

# International Training Course **BASIC INTERNAL DOSIMETRY**

Hosted by FANR in collaboration  
with ICRP and EURADOS

**14-18 OCTOBER 2024**

**Abu Dhabi, United Arab Emirates**

# INTERNATIONAL TRAINING COURSE: BASIC INTERNAL DOSIMETRY

Hosted by FANR in collaboration with ICRP and EURADOS



14 - 18 October 2024



Grand Hyatt Abu Dhabi Hotel & Residences Emirates Pearl  
West Corniche Corniche Road, Abu Dhabi, United Arab Emirates

## Training Course Overview

Radiation doses arising from the introduction of radioactivity in the human body cannot be measured, and can only be assessed on the basis of bioassay measurements, internal dose coefficients, and a number of appropriate assumptions on the introduction.

The International Commission on Radiological Protection (ICRP) recently reviewed and issued the most updated compilation of dose coefficients for internal exposure of Workers, in its OIR Publication Series, and is currently undergoing the review of dose coefficients for the exposure of the General Public, in its EIR Publications Series.

The international “Basic Internal Dosimetry” training course, hosted by FANR in collaboration with ICRP and the European Radiation Dosimetry Group, EURADOS, is designed to provide participants with a comprehensive understanding of internal dosimetry principles and basic calculations. Throughout this five-day course, attendees will gain both theoretical knowledge and practical experience in assessing internal exposure to radiation.

## Purpose of the Course

The course is aimed at professionals operating in Radiation Protection and related fields who seek to develop or enhance their skills in internal dosimetry. By the end of the course, participants will be equipped with the necessary tools to assess internal exposure intakes and estimate corresponding radiation doses.

## Course Structure

**Morning Sessions – Theory Lectures** Each morning will be dedicated to lectures delivered by ICRP and EURADOS Experts in the field. These sessions will cover key concepts, including radionuclide intake routes, biokinetic models, dose coefficients, and bioassay assessment techniques. The theoretical framework provided in these sessions is essential to building a solid foundation in internal dosimetry.

**Afternoon Sessions – Practical Exercises** In the afternoons, participants, in small groups, will engage in hands-on exercises that allow them to apply the concepts learned during the morning lectures. These exercises are designed to simulate real-life scenarios, giving participants practical experience in solving internal dosimetry problems. **Participation in the afternoon exercises is compulsory**, as they are a critical component of the learning process.

## Important Information for Participants

**Compulsory Participation** Participation in all theoretical and practical exercise sessions is **mandatory**. Active involvement in the exercises is essential to successfully completing the course. A course certificate, issued by FANR, ICRP and EURADOS will be delivered only to those who diligently attended all the sessions.

**Laptop Requirements** Participants are required to bring their own laptops to the course, and will need to install and use specific software tools necessary for completing the exercises. A computer without corporate security requirements, so that Participants can freely install software, is needed. Instructions for software installation will be provided prior to the course.

## MONDAY 14 OCTOBER 2024

### BIOKINETICS AND DOSIMETRY

8:30 - 9:30	<b>Welcome and Course Purpose</b> Aayda Al Shehhi (FANR), Christopher Clement (ICRP), and Juan Francisco Navarro Amaro (EURADOS)
9:30 - 10:20	<b>Introduction to Internal Dosimetry</b> Daniele Giuffrida (FANR)
10:30 - 11:20	<b>Biokinetics: Inhalation, Ingestion and Systemic Models</b> Bernard Landry (EURADOS)
11:20 - 11:50	<b>Coffee Break</b>
11:50 - 12:40	<b>Dosimetric Models and Statistical Methods for Internal Dose Assessment</b> Maia Avtandilashvili (ICRP)
12:40 - 14:00	<b>Prayer and Lunch Break</b>
14:00 - 14:30	<b>Introduction to the Afternoon Exercise Session: Scope and Purpose</b> FANR-ICRP-EURADOS
14:30 - 15:20	<b>First Exercise</b> FANR-ICRP-EURADOS and Participants in Groups
15:20 - 15:40	<b>Coffee Break</b>
15:40 - 16:30	<b>Second Exercise</b> FANR-ICRP-EURADOS and Participants in Groups
16:30 - 17:00	<b>Q&amp;A and Discussion</b> FANR-ICRP-EURADOS

