Centre for Energy Research

The Virtual Radioactive Source System (VRSS)

Reaching the impossible….

Designed & developed by EK for the MEST (Mobile Expert Support Team) + Worldwide

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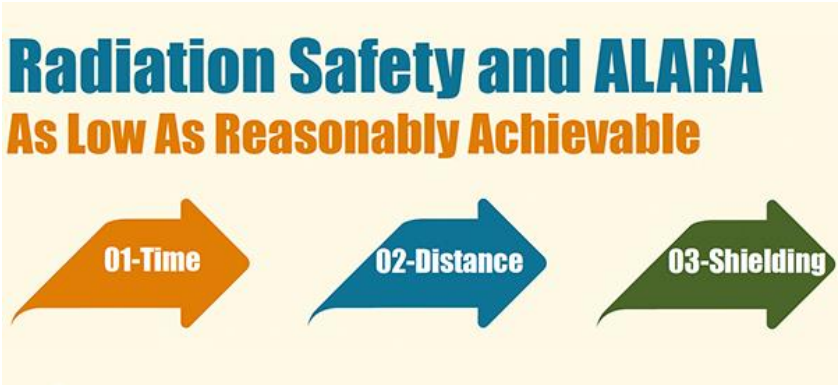
VRSS what it is?

- The developed virtual gamma system is a true radiation-free, real action (i.e., not computer-run) simulation system using electronic hardware and software tools. The system is intended for creating any kind of radiation detection condition implemented without real radiation, real source, real measuring detector.
- It includes a ("virtual") hardware/electronic source and detector, as well as a software measurement scenario and user interface display on a computer. A user performs/experiences the simulation, which is controlled by the operator. The system can be also programmed for alpha, beta, neutron; dose, dose-rate, count-rate, spectra identification detection and surface contamination (alpha, beta) detection. The system can be programmed for any kind of shielding object and its factors to the source and map (e.g.: concrete wall, barrier, packaging). Shielding objects and factors can be represented virtually on the simulation operation area.
- Operator can see dose rate map and manipulate the simulation by adding/removing shielding. Initial software components and hardware prototypes have been implemented as the first phase of the project. These developments were mainly intended to assess the possibilities and boundaries of the simulations.

Indication

- At the training sites, only „D” physical protection level sources can be used, by the licence of the Hungarian Atomic Energy Authority (HAEA)
- At the trainings, demonstrations it is strictly **not allowed** to use high dose rate areas and surface contaminated objects by the ALARA principle!

- The demonstrations and trainings have limits!!!
- It is impossible to prepare for rare but very dangerous cases like high activity source goes out of shielding, or decontaminating a surface contaminated object.
  It means a well trained MEST member has no any practice for that cases.
- Also at a training, a real source can be damaged and it can contaminate the training participant, it was happened (not at EK☺).
  So beyond a proper license the safety cannot be 100%.
  But never???!!!

