



UNIVERSITY OF TARTU

Estonian environmental radioactivity research & CONCERT topic 2

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CONCERT Info Day, BfS, Munich, 27 January 2016



Laboratory of Nuclear Spectroscopy

- Development of nuclear detection methods (gamma-ray spectroscopy, liquid scintillation spectroscopy)
- NORM-waste generation in technogenic processes – emissions of natural radionuclides from oil shale power plants and NORM waste from drinking water treatment plants.
- Distribution and propagation of natural (Pb-210) and artificial (Cs-137) radionuclides in the atmosphere, soil, peatland and water.
- Modelling the propagation of radionuclides (*RESRAD, METEX, Geant4 etc.*)



Ongoing & planned activities

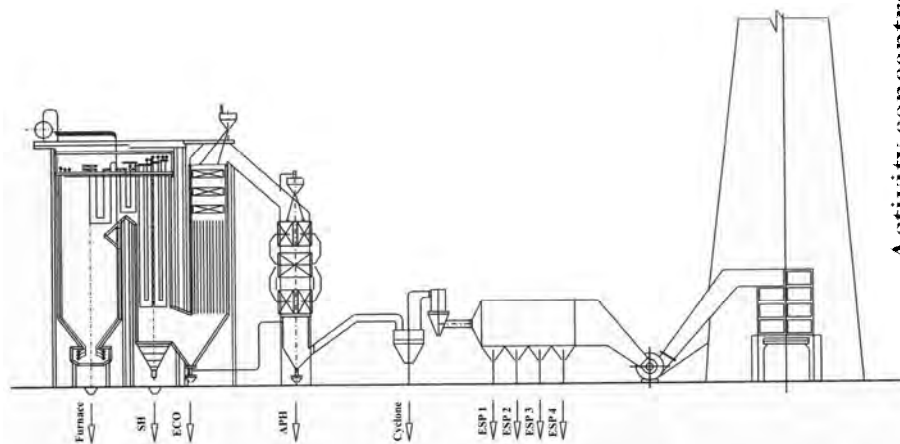
- The radiological impact of oil shale industry – enrichment of natural radionuclides in the oil shale ash.
- Drinking water treatment by removing natural radionuclides.
- Analyze the radiological impact when using NORM waste in building materials.
- HPGe γ -spectrometry and liquid scintillation counting for the determination of natural radionuclides.
- Examine the methodology and possibilities of in-situ radon measurements.
- Radiological impact of Rare Earth Element (REE) industry

