



Develop International Standards on AI for Nuclear Energy

Daowei BI

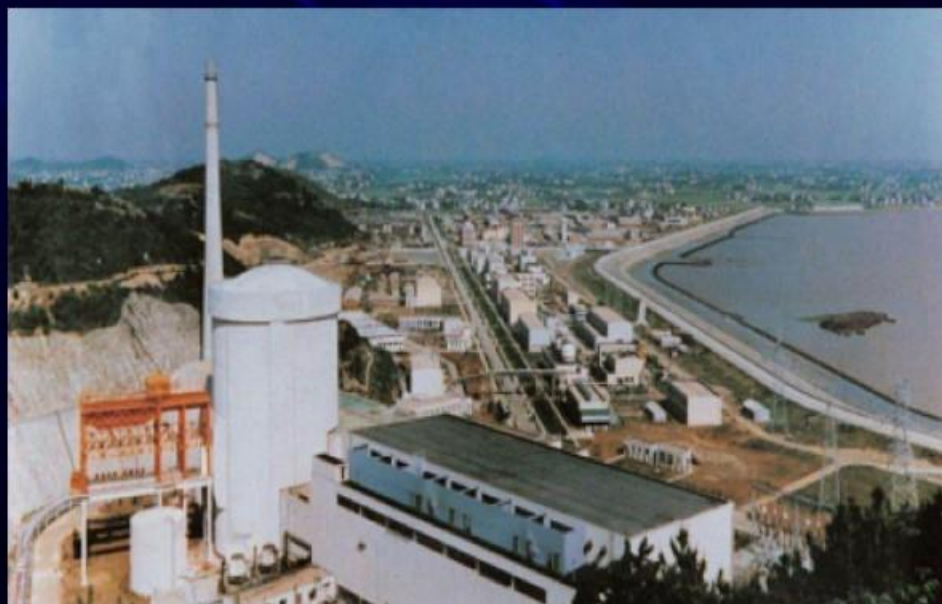
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A leading nuclear energy R&D organization in China.

With a history of more than 50 years of nuclear energy R&D.

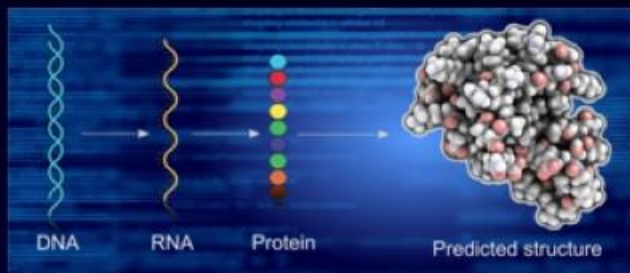


Designed the first nuclear power plant in the mainland of China- Qinshan NPP



Leading the National Science and Technology Major Project on advanced PWR and conducting R&D on cutting-edge technologies

