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Practical Use of the Mobile Radiological Laboratory to Support the Nuclear Regulatory Authority of Ukraine

- In the framework of the IAEA project UKR/9/028 “Strengthening of nuclear and radiation safety infrastructure”, the Nuclear and Radiation Safety Regulatory Authority of Ukraine (SNRIU) received a mobile radiological laboratory RanidSONNI at the end of 2010.
- The mobile laboratory was developed and manufactured in Finland by the company Environics. The delivery was done via IAEA in cooperation with the Nuclear and Radiation Safety Regulatory Authority of Finland (STUK).
- Since 2011 the mobile laboratory RanidSONNI is on the balance of SSTC NRS and is used by its personnel.

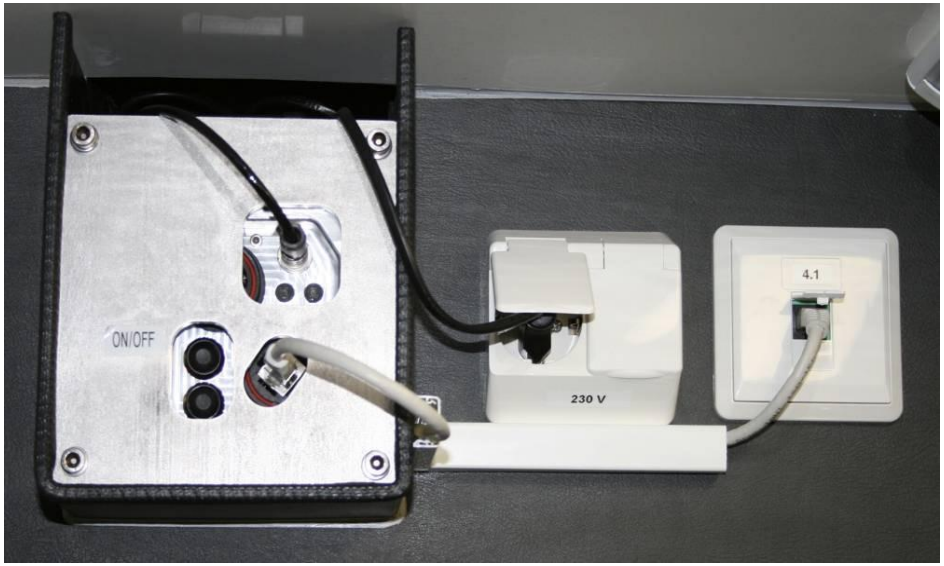

Hella
Hella

Equipment of RanidSONNI

- The measurement system has two large NaI(Tl) scintillation detectors which are mounted on the opposite walls facing the sides of the RanidSONNI. Steel shields of 10 mm around the detectors create 180° fields of view opening outwards.

Equipment of RanidSONNI

- RanidPro100 LaBr3 detector is mounted in front of the vehicle. It is located above and in between the driver and co-driver's seats. It is installed inside a 10 mm thick background radiation shield tube opening in the direction of travel. This type of collimation makes it possible to provide a spatial scan of the incident site from a distance.



- In addition, it gives a capability to pinpoint target vehicles among the traffic