Case study: Fossil fuel plant activity

Oil shale = Estonian fossil fuel, 85% electricity

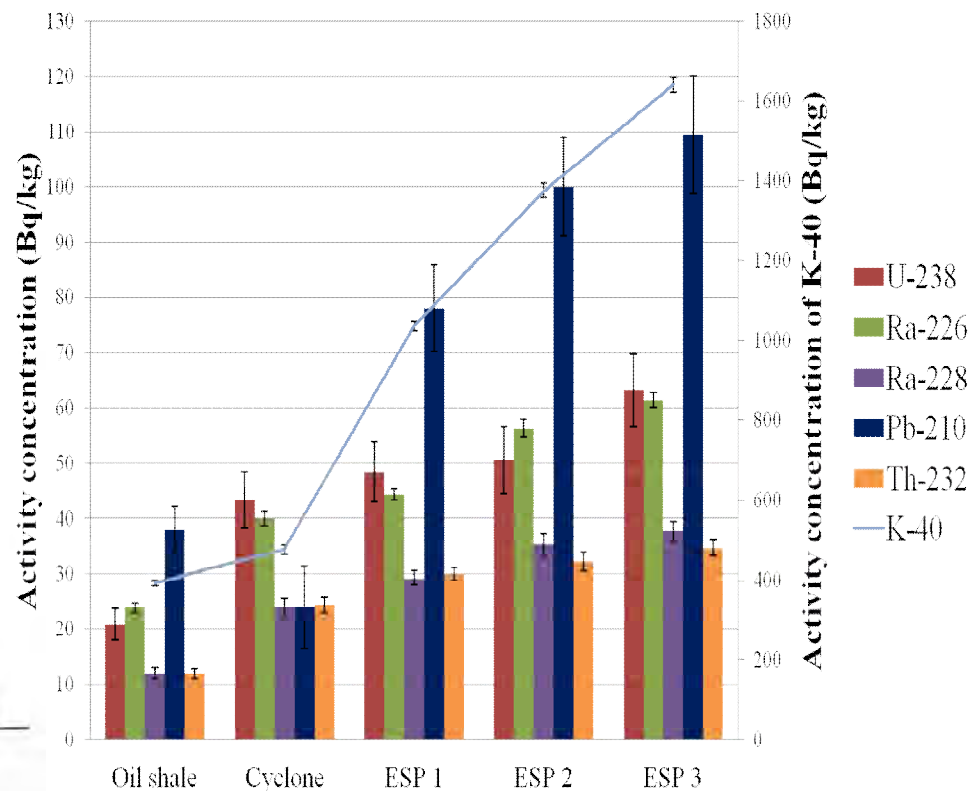


• Oil shale • Mining • Ash • Natural radionuclides



*Ots, *Oil shale fuel combustion*, 2006.

Activity concentration



*Vaasma, Kiisk, Meriste, Tkaczyk. *J Envir Rad*, 2014.



Our main NORM interest

1. Generate more site-specific data points to improve models and reduce uncertainties
2. Assess migration and leaching risks from use of NORM materials in construction
3. Migration of radionuclides in the environment and accumulation, based on environmental conditions
4. Radiation impact assessment

Proposal to form TOPIC 2 consortium (Reducing uncertainties in human and ecosystem radiological risk assessment & management in nuclear emergencies and existing exposure situations, including NORM).

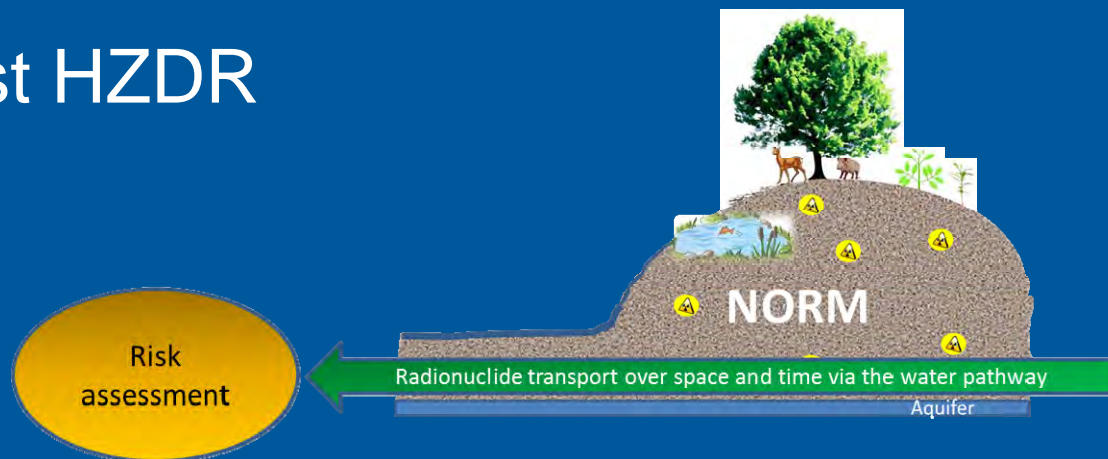
TOPIC: Addressing issues related to uncertainties and “data caps” in human and ecosystem radiological risk assessments and modelling

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1st CONCERT Call - Topic 2

Reducing uncertainties in human and ecosystem radiological risk assessment and management in nuclear emergencies and existing exposure situations, including NORM