AI is everywhere in our life



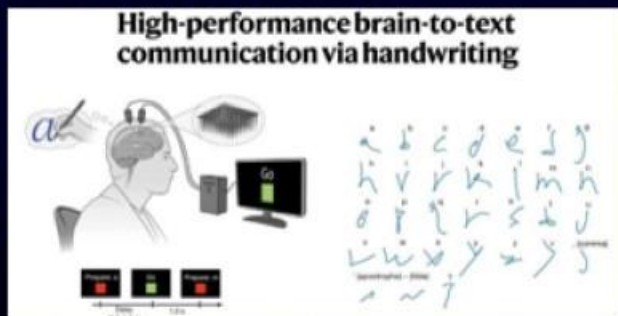
AlphaFold predicts 3D models of protein



AlphaGo Beats World Champion at Go



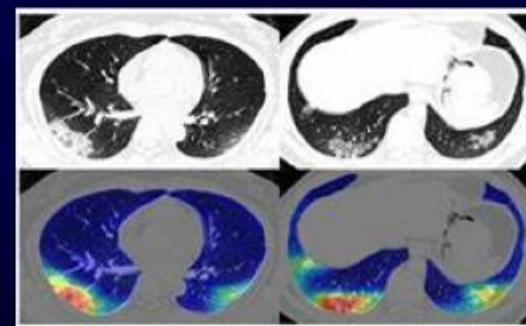
Boston Dynamics' Robots ATLAS



NATURE cover story on brain to text

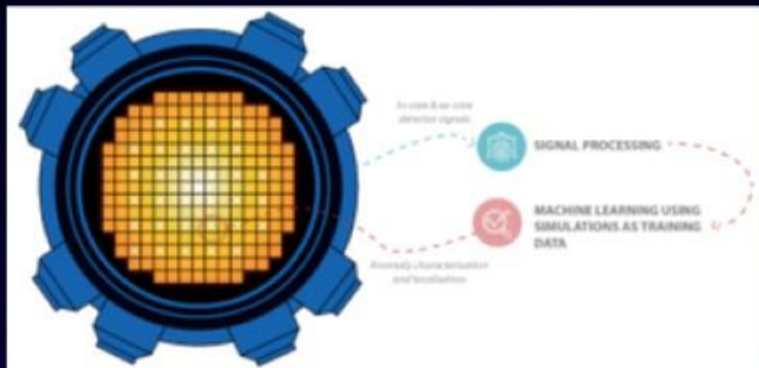


Amazon autonomous Scout delivery robot

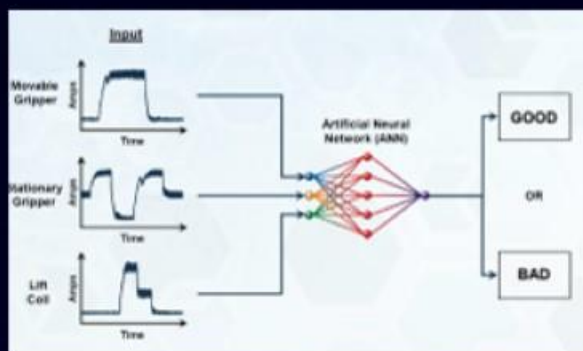


AI CT Scan for COVID-19 Detection

AI seems to be everywhere for nuclear energy



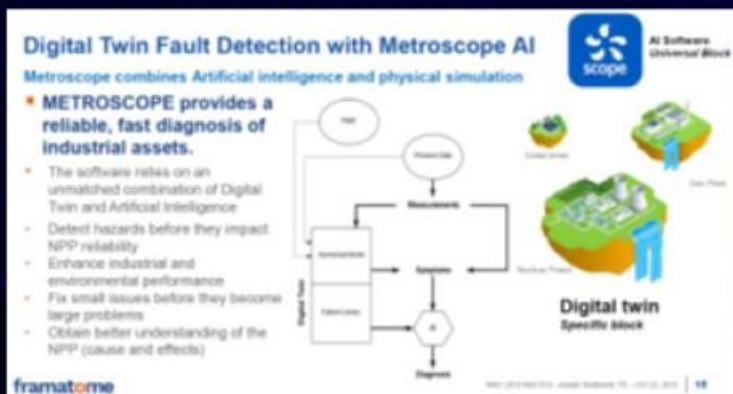
EU CORTEX consortium: machine learning for neutron noise-based core diagnostics