Equipment of RanidSONNI

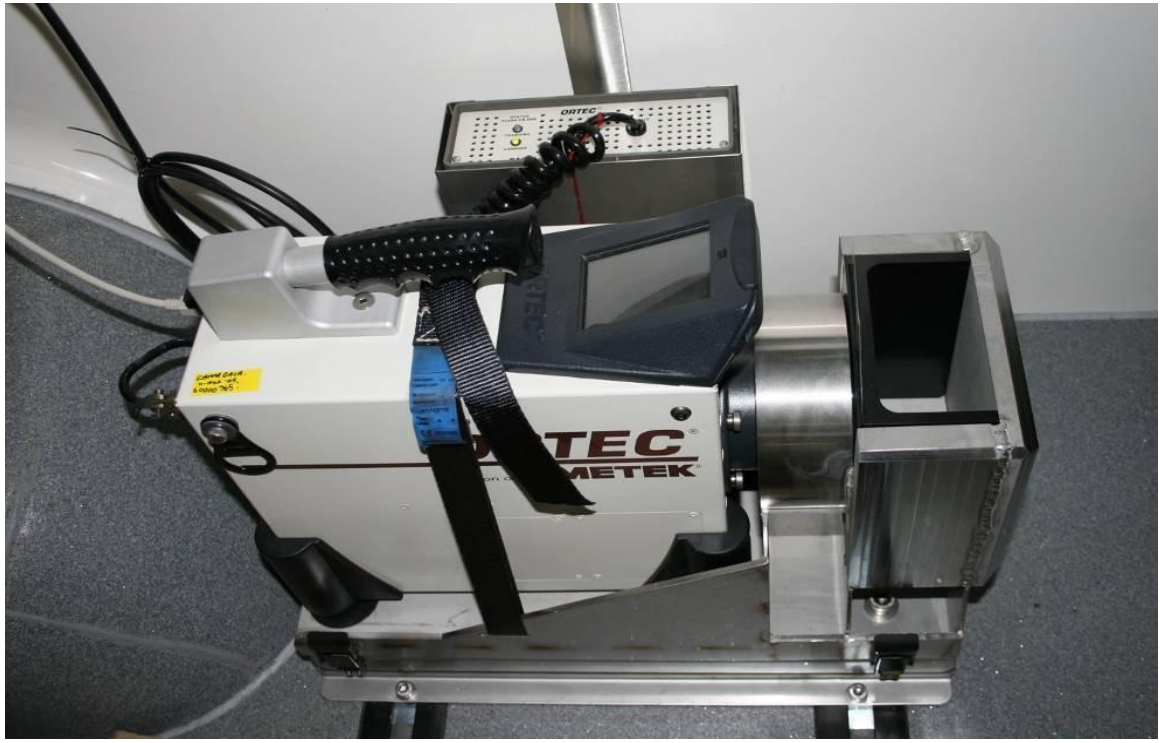
- The mobile laboratory is equipped with two fixed air samplers. The filters are laminated into a plastic cassette, which makes sample handling easy in the moving vehicle. Sample preparation is not needed before measurement because of the design of the filter cassette.
- The main features of the system are as follows:
  - two collection lines for air sample collection;
  - adjustable air flow from 10 to 40 m^3 per hour, with possibility of stepwise adjustment;
  - filter holder cassettes to facilitate easy sample handling;
  - possibility to use glass fiber and membrane filters;
  - collection areas compatible with 76 mm diameter gamma spectrometer end cap.

Equipment of RanidSONNI

- Air sampling system

Equipment of RanidSONNI

- The RanidSONNI is equipped with a portable spectrometer “ORTEC-AMETEK” on the basis of pure germanium (with electric cooler), what allows making measurements of samples and filters directly at the sampling point.



Equipment of RanidSONNI

- The RanidSONNI is also equipped with a portable measurement system Vasikka in a backpack used for online assessment of radiation situation.
- Vasikka is a portable device for detection, identification and data collection. Vasikka is composed of a laptop, gamma and neutron detectors. For remote system control, a mobile phone or palmtop can be used.
- Vasikka continuously collects and analyzes radiation information from detectors. All collected data are stored in a database for subsequent review or detailed analysis.
- Vasikka system is controlled by specially developed software, which ensures performance of field spectrometry, radiation monitoring in real-time mode and data transfer. The same software is installed on the server and RanidSONNI workstations.

Equipment of RanidSONNI

- Portable measurement system Vasikka in a backpack

Equipment of RanidSONNI

- The RanidSONNI has a portable air sampler.

- The stand-alone sampler is portable and battery-powered; so they can be dropped at any location for fully autonomous sampling. The filters are laminated into a plastic cassette, which makes sample handling easy. Sample preparation is not needed before measurement because of the design of the filter cassette. Air consumption is up to 12 m^3/h.