Research Interest HZDR

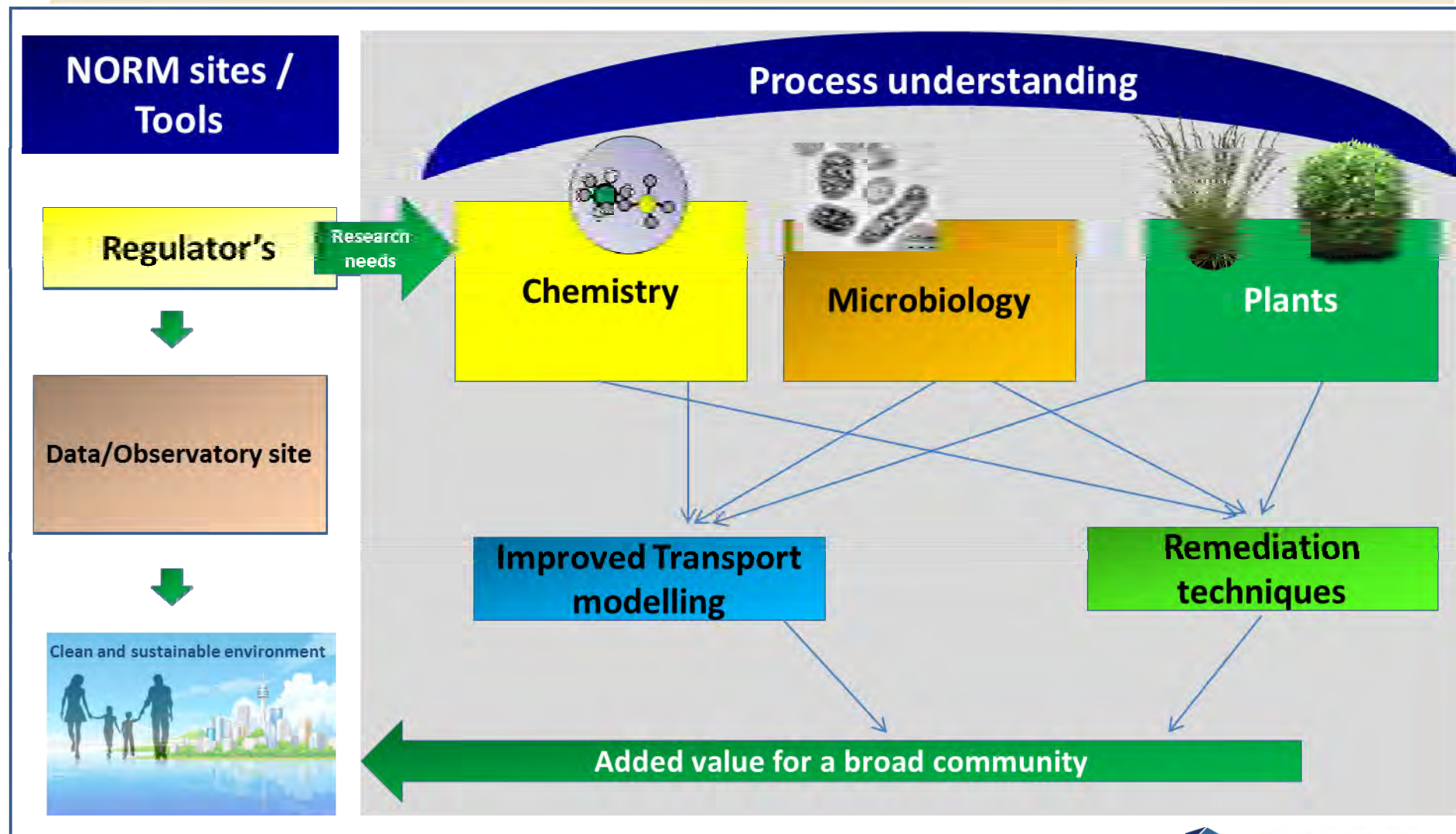


27th January, 2016

Oberschleißheim, Germany



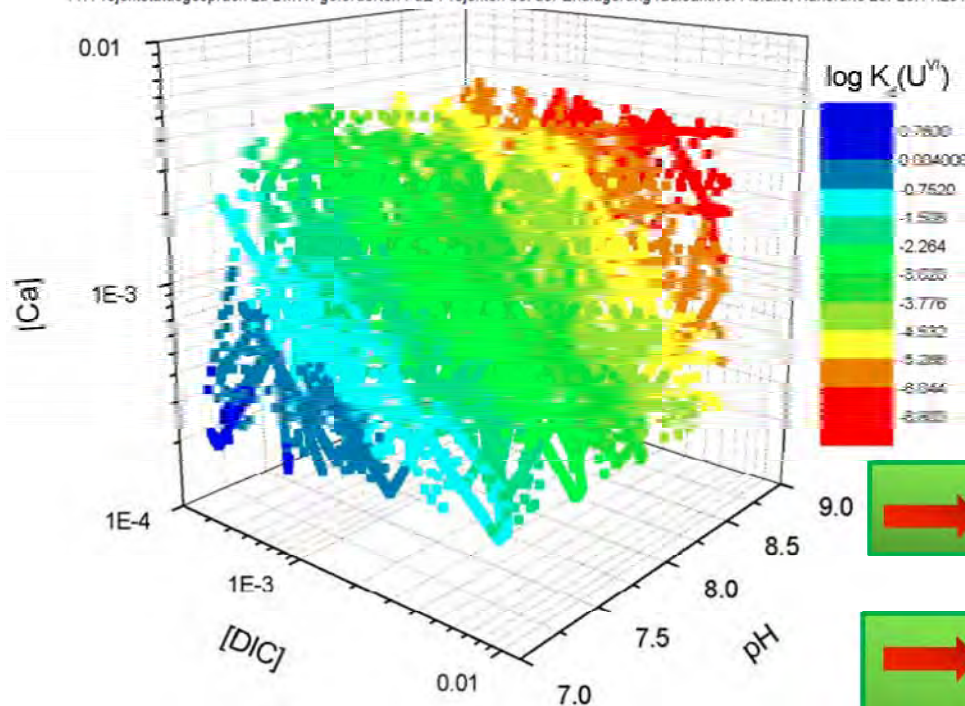
Improving transport modelling of RN from NORM sites into uncontaminated environments by better addressing the influence of chemical and biological/microbiological processes



Improving transport modelling of RN from NORM sites into uncontaminated environments by better addressing the influence of chemical and biological/microbiological processes

Example: Immobilization of U(VI) on sedimentary rock

11. Projektstatusgespräch zu BMWI-geförderten FuE-Projekten bei der Endlagerung radioaktiver Abfälle, Karlsruhe 25.-26.11.2014



Multidimensional K_d matrices

- Implementation of geochemical parameters (pH, I, [DIC], [Ca])
- Interpolation for specific conditions at every location and specific time frames

→ K_d ranges from approximately 10^{-7} to 6 !

→ Need for improvement of currently used models describing NORM sites is urgently required!

Reducing uncertainties in radiological risk assessment of existing long-term exposure situations, including NORM

HZDR is interested together with WG NORM members and interested external partners to discuss a possible NORM related proposal.





Information Day
CONCERT 1st Open RTD Call
27.1.2016, Munich, Germany

VUJE Experience and Research Interests

Tatiana Duranova

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Department of Safety Analysis



Content

- **Organization**
- **VUJE experience and research interests**
- **Participation in the European research and expert projects**
- **Role in the CONCERT Project**
- **Key personnel**





Organization

Established in 1977 as a state research institute

In 1994 transformed into a joint stock company whose shares are owned by company employees and former employees

