Disruptive, Innovative and Emerging Technology and the Canadian Nuclear Safety Commission
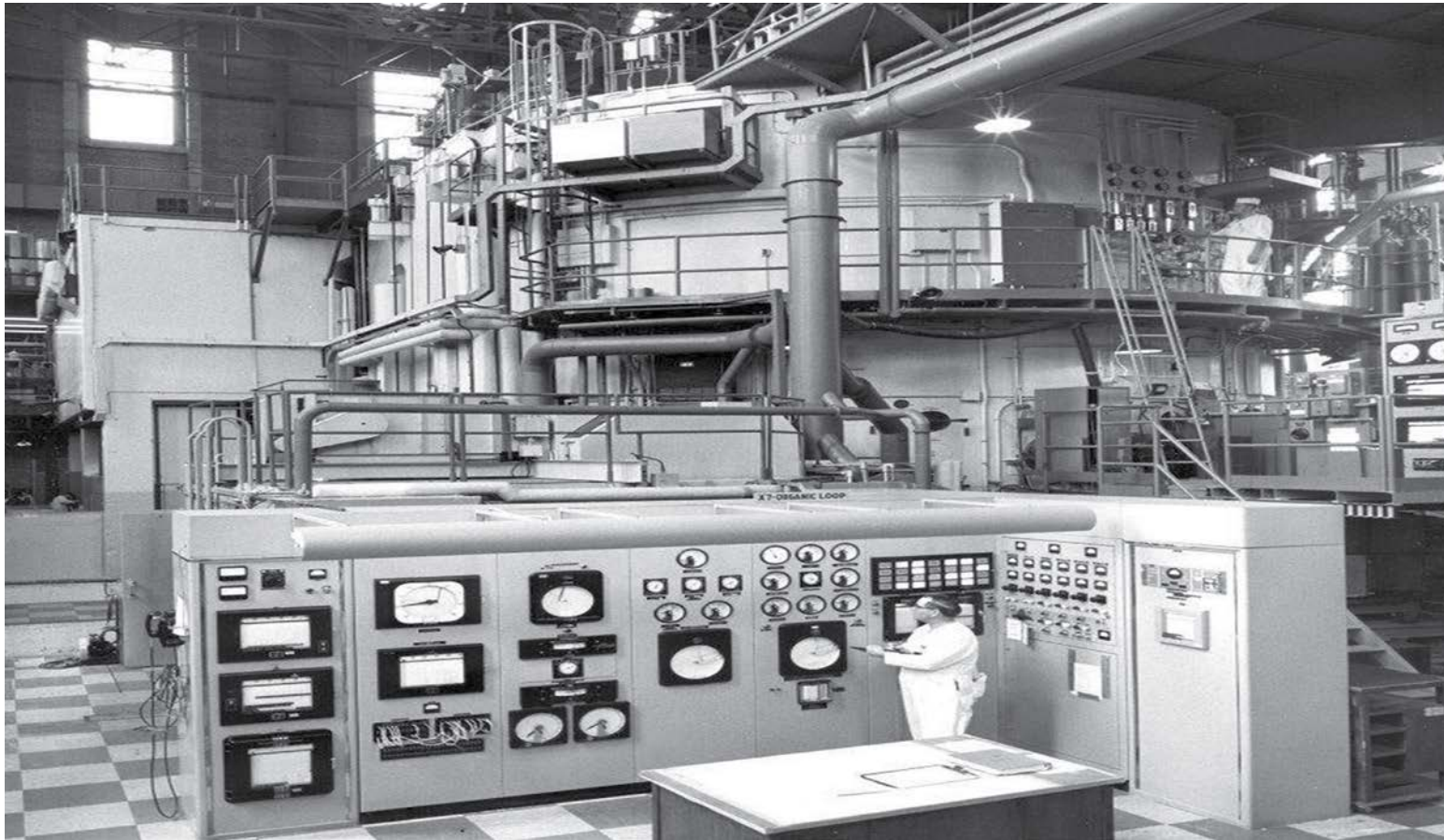
NRC AI Workshop
September 19, 2023

Kevin Lee - Innovation and Research Division

Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

EDOC: 7126706

Canada

Historical Perspective

Established in 1946 as the Atomic Energy Control Board
Over 75 Years Regulating Nuclear Safety

CNSC Mandate

* Regulate the use of nuclear energy and materials to protect health, safety, security and the environment

