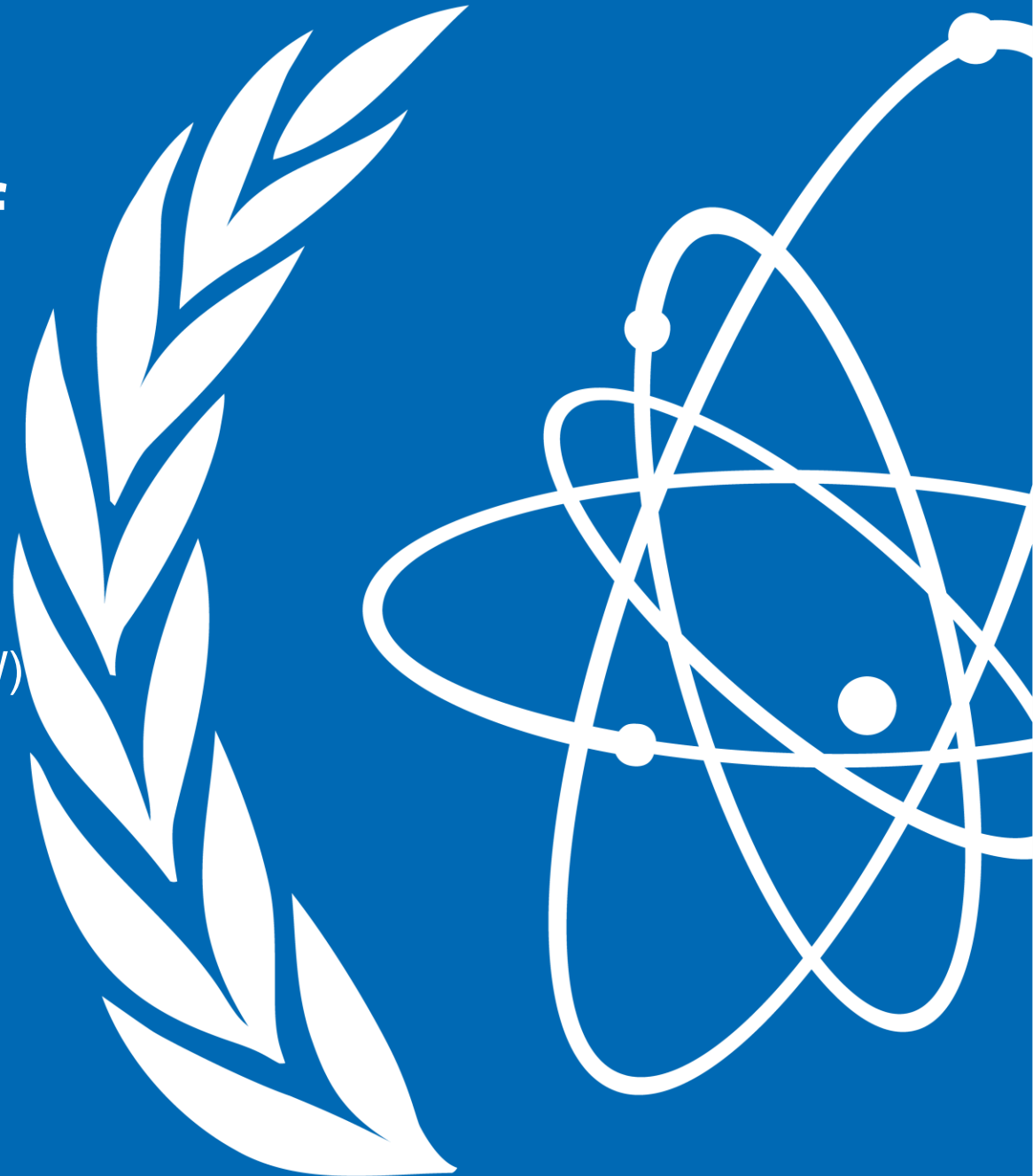


Safety Standards, the Role of AI in Safety During Decommissioning

Duriem Calderin Morales
Decommissioning and Remediation Unit (DRU)
Division of Radiation, Transport, and Waste Safety (NSRW)
Department of Nuclear Safety and Security

DORADO (Digital twins and Ontology for Robot Assisted Decommissioning Operations)

April 7th 2025, online, Vienna-AT



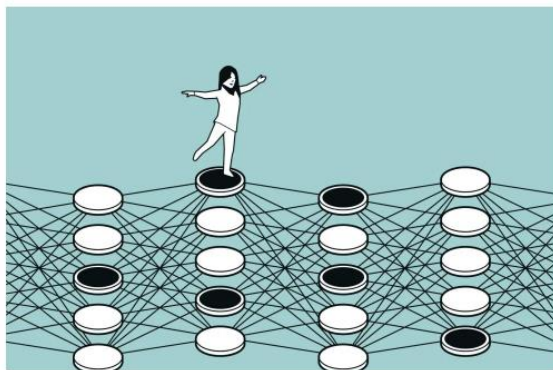
Highest Honor Recognition

They used physics to find patterns in information

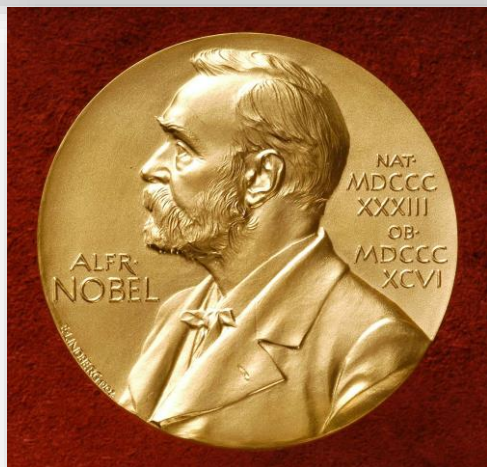
This year's laureates used tools from physics to construct methods that helped lay the foundation for today's powerful machine learning. John Hopfield created a structure that can store and reconstruct information. Geoffrey Hinton invented a method that can independently discover properties in data and which has become important for the large artificial neural networks now in use.

Related articles

[Press release](#)



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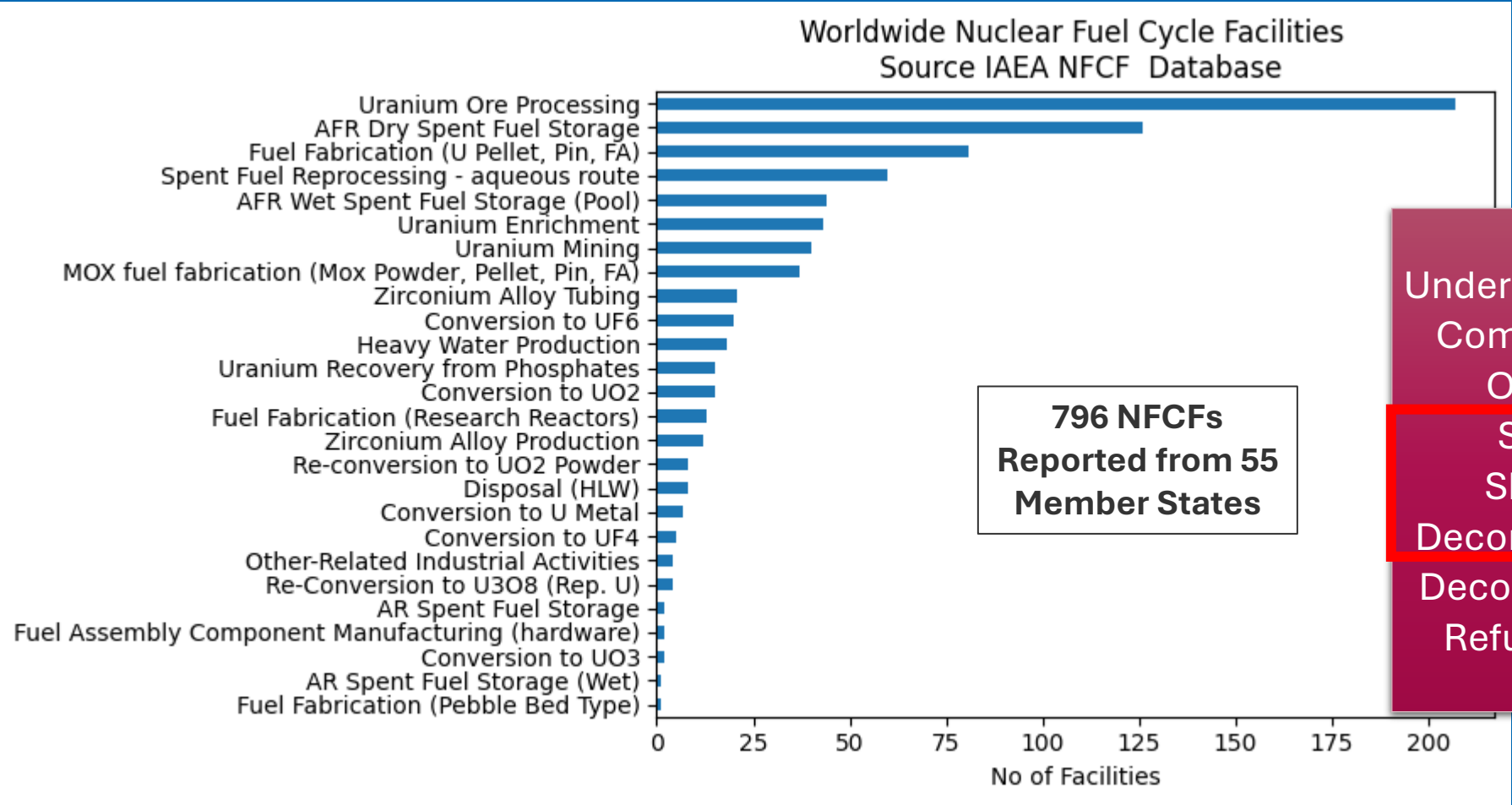
Requested by Member States GC68