Presently implements large projects mainly in the field of nuclear power generation

Current scope of company operations includes all activities related to the preparation, implementation, operation and termination of operation mainly of nuclear energy installations

VUJE a.s. has an established integrated management system based on international standards and related national regulations aimed at improving the safety of nuclear facilities exploitation, the environment protection as well as occupational safety and health protection. It also applies requirements and recommendations of IAEA.



Organization (cont.)

VUJE is founding member of

- NERIS and
- NUGENIA.

VUJE is also member of ETSON.

VUJE has wider involvement in the OECD/NEA working groups nominated there by Nuclear Regulatory Authority of the Slovak Republic as their Technical Support Organization.

VUJE has links to a wide range of stakeholders involved in radiation protection, emergency management and decision making including post-nuclear accident situations, nuclear safety and nuclear waste management.



VUJE experience and research interests

Topic 2: Reducing uncertainties in human and ecosystem radiological risk assessment and management in nuclear emergencies and existing exposure situations, including NORM

- development and implementation of decision support systems,
- accident management and risk assessment,
- source term evaluation,
- atmospheric dispersion and dose modeling,
- uncertainty handling and sensitivity analyses,
- exercises preparation and conducting,
- training courses development and conducting,
- governance of hazardous activities and situations (including post-nuclear accident situations),
- stakeholder engagement processes and facilitation of multi-stakeholder processes.