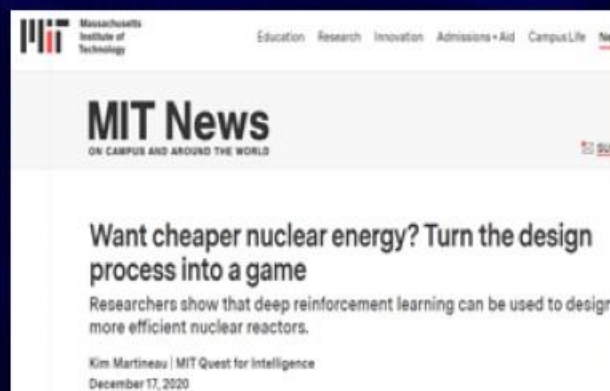
US company AMS's AI for CRDM



Machine Learning for Nuclear NDT



Metroscope AI for nuclear applications

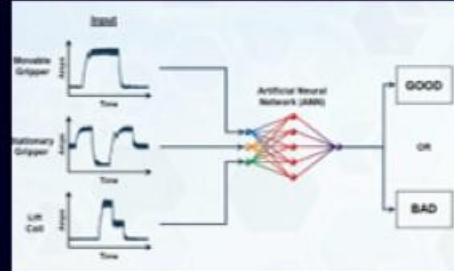
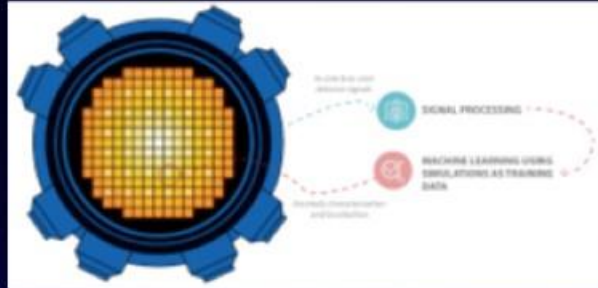


RL for nuclear core refueling design



IAEA's TM on AI for Nuclear

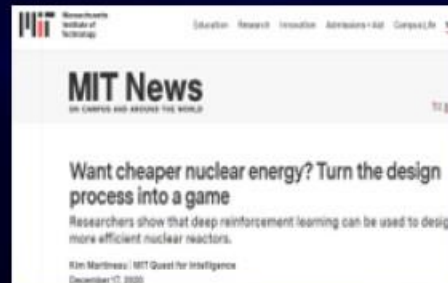
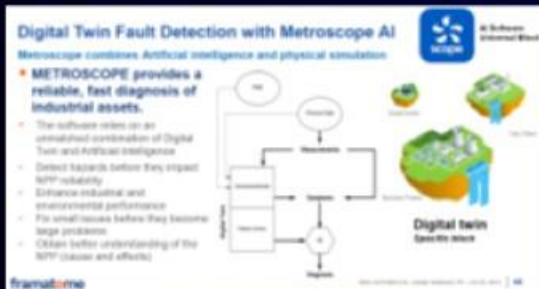
AI seems to be *ELUSIVE* for nuclear energy