## TUESDAY 15 OCTOBER 2024

### IN-VIVO MONITORING AND WBC

8:30 - 9:00	<b>Welcome and Recap</b> Daniele Giuffrida (FANR)
9:00 - 10:00	<b>Whole Body Counter Facilities: Organization and Operation; Techniques and Methods for Direct Bioassay Measurements</b> Juan Francisco Navarro Amaro (EURADOS)
10:00 - 11:00	<b>Intake Assessment by Direct Bioassay Measurement in a Whole Body Counter Facility</b> Juan Francisco Navarro Amaro (EURADOS)
11:00 - 11:30	<b>Coffee Break</b>
11:30 - 12:30	<b>Accuracy Requirements and Uncertainty Analysis in Internal Dosimetry</b> Maia Avtandilashvili (ICRP) and George Tabadatze (ICRP)
12:30 - 14:00	<b>Prayer and Lunch Break</b>
14:00 - 14:30	<b>Introduction to the Afternoon Exercise Session: Scope and Purpose</b> FANR-ICRP-EURADOS

## TUESDAY 15 OCTOBER 2024 (CONT.)

### IN-VIVO MONITORING AND WBC

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- 14:30 - 15:20**    **First Exercise**  
FANR-ICRP-EURADOS and Participants in Groups
- 
- 15:20 - 15:40**    **Coffee Break**
- 
- 15:40 - 16:30**    **Second Exercise**  
FANR-ICRP-EURADOS and Participants in Groups
- 
- 16:30 - 17:00**    **Q&A and Discussion**  
FANR-ICRP-EURADOS
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## WEDNESDAY 16 OCTOBER 2024

### IN-VITRO MONITORING AND CODES FOR ID

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- 8:30 - 9:00**    **Welcome and Recap**  
Daniele Giuffrida (FANR)
- 
- 9:00- 10:00**    **Techniques and Methods Used in Excreta Analyses**  
Maria Inmaculada Sierra Bercedo (EURADOS)
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- 10:00 - 11:00**    **Intake Assessment by Indirect Bioassay Measurement of Excreta**  
Maria Inmaculada Sierra Bercedo (EURADOS)
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- 11:00 - 11:30**    **Coffee Break**
- 
- 11:30 - 12:30**    **Codes and Software for Internal Dosimetry (I)**  
Maria Inmaculada Sierra Bercedo (EURADOS) and Bernard Landry (EURADOS)
- 
- 12:30 - 14:00**    **Prayer and Lunch Break**
- 
- 14:00 - 14:30**    **Introduction to the Afternoon Exercise Session: Scope and Purpose**  
FANR-ICRP-EURADOS
- 
- 14:30 - 15:20**    **First Exercise**  
FANR-ICRP-EURADOS and Participants in Groups
- 
- 15:20 - 15:40**    **Coffee Break**
- 
- 15:40 - 16:30**    **Second Exercise**  
FANR-ICRP-EURADOS and Participants in Groups
- 
- 16:30 - 17:00**    **Q&A and Discussion**  
FANR-ICRP-EURADOS
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## THURSDAY 17 OCTOBER 2024

### ICRP JOURNEY, RADON, AND PHANTOMS

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- 8:30 - 9:00**    **Welcome and Recap**  
Daniele Giuffrida (FANR)
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- 9:00- 10:00**    **The ICRP Journey in Internal Dosimetry: OIR Publications, EIR and the New ICRP Approach to Radon Exposure Calculations**  
Christopher Clement (ICRP)
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## THURSDAY 17 OCTOBER 2024 (CONT.)

### ICRP JOURNEY, RADON, AND PHANTOMS

10:00 - 11:00	<b>Human Phantoms and Their Use in Internal Dosimetry</b> George Tabadatze (ICRP)
11:00 - 11:30	<b>Coffee Break</b>
11:30 - 12:00	<b>Decorporation Treatments</b> Bernard Landry (EURADOS)
12:00 - 12:30	<b>Codes and Software for Internal Dosimetry (II)</b> Maia Avtandilashvili (ICRP), George Tabadatze (ICRP), and Bernard Landry (EURADOS)
12:30 - 14:00	<b>Prayer and Lunch Break</b>
14:00 - 14:30	<b>Introduction to the Afternoon Exercise Session: Scope and Purpose</b> FANR-ICRP-EURADOS
14:30 - 15:20	<b>First Exercise</b> FANR-ICRP-EURADOS and Participants in Groups
15:20 - 15:40	<b>Coffee Break</b>
15:40 - 16:30	<b>Second Exercise</b> FANR-ICRP-EURADOS and Participants in Groups
16:30 - 17:00	<b>Q&amp;A and Discussion</b> FANR-ICRP-EURADOS

