RGC HPS Technical Meeting March 29, 2025

Date: Saturday March 29	Time
A Practical Approach to Modeling Glovebox Designs for External Radiation Exposure	9am
Radiation Exposure Compensation Act (RECA): Proposed Expansion.	9:20am
Plutonium-239: Toxicity and Human Health Effects from Discovery to the Present.	10:15am
Modeling and Simulation of ICRP Phantoms Using MCNP in Radiation Medicine	10:55am
Lunch Break	11:30am
Pillow Talk: The Myths and Facts of the 'Tritium Pillow'	12:30pm
Highlights of 2025 Annual Meeting of National Council on Radiation Protection and Measurements.	1:10pm
Interactive Radio Epidemiology Program for Estimation of Probability of Causation for Cancer Induction from Radiation Exposure	1:50pm
Improving MCNP Simulation Accuracy through Advanced 3D Scanning of As-Built Geometries at LANSCE	2:30pm
Application of Unstructured Mesh in MCNP to Support Realistic Geometry Modeling at LANSCE	2:50pm
Understanding ALARA in the DOE Complex	3:10pm
Guest Speaker	4:00pm
Chapter Meeting	4:30pm

Saturday March 29th:

A Practical Approach to Modeling Glovebox Designs for External Radiation Exposure

Speaker- *Esteban Gonzalez*

This presentation walks through the methodology of simplifying MCNP glovebox model inputs for cost effective results. Factors considered in simulation design include modeling methods, glovebox design, dose regulation requirements, and model results. A summary of the simplifications describes major factors to consider for shielding design, worker external dose, and particle transport modeling.

Radiation Exposure Compensation Act (RECA): Proposed Expansion.

Speaker- *Steven E. Rademacher*

RECA was established in 1990 to compensate downwinders from US atmospheric nuclear tests, on-site participants in nuclear tests, and uranium workers. It sunset in the summer of 2024. The 118th Congress introduced a bill in 2024 to extend the benefit period and expand coverage. A similar bill was introduced in 2025. This talk will provide background information on the history and discuss technical aspects of the proposed extension and expanded coverage.

Plutonium-239: Toxicity and Human Health Effects from Discovery to the Present

Speaker- Roger O. McClellan

The saga began on December 14, 1940, when Seaborg and his team used the University of California-Berkeley cyclotron to bombard 238U with deuterons to produce 239Pu. It was soon discovered that 239Pu and 235U were fissionable offering two avenues to create an Atomic Bomb. To achieve that secret objective, the Manhattan Project was created on August 13, 1942 within the U.S. Army Corp. of Eng. Teams of scientists and engineers were assembled, and new unique facilities built at 3 locations: (1) Oak Ridge, TN to produce 235U, (2) Hanford, WA to produce 239Pu and (3) Los Alamos, NM to build the bombs. At Hanford, Cantril and Parker prepared a report, MDDC-1100; "The Tolerance Dose", to guide protection of workers producing a secret product. Key input was from past "human misfortune" from Radium Dial Painters and U miners who had suffered ill effects. In early 1945, 239Pu from Hanford and 235U from Oak Ridge were shipped to Los Alamos. In April 1945, the first human volunteer was injected with 239Pu, and Laughan at Los Alamos used the data to develop equations estimating 239Pu body burdens from urinary excretion of 239Pu.

On July 16, 1945, a 235Pu-fueled bomb was detonated at the Trinity Site in NM. On August 6, 1945, a 235U-fueled bomb was detonated over Hiroshima, Japan followed on August 9, 1945, by detonation of a 239Pu-fueled bomb over Nagasaki, Japan. Japan surrendered on August 14, 1945. In 1949, Russia detonated its first Atomic Bomb. The nuclear weapons race began!