Participation in the European research and expert projects / Infrastructure (1)

NERIS-TP: Towards a self sustaining European Technology Platform on Preparedness for Nuclear and Radiological Emergency Response and Recovery

- establishing and operation of a **European NERIS Platform** on emergency and post-accident preparedness and management to further improve emergency response and recovery preparedness in Europe,
- strengthening of the **preparedness at the local/national level** by **setting up dedicated fora** and **developing new tools or adapting** the tools developed within the EURANOS projects,
- The **training course, dissemination workshops and exercises** have been conducted in the second half of the project to distribute the information on the new tools to all interested parties. This resulted in several national exercises testing the new products and providing feedback to the developers.



Participation in the European research and expert projects / Infrastructure (2)

PREPARE: Innovative integrative tools and platforms to be prepared for radiological emergencies and post-accident response in Europe

- review of existing **operational procedures** in dealing with long lasting releases,
- developing of missing functionalities in decision support system in the area of **improved source term estimation** – Fast and simple method with NPP fence measurements for source term estimation and its integration in JRODOS,
- as the management of the Fukushima event in Europe was far from being optimal, the means have been developed on a scientific and operational basis to **improve information collection, information exchange and the evaluation** for such types of accidents. This was achieved through a collaboration of industry, research and governmental organizations in Europe taking into account the networking activities carried out under the NERIS-TP project.



Role in the CONCERT Project

VUJE is actively participating in the work of:

- WP2:** Integration and SRA development in radiation protection research
- WP3:** Priority research and Joint programming needs in the perspective of European integration
- WP5:** Stakeholder involvement and communication of scientific evidence base and radiation protection research
- WP7:** Education & Training



Key personnel

Ms. Tatiana Duranova is mathematician and social worker, emergency planning expert, project manager, heads VUJE RODOS Team, working at VUJE since 1981. T. Duranova is Management Board Member of NERIS Platform Association since 2010, member of the WPNEM at NEA OECD, Deputy Chair of the RODOS Users Group. She was and is involved in a number EC-funded projects having been the Work Package leader in some of them and Coordinator of them within the Slovak Republic, currently involved in the EC-funded project PREPARE and CONCERT. Contact: Tatiana.Duranova@vuje.sk

Ms Jarmila Bohunova is mathematician, emergency planning expert, project manager and heads Group of radiological consequence analysis, working at VUJE since 1993. She is member of the NERIS R&D committee. She is involved in the EC-funded project PREPARE. Contact: Jarmila.Bohunova@vuje.sk

Dr. Juraj Duran holds a Ph.D. in meteorology, theoretical physicist, emergency planning specialist, project manager, working at VUJE since 1990. He is leading and carrying out research and development of tools for accident analyses and decision support. He is involved in the EC-funded projects PREPARE and CATO. Contact: Juraj.Duran@vuje.sk

Mr. Albert Bujan is physicist, emergency planning expert, project manager, working at VUJE since 1981. He is responsible for environmental source term evaluation both during the severe accidents and design basic accidents, development of the computational models for European integral code ASTEC, He is involved in the EC-funded projects PREPARE and CESAM. Contact: Albert.Bujan@vuje.sk



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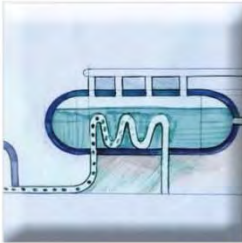
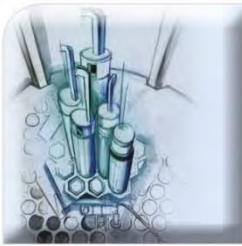
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*Thank you very much
for your attention*



Information for potential partners

Vladimir Fiser
27 January 2016

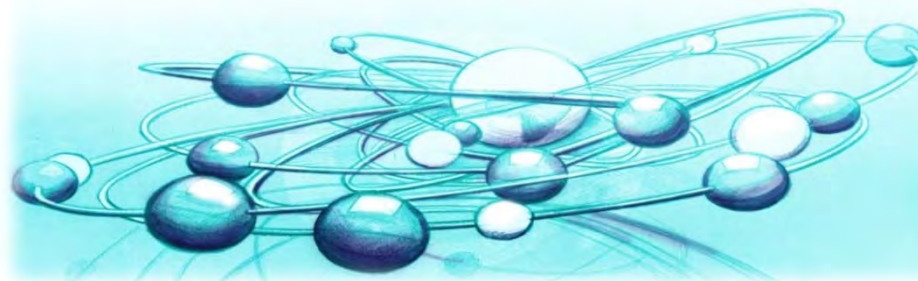
Service provider in the field of applied research and engineering
for 60 years