## FRIDAY 18 OCTOBER 2024

### DOSE ASSESSMENTS AND INFRASTRUCTURE

8:30 - 9:00	<b>Welcome and Recap</b> Daniele Giuffrida (FANR)
9:00 - 9:30	<b>Internal Dosimetry Infrastructure Development Needs in the UAE</b> Aayda Al Shehhi (FANR)
9:30 - 10:00	<b>Internal Dosimetry as a Service in Radiation Protection in the UAE</b> Dejan Trifunovic (FANR)
10:00 - 11:00	<b>Round Table Discussion on the Requirements to Setup In-vivo and In-vitro Laboratories for Bioassay Intake Assessments in the UAE</b> Aayda Al Shehhi and Ali Alremeithi (FANR) Chrstopher Clement, George Tabadatze, and Maia Avtandilashvili (ICRP) Bernard Landry, Maria Inmaculada Sierra Bercedo, and Juan Francisco Navarro Amaro (EURADOS)  Moderated by Daniele Giuffrida (FANR)
11:00 - 11:30	<b>Coffee Break</b>
12:00 - 12:15	<b>Open Discussion with the Participants and Course Feedback</b> FANR-ICRP-EURADOS and Participants
12:15 - 12:30	<b>Final Remarks and Closure of the IDTC</b> FANR-ICRP-EURADOS



### Ali Khalifa Alremeithi

Ali Khalifa Alremeithi is a Specialist in Emergency Preparedness and Response (EPR) at the Federal Authority for Nuclear Regulation (FANR) in the UAE, holding an MSc in Radiation and Environmental Protection from the University of Surrey. Focused on nuclear and radiological safety, Ali plays a key role in developing and implementing EPR initiatives to ensure that national policies align with international best practices. He is also involved in coordinating key exercises and events to enhance FANR's visibility at both national and international levels. Ali's expertise extends to licensing and inspections of EPR-related matters, as well as the development of regulations and guidance documents. He has contributed significantly to establishing regulatory control systems to enhance the UAE's radiation protection infrastructure. Currently, Ali is leading the efforts of Taskforce C for Radiation Dosimetric Infrastructure under the UAE Radiation Protection Committee, reinforcing the country's commitment to safety and preparedness.



### Aayda Al Shehhi

Ms. Aayda Al Shehhi is specialized in Radiation Safety area and working at Federal Authority for Nuclear Regulation, member of the Commission of Safety Standards of the International Atomic Energy Agency (IAEA), Vice Chair of the UAE National Radiation Protection Committee, IAEA Steering Committee on Education and Training in Radiation, member of the advisory group of the College of Science at the UAE university.

Ms. Aayda holds a Bachelor's Degree in Physics as well as a Master's Degree in Quality Management, and has over 15 years' experience in the area of the Radiation Protection, she is currently director of the Radiation Safety Department at the UAE regulatory body, she is responsible about the area of regulating the Radiation Safety activities in Nuclear Power plants and other non-nuclear applications, Waste Management, Environmental monitoring and Radiation Calibration. Ms. Aayda has contributed in establishing the regulatory framework for the radiation safety and participated in building the Radiation Protection Infrastructure in the UAE. Ms. Aayda shared her experience internationally through her participation as recognized IAEA Expert in IAEA Integrated Regulatory Review System (IRRS), Occupational Radiation Protection Appraisal Service (ORPAS) missions. In addition the UAE representative to UNSCEAR since the 69th session in 2022.



### Juan Francisco Navarro Amaro

Juan Francisco Navarro has been involved in internal dosimetry for more than 20 years. He is Head of in-vivo Monitoring Laboratory on Internal Dosimetry Group at CIEMAT, having experience in designing calibration and measurement procedures for in vivo monitoring of workers exposed to internal contamination and in the management of nuclear or radiological emergencies. This includes his involvement in the in vivo measurement of the exposed population in Spain following the FUKUSHIMA NPP accident. He is responsible for organizing national intercomparison exercises for in vivo monitoring at the Spanish NPP, providing technical support to the Spanish Regulatory Body (CSN). Since 2014, J.F. Navarro is member of EURADOS (European Radiation Dosimetry Group) and has participated as an expert in internal dosimetry at the IAEA ORPAS mission to the Slovak Republic.