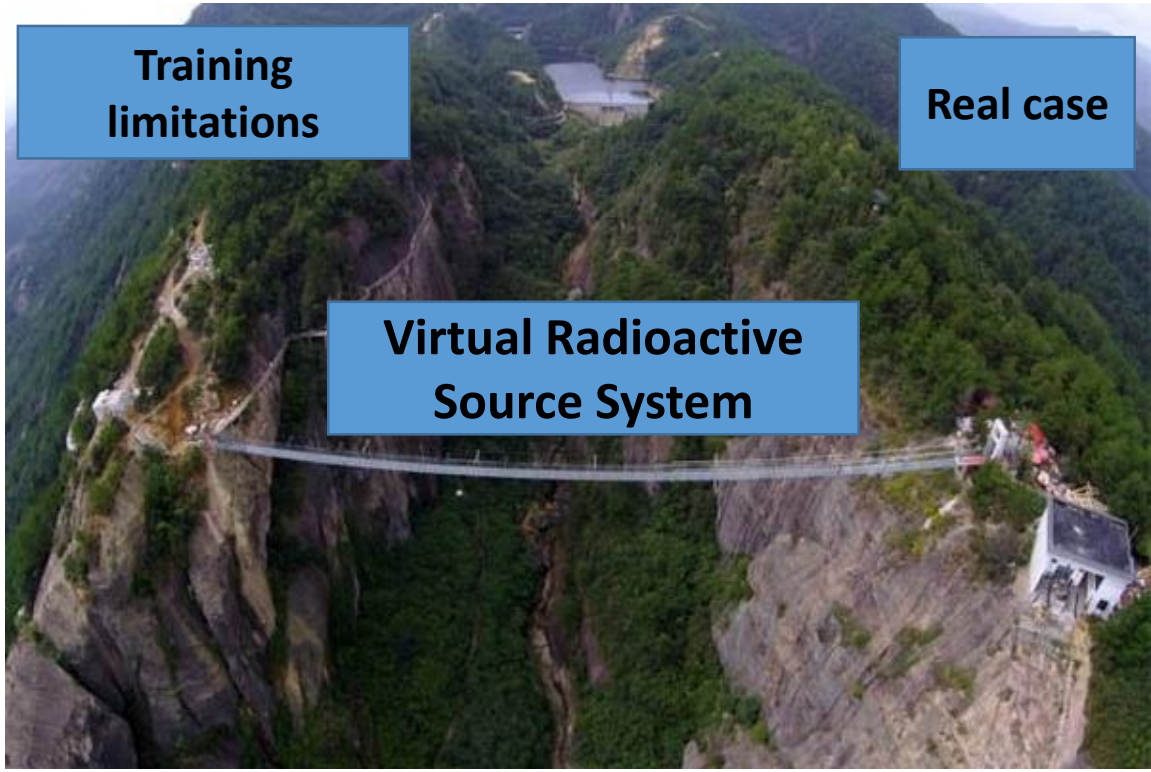


Goals

There is a gap between real cases and training possibilities, the bridge of the gap is the main goal.

The goals:

- **Is to design a system that behaves like a real**
  - **radioactive source**
  - **radioactive contamination**
  - **dose rate meter**
  - **surface contamination meter**
  - **nuclide identifier.**



- **Maximizing the radiation protection safety/security.**
- **Step over the limitations.**
- **Opportunity to open the source searchning for everyone, everywhere, everytime.**
- **No licenese needed.**
- **Design the system to be user friendly and be able to operate easily.**

Possibilities

- Trainings with „regular” cases
- Trainings for rare, very dangerous cases (high dose rate areas, contaminated objects)
- Trainings for beginners
- Testing the MEST members
- Training the trainers, judges with designed placement of hidden mistakes
- Training the authorithy persons (identifiy mistakes by the laws, RP ordinances, standards)
- Train the UGV, drone operators for locating the „radioactive” sources
- Do this at maximum Radiation Porotection safety/security!!!

How it works??? Real sources vs. Virtual Radioactive Source System

Real case

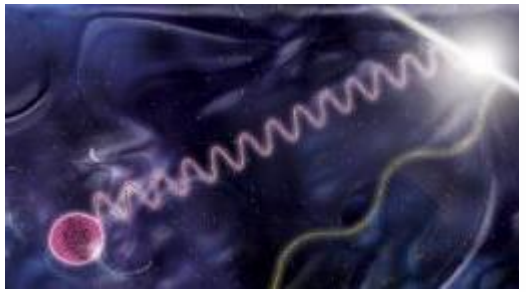
Measures Count rate (in count per sec) and calculates the dose rate

$$\Delta H/\Delta t = H = DCF \times A/r^2 \cong H^*(10)$$

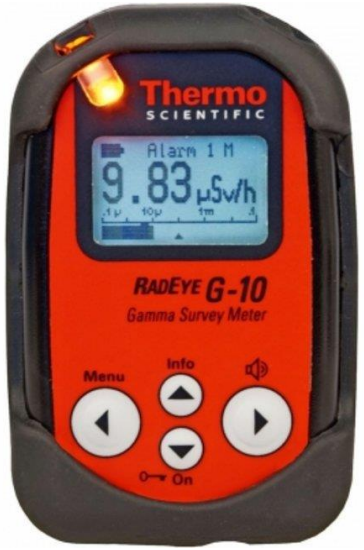
A: activity
r: distance
H: calculated dose rate
DCF: dose coefficient factor
H*(10): measured dose rate