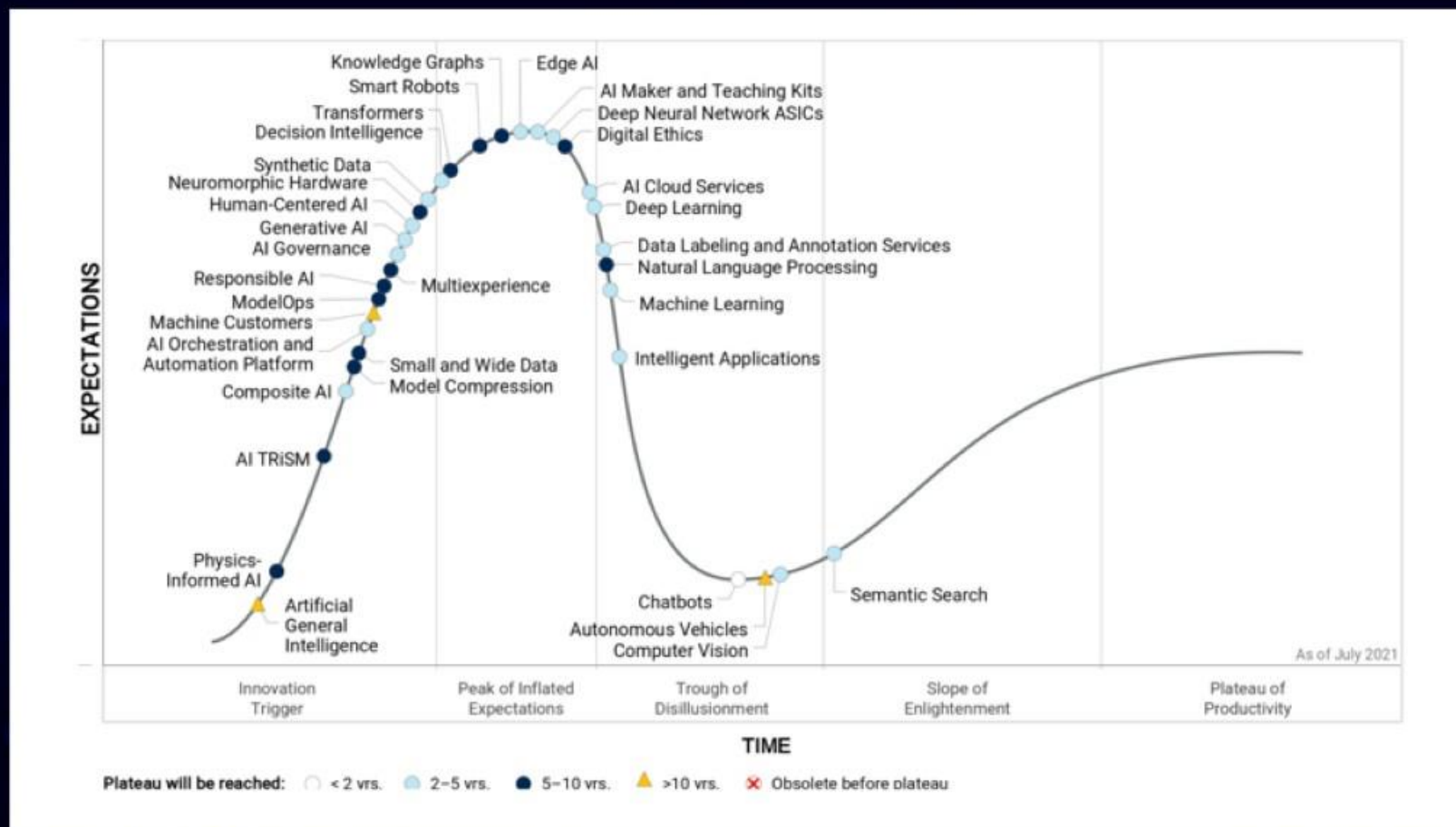
What is AI?

What can/cannot be done with AI?

How to efficiently and effectively deploy AI?



Standardization is key to resolve this seemingly paradox



- *Common terminology*
- *State of the art*
- *Stages of maturity*

Hype Cycle for Artificial Intelligence (Source: Gartner, September 2021)



