OPTIMIZATION IN DESIGN

PRELIMINARY PROGRAMME

Location: Tabloo, Dessel, Belgium
Date: April 22nd - 24th, 2026
Register in advance at: https://www.ean-workshop.net/

SCHEDULE – Wednesday, 22nd April 2026

9h00 Registration – Welcome coffee

10h00 **Welcome**
Peter BAETEN and Christophe BRUGGEMAN (SCK CEN)

10h20 **Presentation of the EAN**
Fernand VERMEERSCH (SCK CEN)

THEME 1 – INTERNATIONAL STANDARDS, REGULATORY AND METHODOLOGICAL GUIDANCE

10h40 **Integrating and optimizing radiation protection at the design stage of installation**
Caroline SCHIEBER (CEPN)

11h00 **Drawing the map, not the maze: setting the bar as a regulator**
Berlamont JOLIEN and Daan VAN DER MEERSCH (FANC/Bel V)

11h20 **Demonstrating the ALARA/ALARP safety case in the design phase**
Presenter to be confirmed shortly (ONR)

11h40 **Regulatory frameworks to ensure optimization in radiation technology applications**
Ronald PACHECO-JIMENEZ (IAEA)

12h00 Lunch

THEME 2 – CASE STUDIES: ACCELERATORS

13h00 **Shielding design and radiation monitoring: Radiation protection during design and operation of a new facility using the free-electron laser SwissFEL as example**
Eike HOHMANN (PSI)

13h20 **Radiation protection motivated measurements for shielding optimization for IMPACT the future upgrade of PSI's high-intensity proton accelerator**
Sophie HARZMANN (PSI)

13h40 **ALARA in the design of HL-LHC**
Presenter to be confirmed shortly (CERN)

14h00 **ALARA during accelerator maintenance and upgrade**
Presenter to be confirmed shortly (CERN)

THEME 3 – CASE STUDIES: MEDICAL AND RADIOPHARMACEUTICAL

14h20 **Design of the Molybdenum Production Facility (MPF) in Petten: Limitations and changing demands**
Folkert DRAAISMA (NRG | PALLAS)

14h40 **Optimization in design of an industrial producer of radio-isotopes**
Pascal FROMENT and colleagues (BeSure)

15h00 **The Centralized Radiochemical Facility and its role in therapeutic radio-isotopes and radiopharmaceutical development**
Presenter to be confirmed shortly (SCK CEN)

15h20 Coffee

WORKING GROUPS

16h00 **Introduction to the working groups**
Laura WOODWARD (UKHSA) and Pascal CROUAIL (CEPN)

TABLOO exhibition and poster session

16h15 **Guided visit**

17h30 **End of day**

19h00 **Gala dinner**

SCHEDULE – Thursday, 23rd APRIL 2026

9h00 Coffee

THEME 4 – CASE STUDIES: MODULAR AND SMALL MODULAR REACTORS

9h30 **Integration of radiation protection in LFR reactor design**
Anne-Claire SCHOLER (Newcleo)

9h50 **Application of the ALARP principle to advanced modular reactor design and incorporation of lessons learned from nuclear test reactor design**
Simon WILLIAMS (Rolls-Royce)

10h10 **Optimization strategies for radiation protection in SMR design**
Gilles GENNARD (Tractebel)

10h30 Coffee

11h00 **ALARA in design for LEANDREA**
Bernard VAN DER WALT (SCK CEN)

11h20 **Investigating severe accident scenarios for NNRs: developing the GIROSCOPE methodological framework for ER&R**
Luke LEBEL (Canada Nuclear Laboratories)

11h40 **Operational Pathways for SMRs: Feedback from IAEA**
Burçin OKYAR (IAEA)

12h00 Lunch

THEME 5 – CASE STUDIES: REACTOR FACILITIES

13h00 **Status of ITER Radiation Safety and ALARA**
Subhash PUTHANVEETIL (ITER)

13h20 **Optimization in the design of the PALLAS reactor**
Presenter to be confirmed shortly (NRG | PALLAS)

13h40 **Advanced computational tools for radiation protection motivated by nuclear decommissioning**
Lucian IVAN (Canada Nuclear Laboratories)

14h00 Coffee

WORKING GROUPS

15:00 **WG 1 – International standards, regulatory and methodological guidance**
15:00 **WG 2 – ALARA in design – Accelerator**
15:00 **WG 3 – ALARA in design - NNR**
15:00 **WG 4 – Education and training**

18:00 End of the day

SCHEDULE – FRIDAY, 24th APRIL 2026

8:30 Coffee

Feedback from the Working Groups

09:00 **Working Group, no 1**

09:20 **Working Group, no 2**

09:40 **Working Group, no 3**

10:00 **Working Group, no 4**

10:20 Coffee

Closing

11:00 **Conclusions and recommendations of the workshop**
Laura WOODWARD (UKHSA)

11:45 **Closing remarks**
Fernand VERMEERSCH (SCK CEN)

12:00 Lunch

13:00 **TABLOO exhibition**

Anne-Claire SCHOLER and Joffrey GERMA.