In 1950, the AEC initiated a long-term dog study of injected 239Pu and radionuclides the Radium Dial Painters had been had ingested to provide data for improved risk estimates for 239Pu workers. In the early 1950s Hanford initiated lifespan studies in rodent and dogs with inhaled 239Pu. Later studies were initiated with 238Pu. In 1960 a new project was initiated by the Lovelace Organization in Albuquerque to study inhaled fission product radionuclides in rodents and dogs. That study was expanded in the 1970s to include inhaled 238Pu and 239Pu. The dog studies confirmed the critical organs for inhaled Pu as lung, liver, and skeleton with excess cancers produced in all 3 organs. With a lull in the cold war, the USA gained access to data on 239Pu workers at the Russian MAYAK facilities, remarkably similar to those at Hanford. The exposures of Russian workers were poorly controlled yielding another set of "human misfortune" data. When the lung cancer data were adjusted for smoking and liver cancer data adjusted for alcohol consumption, the resulting cancer risks in Russian workers were in remarkable agreement with excess cancer risks estimated from dogs exposed via inhalation to 239Pu. The dogs did not smoke nor consume alcohol.

This remarkable saga will be reviewed with an emphasis on lessons learned.

Modeling and Simulation of ICRP Phantoms Using MCNP in Radiation Medicine

Speaker- Victor Kuhns

The modeling and simulation of ICRP (International Commission on Radiological Protection) phantoms play a crucial role in radiation medicine, enabling accurate dose assessments and treatment planning. Using the Monte Carlo N-Particle (MCNP) transport code, these phantoms can be simulated to analyze radiation interactions within the human body, improving safety and effectiveness in medical applications. This presentation explores the implementation of ICRP phantoms in MCNP simulations, focusing on their relevance in radiation dose calculations, shielding assessments, and therapeutic planning.

In addition, the presentation will review the industry software capability known as TurbOS from Hoonify Technologies Inc, which enables MCNP to run immediately on any CPU technology, delivering supercomputing results outside of a data center and at the edge. The performance benchmarks of TurbOS will be showcased using results produced from various government agencies, demonstrating its efficiency and scalability in high-performance radiation transport simulations.

Hoonify has partnered with NorthStar Medical Radioisotope (NMR) to provide offsite high performance computing resources to NMR for activation and isotope production calculations, shielding design and analysis, and dose rate calculations with tools such as MCNP and FLUKA. NMR mission is to provide patients global access to game-changing radiopharmaceuticals.

Pillow Talk: The Myths and Facts of the 'Tritium Pillow'

Speaker- Audrey Rotert

Highlights of 2025 Annual Meeting of National Council on Radiation Protection and Measurements.

Speaker- Roger O. McClellan

This presentation will review highlights of the Annual Meeting of the National Council on Radiation Protection and Measurements (NCRP) being held in Bethesda, MD, March 23-25, 2025. Roger McClellan, with the Lovelace organization in Albuquerque from 1966-1988, will be participating in the NCRP meeting as a former member of the NCRP Council (1971-2001) and Distinguished Emeritus Member since 2001.

His presentation at the Rio Grande Chapter meeting will include a summary of remarks by NCRP President Kathryn A. Higley and key actions from the business meeting. Further, he will review key take home messages from the scientific program, "The Million Person Study: Current Results and Vision for Radiation Epidemiology and Protection", the keynote address by Richard Wakeford - "Challenges Faced by Studies of Nuclear Industry Workers" and the Lauriston S. Taylor lecture by Roy E. Shore -"Epidemiological Contributions to Radiation Risk Assessment". McClellan will close with personal remarks on the importance of the NCRP to the field of radiation protection.

Interactive Radio Epidemiology Program (IREP) for Estimation of Probability of Causation for Cancer Induction from Radiation Exposure.

Speaker- *Steven E. Rademacher*

The IREP program is widely used for adjudication of Energy Employees Occupational Illness Compensation Program (EEOICPA) and Veteran Administration radiation exposure claims. This talk will provide an overview of the code and provide examples of screening dose levels for various organs and tissues. Unique examples will be provided for internal plutonium exposure cases.