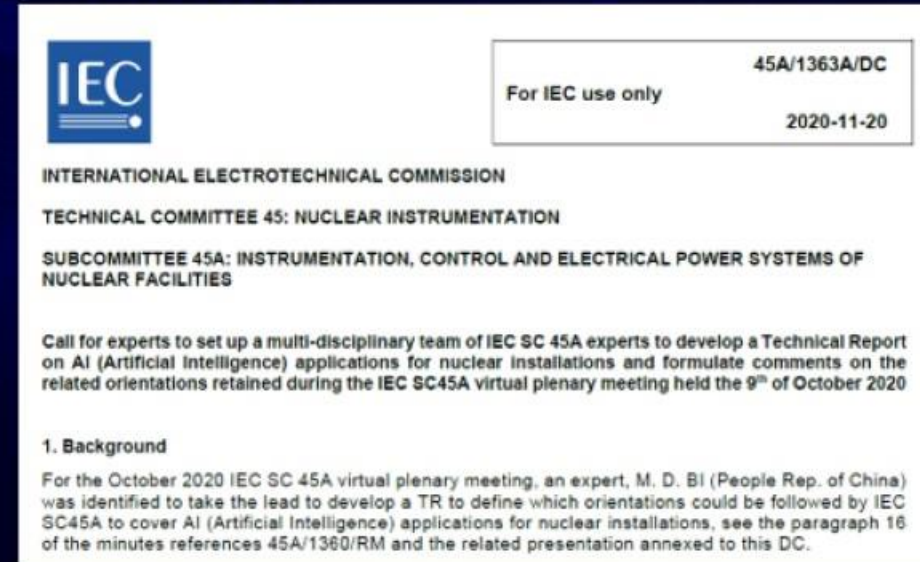
Address Nuclear Energy AI needs at IEC

- IEC
 - International Electrotechnical Commission
 - Develops and publishes standards concerning electrical technologies
 - Headquartered in Geneva, Switzerland, IEC standards reach over 150 countries.
- IEC SC45A
 - Refers to Subcommittee 45A : Instrumentation, control and electrical power systems of nuclear facilities
 - Prepares standards applicable to the **electronic and electrical functions** and associated systems and equipment used in nuclear energy generation
 - In particular, its scope covers the application of emerging electronic techniques, including **artificial intelligence**, for nuclear energy generation












Address Nuclear Energy AI needs at IEC

- IEC SC45A addresses nuclear energy industry needs for AI technologies with official discussion at the 2020 IEC SC45A plenary meeting
- A new project is approved to develop a TR on AI applications for nuclear installations.
- Project leader: Daowei BI; experts from 7 countries joined the project team



What is AI: Follow ISO/IEC terminology and framework

- ISO/IEC JTC 1/SC 42 - Artificial intelligence
 - Created in 2017, Secretariat: ANSI
- Scope: Standardization in the area of Artificial Intelligence
 - Serve as the focus and proponent for JTC 1's standardization program on Artificial Intelligence
 - Provide guidance to JTC 1, IEC, and ISO committees developing Artificial Intelligence applications

REFERENCE 	TITLE	TYPE
ISO/IEC JTC 1/SC 42/AG 2 	AI Systems Engineering	Working group
ISO/IEC JTC 1/SC 42/AHG 1 	Dissemination and outreach	Working group
ISO/IEC JTC 1/SC 42/JWG 1 	Joint Working Group ISO/IEC JTC1/SC 42 - ISO/IEC JTC1/SC 40: Governance Implications of AI	Working group
ISO/IEC JTC 1/SC 42/WG 1 	Foundational standards	Working group
ISO/IEC JTC 1/SC 42/WG 2 	Data	Working group
ISO/IEC JTC 1/SC 42/WG 3 	Trustworthiness	Working group
ISO/IEC JTC 1/SC 42/WG 4 	Use cases and applications	Working group
ISO/IEC JTC 1/SC 42/WG 5 	Computational approaches and computational characteristics of AI systems	Working group



What is AI: Refer to ITU and other SDO's documents

- ITU-T (STANDARDIZATION)

Work item	Status	Liaison relationship	Subject / Title
F.748.11 (ex F.AI-DLPB)	Approved 2020-08-13	-	Metrics and evaluation methods for deep neural network processor benchmark
F.748.12 (ex F.AI-DLFE)	Approved 2021-06-13	-	Deep learning software framework evaluation methodology
F.748.13 (ex F.AI-MLTF)	Approved 2021-06-13	-	Technical framework for shared machine learning system
F.AICP-GA	Under study	ISO/IEC SC42	Technical specification for artificial intelligence cloud platform: General architecture
F.AICP-MD	Under study	ISO/IEC JTC1 SC42	Technical specification for artificial intelligence cloud platform: Model development
F.AI-CPP	Under study	-	Technical specification for artificial intelligence cloud platform: Performance
F.AI-DMPC	Under study	-	Technical framework for deep neural network model partition and collaborative execution
F.AI-FASD	Under study	-	Framework for audio structuralizing based on deep neural network
F.AI-ILICSS	Under study	-	Technical requirements and evaluation methods of intelligent levels of intelligent customer service system
F.AI-ISD	Under study	-	Requirements for intelligent surface-defect detection service in industrial production line
F.AI-MKGDS	Under study	-	Requirements for the construction of multimedia knowledge graph database structure based on artificial intelligence
F.AI-RMCDP	Under study	-	Requirements of multimedia composite data preprocessing
F.AI-RPAS	Under study	-	Technical requirements and evaluation methods for a robotic process automation system
F.AI-RSRReqS	Under study	ITU-T SG9, IEEE	Requirements for real-time super-resolution service based on artificial intelligence
F.AI-SCS	Under study	-	Use cases and requirements for speech interaction of intelligent customer service
F.AI-SF	Under study	-	Requirements for smart factory based on artificial intelligence
F.AI-VDSLWS	Under study	ISO/TC 154, ISO/IEC JTC1/SC42, OneM2M	Requirements for artificial intelligence based vision detection service in smart logistics warehouse system
F.AITRL-Fr	Under study	-	Framework for AI technology readiness level for human factors

