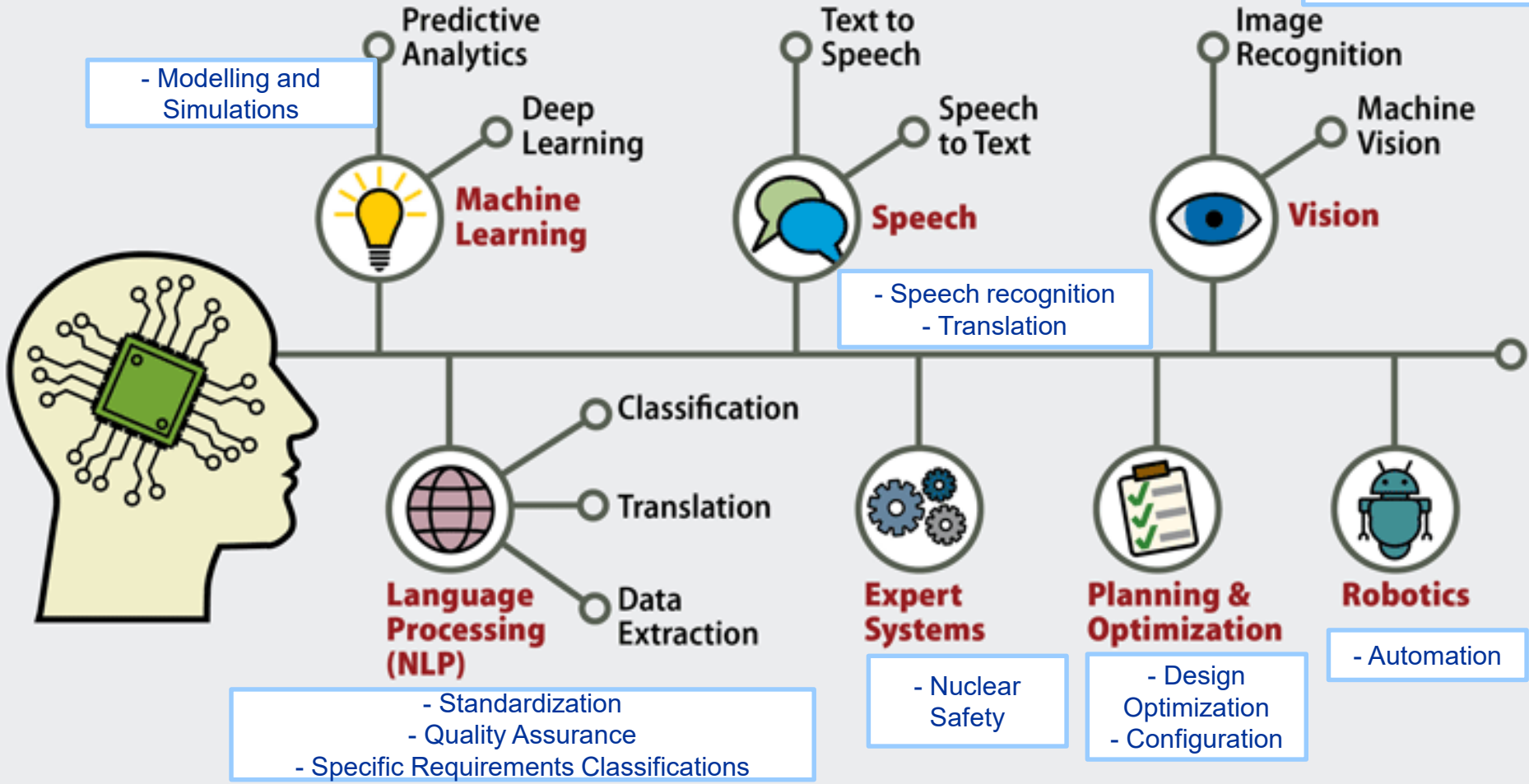


# IAEA's role in the deployment of AI for Nuclear Power

**Aline DES CLOIZEAUX**

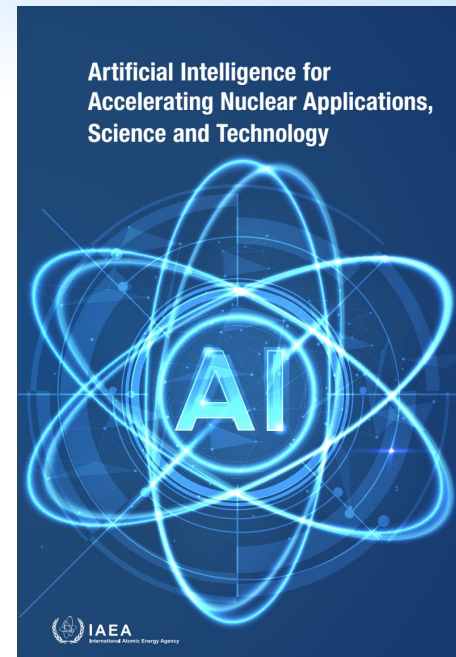
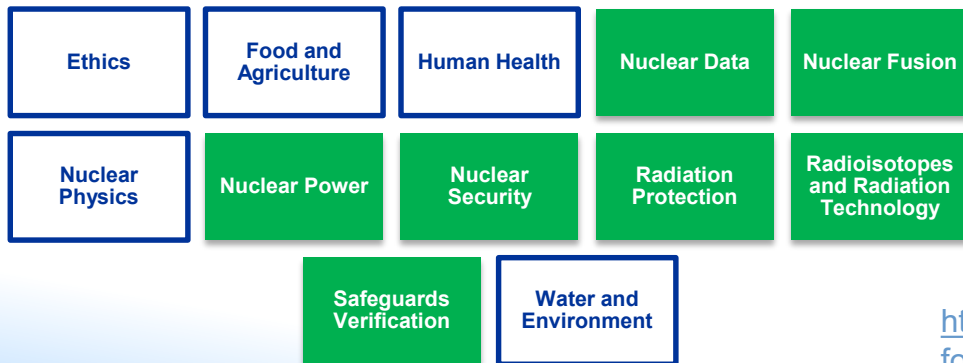
**Director, Division of Nuclear Power, IAEA**

# What is AI for? Artificial Intelligence



# Technical meeting: AI for Nuclear

- Technical Meeting on Artificial Intelligence for Nuclear Technology and Applications: **25-29 October 2021**
- 2 plenary topics and 12 Working Groups.
- All [meeting material](#) is freely available and a [networking site](#) is established to enhance coordination



<https://www.iaea.org/publications/15198/artificial-intelligence-for-accelerating-nuclear-applications-science-and-technology>

# AI for Nuclear Power - opportunities

- Working Group on Nuclear Power (WGNP) identified broad opportunities for IAEA support to deliver enabling outcomes
  - Increased **data availability** for AI applications to achieve their potential systems and to facilitate and accelerate the application of AI technology.
  - Improved **modelling and simulation capabilities** relevant to AI applications.
  - **Bridging the gap between the AI community and the industry** to identify specific generic applications of interest.
  - **Capacity building** to develop workforce competencies (students and practitioners) highlighting the value, mechanics and limitations of AI techniques
  - Increased confidence in the adoption of AI in existing and future plants by providing **guidance on the deployment** of the technology.
  - **Streamlined licensing processes** of designs comprising AI solutions \ (through the increased confidence).
  - The availability of **specific recommendations** to NPP utilities, regulatory bodies, research and design organisations, as well as vendors with respect to the application of AI technologies.

