procedure. With the training of different scenarios, education most of those development possibilities can be tested. The use of not completely tested procedure can cause significant radiation protection related problem.

THE USE OF FOSTER SITES AT EK

The Governmental Decree (490/2015) delegates the task to the Centre for Energy Research as the responsible institution for analysis and characterization of confiscated or found nuclear materials with unknown origin. The procedure used for this activity is carried out by the Nuclear Security Department.

In the case of confiscation or finding of nuclear material with unknown origin, their identification and first characterization/categorization is performed in-field by the Mobile Expert Support Team (MEST) with the support of the Mobile Laboratory.

The Centre for Energy Research established an indoor and an outdoor training field at the EK premises for the training and harmonizing the different organization's procedures of exploring orphan radioactive sources/nuclear materials.

Several scenarios can be performed at these training fields utilizing the available laboratories and buildings like the „C" level isotope laboratory, a hangar with natural background and enhanced background supplemented with neutron field.

The EK collaborates with different organizations delegated by the 490/2015. (XII.30.) in order to work and train together for the exploration of orphan sources. For this purpose, the EK established an indoor and an outdoor training sites.

The indoor training site is located near the EK's central isotope facility (Figure 8.):

Figure 8: Indoor training site, [own construction]

At this site the indoor scenarios can be practiced. The indoor site can considered very special, because at the first half of the site there is normal dose rate background, but at the other side of the place the background is about 2-3 times higher than the natural background (Figure 9.). In this environment it is extremely hard to explore orphan sources.

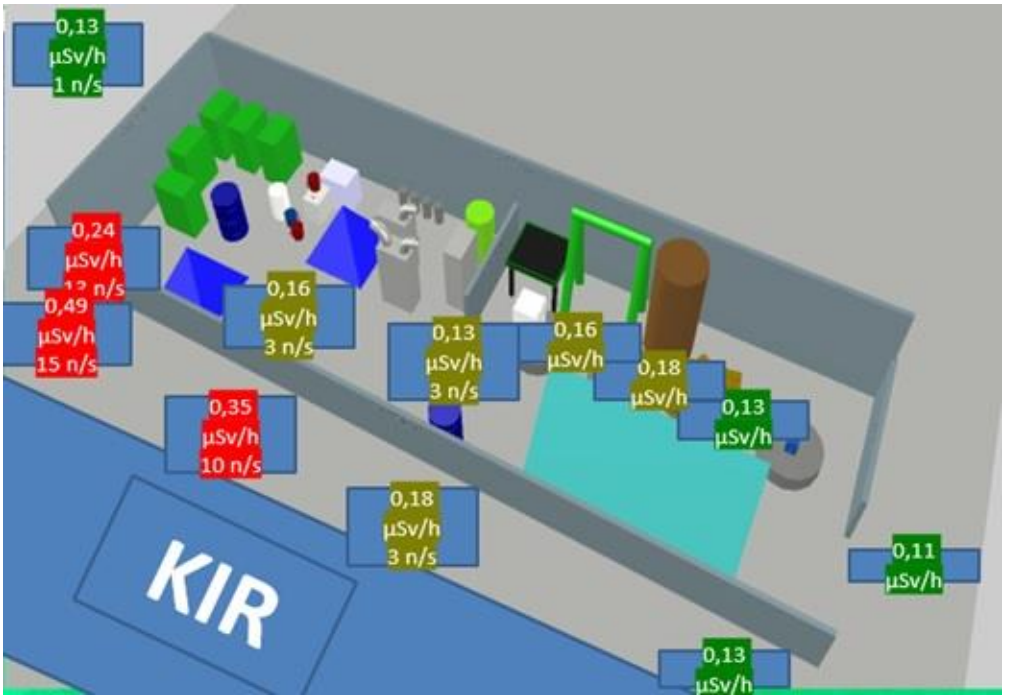

Figure 9: The dose rate map of the indoor training site, [own construction]

The indoor training site is an advanced one, where the orphan source exploration can be done in a special environment. Most of the real scenarios are not as difficult as at the indoor site, but if a first responder can successfully explore the sources than at any case the efficiency of the exploration can be high.