The LFR (Lead-cooled Fast Reactor) is a fast-spectrum reactor that promotes efficient use of nuclear fuel and enables closure of the fuel cycle. The LFR is a pool concept: the lead coolant remains within the primary vessel, and most radiological inventories are contained within it, with a few exceptions.

The objective of radiation protection is to limit and control exposure to ionizing radiation for workers, the public, and the environment. The compact LFR concept results in significant activation of structural materials and coolant. For example, the dose rate must be evaluated above the roof of the reactor vessel, around handling machine for fuel assemblies and components and near piping carrying activated fluids.

A radiation protection approach is implemented from the reactor design phase:

- Identification of radiation sources.
- Neutron flux, gamma flux, dose equivalent rate (DER) and dose calculations.
- Selection of design options such as implementation of neutron or biological shielding, requirement on wall composition and thickness based on multiple criteria: dosimetry, safety, performance, feasibility, cost.
- Radiological zoning and ambitious design criteria for shielding.
- Radiological monitoring.
- Optimization program initiated from the design phases.
  newcleo will present its LFR concept, the main radiation protection challenges and how they are considered from the design phase.

Luke LEBEL.

The global emergence of **Novel Nuclear Reactors (NNRs)** poses a critical question for the international safety community: to what extent might their severe accident scenarios differ from those of large, traditional reactors? Answering this is essential for ensuring robust public protection. The GIROSCOPE project is tackling this question by developing a new methodological framework to systematically analyse NNR designs and their implications for accident progression.

The development of this framework begins with first principles, analysing the fundamental design characteristics that distinguish various NNR technologies. This analysis is being applied to diverse case studies—including **High-Temperature Gas-cooled (HTGR)**, **Compact Molten Salt (CMSR)**, and advanced **Small Light Water (SLWR)** reactors—to hypothesise and explore **new potential accident progressions and release pathways** that may not be captured by existing models. Our work investigates how design differences in these reactors could alter the timing, magnitude, and isotopic composition of potential radioactive releases, forming the basis for a new generation of source term assessments.

This investigation is fundamental to modernising Emergency Preparedness **and Response (EP&R)**. Understanding *how* and *why* NNR accident scenarios may differ is crucial for establishing credible and proportionate **Emergency Planning Zones (EPZs)** and protective action strategies. Instead of applying legacy assumptions, this research provides the technical basis to tailor emergency plans specifically to the risk profile of advanced reactor technologies, enhancing the effectiveness of and public trust in safety measures.

The insights gained from this developmental work will inform the future structure and content of a comprehensive **Source Term Database**, intended as a resource for decision support tools. This research is a critical step towards building the next

generation of safety cases and EP&R frameworks for innovative nuclear energy systems.

Gilles GENARD.
Optimisation of radiation protection during the design phase is a cornerstone of the ALARA principle and a key expectation for new reactor concepts. Small Modular Reactors (SMRs) introduce specific design considerations compared to large conventional units, such as compact layouts and modular construction, which influence how radiation protection requirements are integrated. The focus of this contribution is on SMRs based on Light Water Reactor technology, drawing on recent updates to design requirements reflected in the European Utility Requirements (EUR) to ensure compliance for these concepts. The discussion will present key aspects considered during this review and how they support the implementation of the ALARA principle at an early stage of design requirements definition. An outlook will also address general optimisation considerations relevant to other SMR technologies, aiming to provide a broader perspective and stimulate dialogue on effective integration of radiation protection strategies across different designs.

Burçin OKYAR.
Small Modular Reactors (SMRs) present unique opportunities and challenges for the nuclear industry, particularly in the area of occupational radiation protection (ORP). As SMR technologies advance toward deployment, ensuring robust radiation safety measures for workers remains a critical priority. This presentation summarizes insights and feedback from the International Atomic Energy Agency (IAEA) on operational pathways for SMRs, based on recent consultancy meeting discussions and ongoing initiatives.
The session will address five key objectives:

1. Review Current Practices and Challenges: An overview of existing ORP strategies in SMR designs and operations, highlighting distinctive challenges compared to conventional reactors.
2. Evaluate Regulatory Frameworks: Analysis of national and international regulatory approaches, identifying gaps and opportunities for harmonization.
3. Exchange Technical Knowledge and Experience: Sharing operational experience (OPEX), lessons learned, and best practices from global SMR projects, including innovations in radiation protection technologies.
4. Develop Technical Guidance: Contributions toward IAEA technical documents (e.g., Safety Reports) with expert input on design, operational, and emergency preparedness considerations.
5. Support Future Research and Collaboration: Recommendations for research priorities and strategies to foster international partnerships in advancing ORP for SMRs.

