

A new IAEA Technical Document on Occupational Radiation Protection in Decommissioning of Nuclear Installations – Main Aspects of Management, Planning and Conduct

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DigiDecom 2021 – DIGITAL

Online international workshop focusing on digital transformation, robotics and other game changing trends in nuclear decommissioning



Purpose of Talk



To outline:

- IAEA approach on occupational radiation protection
- Perspectives on how to enhance radiation protection of workers and the future of workplace safety (innovative applications, technological changes in Safety Standards)
- TECDOC on Practical Occupational Radiation Protection during the Decommissioning of Nuclear Installations

IAEA - Occupational Radiation Protection Program



• **Objective**: To promote an internationally harmonized approach to ORP through the development and application of standards for optimizing protection and safety, restricting exposures and applying current radiation protection techniques in the workplace

To ensure an appropriate control of occupational exposure due to external and internal irradiation from both artificial sources and natural sources of radiation

- This is achieved through provision of operational services for radiation monitoring and protection to the Agency's own operations; and <u>through assistance to Member States in</u> <u>establishing, maintaining and, where necessary, improving programs for the radiation</u> <u>protection of workers.</u>
- Activities are targeting workers, employers, regulatory authority staff and radiation protection professionals.

Work environment











































About a worker

- Any person who works, whether full time, part time or temporarily, for an employer and who has recognized rights and duties in relation to occupational radiation protection (IAEA glossary, 2019)
 - A self-employed person is regarded as having the duties of both an employer and a worker.
- Protection and safety is an integral part of a general occupational health and safety programme (*specific obligations and responsibilities*)
- The Board of Governors of the IAEA first approved health and safety measures in March 1960













Occupational Exposure

- All exposure of workers incurred in the course of their work
 - Workers are exposed to ionizing radiation in a wide range of occupational settings (artificial & natural)
- Over 23 million monitored workers worldwide (57% 13 million, exposure natural sources of radiation workers; 43% - 10 million, manmade source; 860,000-nuclear industry, 870,000 -industry, 3.5 million medical), numbers continue to increase
- Area with multiple actors (global / national level)
 - Requirements for protection of workers (IAEA ILO)
 - Ministries, Regulators, OHS, etc.
- Safety Standards To protect occupationally exposed workers against the risks associated with ionizing radiations ("Overall objective")
- Requirements & guidance are provided in GSR Part 3 & GSG-7







IAEA Safety Standa

Radiation Protection and Safety of Radiation Sour

International Basic Safety Standards

() IAEA

International Basic Safety Standards, GSR Part 3

IAEA Safety Standards

Radiation Protection and Safety of Radiation Sources:

International Basic Safety Standards

No. GSR Part 3

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Jeef yaanoond by EC, FAO, IMEA, R.O. GECONEA, FAHO, UNEP, WHO MEAN OF AN AND AND AND AND AND AND MEAN OF AND AND AND AND AND General Safety Requirements Part 3



- An integrated and consistent set of Safety Requirements that establishes the requirements that must be met to ensure the protection of people and the environment, both now and in the future.
 - GSR Part 3 (BSS) follows ICRP 103 recommendations
 - Protection and Safety requirements of the BSS apply to all facilities and activities
 - Planned, emergency and existing exposure situations
 - Occupational, public and medical exposure categories
 - 52 overarching requirements for governments, regulatory bodies, industry, health and safety professionals, workers, public and service providers such as technical support organizations
 - 12 requirements for ORP; Control, monitoring and recording
 - Regulator, TSP (authorization or approval of service providers for individual monitoring and calibration services) & Operators

GSR Part 3 coverage for ORP



Planned exposure situation



Occupational exposure

Req 19: Responsibilities of the regulatory body

- Req 20: Requirements for monitoring and recording of occupational exposure
- Req 21: Responsibilities of employers, registrants and licensees
- Req 22: Compliance by workers (Responsibilities of workers)
- Req 23: Cooperation between employers, registrants and licensees
- Req 24: Radiation protection programme
- Req 25: Assessment of occupational exposure and workers' health surveillance
- Req 26: Information, instruction and training
- Req 27: Conditions of service
- Req 28: Protection and safety for female workers and for persons under 18 years of age