Where else is this practical knowledge useful? At a decommissioning site or at special places where neutron field is generated, it causes activation and hot spots like in NPPs and irradiation facilities.

Technical design of the FOSTER

The main operator laptop is connected to the four HD space cameras and to the body cameras. The camera signals from the site can be transferred, streamed to the far away terminals and users.

At the indoor site the environment can be changed during the exploration, fire, dust can be generated by the operator, other hazards can be placed like chemical materials, sound, and light effects also available.

With these techniques the capabilities of the in- and outdoor sites are as follows:

- Online, real time or „podcast" mode: The FOSTER can be operated on-line-real time mode from the operator room; thus the far away observer can see exactly what the reconnoitrer sees on spot, including the operator room and the whole site. The streaming can be recorded and can be uploaded to a channel for later control.
- Real Avatar Reality: The FOSTER allows for the far away observer to see what the reconnoitrer sees and can communicate with him, so the observer can remote the reconnoitrer as an avatar.
- Back up support: The far away observer can help the MEST to make back up calculation, the observer can see measured values and he can make the calculations in a comfortable mode at any place; with his help the efficiency of the reconnaissance can be increased.
- Active FOSTER: At the first part of the site there is natural radiation background, but at the back part the dose rate level is about 2-3 times higher then the natural level, and neutron radiation can also be measured. At this environment most of the detectors fail to measure, so it is a hard challenge to continue the work.
- Dinamic FOSTER: At the site the environmental conditions can be varied, the operator can remotable switch on/off the lights, can make fire with smoke and can make any kind of music or noises.
- Virtual forbidden FOSTER: To work with very high activity sources without shielding is strictly forbidden. At the FOSTER it is possible to work with „very high activity" (virtual) sources, because the FOSTER can imitate real radioactive sources.

Radioactive material exploration demonstration with the Hungarian National Police, National Bureau of Investigation

At the indoor training site the EK and the Hungarian National Police, National Bureau of Investigation made a demonstration showing how a joint exercise takes place (Figure 10-11.). The scenario was to find, collect and analyze radioactive material at an illegal laboratory. The whole work was done based on the common operating procedure.

Figure 10: Joint exploration exercise at illegal laboratory, exploration of illegal sources, [own const ruction, Courtesy of Duna Tv, 6]

Figure 11: Joint exploration exercise at illegal laboratory, collecting, measuring the found sources, [own construction, Courtesy of Duna Tv, 6]

THE OUTDOOR SITE

For outdoor scenarios, the EK created an outdoor site at the KFKI campus (Figure 14.). It is located inside a forest in concreted area. A hot zone can be designated, and an

observer station is placed at the site. At the indoor site, several scenarios can be performed like parking lot, border control point, highway accident etc.

At the training sites UGV and UAV testing is also available. The EK also made UGV tests.

The outdoor site was tested by the National Directorate for Disaster Management, the scenario was a BCP (Border Control Point) event (Figure 12.). At the test, the camera and streaming system were tested and the NDDM tested their new backpacks and other measurement devices. Inside the vehicle several sources were hidden. The task was to find all the sources in the car. The other task was to detect the sources at high vehicle speed when the backpacks were inside the van, and also when the sources were under the vehicle (Figure 13).

Figure 11: BCP scenario at the outdoor site, [own construction]

Figure 13: Radioactive source exploration under vehicle, backpack testing at high speed, outdoor site, [own construction]

Figure 14: The streamed picture of the outdoor training facility, [own construction]

The „Train the trainer" event at the FOSTER

At the outdoor site the "Train the Trainer" event was held by the US NNSA NSDD (National Nuclear Security Administration National Nuclear Smuggling Detection and Deterrence). The experts of NSDD controlled the Hungarian expert teams (Counter Terrorism Centre, National Directorate for Disaster Management) from far away via internet. The event was broadcasted with the four HD on-site cameras and with several body cameras (Figure 15.). Each team had to make a demonstration and presentation of their equipment and a BCP test was done at the indoor site, to demonstrate how the RPM-s (Radiation Portal Monitor) detect the "smuggled" radioactive material. The faraway observers, controllers were able to see on-line in real time the views of the body cameras and the on-site cameras, and they controlled the action from far away. During the demonstration professional translation was organized on-line from Hungarian to English and from English to Hungarian.

