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## **Adding resilience features in new reactor designs to adequately fulfil nuclear safety principles: Insights from small modular reactors**

Given the importance of safety principles from both nuclear energy ethics[1] and the IAEA[2], how could we ensure that new reactor designs, particularly Small Modular Reactors (SMRs), adequately fulfil these principles?

Among existing SMR designs, the ARIS (Advanced Reactors Information System) database notes that NuScale, an American SMR company with approved designs by the US Nuclear Regulatory Commission[3][4] distinguishes resilience features[5] from safety features[6]. This distinction could provide insights on adequate fulfilment of safety principles.

This is a contribution from nuclear energy ethics to nuclear energy policymaking. By highlighting resilience features, we argue that new reactor designs can adequately fulfil safety principles when resilience features are added to safety features. We do this by 1) showing that the addition of resilience features as exemplified by NuScale's SMR designs enhances nuclear safety; 2) explaining how adding distinct resilience features on top of safety features ensures the fulfilment of IAEA's safety principles, particularly responsibility for safety (principle 1), prevention of accidents (principle 8), emergency preparedness and response (principle 9), and reducing unregulated radiation risks (principle 10). Finally, we 3) propose how readiness towards the unanticipated as the core of resilience features are applicable to regulations for new reactor designs.

Keywords: Small Modular Reactor (SMR), safety features, resilience features, safety principles, nuclear energy ethics.

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