By consolidating feedback from Member States and industry stakeholders, this presentation aims to inform the development of comprehensive guidance and collaborative frameworks that enhance radiation safety in SMR operations worldwide.

Sophie HARZMANN Matteo BOLZONELLA, Eike HOHMANN, Marco TISI, Lisa PEDRAZZI, Sabine MAYER.
The Paul Scherrer Institute (PSI) operates several large-scale research facilities, including the High-Intensity Proton Accelerator Facility (HIPA), where protons are accelerated up to a maximum energy of 590 MeV with an average current of 2.2 mA and used to produce various types of secondary particles such as muons, pions and neutrons. Within the institute-wide large-scale project IMPACT (Isotope and Muon Production with Advanced Cyclotron and Target technologies), two major upgrades

of HIPA are foreseen: first, an upgrade of the first meson production target station to significantly increase the muon flux, and second, a new isotope production facility for the manufacture of rare theragnostic radionuclides. The muon target station upgrade will affect beamline and shielding components with local dose rates of up to several Sv/h. This results in various challenges for radiation protection, especially for the planning and execution of measurement campaigns in order to assess the complex PSI stray radiation fields. This talk gives a general overview of the IMPACT project and addresses the challenges for radiation protection measurement campaigns.

Lucian IVAN, David GAUNT, Joachim SARR, Brendan SOMMERS, Morteza NAMVAR, Justin WALLWORK, Scott MOLSON, Sean CHISNELL, Codie GOSNELL, James G. MCDONALD.

Effective radiation protection in nuclear applications requires accurate assessment of radiological conditions for all stages over the lifetime of a facility, including decommissioning planning and execution. This work introduces a computational and visualization framework designed to reconstruct distributed radioactive sources and present radiation fields through immersive technologies, enabling safer and more efficient decommissioning operations.

The proposed methodology employs a two-step source-reconstruction technique. An initial computationally intensive stage pre-computes Monte Carlo particle transport solutions for a discretized region of interest, representing the source as a weighted sum of polynomial basis functions. In the second stage, real-time measurements are incorporated using a non-negative least-squares algorithm to refine source estimates dynamically. This approach delivers progressively more accurate radiation field predictions as data accumulates.

To enhance situational awareness, reconstructed radiation maps are integrated into augmented reality (AR) and virtual reality (VR) environments. Using LiDAR- generated facility geometry and CAD-based models, the system overlays transparent 3D radiation "heat maps" onto physical spaces via HoloLens 2 or WebXR platforms. Interactive features, such as slicing and filtering, allow intuitive visualization of dose distributions for planning, training, and in-field protection.

Validation through computational benchmarks and experimental studies at Canadian Nuclear Laboratories demonstrates the feasibility and effectiveness of this integrated approach, which can be extended to other related applications.

ADDITIONAL INFORMATION – TOPICS TO BE DISCUSSED IN THE WORKING GROUPS

INTERNATIONAL STANDARDS, REGULATORY AND METHODOLOGICAL GUIDANCE

- What are the requirements/expectations regarding optimization of radiation protection in design with regards to licensing?
- How do operators and regulators interact on this topic?
- What are the national regulations and are the requirements/expectations harmonized?
- Is there sharing of ALARA design principles between countries/how can this be improved?

ALARA IN DESIGN - ACCELERATOR

- What are the elements to conduct/review an optimization approach in the design phase?
- What are the approaches with regards to optimization of occupational exposure and protection of the public and the environment?
- Are there optimization considerations for emergency preparedness and response?
- Are there particularities depending on the type of installation being designed?

ALARA IN DESIGN - NNR

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- What are the approaches with regards to optimization of occupational exposure and protection of the public and the environment?
- Are there optimization considerations for emergency preparedness and response?
- Are there particularities depending on the type of installation being designed?

EDUCATION AND TRAINING

- Is there a need for a design optimization training course?
- Is there a need for a platform for sharing experience?
- What education/expertise is required for designing these facilities?
- What education/certification is required for reviewing these designs?
- Is the training requirement harmonized across Europe?
- Are there further training requirements for the optimization in design process?