What can be done by AI for nuclear energy?

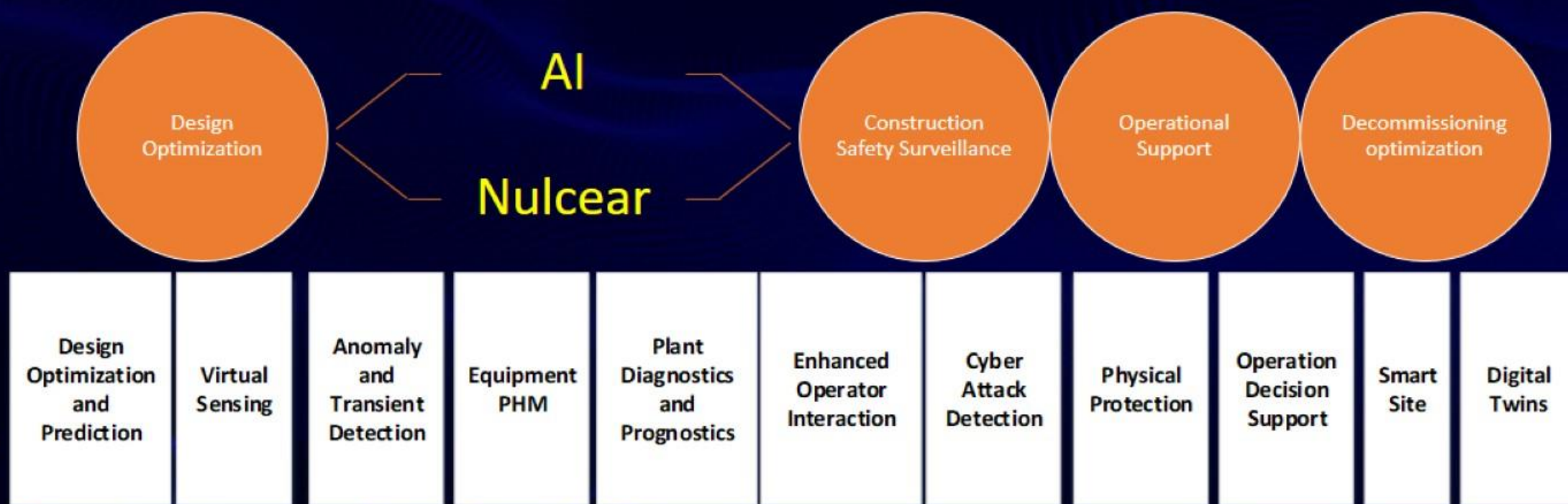
- Explain AI in more readable texts in SC45A documents, to promote common understanding and adoption of AI in the general sense
- Capture the proven/potential AI applications for nuclear Energy
 - AI is not new for the nuclear power industry
 - Has been studied for several decades and much knowledge has accumulated

The IAEA Specialists' Meeting on Artificial Intelligence in Nuclear Power Plants was held in Helsinki, Finland, on October 10-12, 1989.