Equipment of RanidSONNI

- The RanidSONNI is equipped with peripheral systems and equipment:
  - **The wireless intercom system** for up to 4 users. The system consists of one base unit where four handsets could be connected.
  - **GPS positioning system**. A combined GPS antenna & receiver is mounted on the roof of the vehicle. The vehicle location will be stored in the database.
  - **Surveillance camera**. The system has a forward looking surveillance camera (Bosch DinionXF IP camera) with digital image storage to the commander's laptop.

Equipment of RanidSONNI

- The main server uses computer hardware tools, including radionuclide identification software. The main server handles all of the measurement data from the different detectors and measurement systems. Measurement data are analyzed with Vasikka radionuclide identification software
- All sensors are connected to the server via communication network.
- The working stations are connected to the main server through local area network. All working stations can operate independently and manage the measurement data through local area network.

Equipment of RanidSONNI

- The vehicle is also equipped with a 3G-modem to transfer the measurement data (from each detector) and information on the vehicle location (GPS-coordinates) to the SSTC NRS server in automatic on-line mode.
- On the SSTC NRS server, the data are processed and stored in a special database, which is accessible for on-line support of radiation reconnaissance as well as for subsequent, more detailed analysis of results.

Main Tasks for the Mobile Laboratory

- The mobile laboratory RanidSONNI is used for:
  - monitoring of radiation situation around radiation-hazardous facilities (NPPs, research reactors, uranium mining and processing enterprises etc.) at all stages of their life-cycle;
  - search, identification and preliminary categorization of orphan ionizing radiation sources (IRS), and IRS which can be out of regulatory control due to natural disaster, emergency situations, etc.;
  - radiation monitoring for early detection of IRS in places of mass events;
  - support of regional state nuclear and radiation safety inspectorates under surveys of radiation-hazardous facilities.

Practical Experience in Use of the RanidSONNI

UEFA Football Championship EURO-2012

- To fulfill SNRIU order and to ensure systematic radiation monitoring along the perimeter and on the territory of the fanzone at the Independence Square in Kyiv during the EURO-2012 Finals, the SSTC NRS Radiation Protection Department implemented the corresponding activities.
- All available measurement devices were used, and, in addition, for the period of the EURO-2012, the IAEA provided search equipment such as: portable spectrometer with gamma and neutron detectors МКС-АТ6101С, which is similar to “Vasikka” system, and two pagers of Polimaster type with CsI detectors.

Practical Experience in Use of the RanidSONNI

- All activities involving use of the RanidSONNI were coordinated with SNRIU. The following measures were implemented to fulfill the assigned tasks:
  - Theoretical and practical sessions for training of mobile laboratory staff and a workshop focusing on the concept of RanidSONNI use during EURO-2012, in cooperation with representatives from the STUK and the Environix, were conducted;
  - In cooperation with the Kyiv City Administration, routes for radiation surveys around the fanzone and parking spot for the vehicle were identified. The staff involved into EURO-2012 activities was appropriately certified

Practical Experience in Use of the RanidSONNI

Route for monitoring of the fanzone in Kreschatic, Pushkinska, Grinchenko Streets and Independence Square

Practical Experience in Use of the RanidSONNI

- On the opening day of EURO-2012 Finals, 8 June 2012, background level was measured around the Olimpiysky Stadium, fanzone and adjacent streets using RanidSONNI stationary (on-board) equipment and portable devices;
- At the preparatory stage, crews were staffed with experts of the SSTC NRS Radiation Protection Department and SNRIU Radiation Safety Department and procedures were developed for operation of the RanidSONNI mobile laboratory from 7 June to 2 July 2012.