Real radioactive source

Gamma radiation



Real dose rate meter



Virtual case

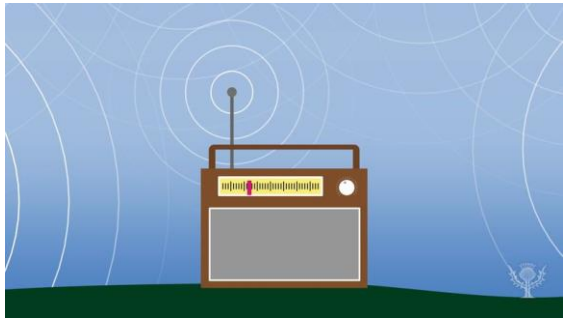
Measures distance every sec between the emitter and transceiver and calculates the dose rate

$$H_{real} \cong H_{virtual}$$

At every sec, every distance

Virtual source (Emitter)

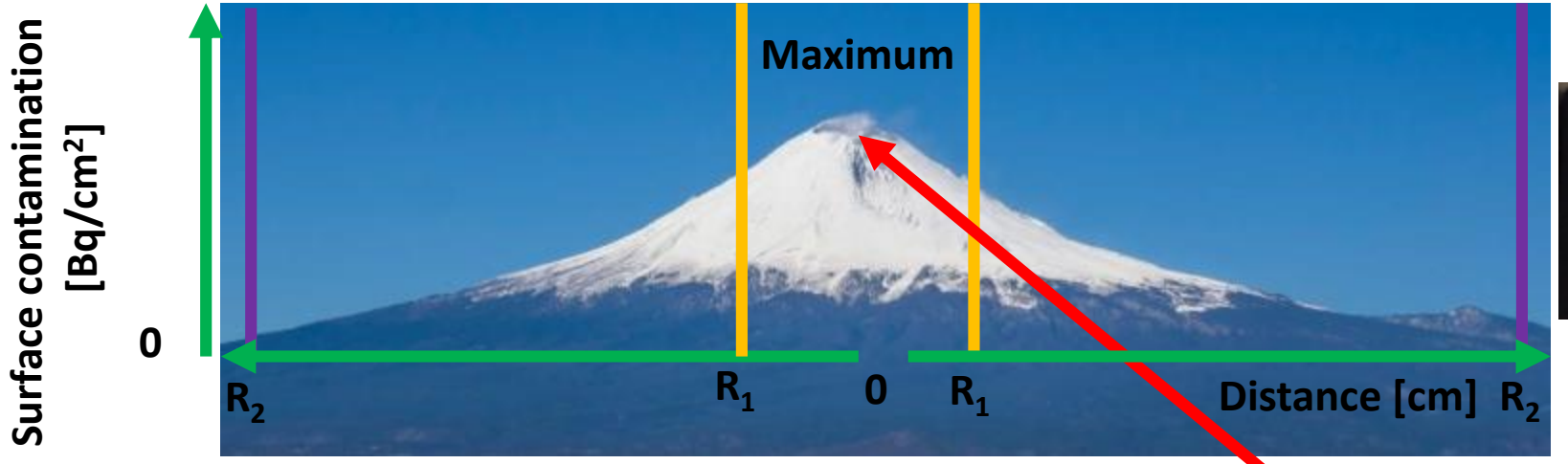
Radio waves



Virtual dose rate meter Transceiver

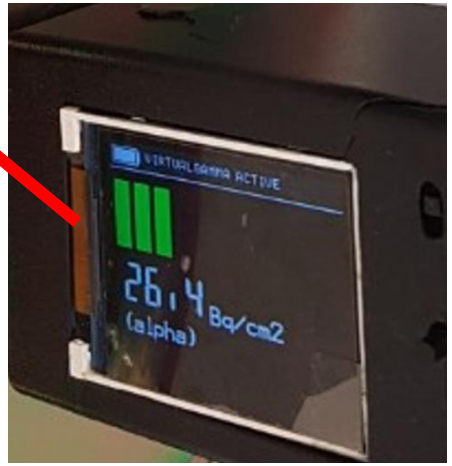
How it works??? Surface contamination (Volcano) mode

To imitiate surface contamination on a table the virtual surface contamination meter has a special equation: It measures the distance every sec between emitter & transceiver, between R_1-0 cm the contamination is maximum, between R_1-R_2 the contamination is proportional, after a distance R_1 the contamination is 0.