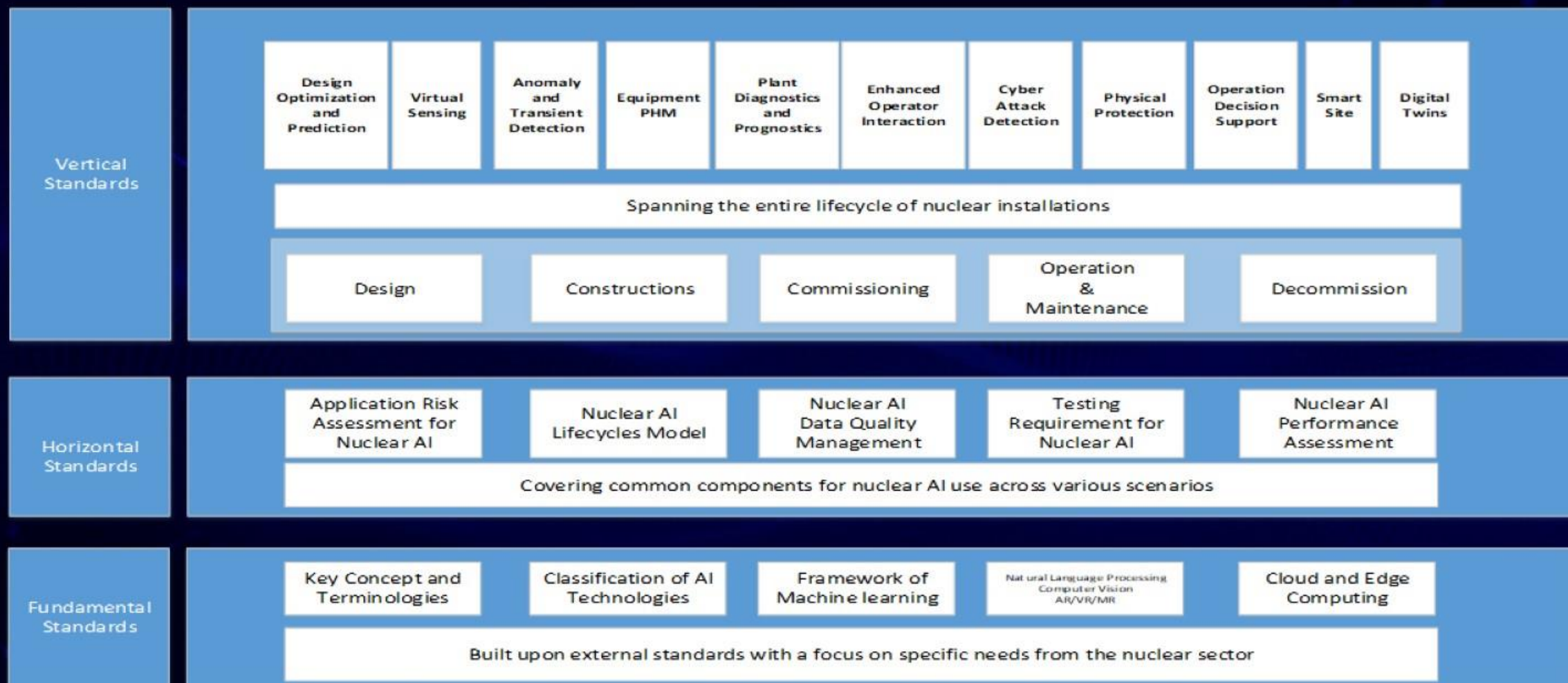


Enable wide adoption with specific standards

- Targets at the full lifecycle of a nuclear energy project
- Based on proven applications, remains neutral with regard to AI vendors



Preliminary architecture for SC45A AI portfolios



Major Milestones

- First draft by January 2022
- Working group discussion at 2022 IEC/SC45A Plenary Meeting
 - to be held in Sweden, May 2022.
- Official publication: before the end of 2023.

Together, reshape

the landscape of

AI for Nuclear Energy

Thank you for the attention.