Wide range of complex scientific and research projects implementer
specifically, in energy and nuclear installations and radiopharmaceuticals

Employer of 700 staff members of various professions
more than 62% with university degrees

Long term profitable company evaluated by customers and partners

Broad international cooperation reflects the level of our scientific research and business activities



Portfolio of Products and Services

- **Designing and engineering activities in energy industry**
- **Support for the operation of nuclear power plants**
 - Lifetime and efficiency improvement
 - Safety, reliability, diagnostics and equipment qualification
- **Emergency preparedness and response**
 - Source term calculations, accident assessment and prediction
 - Modeling of accident scenario, consequences, countermeasures implementation
- **Radioactive waste**
 - Radioactive waste management and repositories, spent fuel transportation
 - Decommissioning, fragmentation and decontamination services
- **Radiopharmaceuticals**
- **Applied research** in the field of nuclear energy and ionizing radiation



Research topics for 1st call of CONCERT

□ Topic 2: Reducing uncertainties in human and ecosystem radiological risk assessment and management in nuclear emergencies and existing exposure situations, including NORM

- Advanced methods and fast tools (including software development) for best estimate prediction of release of radioactive substances into environment and for radiological consequences in light of new approach of ICRP 103 recommendation and in the light of previous lessons learnt from Fukushima and Chernobyl accidents. *Aiming for utilization under real terrain conditions by members of intervention teams.*
- Software for prediction of radioactive substances dispersion and deposition in urban condition after terrorists attacks with use of dirty bomb and/or dissemination of radioactive substances. *Support for decision making of intervention teams during real threat.*
- Improvement of source term assessment using reverse modelling based on real measurement in terrain. Interactive and iterative improvement of source term assessed in ad-hoc situation without justified information on radioactive substances inventory in case of dirty bomb attacks.
- Utilisation of drones (unmanned aerial and/or ground vehicles) for radiological reconnaissance in urban conditions (protection of crowded places). Proposal of hardware (sensors, vehicles, communication, control and data transfer), methods (procedures and guidance for reconnaissance) and software for evaluation of measurements and their integration into the dissemination model.

References

- R&D Project MD (Ministry of Defence of Czech Republic) 0601 5 3040 S “Knowledge-based support for command and management of emergencies - reconnaissance optimization and model-based prediction of radiation and chemical situation with use of remotely controlled mobile vehicles”
- R&D Project MD 0501 5 3020 “Advanced methods and tools for command and crisis management and simulation tools for specialists preparation and training”
- R&D Project MD 0301 2 5555 S “Decision support system for commanding managers during state infrastructure endangerment”
- R&D project MIT (Ministry of Industry and Trade of Czech Republic) FC-M/48“STRATEGY” – Application of nuclear methods for army and armament industry, including development of methods and tools for prediction of radiological consequences after release from low-potential sources (NPPs)
- PHARE project PH11.07/97C „Crisis Centre Organisation and Equipment“, development of methods and tools to support decision making of crisis team on analysis and prediction of NPP accident course and consequences
- R&D Project MIT FI-IM5/196 “Methods and tools for design, implementation and evaluation of advances form of complex technological process monitoring and control by new user interface displays generation”
- R&D Project MIT FI-IM3/092 “Research of fuzzy neural modelling methods for non-destructive on-line monitoring and validation of technological process sensors”
- R&D Project MIT FI-IM/061 “Augmented and Virtual Reality Tools for safety and effectiveness improvement of complex and/or risk classified human activities”



Thank you for your attention

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Reducing uncertainties in human and ecosystem
radiological risk assessment and management in
nuclear emergencies and existing exposure
situations, including NORM - IFIN-HH Romania,
Life&Environmental Physics Dept., Environmental Modelling Group

Dan Galeriu, PhD

“Horia Hulubei” National Institute for Physics and
Nuclear Engineering, Bucharest – Magurele,
ROMANIA

