FROM CONCEPTION TO TECHNOLOGICAL IMPLEMENTATION - SMR`s TECHNOLOGY READINESS LEVELS

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The transition of Small Modular Reactors (SMRs) from conceptual design to technological implementation represents an important milestone in the advancement of nuclear energy solutions. SMRs represent an innovative approach to nuclear energy, offering enhanced safety, modularity, and economic feasibility. However, their widespread deployment depends on their progress through defined Technology Readiness Levels (TRLs). This presentation examines the journey from theoretical conception to experimental validation and final deployment, highlighting the technical, regulatory, and economic challenges encountered at each TRL stage. We will discuss the TRL status of different SMR designs, including pressurized water reactors (PWRs), high-temperature gas-cooled reactors (HTGRs), molten salt reactors (MSRs), and liquid-metal-cooled fast reactors (LMFRs). While some water-cooled SMRs have reached demonstration stages (TRL 7-8), more innovative concepts like MSRs and HTGRs are still in earlier stages of development (TRL 4-5) due to material challenges and licensing difficulties. By evaluating the maturity of SMR technologies against TRL criteria, this work provides insights into the timeline and feasibility of their integration into global energy markets.

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