GC(68)/RES/8
Page 7

1. General

1. Urges the Agency to continue to strengthen its efforts to maintain and improve nuclear, radiation, transport and waste safety and emergency preparedness and response, and to enhance its support and assistance to Member States, upon their request;
2. Encourages Member States to develop, maintain and improve their nuclear and radiation safety infrastructure and related scientific and technical capabilities, including through international nuclear cooperation; and both requests the Secretariat and encourages Member States in a position to do so, to assist in this regard, upon request, in a coordinated, efficient and sustainable manner;
3. Encourages Member States to develop and maintain strategies, approaches and contingency plans in managing extraordinary circumstances, such as the COVID-19 pandemic, extreme natural disasters and armed conflicts, in order to ensure nuclear and radiation safety;
4. Encourages the Agency to continue providing technical support and assistance to interested Member States in maintaining and improving nuclear safety and security for nuclear facilities and activities involving radioactive sources, including during armed conflicts, and to enhance this support and assistance upon request;
5. Requests the Secretariat, in close consultation with Member States, to continue identifying potential benefits and challenges of **artificial intelligence** in support of nuclear safety, to provide relevant technical assistance to Member States upon request, and to keep Member States informed of any progress;

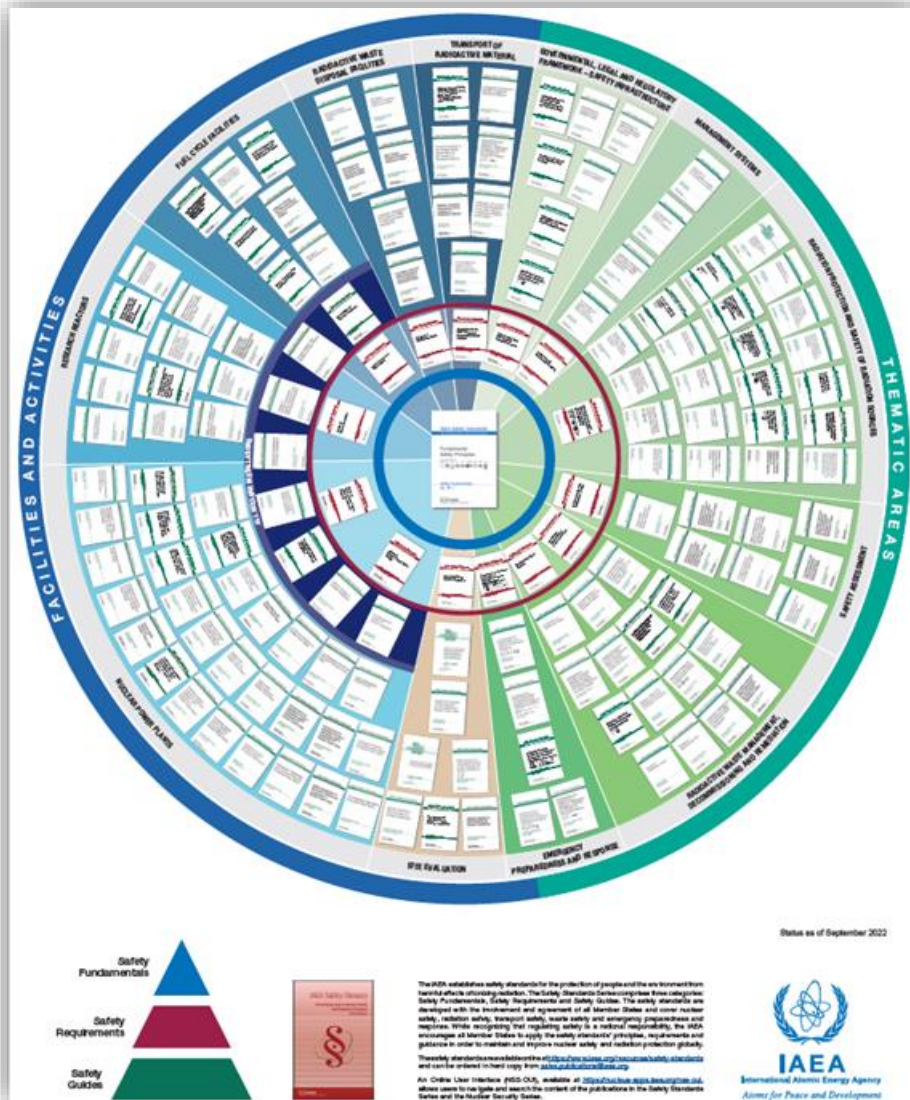
Nuclear Fuel Cycle Facilities Around the World are going to or expected to be Decommissioned



NFCF	No of NFCF
Under construction	36
Commissioning	4
Operation	353
Stand by	31
Shutdown	93
Decommissioning	75
Decommissioned	157
Refurbishment	2
Others	45