Info Day CONCERT, BfS Munich, Germany, January 27 2016

- 
- INSTITUTUL OF ATOMIC PHYSICS (IFA) Romania; "HORIA HULUBEI" NATIONAL INSTITUTE FOR PHYSICS AND NUCLEAR ENGINEERING (IFIN-HH), affiliated or linked to IFA-MG
 - Dan Galeriu, senior researcher and project manager
 - **Romania develops nuclear energy with Heavy Water Reactors of CANDU type. Unit I operates since 1996 and Unit II since 2007. Many PWR- Russian style reactors are around. We experienced Chernobyl**
 - IFIN-HH contribution to Chernobyl: in Romania - external dose, air concentration, deposition (gamma spectroscopy long list of radionuclides); first assessment of consequences (Sept 1986, not public); international - Chernobyl Fallout Data from the Central Bohemia - Scenario CB. VAMP , [IAEA-TECDOC-795](#) (1995); Southern Finland - Scenario S VAMP , [IAEA-TECDOC-904](#) (1996) Testing of environmental transfer models using Chernobyl fallout data from the Iput River catchment area, Bryansk Region, Russian Federation, [\(IAEA-BIOMASS-4\)](#) (2003)

IFIN-HH in RODOS and tritium expertise

- **IFIN-HH in RODOS:** customisation for Romania, First Tritium accident module FDMH (1998-2000); Review of processes - RODOS (WG3)-TN(98)-07 (1998), Model Description, RODOS (WG3)-TN(99)-54, (2000); Documentation - RODOS(WG3)-TN(99)-56, (2000)
- **Recognised expertise in Tritium and ^{14}C :** BIOMOVs Tritium transfer in the foodchain Report 8 and 13 (1998); Modelling the environmental transport of tritium in the vicinity of long term atmospheric and sub-surface sources, ([IAEA-BIOMASS-3](#)) (2003); EMRAS I WG 2 Modelling of tritium and carbon-14 transfer to biota and man working group
- **TRANSFER OF TRITIUM IN THE ENVIRONMENT AFTER ACCIDENTAL RELEASES FROM NUCLEAR FACILITIES, Report of Working Group 7 "Tritium Accidents" of EMRAS II IAEA_TECDOC-1738, ISBN 978-92-0-102814-3, 2014**
- **TRITIUM IN THE ENVIRONMENT;ENCYCLOPEDIA OF SUSTAINABILITY SCIENCE AND TECHNOLOGY, Editor-in-chief: Meyers, Robert A., Springer, New York, ISBN 978-0-387-89469-0 2012 , vol. 15: ENVIRONMENTAL RADIOACTIVITY AND ECOTOXICOLOGY OF RADIOACTIVE SUBSTANCES, Editor: Glen Bird, pages 10997-11025. P. Davis, D. Galeriu**
- **RADIONUCLIDES IN THE ENVIRONMENT, Chapter - TRITIUM, Edited by David A. Atwood, Copyright 2010, John Wiley & Sons Ltd., West Sussex, England, pp. 47-65, ISBN 978-0-47071434-8 Dan Galeriu, Anca Melintescu**
- >35 Invited lectures and international reports
- Commercial in confidence ITER.ORG, ICSI, CNE
- PHWR, Fuel reprocessing , Fusion

Nuclear energy must be safe and need robust radiological and environmental impact assessment (DETRIMENT)- LARGE UNCERTAINTIES FOR TRITIUM (10)

- Tritium, as ^3H is a life radionuclide (water cycle and dry matter cycle) → **interdisciplinary research, process oriented**
- Forms: tritiated water (HTO), Tritiated gases, Buried Tritium, a biotic organics, Exchangeable and Non-exchangeable Organically Bound Tritium (OBT), NE-OBT&DNA damage, work place tritium
- Fukushima tritium → need to upgrade AQUATRIT, from Whole body to organs
- Dynamics in domestic mammals & birds and wild animals (biota radioprotection) - few experimental data, human dosimetry
- Routine release High OBT/HTO ratio - not explained
- Crops - OBT formation (under-prediction, night processes); needs new, well designed experiments); respiration paradigm

Work in progress needing collaboration animals and OBT in crops