J.F. Navarro has been participating as a lecturer in several training courses related to radiation protection and dosimetry organized by CIEMAT, IAEA and EURADOS. He has published more than 20 international papers in peer-reviewed scientific journals. Additionally, He is a member of the Spanish Radiological Protection Society (SEPR). Since 2023, he has been the Director of "RADIOPROTECCIÓN," a scientific open-access journal edited by the society.



### Maia Avtandilashvili

Dr. Maia Avtandilashvili is an Associate Research Professor at Washington State University, College of Pharmacy and Pharmaceutical Sciences, United States Transuranium and Uranium Registries (USTUR). She earned her Diploma with Honors (equivalent to MS) in Experimental Nuclear Physics from Ivane Javakishvili Tbilisi State University (Georgia) and PhD in Health Physics from Idaho State University (USA). Dr. Avtandilashvili's research interests have involved the fields of applied nuclear physics, environmental radioecology, and radiation protection. Her current research at the USTUR focuses on internal radiation dosimetry and biokinetic modeling of actinides in humans. Dr. Avtandilashvili has been a member of the National

Council on Radiation Protection and Measurements (NCRP) since 2023. She had served on the NCRP Scientific Committee 6-12 on brain dosimetry and currently serves on the NCRP Scientific Committee 6-13 on estimating doses from intakes of radium. Dr. Avtandilashvili also serves on the Environmental Protection Agency (EPA) Science Advisory Board's (SAB) Radionuclide Cancer Risk Coefficients (RCRC) Review Panel and the American National Standards Institute (ANSI) accredited Health Physics Society Standards Committee (ASC) N13 Working Group. Internationally, Dr. Avtandilashvili is a member of the European Radiation Dosimetry Group (EURADOS) Working Group 7 on Internal Dosimetry and serves on the Editorial Board of the Austin Biometrics and Biostatistics journal.



### Maria Inmaculada Sierra Bercedo

Dr. Inmaculada Sierra has been involved in internal dosimetry for 25 years. She is Head of in Vitro Bioassay Laboratory on Internal Dosimetry Group at CIEMAT. This laboratory is the Spanish reference laboratory and it is accredited laboratory according to ISO 17025 for measurements of excreted activity rate in biological samples, acting as technical support of the national regulatory body.

She participates in agreements and research projects at national and international level such as CSN, CSIC, ENUSA, EU, IAEA, WHO and projects such as CONFIDENCE, TECHREC, MEYER, ALMAS... She has extensive experience in emergency and accidental situations in the field of conventional and radiological contamination. She is a scientific council member of Procorad, is a member of EURADOS since 2014 and she currently coordinates the initiative of "In vitro Emergency Bioassay Methods" in WG7/TG on "Internal Dosimetry for Emergency" of EURADOS. She is a member of the editorial board of Radioprotección Journal of SEPR.

She was also involved in the WG "Internal contamination" of REMPAN, a WHO Network on Radiation Emergency Medical Preparedness and Assistance.

She has participated in the EC Project TECHREC (2014-2016) for the elaboration of European Technical recommendations for Monitoring Individuals for Occupational Intakes of Radionuclides and in CONCERT EJP (2015-2020).

She has collaborated as an Expert in a IAEA Technical Cooperation Programme-PIP-TC20141224-001 in EVT1802989 - ARG0015 Project - National Training Course on "in vitro" monitoring techniques for occupational exposure assessment (CNEA-2018).



### Christopher Clement

Christopher Clement is the Scientific Secretary and Chief Executive Officer of the International Commission on Radiological Protection (ICRP). He became Scientific Secretary in 2008, the ninth to hold this position since ICRP (originally named the International X-Ray and Radium Protection Committee) was established in 1928. He oversees the daily business of ICRP, represents the organisation in many international fora, and has presented well over 300 invited lectures on radiological protection in more than 40 countries. He has overseen the production of more than 70 issues of Annals of the ICRP as Editor-in-Chief, the basis of radiological protection standards, legislation, and practice world-wide. In addition to his ICRP duties, since 2012 he has been a member of the International Radiation Protection Association (IRPA) Executive Council, and Vice-President of IRPA since 2021.

Mr Clement has a Master of Science degree in Medical Physics and is a Certified Health Physicist. He has more than thirty years of experience in radiological protection, and prior to joining ICRP worked in environmental monitoring and remediation, radiological counterterrorism, and as Director of Radiation Protection at the Canadian Nuclear Safety Commission overseeing radiation protection regulation in all sectors across the country. For several years he represented Canada at the IAEA Radiation Safety Standards Committee, and the OECD Nuclear Energy Agency's Committee on Radiation Protection and Public Health.