Large amount of data
in different types of
format

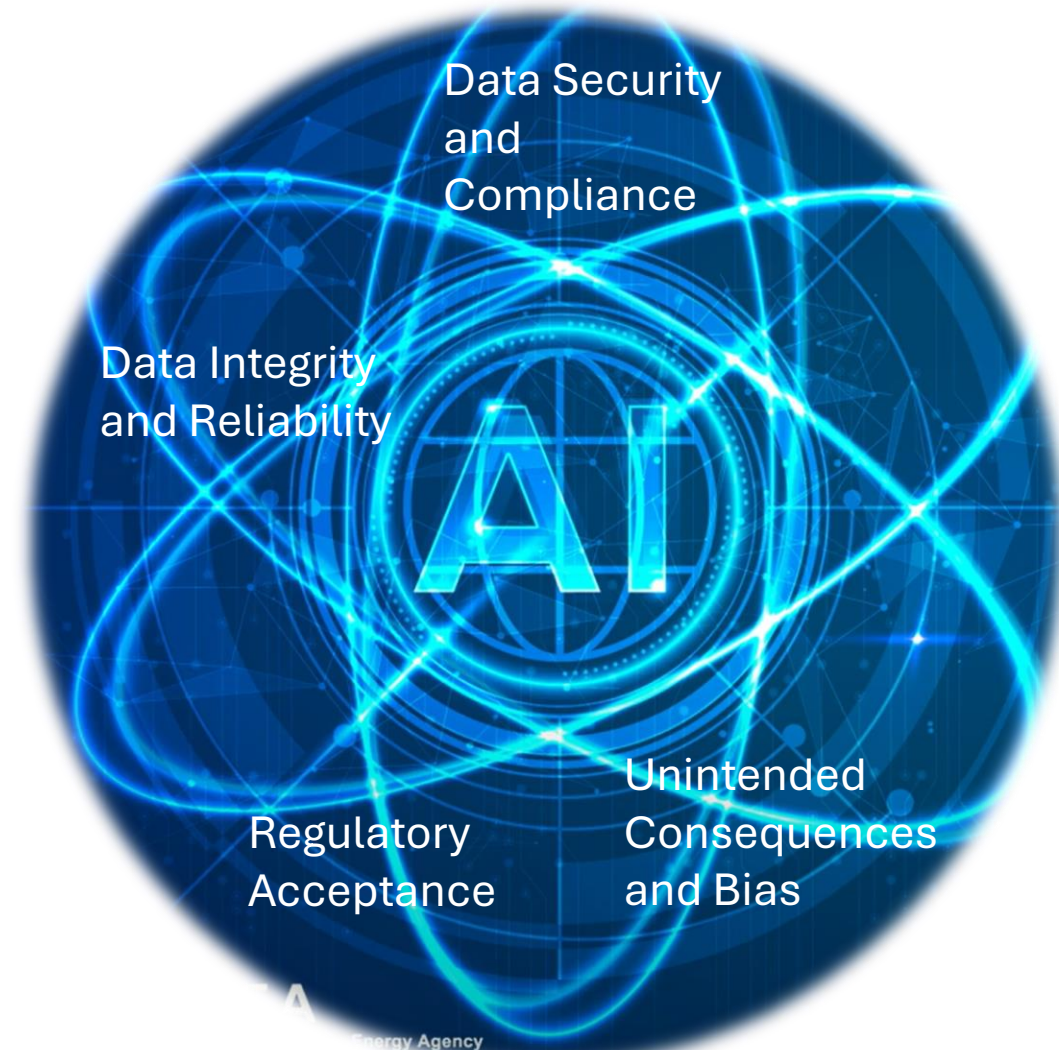
Safety and Artificial Intelligence

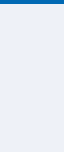


What safety considerations need to be put in place?



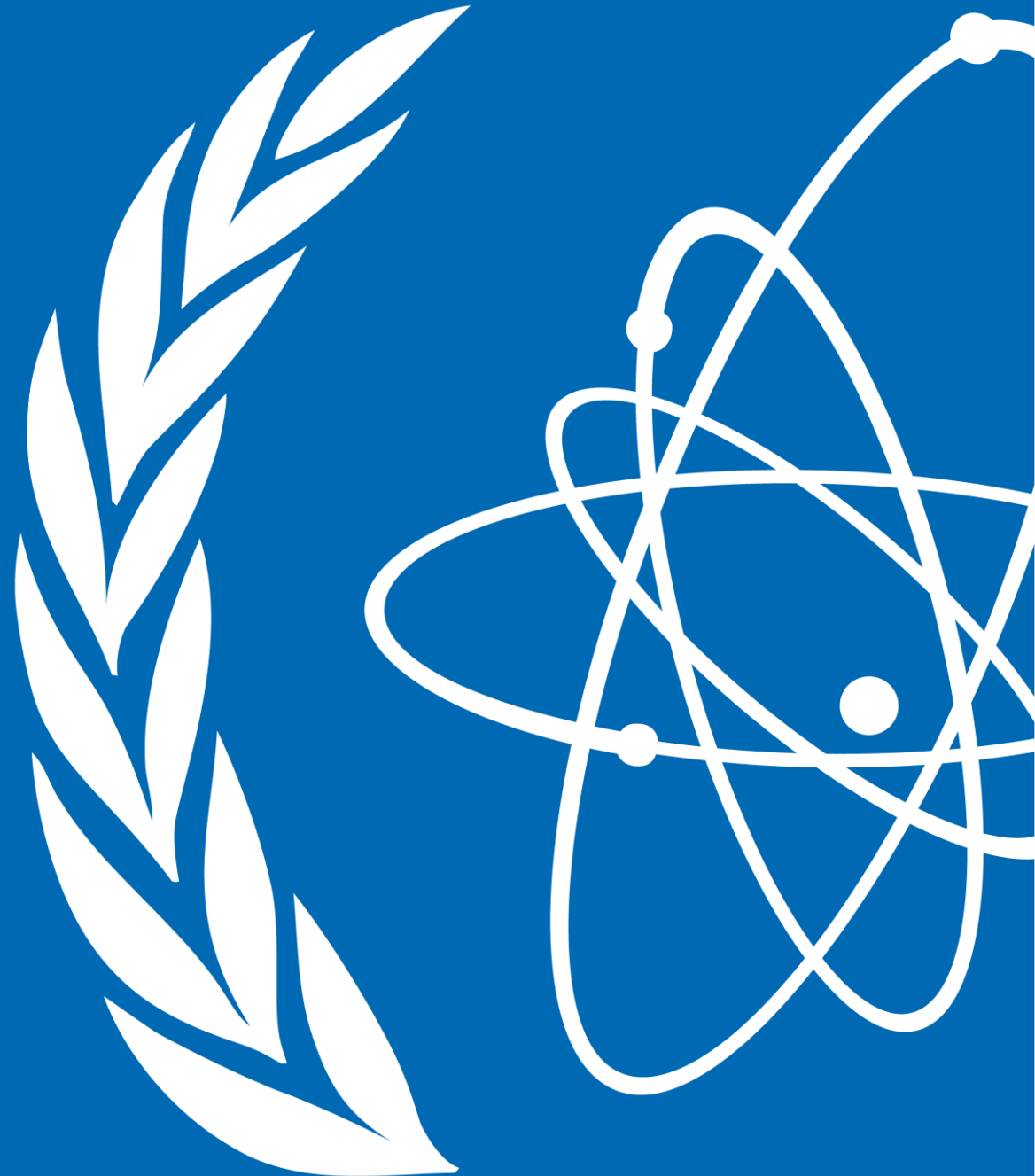
What requirements will it need?



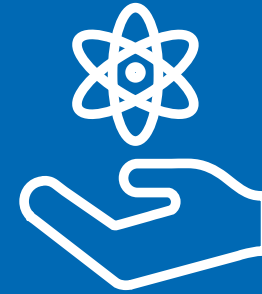
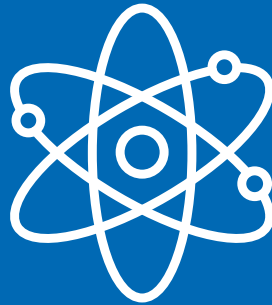


Consultancy Meeting on Application of AI Large Language Models for Safety in Decommissioning of Nuclear Fuel Cycle Facilities

Dates: 29 Oct- 1 Nov 2024
Location: Vienna Austria



Objectives



- Understand how Member States are Approaching Large Languages Models (LLMs) in the context of nuclear safety, especially in Decommissioning of Nuclear Fuel Cycle Facilities (NFCF)
- Develop a roadmap for future direction (workshops, technical meetings, trainings) of AI LLM applications in NFCF decommissioning safety for benefit of Member States.
- Share experience on AI Policy in nuclear safety

Consultancy Meeting Outcomes (*cont.*)