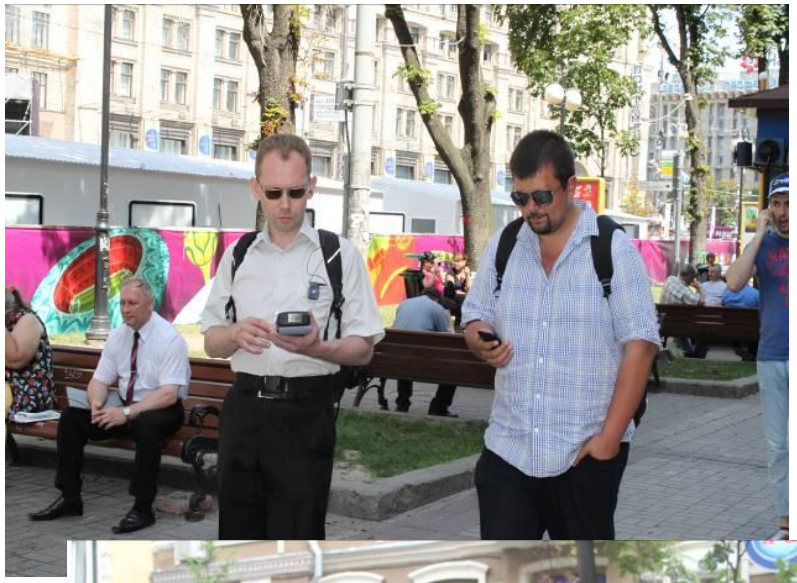
Practical Experience in Use of the RanidSONNI

- Measuring background level prior to opening of EURO-2012

Practical Experience in Use of the RanidSONNI

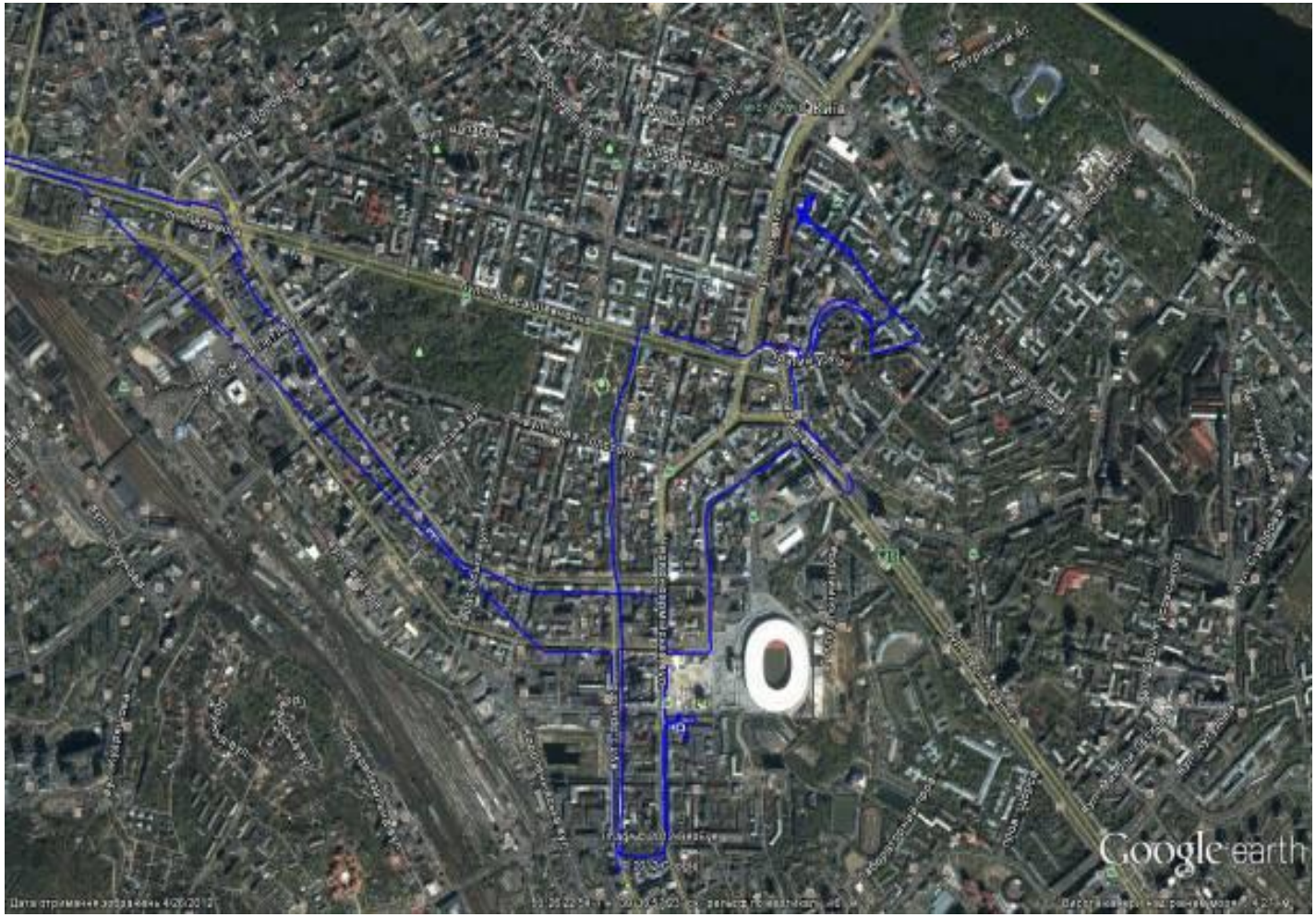
- Radiation surveys were conducted on a daily basis, including weekends and holidays, twice a day. In the morning, the fanzone was checked using portable spectrometers to monitor potential locations of radiation sources (cars parked nearby, trash containers etc.). In the afternoon, the fanzone territory was checked after its opening using pagers.
- In addition, radiation survey of city streets on the vehicle route using stationary devices was conducted. The routes were chosen in advance to cover as many city streets and squares as possible. The spectral data and results were remotely transmitted to the SSTC NRS server, thus enabling real-time supervision and guidance of the field performance.