# AI for Nuclear Power - challenges

- Interpretability, confidence, and robustness measures of performance for AI
- Development of AI technologies for safety critical applications could present a challenge to regulators, as many traditional V&V approaches might not be easily applicable
  - Limited transparency of AI/ML
- Demonstration of compliance with standards
  - High level regulatory safety assessment principles and guidance may need to be developed
- Security poses unique challenges through data management and threats of adversarial attacks
- Development of standards is important for the adoption of new technologies
  - E.g. IEC SC 45 A: Instrumentation, control and electrical power systems of nuclear facilities
  - Developing a technical report on AI applications for nuclear installations



45A/1363A/DC  
For IEC use only  
2020-11-20

INTERNATIONAL ELECTROTECHNICAL COMMISSION

TECHNICAL COMMITTEE 45: NUCLEAR INSTRUMENTATION

SUBCOMMITTEE 45A: INSTRUMENTATION, CONTROL AND ELECTRICAL POWER SYSTEMS OF NUCLEAR FACILITIES

Call for experts to set up a multi-disciplinary team of IEC SC 45A experts to develop a Technical Report on AI (Artificial Intelligence) applications for nuclear installations and formulate comments on the related orientations retained during the IEC SC45A virtual plenary meeting held the 9<sup>th</sup> of October 2020

## 1. Background

For the October 2020 IEC SC 45A virtual plenary meeting, an expert, M. D. Bi (People's Rep. of China) was identified to take the lead to develop a TR to define which orientations could be followed by IEC SC45A to cover AI (Artificial Intelligence) applications for nuclear installations. See the paragraph 16 of the minutes references 45A/1360/R36 and the related presentation annexed to this DC.