Collaborative Knowledge Sharing



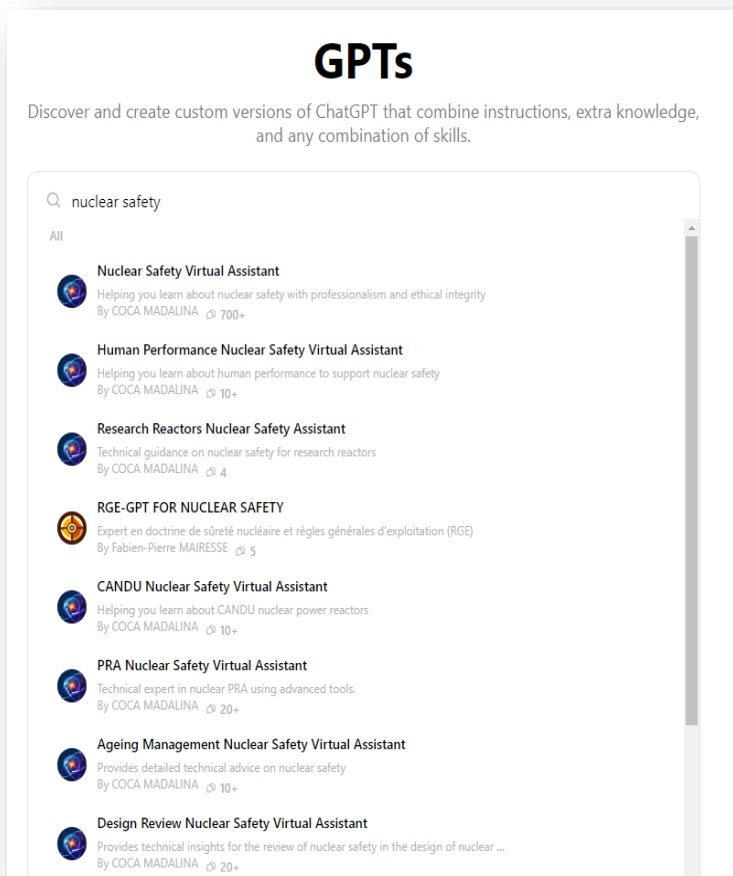
Capacity Building and Internal Adoption



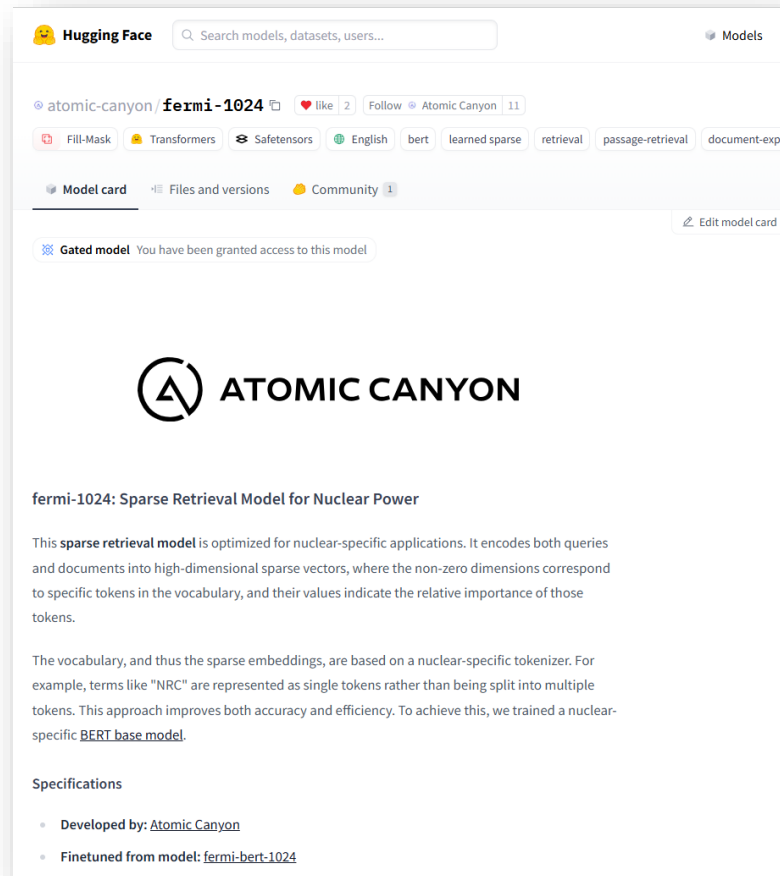
Data Accessibility and Integration



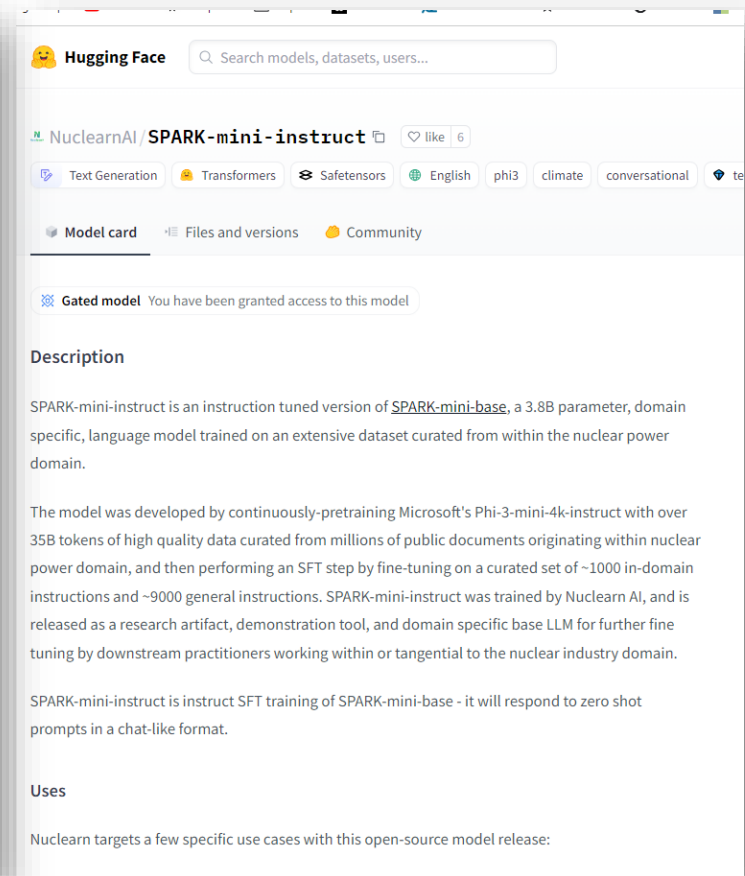
Examples of AI –LLMs in Public Platforms



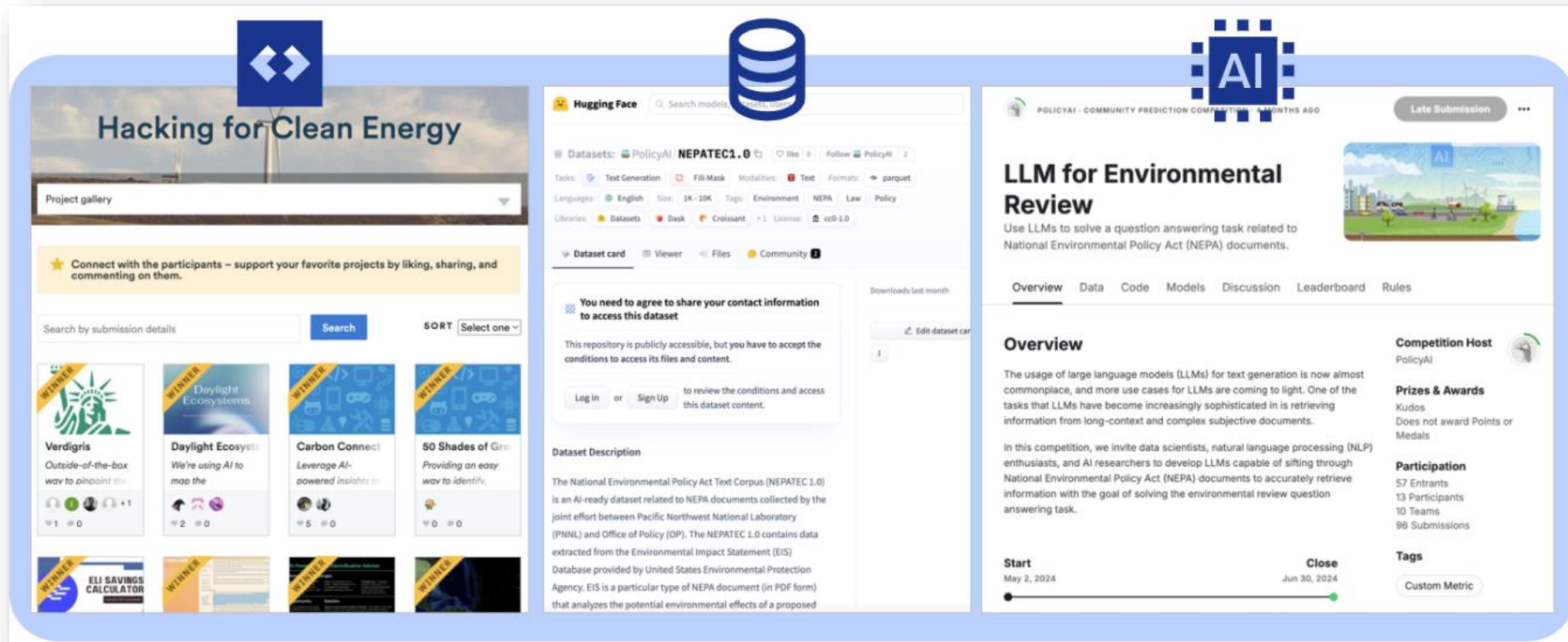
Minimum code requirements, user “intuitively” defines prompt for system and users, enable with latest GPT-model



