

Measuring the Scope of Emerging Technologies in Nuclear Technology: Scalability of Cyber Security, Nuclear Safeguards & Nuclear Security by Design.

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The scope of emerging technologies in Nuclear Technology is demonstrated in nuclear designs, application of infrastructure (instruments, institutions, regulatory bodies/ organizations) systems of operation, platforms & third party supply chains, value chains and ecosystems. This also conflates nuclear commercial activities and nuclear frameworks in areas of facility operations, international safeguards, material control & accounting, nuclear security, physical protection and packaging, transportation and disposition.

In a similar vein, advanced reactor designs augmented with emerging technologies and data analytics gives rise to more renewable generating sources, less expensive with a clear cut agenda to protect clean air and supply energy to growing economies and advanced economies alike. Also, Data collected and analyzed for IOT enables optimum, predictive maintenance and capabilities in Nuclear Plants. The composition of IOT sensors augmented with big data and machine learning translates raw and unstructured data from data analysis to analytics ensuring situational awareness (predictive monitoring solutions & actionable insights in real time) and optimum decision making for confidence in asset maintenance. Thus, Security by design and Safeguards by design is the lifeline that guarantees smooth nuclear commercial activities whilst reiterating the objectives of nuclear safeguards, nuclear security and nuclear safety are comprehensively accommodated in maintenance processes and component designs; some of which involves additive manufacturing and advanced fuels to name a few.

Furthermore, the scope of emerging technologies in Nuclear Technology is dual use by nature. Nuclear Designs, Infrastructure, Instruments, National Regulatory Organizations and Law Enforcement are currently subject to disruptive innovation technologies. Hence, Nuclear policy and regulatory frameworks should include delayed attribution, AI ethics, Intangible dual use (Outsider& Insider Threat) and development of Nuclear Security Cultural Orientation for Nuclear Newcomer States.

Appropriately, another necessary inclusion is the scalability of cyber security in Nuclear Technology. This ranges from simple DIY workshops on phishing emails, systems backup, updates of software, cloud storage and infrastructure to complex spotting of illicit software updates through the supply chains, scaling analytics of emerging technologies in SMRs and MMRs against workforce/human capital, population density, finance, nuclear safeguards and security by design and political will in developing countries, calibrating optimized and predictive performance of IOT in Nuclear Plants for nuclear policy; highlighting that unsupported or older versions of software and delays in patching increases assets vulnerabilities, increase

scalability of cloud storage, segmentation of assets, network slicing and encryption capacity-building in Developing Countries, need to introduce DIY automated backups to mitigate against asset loss if there is a ransomware cyber attack and need to seek out measures that includes cyber- security policy to designs, security and safeguards by design.

In conclusion, it is therefore imperative to seek measures to address these thematic concerns to avoid diversion, disruption & total shut down of nuclear plants and nuclear terrorism. Unrelatedly, one of the most important lessons learnt from the Covid-19 pandemic is preparedness.

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