He has received the two highest honours of the Canadian Radiation Protection Association (CRPA): the Distinguished Achievement Award, and the Richard V. Osborne Founders' Award. In March 2019, he also received the Ambassador's Award from the Ambassador of Japan to Canada for his work in recovery after the Fukushima Daiichi accident and the promotion of mutual understanding and friendly relations between Japan and Canada.



### Daniele Giuffrida

Daniele Giuffrida is the Radiation Protection Expert at the Federal Authority for Nuclear Regulation (FANR) and Member of the International Commission on Radiological Protection (ICRP) Committee 4. A Polytechnical Institute of Milano Nuclear Engineering graduate, he obtained the three levels of specialization as a Qualified Expert in Radiation Protection in Italy. He started his career in the French nuclear industry, joined the European Commission as a civil servant in 2012 and was appointed Head of the Radiation Protection Sector and Qualified Expert of the JRC-Ispra Site, where he served for 12 years.

Since joining FANR, he was involved in several projects and activities related to the development of the Radiation Protection infrastructure in the UAE, including education and training, UAE-IAEA cooperation, dosimetry and Occupational Radiation Protection.



### Bernard Landry

Dr Bernard Landry is an Occupational physician. He has undergone specialized training in the field of radiation protection of workers. He has been working in EDF's nuclear power plants for about thirty years. He has a good experience in the practical aspects of care of workers affected by a contamination incident. He was the technical manager of the Whole-Body Counting facilities of the occupational health services. For the past 10 years, he has specialized in internal dosimetry. He has led training courses on internal contamination for EDF's medical teams. He has been thesis director for several students, including one on dose calculation in case of hot particle ingestion. He is the developer of CADORmed III and is a member of the European Radiation Dosimetry Group (EURADOS) Working Group 7 on Internal Dosimetry. He published "CADORmed : a tool for internal dose assessment" in Radiation Protection Dosimetry.



### George Tabatadze

Dr. George Tabatadze is an Associate Professor at Washington State University, College of Pharmacy and Pharmaceutical Sciences, and Assistant Director of the United States Transuranium and Uranium Registries (USTUR). He holds a PhD in Applied Physics from Idaho State University and an MS in Health Physics from the University of Nevada Las Vegas. His multi-disciplinary research interests involve applied physics, computer science, environmental protection, and radiation safety. His research at the USTUR focuses on radiation measurements, radionuclide imaging in human tissues, and radiation transport modeling, with an emphasis on internal and micro-dosimetry. Dr. Tabatadze has been a dedicated member of the Health Physics Society since 2005, serving on several committees, including the Academic Education, Science Support, and International Collaboration Committees. He has also held many leadership roles in the Columbia Chapter of the Health Physics Society, including president of the Chapter between 2017 and 2020. He is also a founding member of the Georgian Health Physics Association since 2007. Dr. Tabatadze is the author and co-author of more than 30 peer-reviewed publications, conference abstracts, proceedings, and reports and serves on the editorial board of Physical Science & Biophysics Journal.



### Dejan Trifunovic

Mr. Dejan Trifunovic is senior specialist in radiation safety department in the Federal Authority for Nuclear Regulation (FANR) involved with maintenance and implementation of the FANR legal and regulatory framework. Before joining FANR Mr. Trifunovic was appointed by the Croatian Government to the role of the Head of European Union accession Project Implementation Unit within Chapter 15 Energy, responsible for effective transposition and implementation of the EU requirements to the Croatian legislation and practice related to nuclear and radiation safety, safeguarding and non-proliferation of nuclear materials.

Mr. Trifunovic represented the Republic of Croatia in the International Atomic Energy Agency (IAEA) in the Safety Standards Committee on Radiation Safety, and Radioactive Waste Management. Within framework of the European Atomic Energy Community (EUROATOM), he acted as a Croatian representative to the Heads of the European Radiological Protection Competent Authorities group (HERCA), and as a senior advisor Mr. Trifunovic participated in a various projects founded by the IAEA and EU related to transfer of knowledge in nuclear and radiation safety in preparation for EU accession.

Mr. Trifunovic's academic interest include application of quantum physics in modelling fluid dynamics, and estimation of radiation induced health risk.