Pre-trained on nuclear specific datasets by Atomic Canyon (left) and NuclearnAI (right),

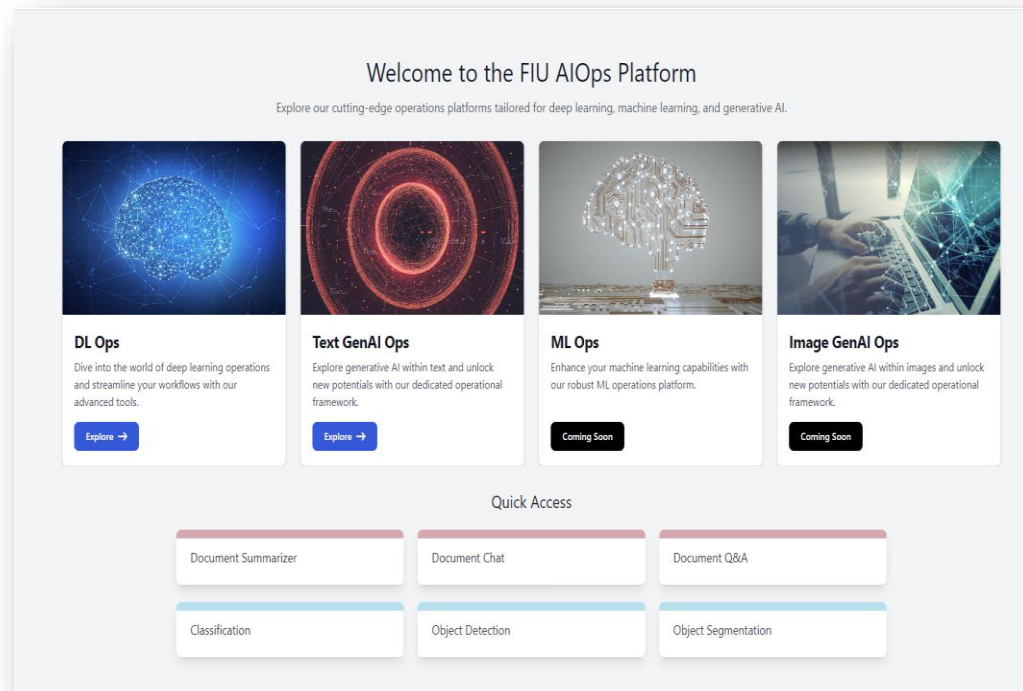


Examples of AI –LLMs in Public Platforms

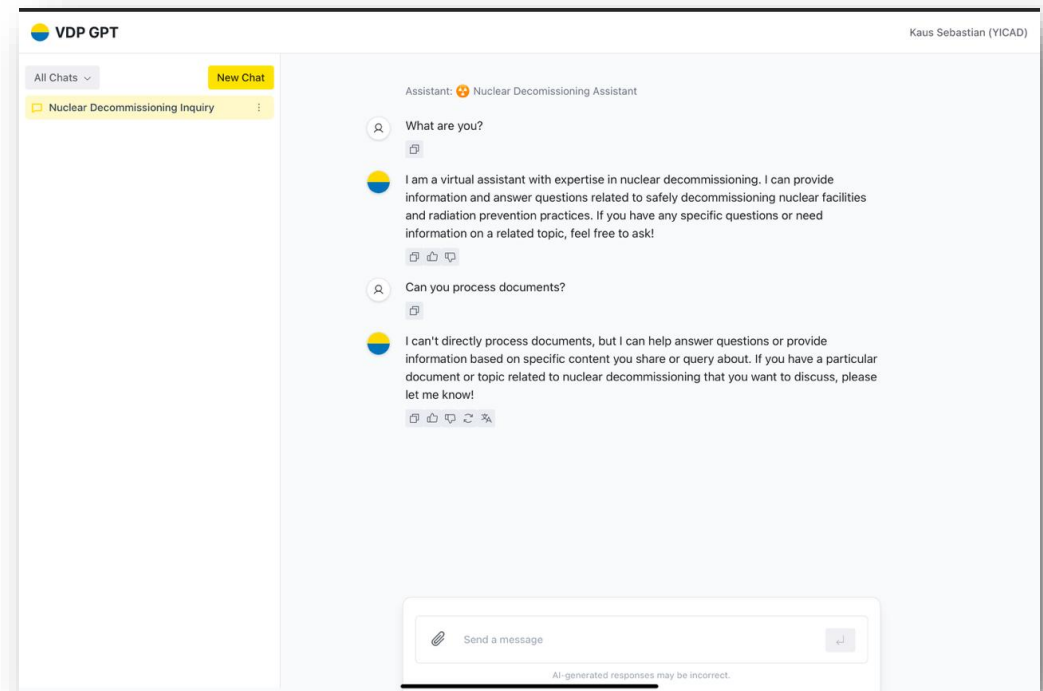


Open, Standardized, and AI-Compatible For Community Engagement,
Pacific Northwest National Laboratory (PNNL), USA

Examples of AI –LLMs in development for decommissioning and waste

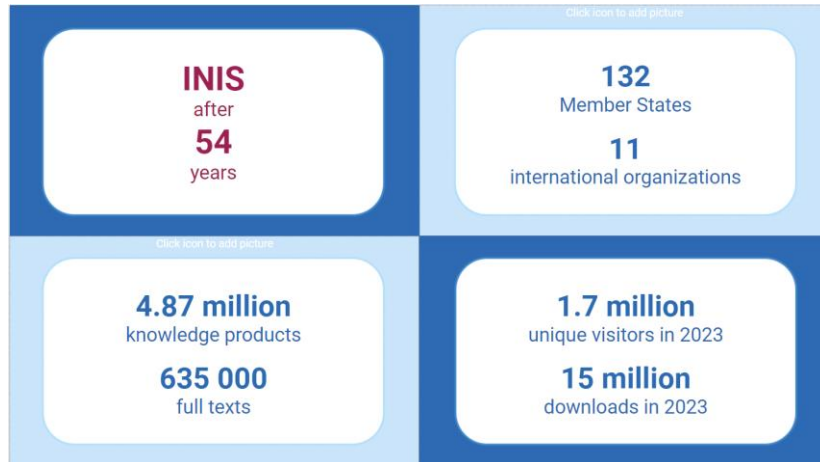


Florida International University, (FIU) over 30 years supporting D&D in the USA.