* Implement Canada's international commitments on the peaceful use of nuclear energy

* Disseminate objective scientific, technical and regulatory information to the public

The CNSC Regulates All Nuclear-Related Facilities and Activities in Canada

Uranium mining

Transportation

Dosimetry

Nuclear research

Uranium fuel processing

Nuclear medicine

Nuclear power generation

Radioactive waste management

Nuclear substance processing

At the CNSC Innovation is DIET

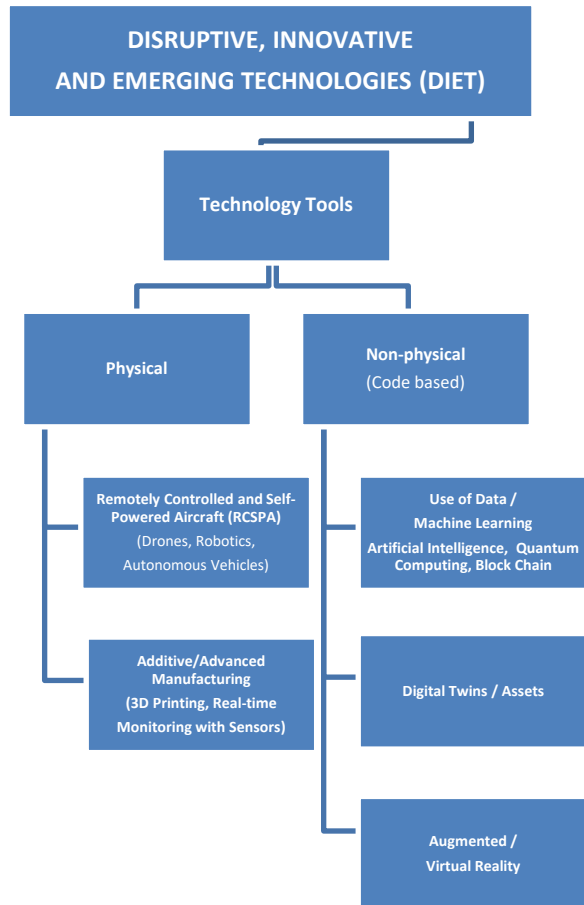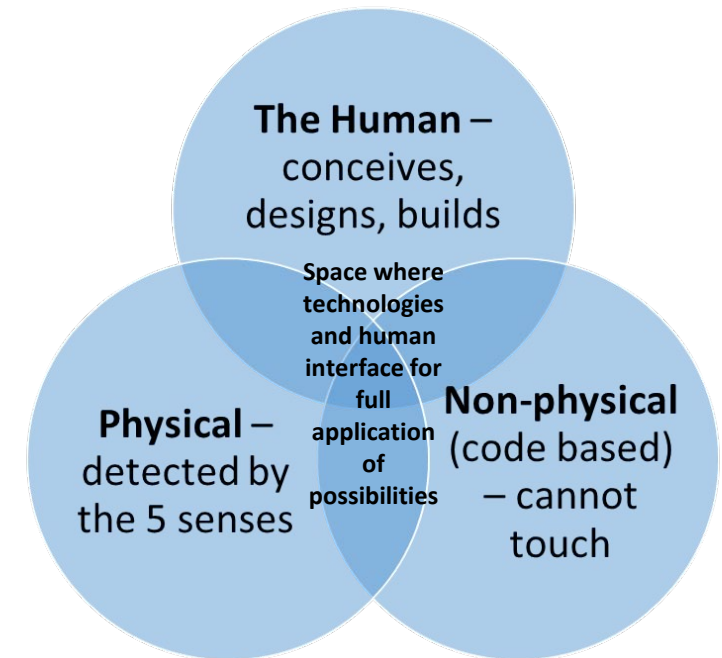| Disruptive, Innovative, Emerging Technologies	
Disruptive	Displaces or radically reconfigures established technologies, significantly altering how organizations operate.
Innovative	The use of new technology or modified strategies, capabilities, products, services, or processes.
Emerging	Technologies under development or exploration for use in the near future.