Exposure of Emergency Workers

Req 45: Protection of emergency workers (arrangements for controlling the exposure

Existing exposure situation



Occupational exposure Req 52: Protection of workers in existing exposure situations (remedial actions, Rn in workplaces, exposure of air crew)

General Safety Guide on ORP (GSG-7)



IAEA Safety Standards for protecting people and the environment
Occupational Radiation Protection
General Safety Guide No. GSG-7

- Provides guidance on the control of occupational exposure (technical and operational aspects)
- Based on "exposure situations", and provides information on ORP framework, exposures of workers in different exposure situations, protection of workers in special cases, dose assessment, management system for service providers, control measures as well as health surveillance
- New approaches for itinerant workers, female workers during and after pregnancy, monitoring of lens of the eye, etc.

New TECDOC

- Practical Occupational Radiation Protection during the Decommissioning of Nuclear Installations
- Emphasis on ORP issues during decommissioning
- Intended audience: RP professionals, QE, decommissioning project managers and TE involved in decom operations, RB & TSPs
- Experiences in the protection of workers against exposure to ionizing radiation in decommissioning activities exist but are limited to few member states.
 - Compared to the operational phase of nuclear installations, the work activities and exposure scenario during decommissioning will be different
 - Decommissioning activities mainly related to dismantling of structures, systems and components (SSCs)
 - Due to this, the occupational workers would be subjected to other types of risks and hazards besides the radiation exposure
 - Further guidance and examples in relation to decommissioning activities, including control of occupational hazards





Structure



- Impact of decommissioning on the protection of workers
- Establishment of a radiation protection programme for decommissioning
- Radiological characterization and site preparation
- Consideration on non-radiological hazards
- App:
 - Defining the process and criteria for detailed planning of occupational radiation protection during decommissioning
 - Sample work planning
 - Example of the impact of protective suits on exposure time
 - Sample contamination map
 - Sample predefined sets of nuclide vectors



Strong emphasis

- Dose estimation- application of different computer codes
- 3-D simulation of the local situation for planning and understanding of the local conditions and individual work steps
 - Software to model workplaces and operations
 - Validated by measurements
 - For the preparation phase as well as during the dismantling operations
 - Planning and training

Work simulation software (courtesy of Bradwell, United Kingdom)









Acknowledgements

• Contributors to drafting and review

Abela, G.	Électricité de France, France
Achmedov, V.	State Nuclear Power Safety Inspectorate, Lithuania
Anderson, E.	Nuclear Energy Institute, USA
Bowers, J.	Magnox Ltd, United Kingdom
Brendebach, B.	Gesellschaft für Anlagen- und Reaktorsicherheit GmbH, Germany
Clarke, T.	Magnox Hinkley Point A Site Nr Bridgewater, United Kingdom
Deboodt, P.	Nuclear Research Centre, Belgium
Gadbois, N.	Canadian Nuclear Safety Commission, Canada
Hofvander, P.	Consultant, Sweden
McQueen, M.	Professional Radiation Safety Management, Canada
Robinson, I.	Consultant, United Kingdom
Schmollack, J.W.	TUV Rheinland Industrie Service GmbH, Germany
Suriyamurthy, N.	Consultant, India



- Consultancy Meetings
- Workshop
- Technical Meetings

Virtual Technical Meeting

VIRTUAL EVENT #AI4Atoms (Virtual Event) Technical Meeting on Artificial Intelligence for Nuclear

(Virtual Event) Technical Meeting on Artificial Intelligence for Nuclear Technology and Applications

25 - 29 Oct 2021

Vienna, Austria

Event code:

EVT2004304

Artificial Intelligence (AI) refers to a collection of technologies that combine numerical data, algorithms and continuously increasing computing power to develop systems capable of tracking complex problems in ways similar to human logic and reasoning. AI technologies can analyse large amounts of data to learn how to complete a particular task, a technique called machine learning.

Al is advancing exponentially and can already sort and interpret massive amounts of data from various sources to carry out a wide range of tasks, and help tackle many of the world's most urgent challenges.