Vattenfall customizable LLM (gpt 4o, possibility to use others) assistant (ability to prompt, RAG on the fly)

Example of IAEA AI Model: NADIA Using AI to Index Nuclear Information



NADIA
Neural Artificial Intelligence
for
Document Indexing Automation

Some criteria for a successful machine learning project:

A lot of data for training

Data should be well-labelled

Project should replace a repetitive,
boring, unrewarding task

Thank You to the Experts





IAEA Integrated AI-Work

AI Working Group



International **knowledgeable stakeholders**

Nuclear utilities, Nuclear regulators, AI vendors (developers/providers), Research institutes and Universities, Other organizations

Experts pool available for all IAEA activities

Inclusive group:

All knowledgeable stakeholders from IAEA Member States
Active members

- ✓ 106 Members
- ✓ EPRI
- ✓ WANO
- ✓ IEC
- ✓ NEI

Collaboration with IEC SC45A – WG12, WG9



AI for Atoms

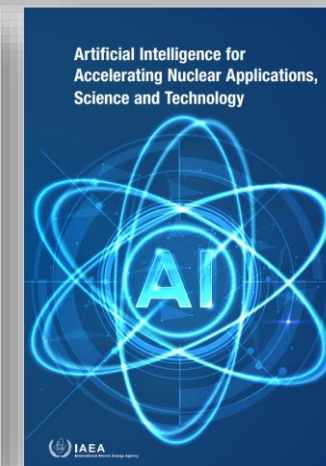
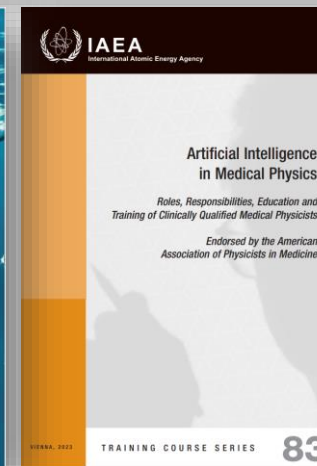
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Send by email

Published 11/13/2023

The IAEA's platform for partnership on AI

AI for Atoms: the IAEA's knowledge-sharing platform for partnership on AI applications in the nuclear field



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IAEA Officers / Scientific Secretaries

ITU Publications

International Telecommunication Union

United Nations Activities on Artificial Intelligence (AI)
2022



Upcoming Events on AI at the IAEA

Technical Meeting on the Application of Artificial Intelligence for Nuclear Security

- **Date:** 20-24 October 2025
- **Purpose:** The purpose of the event is to enhance the cooperation and information exchange among Member States in the areas of artificial intelligence and machine learning for nuclear security.
- **Contact:** Rodney Busquim E Silva, r.busquim@iaea.org

International Workshop on Instrumentation and Control and Computer Security for Small Modular Reactors

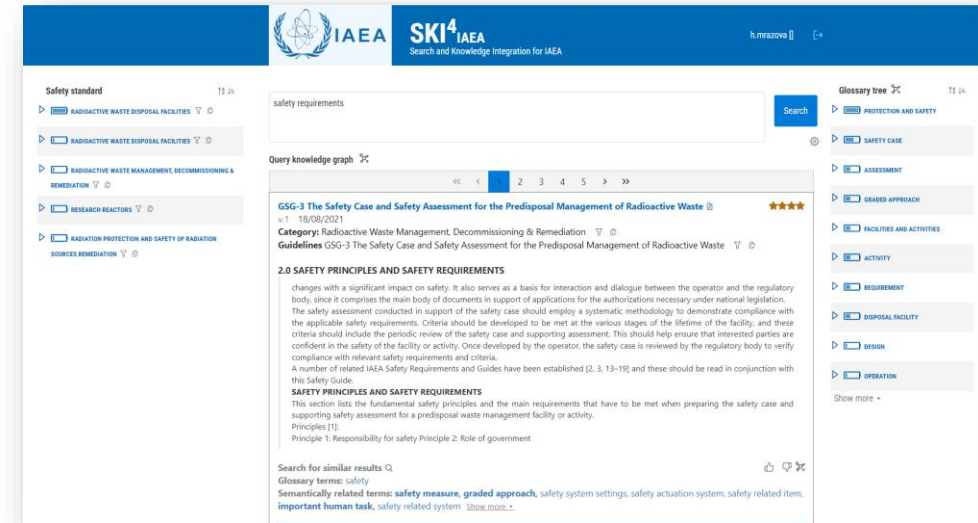
- **Tentative date:** 4-8 August 2025, MIT, USA
- **Purpose:** This event aims to enhance participants understanding of instrumentation and control, computer security aspects related to innovations on digital technologies a, including AI/ML for small modular reactors.
- **Contact:** Rodney Busquim E Silva, r.busquim@iaea.org

Technical Meeting on Safety Considerations in the Use of Artificial Intelligence in Nuclear Power Plants with a Focus on Human Factors Engineering and Instrumentation and Control Systems

- **Date:** 10 – 14 November 2025, ROK
- **Purpose:** The purpose of the event is to provide a platform for Member States to advance discussions on the safety implications of the use of artificial intelligence in the nuclear field, with a focus on the design of nuclear power plants.
- **Contact:** Yun Goo Kim, y.g.kim@iaea.org

Technical Meeting on Innovations in Data Analysis and Retrieval for Nuclear Decommissioning

- NEFW/DERS event scheduled on **18 - 22 August 2025** with support of NSRW/DRU
- Key Objectives:
 - Enhance discussion on the **role of digital technologies** in facilitating decommissioning data management.
 - **Innovations** in **access and retrieval** of decommissioning knowledge.
 - Exploring challenges of verification, reliability and quality of data.
 - Understanding of Large Language Models and other Semantic technologies in the domain of nuclear decommissioning.
 - **Promoting** wider access to knowledge useful for planning and implementation of decommissioning.



ADVANCED ACCESS AND RETRIEVAL OF DATA



Helena Mrazova
Decommissioning
Technology Specialist

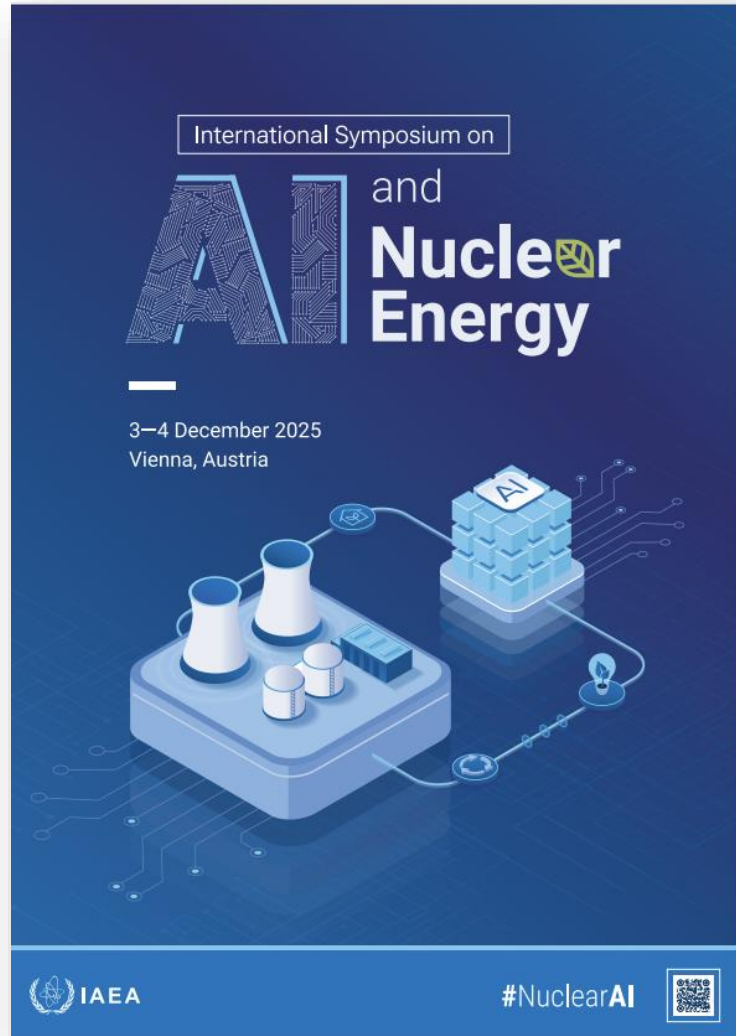
h.mrazova@iaea.org

Technical Meeting on the Role of Artificial Intelligence in Emergency Communication