Table

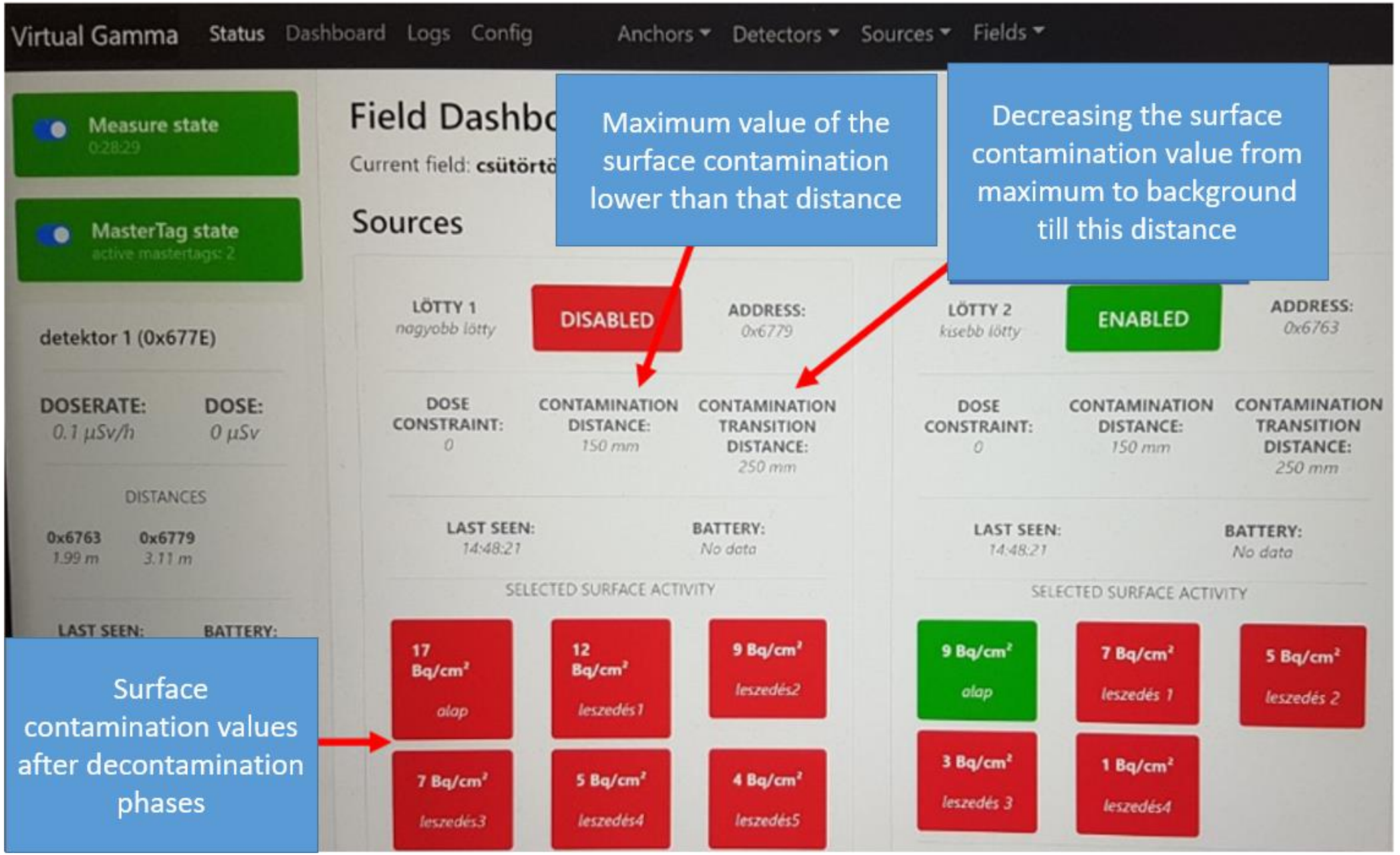
Virtual source (Emitter)



How to operate???

- Turn on the Virtual Radioactive Source System (VRSS).
- Design the scenario/simulation:
- Define the sources
- Geometry
- Shielding
- Add the source informations into the user interface and place the virtual radioactive source and the shielding.
- Let’s go!!!!
- The system are automatic only at the proper time the VRSS operator have to switch the values.
- The system’s time for changing is 1 sec.
- It can be operated from smartphone.
- The VRSS operator can follow the training from far away and control the simulation.