For example, Al's ability to recognize data patterns and analyse high-resolution images from satellites, drones or medical scans can improve responses to humanitarian emergencies, signal drought or floods by detecting global hydro-climatic changes, help doctors identify cancers and other diseases, increase agricultural productivity, track animal and marine migrations. In fact, Al will be an integral part of the Agency's new ZODIAC project helping to identify and contain future zoonotic disease outbreaks.

In addition, AI is used in the nuclear industry to augment automation, for refuelling and maintenance planning, to train nuclear personnel for normal and abnormal operation, for in-service inspections, evaluation and characterization of cracks and flaws, in reactor design, safety, security, real-time risk assessment, long term operation/lifetime applications, to enhance workplace safety and for on-line dosimetry based on computer simulations. However, the transformative power of AI also comes with

Related resources

 Information Sheet
 Participation Form (Form A)
 Form for Submission of a Paper (Form B)

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Topics

The pienary cross-cut sessions will cover some of the following topics

 Enabling Infrastructure Keywords: anticical instituce (matrine learning: open data science; standardized frameworks; compentensive data management; uncirtainty; quartification; data curation; high performance computing; advanced manufacturing; educational and training activities; ethics.

- Advanced Modelling and Simulation Methodologies Keywords: integrated modelling: multi-chysics multiscale modelling: virtual systemicitigati with activitage optimized system design; improved system performance and user experience.
- The working group sessions whese participants and tails will be established by the Organizers of the Sessions - will focus on the following thematic ansas: Philes

Koywords: trustworthiness; human rights; sustainability objectives; Al ethics. (water ethics, olimate ethics, ethics and health, Al and nuclear safety, Al-energy ethics).

Food and Agriculture

Keywords: food authentication; food safety early warning system; soil type prediction; insect screening; place viability screening;

- Human Health Keywords: diagnoss and treatment of cancer; image interpretation; treatment plans and contouring; adaptive radiocherapy; medical processes.
- Nuclear Data Repwords: nuclear, atomic and molecular data; data analysis; verification; uncertainty quartification; anomaly detection; information discovery.
- Nuclear Fusion
 Keywords: plasma prediction; control system; model generation.
- Nuclear Physics Keywords: data analysis; data management; experimental design and optimization; facility operation.
- Nuclear Power Keywords: sutage, maintenance, planning, scheduling inspection, training, engineering assessment; risk assessment; machine learning.
- Nuclear Security Neywords: anomaly detection; data analysis (flow, sensor, image); data integration;

response, amoning document, element approximate particular, maging tanàné maginatory data amangament, definitivo camputer security (monwork) antibicany (normat of things - cisual services; information protection; performance assessment; systems design analysis; throat analysis; training; w/inerability management.

- Badiation Protection Maywork: computer simulations including work simulations; processes including maliacion exposure with algorithms; health and safety in workplaces; radiatograd data across machines; radiation protection programmes; online datametry; optimization; planning and training validation by measurements; instrumentation; rabotis;
- Radioisotopes and Radiation Technology Keywords: nadiopharmacrustical design and modeling, rediation does distribution -animal models and installated samples; sediment transport rainulations; heat transfer and cooling of targets.
- Safeguards Verification
 Reyverids nuclear measurements; surveillance; non-destructive assay; tampering detection; gamma spectroscopy; spent fuel verification; Ceremico Light; Dynamic calorimetry; fasile mass quantification;
- Water and Environment
 Keywords: water sociarity and protection; complex data analysis spatial and
 temporal; groundwater modeling: study of the hydrological cycle; climate
 modelin.



An international, crosscutting forum

- To discuss and foster cooperation on
- Artificial intelligence applications, methodologies,
- Tools and enabling infrastructure that have the potential to advance nuclear technology and applications, while taking into account existing mandates and programmatic priorities
 - Official designations from MSs
 - 19 July 2021
 - Abstract submission through IAEA-INDICO by 4 July 2021





Thank you!

IAEA ORPNET: <u>https://nucleus.iaea.org/sites/orpnet/home/SitePages/Home.aspx</u>