- Event scheduled on **23-27 June 2025 in Vienna**
- **Key Objectives:**
 - Develop resilient and effective measures to **mitigate harms from human-made and AI-generated disinformation**
 - Support emergency response organizations, regulatory authorities, and operators in **detecting dis/misinformation**, and enhancing emergency **public communication preparedness** and response during routine operations and emergencies **through AI-enabled solutions**



Upcoming Events on AI at the IAEA



Key Themes & Topics

Powering Data Centres with Nuclear Energy

Opportunities and Challenges for AI in the Nuclear Sector

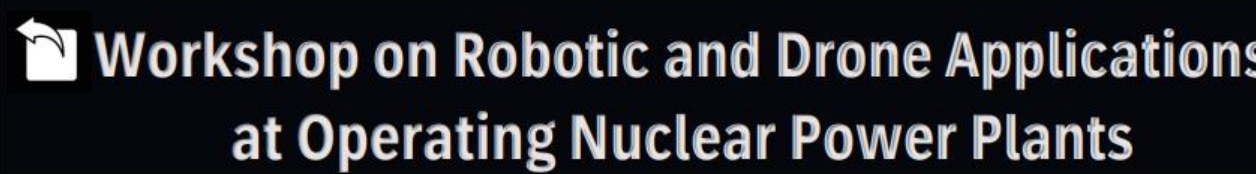
Regulatory Frameworks, Safety and Security Protocols

Current State of Play

<https://www.iaea.org/events/ai-symposium-2025>

Contact: Ed Bradley
email: E.Bradley@iaea.org

Upcoming Events on AI at the IAEA



Workshop on Robotic and Drone Applications at Operating Nuclear Power Plants

Join the Robolution and step into the future of cutting-edge technology

10.06 – 12.06.2025

REGISTER TODAY
www.iaea.org/events/evt2404696

Park Innovaare
Parkstrasse 1
5234 Villigen
Switzerland

ATTENDANCE

- Nuclear industry experts -
- Robotics engineers & drone operators -
- Safety & inspection specialists -
- Innovation & digitalization managers -
- Academics in robotics or nuclear -

ROBOTIC PLATFORMS
From drones to quadruped and bipedal robots – explore diverse systems designed for high-stakes, real-world applications.



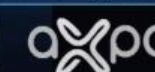

ADVANCED SENSORS & DATA ENGINEERING
Discover how advanced sensors like motion amplification and hyperspectral imaging, combined with holistic data structures, enhance precision, safety, and operational capabilities.

INNOVATIVE APPLICATIONS
Experience how robots and drones revolutionize inspection, maintenance, radiation monitoring, environmental monitoring, waste handling and emergency response within the nuclear sector.

LIVE DEMONSTRATIONS & HANDS-ON CHALLENGES
Watch state-of-the-art drones and robots in action and participate in interactive challenges, including a thrilling robot parkour course, to test your problem-solving and programming skills.

EXPERT TALKS & PANELS
Hear from leading voices in the field on real-world applications of robotics in complex, safety-critical environments.

NETWORKING SESSIONS
Connect with industry professionals, potential collaborators and robotics experts in structured networking events designed to foster meaningful relationships and new opportunities.

[evt2404696-additional-information.pdf](#)

2025 International Network on Innovation to Support Operating Nuclear Power Plants award

SCOPE

- All forms of innovation are welcome. Topical awards are foreseen in the existing ISOP working groups (AI, Advanced Manufacturing, Robotics & Drones and Advanced Instrumentation and Control). A fifth award can be considered for a significant technical or non-technical deployment outside of these three areas.
- Submissions are welcome from the broader nuclear industrial sector: nuclear utilities, regulators, laboratories / R&D organizations, commercial suppliers, academia, etc.
- **The submitted example MUST describe an implemented deployment delivering tangible impact on at least 1 operating nuclear power plant.**

SUBMISSION

- Examples must be summarized using the **Use Case template**, following the guidance.
- Examples must be submitted as MS Word / editable files.
- There is **no limit to the number of Use Cases a person**, team or organization may submit.
- Each example must be fully **deployed in at least 1 operating nuclear power plant**. In the case of, for example, innovations implemented by a regulatory authority; the example must demonstrate a tangible benefit that extends to 1 or more operating nuclear power plants.
- Email completed templates to e.bradley@iaea.org

DEADLINE

Submissions must be received by **Friday, 30 May 2025**.

Contact: Nelly Ngoy Kubelwa N.Ngoy-Kubelwa@iaea.org



Upcoming Webinars

AI/ML/LLM

The poster features a purple background with a stylized circuit pattern. On the right, there is a close-up of a person's face with glowing circuit lines overlaid. On the left, a hand is shown holding a robotic arm. The IAEA logo and tagline are in the top left corner.

IAEA Atoms for Peace and Development

Innovation in Action: Real World Applications in Nuclear Power

Innovations in AI/ML/LLM

Join the Webinar Session on the Latest Trends

Date / Time
20th May, 2025
Start at 15:00

Location
Webex

Secure Your Place Now!

Register!

Advanced Manufacturing

The poster features a teal background with a stylized circuit pattern. On the right, there is a close-up of a mechanical part, possibly a turbine. On the left, a robotic arm is shown working on a metal component. The IAEA logo and tagline are in the top left corner.

IAEA Atoms for Peace and Development

Innovation in Action: Real World Applications in Nuclear Power

Advances in Advanced Manufacturing

Join the Webinar Session on the Latest Trends

Date / Time
17th June, 2025
Start at 15:00

Location
Webex

Secure Your Place Now!

Register!

Conclusions

- Continue work on analyzing Large Language Models (LLMs) for decommissioning safety
 - Create data-driven processes for decision making
 - Repository of Radioactive Waste Management and Decommissioning
- Development of understanding for a Data Governance approach for nuclear safety among all Member States
- Need of more experience by Member States on application of LLMs for decommissioning safety and lessons learned



Thank you!

Duriem Calderin Morales

Decommission and Remediation Unit (DRU)

Nuclear Safety and Radioactive Waste (NSRW)

Department of Nuclear Safety and Security

International Atomic Energy Agency | Vienna International Centre, PO Box 100, 1400 Vienna, Austria |