# XAI in Nuclear Power Plants operation and construction



In July 2022, Consultancy Meeting to develop one or more Agency outputs to support Member States interested in deploying artificial intelligence in nuclear power plants operating or being constructed today.

- 6 recommendations
  1. Engage stakeholders, regulators, and experts to develop and **issue a publication providing overall guidance enabling development and deployment of AI solutions for the nuclear industry**.
  2. Establish an **IAEA Collaborative Center** interfacing with existing IAEA networks, to be focused on addressing the fundamental challenges of AI to help accelerate reaching the IAEA goals on capacity building, training materials, and workforce development for the nuclear power industry.
  3. Issue a user-centric AI or human-informed automation **publication describing the integration of AI in nuclear processes** and including metrics to evaluate explainability of AI across the levels of automation.
  4. Engage regulators from all interested member states, to **facilitate alignment of country specific regulatory framework** and capture this consensus in an appropriate publication of the Agency.
  5. Develop a **publication capturing different implementation of AI based solutions and lessons learned across range of applications in the nuclear industry** globally and their relevant measure of success.
  6. Design and implement **competitive benchmark exercises** and privacy-preserving AI algorithms.

# Next Steps

- Publication under development, supported by participants from the WGNP and the XAI CM addressing recommendations 1 and 5 (partially)
  - Engage stakeholders, regulators, and experts to develop and issue a publication providing overall guidance enabling development and deployment of AI solutions for the nuclear industry.
  - Develop a publication capturing different implementation of AI based solutions and lessons learned across range of applications in the nuclear industry globally and their relevant measure of success.
- Two Technical Meetings are planned for 2023
  - 16 – 19 May / Vienna: TM on Artificial Intelligence and its Existing and Near-term Deployment in Operating Nuclear Power Plants
  - 16 – 20 October / Vienna: TM on the Safety Implications of the Use of Artificial Intelligence in Nuclear Power Plants
- International Conference on Computer Security in the Nuclear World: Security for Safety
  - 19–23 June 2023, Vienna, Austria: One theme on Computer Security of emerging digital technologies for nuclear activities, which will be an opportunity to highlight and focus on the potential impacts and/or applications of
    - smart devices, automation tools, digital twins modelling, Artificial Intelligence (AI)/Machine Learning (ML), Information Technology (IT)/Operation Technology (OT) convergence, cloud computing, Internet of Things (IoT), Block Chain, Quantum computing, etc.

# Application of AI in Coordinated Research Projects

- 2021 October, Consultancy Meeting on **Applications of Artificial Intelligence and Pattern Recognition Techniques for Uncertainty Quantification in Nuclear Power Modelling and Simulation** (Based on the IAEA CRP on Advancing the State-of-Practice in Uncertainty and Sensitivity Methodologies for Severe Accident Analysis in Water Cooled Reactors):
  - In the framework of best-estimate plus uncertainty (BEPU) methodology key challenges are related to potentially high number of code runs and to the characterization of the input uncertain parameter ranges and probability density functions;
  - Continuous advancements in the field of big data analysis and AI provides a novel and innovative gateway for computationally affordable and accurate methodologies for uncertainty quantification and sensitivity analysis in severe accident simulation and modeling;
  - Final conclusions will be captured within the CRP final reports (TECDOCs) to be published in 2023/2024.



# Other activities in collaboration with ITU



- Under the umbrella of AI for good Summit
- **AI for Nuclear Energy** Webinar, ~1200 registrations
  - How do we use digital twins for nuclear plan monitoring?
  - AI for operation and maintenance of nuclear reactors
  - Development of international standards on AI for nuclear energy
  - AI applications for nuclear energy
- One of the most successful event of the summit
- Another webinar on **AI for Atoms**
  - Healthcare, Food and Agriculture, Nuclear Science, Fusion, Ethics



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*Thank you!*