Practical Experience in Use of the RanidSONNI



Practical Experience in Use of the RanidSONNI

GPS route of the mobile laboratory introduced into the SSTC server



Practical Experience in Use of the RanidSONNI

- Radiation monitoring was conducted independently. The STUK and Environics (equipment manufacturer) experts were on call, should a need for support arise.
- Measurement results were reported to the Head of SNRIU Radiation Safety Department on a daily basis.

Practical Experience in Use of the RanidSONNI

- **Results**
  - Based on results of the performed measurements, the RanidSONNI crew on duty concluded that there were no incidents involving radiation sources, and dose rates on the routes remained at background level.
  - Radiation sources were revealed twice by means of portable devices: “medical source” (a patient) and “commercial source” (used in various devices, such as chemical detectors). The source was detected in a special-purpose vehicle of the Ministry of Emergencies of Ukraine. Both sources were detected owing to high sensitivity of the detectors, the dose rate remaining at background level.

Practical Experience in Use of the RanidSONNI

- Based on the positive experience and results, the following should be noted:
  - professional training and well-defined operation of personnel of the mobile laboratory was proved;
  - reliable operation of the hardware complex, on-board equipment as well as portable equipment was confirmed;
  - optimal planning of activities according to available human and equipment resources was accomplished;
  - during survey of the city downtown area, local spots (granite plates) were detected and identified, dose rate of which exceeded 2 μSv/h.

Practical Experience in Use of the RanidSONNI

- Some **lessons** were also learned.
  - Participation in radiation protection survey measures during mass events requires also financial support.
  - For efficient response to possible radiation incidents, even closer cooperation of executive power authorities is needed. As Finnish experience demonstrates, the cooperation with other authorities, such as police, border and customs, in conducting radiation surveys enhances efficiency and effectiveness of the security operations.
  - It would be reasonable to develop a specific program of the Kiev city survey to detect “hot spots” of man-induced origin with the subsequent development of a program of corrective measures.

Practical Experience in Use of the RanidSONNI

Survey of medical institutions

- A number of pilot surveys were conducted, in particular, radiological survey of the National Institute of Cancer.
- The measurement of the radiation situation was conducted along the entire route from the moment of the departure of the RanidSONNI crew to its return to SSTC NRS.
- Continuous measurements of the following areas of the National Institute of Cancer were performed:
  - at parking lot near the administrative building of the Institute
  - at the entrance to the open-source department
  - on the run close to a spent materials settling tank of the open-source department.