Innovation/Disruptive, Innovative and Emerging Technologies (DIET)

DISRUPTIVE, INNOVATIVE AND EMERGING TECHNOLOGIES (DIET)

Technology Tools

Physical

Non-physical (Code based)

Remotely Controlled and Self-Powered Aircraft (RCSPA) (Drones, Robotics, Autonomous Vehicles)

Additive/Advanced Manufacturing (3D Printing, Real-time Monitoring with Sensors)

Use of Data / Machine Learning Artificial Intelligence, Quantum Computing, Block Chain

Digital Twins / Assets

Augmented / Virtual Reality

- CNSC's DIET Working Group enables greater sharing of innovation, internally and externally, by using a safe space format
  - Allows nuclear industry to share early innovation ideas by creating a "safe space" for industry and academia stakeholders to share its innovation, new ideas, and results with CNSC staff
  - Compliments engagement CNSC's Research Program is already involved in
- Coordinates, leverages and builds on the successes of CNSC's collaborative innovation initiatives
  - Serves a triage function, evaluating the maturity and feasibility of the DIET and determining if further evaluation is required

The Human – conceives, designs, builds

Space where technologies and human interface for full application of possibilities

Physical – detected by the 5 senses

Non-physical (code based) – cannot touch

AI – Work with the UKONR and USNRC

- CNSC/UKONR/USNRC have established a tri-lateral relationship over the last few years to share knowledge and discuss DIET/Innovation

- Quickly became evident there was common interest and approaches to AI being used in regulated nuclear activities

- Three regulators have agreed to work together to produce and publish a tri-lateral white paper on AI

  - AI White Paper or Abstract will be jointly published on all three websites sometime in early 2024

- Common regulatory approaches each regulator may use to approach AI highlighted

Artificial Intelligence – Working to Better Understand

Established an RFP in 2022 for a research paper entitled "A Study for the Canadian Nuclear Safety Commission on Artificial Intelligence Applications and Implications for the Nuclear Industry" and with the scope of:

- Definition of AI
- AI Tools and Techniques
- Evaluation of AI Technology
- Future Implementation
- Challenges and Implications of AI within nuclear industry
- Recommendations to address AI within the nuclear industry

Candu Energy Inc won the bid and delivered the final report to the CNSC in March of this year

High-Level Take-Aways:
- AI technology is constantly evolving with new types of explainability methods and algorithms
- Evaluating AI requires a technology neutral approach
- By evaluating the interaction between AI and the environment, deficiencies can be identified and processes can be implemented to eliminate the deficiencies.
- AI should be assessed in terms of the interaction with the environment and the safety significance of the application, to address the risk of reliability, trustworthiness and security.
- Using a risk-informed approach, recommendations are made for enhancing standards (Standard Setting Organizations) with support by the regulators and other industry stakeholders

AI – Working with the IAEA

- IAEA has established the Steering Committee called *Innovation to Support Operating Plants* (ISOP)
  - Established to increase collaboration and experience sharing in the field of innovation for the nuclear industry and first meeting was April 18 to 21, 2023
- First working group formed under ISOP is *Explainable Artificial Intelligence and its Recent and Near-term Deployment in Operating Nuclear Power Plants*
- Working on a new TECDOC tentatively titled: *Deployment of Artificial Intelligence Solutions Applications for the Nuclear Power Industry: Considerations and Guidance*
  - CNSC is lead of the Implementation Considerations Chapter and on the editorial board
- Would include guidance on development and deployment of AI across the nuclear industry, considering the different levels of autonomy and safety significance of the desired targets and applications.
  - Focus on developing guidance for acceptability (verification/validation/fitness for purpose) of AI across different application areas and use cases

AI – Exploring Internal Possibilities

- Regulatory bodies are increasingly exploring the potential for AI to assist regulatory oversight activities
  - Desired outcome is increased efficiency, accuracy, predictability and safety
- CNSC has a small cross-sectional team looking at how disruptive AI technologies may facilitate CNSC staff in their regulatory, licensing, assessment and compliance work
- Exploring the possibility of an inspector or staff assessing a new license application with the assistance of a custom-made natural/plain language processor – ChatCNSC?
  - All relevant open source, the licensee or applicant's data as well the regulatory body's own data (both formatted and unformatted) quickly retrieved and available to assist the human in their analysis and decision making
  - Not autonomous AI but human decision making assisted by AI

Summary

The CNSC continues to focus on:

- Engaging with industry and other stakeholders on initial exploratory discussions on DIET

- Working with industry, industry groups and other regulators to share knowledge

- Engaging staff on DIET and engaging DIET with staff

Work being done at the CNSC on DIET contributes to the CNSC being recognized nationally and internationally as a regulator that:

- Is agile

- Encourages innovation

- Builds, maintains and leverages a technology neutral regulatory framework

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