User interface

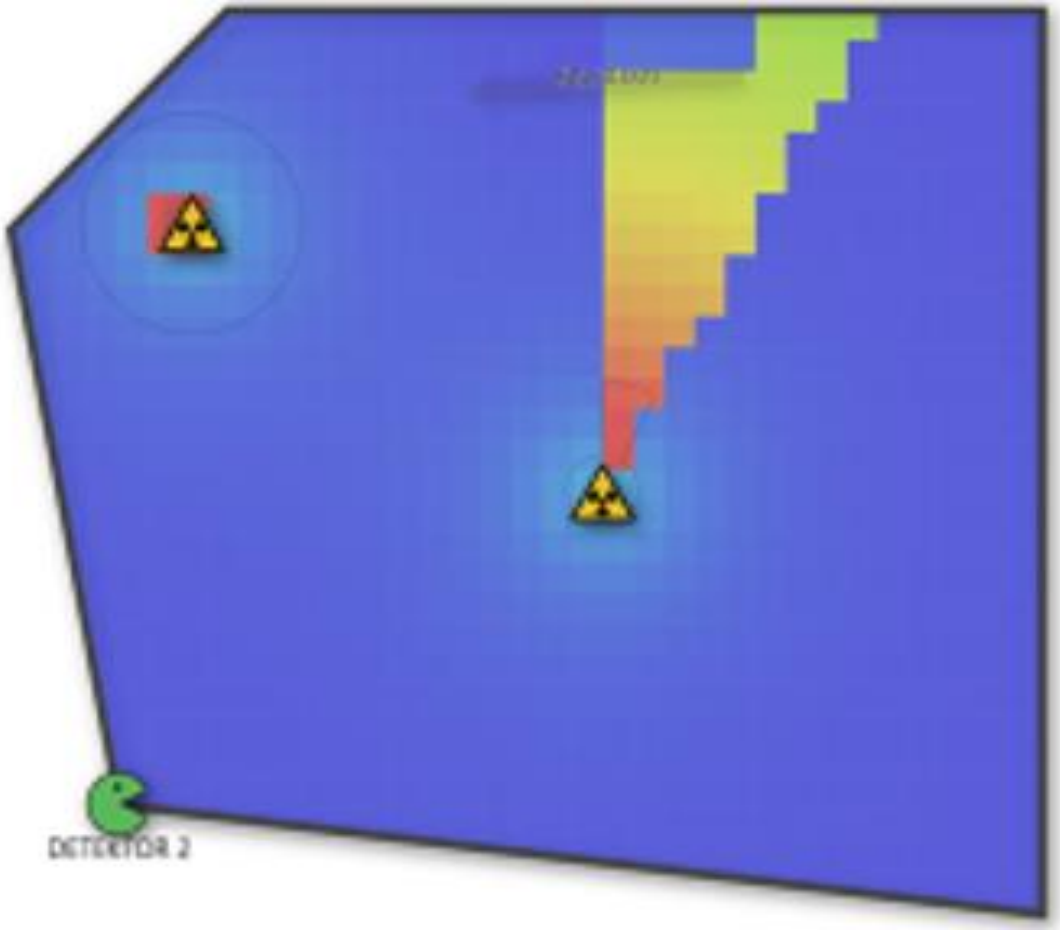


Extra features

On-line, real time on route dose rate monitoring & dose rate map can be displayed!

With the virtual-virtual mode no emitter (virtual hardware source) should be placed on the training site.

Different kind of virtual-virtual radioactive sources can be programmed at the same time.



Demonstration of the capabilities of the Virtual Radioactive Source System

- Background measurement real vs. Virtual dose rate meter
- Dose rate measurement from different at given distances from real vs. Virtual source
- Nuclide identification of real vs. Virtual source
- Virtual dose rate measurements of a high activity radioactive source without shielding, producing very high dose rate field + dose rate measurement using shielding
- Surface contamination background measurements real vs. Virtual surface contamination meter
- Surface contamination measurements real vs. Virtual surface contamination meter
- Measurement of the results of the decontamination process with virtual surface contamination meter
- Demonstrating the virtual-virtual source mode + dose rate map & on-line, real time on route monitoring

With EK everything is possible,
even that means anything…

Thank you for your attention!