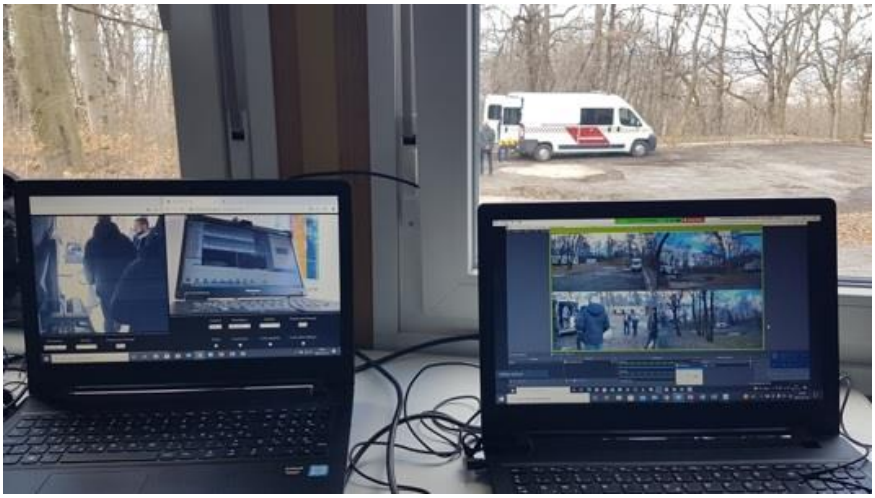

Figure 15: The streamed pictures of the outdoor training facility, left side: the views of the body cameras, right side: views of the four on-site cameras [own construction, Courtesy of NSDD]

Hungarian Joint Action by the frame of the INCLUDING project

At INCLUDING project's Hungarian Joint Action a complex scenario was demonstrated, where the Counter Terrorism Centre arrested a dangerous criminal who was dealing with a radioactive source (Figure 16.). After the arrest, the MEST (the team from the Hungarian National Police, National Bureau of Investigation and the EK SBL) arrived at the house of the arrested person to investigate the location. At the scenario the above mentioned common operating procedure was demonstrated. Furthermore, several technical developments were presented to the INCLUDING team:

- Virtual system: Virtual radioactive source system (VRSS), virtual surface contamination (Figure 17.)
- BCP control with giant scintillation detectors & DOZIMOBIL system (Figure 18.)
- Drone, UGV reconnaissance (Figure 19.)
- Mobile laboratory

Figure 16: Hungarian Joint Action, Counter Terrorism Centre& Rapid Response and Special Police Services& MEST action, [own construction]

Figure 17: Demonstration of the VRSS, [own construction]

Figure 18: Demonstration of the DOZIMOBIL system, [own construction]

Figure 19: Demonstration of the drone and helicopter based survey systems, [own construction]

SUMMARY

At a CBRNe event or an orphan source searching event several organizations must work together. To enhance the efficiency of this interventions the proper preparation is essential. The EK made several demonstrations in explorations and created, developed common operating procedure [2] and training materials, made cooperation agreements with other organizations. At the EK detector testing is available by the test laboratory. The MEST is designated for the exploration, the Mobile Laboratory is able to explore and transport orphan sources to a designated storage facility. At the Nuclear Forensic Laboratory, the orphan sources can be characterized. The EK has all the applications and knowledge about the orphan nuclear materials.

The organization of an exercise often has difficulties. The EK created and developed the training sites (FOSTER) where several kinds of nuclear security related in- and outdoor scenarios can be practiced for Hungarian partners and for international experts, first responders, trainers. The training sites have several capabilities. Nuclear security and the success of an intervention can be increased by the use of the training sites.

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