Practical Experience in Use of the RanidSONNI

- Measurements using portable kit Vasikka and Detective-EX were conducted in the following places:
  - In premises of open-source department of the Institute:
  - Brachytherapy premises (source Co-60 in container);
  - Patients' waiting room after medical procedures with I-131;
  - Under radiation source Co-60 in Rokus AM installation (6000 Ki) at closed gate;
  - Nearby the operating tomograph;
  - Nearby the empty transport container of depleted uranium.
  - Above special drainage system of open-source department.

Practical Experience in Use of the RanidSONNI

- Survey results obtained during movement along Kiev streets:
  - No radiation anomalies were detected during continuous monitoring on the route in Kiev streets using stationary equipment of the mobile laboratory.
  - Spectrometric measurements have identified gamma-radiation sources – those were natural sources 40-K, 232-Th in balance with daughter decay products.

Practical Experiences in Use of the RanidSONNI

- Survey results using detectors of the mobile laboratory on the territory of the National Institute of Cancer:
  - There are no radiation anomalies in the public places, radiation background sources are natural radioactive materials typical for Kiev.
  - On the parking lot near the open-source department, radiation anomalies relating to patients going out of the department after medical procedures were detected. Spectrometric analysis of radiation identified its origin – I-131 used in the department for treatment.
  - Survey of the road near the tank of spent materials coming from the open-source department was conducted. The spectrum clearly demonstrated the peak of I-131.
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Practical Experience in Use of the RanidSONNI

- **Measurement results of premises of the open-source department**
  - Measurements in the brachytherapy premise (source - Co-60 in a container). Both devices – Vasikka and Detective-EX – registered higher level of radiation but did not identify radionuclide.
  - Measurements in patients' recreation room. Vasikka confidently located this room. In measurements during 100 sec, the source type was identified – I-131, dose rate in the room constituted about 200 nSv/h.
  - Measurements at "Rokus AM" installation at closed gate. Both portable devices detected radiation anomaly, but did not identify the source type. Along with that, after analysis of the spectrum, Co-60 was identified.

Practical Experience in Use of the RanidSONNI

- In measurements near the operating tomograph, higher radiation background was registered, but both devices did not identify the source automatically.
- Measurements of empty transportation containers of depleted uranium represent special interest for the future. Both devices detected anomaly even under higher radiation background in the premise. At the same time, Detective-EX automatically identified presence of uranium.
- Measurements above the special drainage system of the open-source department did not detect presence of artificial isotopes.

Practical Experience in Use of the RanidSONNI

Inspection

- Portable equipment of the RanidSONNI was used during the pre-licensing inspection of the Kyiv oncological hospital. The following was surveyed:
  - open-source department,
  - sealed isotopes department,
  - nuclear medicine center (PET-technologies), radiopharmaceuticals cyclotron.
- Use of measurement tools brought positive experience, provided possibility to observe actual levels of radiation, detect radiation sources, identify them and thus assess radiation state of the facility, sufficiency of shielding and other protective measures and means.

Practical Experience in Use of the RanidSONNI

- It is planned to involve the mobile laboratory RanidSONNI in inspections at NPPs of Ukraine, corresponding regulations are currently under development.
- Radiation surveys of territories of medical institutions and around uranium mining and milling enterprises using the mobile laboratory RanidSONNI will be conducted in the near future in the framework of international cooperation with the European Commission (project U3.01/11 Component C) with participation of the regulatory authority of Finland.

Conclusions

- SNRIU obtained the possibility to conduct independent monitoring according to IAEA requirements.
- Mobile laboratory permits its use for different tasks regardless of location of the objects to be surveyed.
- Equipment of the laboratory allows clear identification of radiation anomalies in parked position and during movement. Portable tools allow determining the location and identifying the type of radiation sources.
- SNRIU has the intention to use the mobile laboratory RanidSONNI for a wider range of objectives.