Improving MCNP Simulation Accuracy through Advanced 3D Scanning of As-Built Geometries at LANSCE

Speaker- Josef Svoboda

Josef is a scientist at LANSCE, specializing in spallation target systems at the Lujan Center and WNR facilities. He conducts detailed MCNP simulations supporting experimental research, including beam spot analysis, neutron flux characterization, and target optimization. Recently, Josef has focused on improving simulation accuracy by converting legacy geometry models into precise "as-built" representations using advanced 3D scanning techniques. These enhancements address critical differences between traditional drawings and actual configurations, significantly improving the reliability of neutron transport calculations.

In MCNP simulations, the accuracy and reliability of results depend heavily on multiple factors: physics setup, geometry fidelity, statistical adequacy (number of histories run), and many others. While considerable improvements can be made through proper physics configurations and advanced variance reduction techniques, accurate representation of geometry remains a critical foundation. Even the most effective variance reduction methods cannot overcome errors introduced by overly simplified or inaccurate geometries, especially in high-precision calculations.

Modern facilities typically begin simulation efforts with detailed 3D CAD models, which can be directly translated into the MCNP environment. However, legacy facilities often rely on older, two-dimensional engineering drawings, reconstructed from historical documentation. Unfortunately, discrepancies between these legacy drawings and actual built conditions frequently occur due to practical modifications during construction that were never documented. At LANSCE, addressing these discrepancies is an essential part of our ongoing work. By leveraging the latest 3D scanning technologies, we can accurately capture existing "as-built" geometries, convert these scans into precise 3D models, and ultimately integrate them into MCNP simulations—significantly enhancing simulation fidelity and reliability.

Application of Unstructured Mesh in MCNP to Support Realistic Geometry Modeling at Los Alamos Neutron Science Center (LANSCE)

Speaker- Dusan Kral

Dusan recently completed his PhD and is currently working in a student position at LANSCE, contributing to research on spallation target systems at the Lujan Center and WNR facilities. His work involves detailed MCNP simulations in support of experimental studies, including beam spot analysis, neutron flux characterization, and target optimization. Most recently, he has been exploring the use of unstructured mesh in MCNP to enable more seamless integration of 3D CAD models. Compared to traditional constructive solid geometry (CSG), this approach takes advantage of modern metrology tools (such as laser scanning) and mechanical design workflows, making it easier to create or update MCNP geometry based on real-world configurations.

Accurate geometry representation is essential for reliable MCNP simulations, particularly in complex experimental environments like LANSCE. Traditional Constructive Solid Geometry (CSG) can be difficult to manage for intricate systems, limiting fidelity and increasing the risk of user error. At LANSCE, we are exploring the use of unstructured mesh (UM) geometry in MCNP to streamline modeling workflows and improve simulation accuracy.

Unstructured mesh offers several advantages: it handles complex and curved geometries with greater flexibility, integrate seamlessly with CAD tools, and support localized mesh refinement for enhanced spatial resolution without excessive computational cost. This approach also simplifies the transition from engineering models to simulation-ready geometry, especially when working with as-built configurations derived from laser scanning. By adopting UM-based modeling, we aim to reduce manual setup effort, minimize geometry-related uncertainties, and enable more realistic particle transport in neutron simulations. Ongoing efforts focus on validating this workflow for use in spallation target system analysis and broader applications at LANSCE.

Understanding ALARA in the DOE Complex

Speaker- Lige Smith

Lige Smith, a returning HPS member is a Health Physicist at Los Alamos National Laboratory supporting the Radiological Engineering team. He specializes in MCNP transport modeling and Operational Health Physics solutions. A former Radiological Control Technician and current NRRPT member he has primarily supported waste operations and actinide facility operations through his 10 years in the Nuclear Industry.

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This presentation will establish the framework for ALARA methodologies as a cost-saving analysis. We will explore the cost implications of the Total Effective Dose (TED) within the DOE Complex, highlighting the importance of ALARA in future initiatives. The discussion will conclude with an analysis of subjectivity in cost-benefit methodologies and key areas for improvement.