Email: D.Calderin-Morales@iaea.org T: +(43) 1260022372

IAEA ORGANISATIONAL FRAMEWORK

Nuclear Energy

**Nuclear Sciences
and Applications**

**Nuclear Safety
and Security**

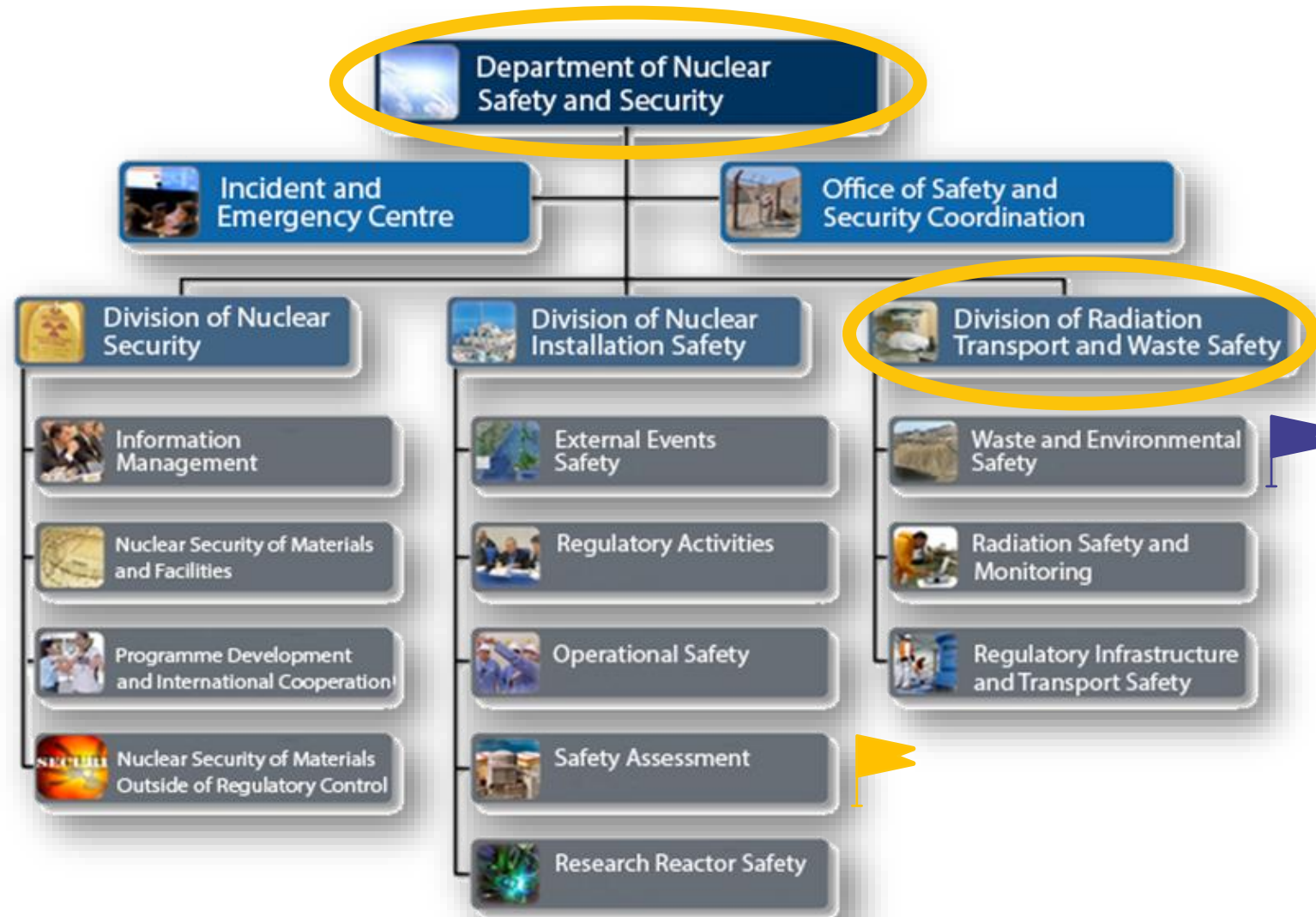
Safeguards

**Technical
Cooperation**

Management

DEPARTMENT OF NUCLEAR SAFETY AND SECURITY (NS)

- The Division establishes safety standards for radiation protection, management of radioactive waste and environmental releases, decommissioning, remediation and transport.
- Supporting Member States with expertise on decommissioning, environmental remediation, and management of radioactive waste and spent fuel.
- Making sure we protect people and the environment while enabling nuclear science and technology.





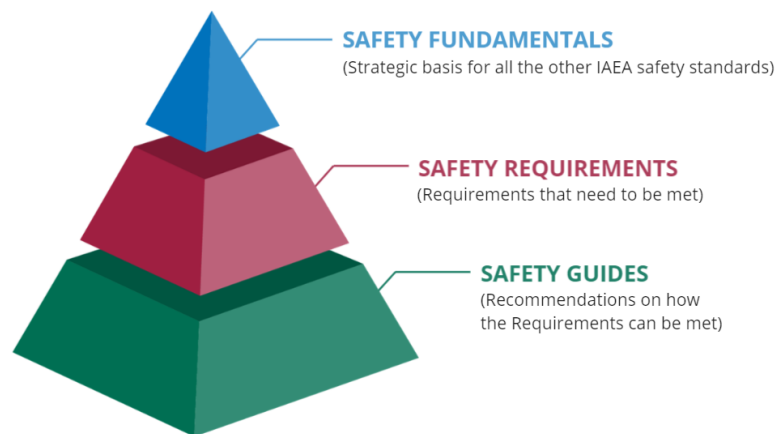
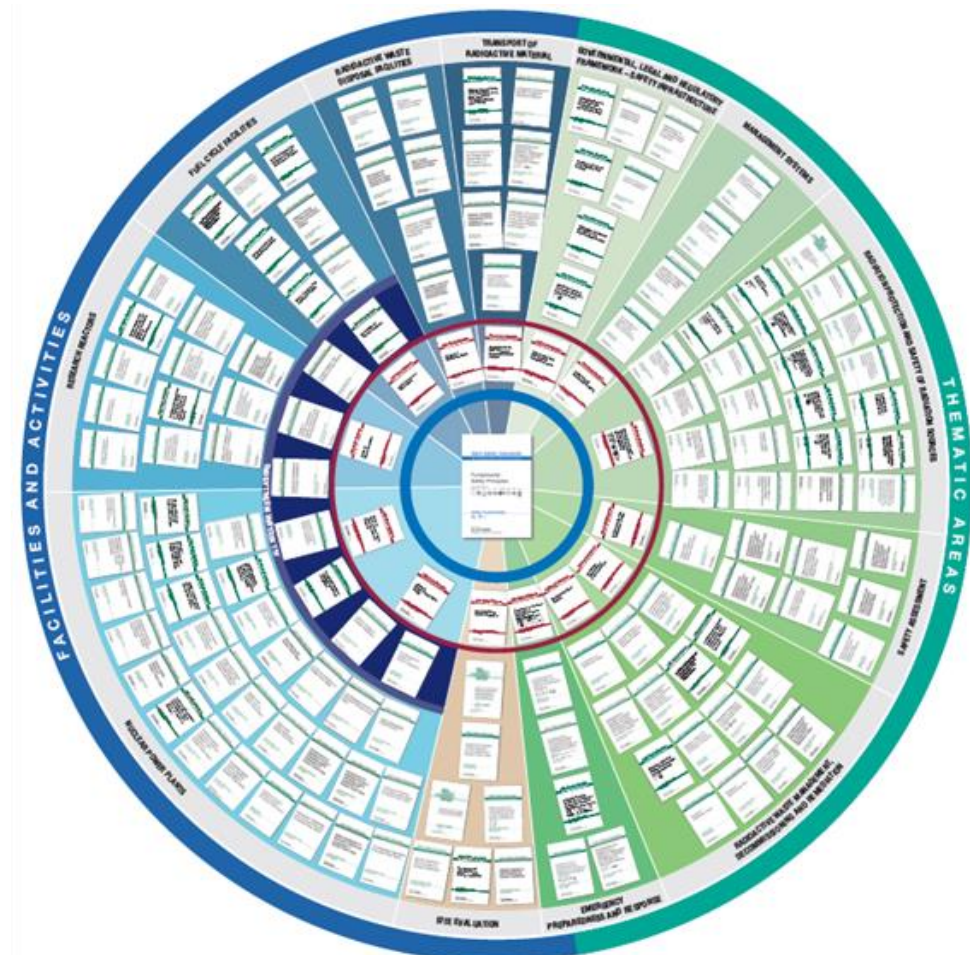
IAEA

Safety Standards Review

Safety means **protecting people** and the **environment** from **harmful effects of ionizing radiation**, and the safety of **facilities** and **activities** that give rise to **radiation risks**.

The standards aims to:

1. control radiation exposure of people and the release of radioactive material to the environment;
2. restrict the likelihood of events that might lead to a loss of control over a nuclear reactor core, nuclear chain reaction, radioactive source or any other source of radiation;
3. mitigate the consequences of such events if they were to occur.



International
Consensus



The IAEA establishes safety standards for the protection of people and the environment from ionizing radiation. The standards are developed by the IAEA in cooperation with the International Atomic Energy Agency (IAEA) and the International Commission on Radiological Protection (ICRP). The standards are developed with the involvement and agreement of all Member States and cover nuclear safety, radiation safety, transport safety, waste safety and emergency preparedness and response. While recognizing that regulating safety is a national responsibility, the IAEA encourages all Member States to apply the safety standards' principles, requirements and guidance in order to maintain and improve nuclear safety and radiation protection globally.

For more information, visit <http://www.iaea.org/publications/safety-standards>

An Online User Interface (OUI) is available at <http://oui.iaea.org>

Other users to see full and search the content of the publications in the Safety Standards Series and the Nuclear Security Series.

Status as of September 2022

