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Report on Small Nuclear Reactors SMRs

E&E Consultant (sarl) publishes on Tuesday, March 19, 2024 a report on technology and industry issues raised by Small Modular Reactors (SMRs). This reference document (110 p.+ abstracts) can be uploaded after 18-30 PM on www.ee-consultant.fr

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Abstract

Small Modular Reactors (SMRs) have been a focus of much media attention. The buzz for SMRs has little relation to their reality or potential. They symbolize the **hope of a revival of the nuclear industry**. They are reviving concepts that were abandoned for good reasons sixty years ago.

(1) The vast majority of the proposed projects are currently in an **early phase** of development, with the exception of four prototypes in China and Russia. The report proposes a typology of reactor projects, first of all water reactors, close to the equipment used in submarines, but also gas, liquid metal or molten salt systems, all of which need to be developed.

(2) SMRs are meant to address the **high costs and delays** of large nuclear reactors. In reality, their initial cost of development and construction is quite high. Lowering these costs by scale effects is illusory. Building a small nuclear reactor remains a **site-related project, not a mass-produced industrial** equipment. To develop SMR prototypes, the financing envisaged in France and worldwide is in billions of Euros. But these amounts would represent only a fraction of the investment needed to make them competitive in the long run.

(3) In both the United States and France, proponents of small SMR reactors aim **to limit regulatory requirements** against internal (safety) or external (security) threats. This relief for reactor design or operation is not justified. In particular, the threat of foul play or even terrorism is far from overcome.

(4) SMRs would bring an **increased risk of nuclear proliferation**. The diffusion of technologies and materials for the manufacture of atomic bombs is multiplied with the dispersion of sites. The fragile international regime protecting the world from this risk would be threatened by their multiplication, and even more so if we involve **small start-up companies**. Commercial models of nuclear reactor sales with offshoring of fuel and waste management are problematic. Finally, the **breeder generation** proposed for some projects, represents specific risks.

(5) **Serious accidents** caused by reactor core water supply shutdown are still not excluded. The size of the nuclear boiler limits its thermal inertia in the event of an accident. But the size of these reactors is comparable, for example, to the smallest reactor in the Fukushima accident. The other SMR projects, which are not based on a water circuit, are still **described only briefly**. Their materials and subsystems have not been demonstrated or even invented. However, their potential vulnerability to irradiation, thermal and mechanical stresses, the risks of corrosion and erosion suggest very significant risks for transport, operation or dismantling.

(6) Small SMR reactors require **more building materials and metals** in the parts and sub-systems for their construction and operation than a large reactor for a given production. The very geometry of the reactors explains these greater needs. The small size of the boiler also induces a less optimal neutron flux distribution. **The consumption of nuclear fuel and the amount of nuclear waste** are significantly increased.

7) The **potential market** for SMRs represents a small fraction of the global nuclear market. The SMR projects proposed by the United States, France or Great Britain are far too big for isolated sites or islands. They cannot replace coal-fired power in time for the necessary climate transition. The SMR systems proposed to directly supply electricity to heavy industries are **not viable economically**; their legal or insurance framework is inextricable. Similarly, the use of SMRs to produce hydrogen has no business case in the light of competition from cheap renewables. Finally, there are only few use cases for isolated sites, mainly related to extraction of fossil fuels (e.g. mining or hydrocarbon exploitation). The development of industrial nuclear projects by start-ups is constrained by the specific risks of nuclear power. The cycle of innovation, development and industrialization of new reactors takes **decades**. The duration is not a simple bureaucratic constraint that can be lifted by political will, but **an intrinsic fact of the nuclear sector**, linked to its specific risks.

(8) The promotion of SMRs aims at the **perpetuation the nuclear industry**. Small reactors are not strategic for the nuclear recovery desired by the French government. They are of little interest to the French electricity, nuclear or renewable industries. They face much more important and urgent funding and recruitment challenges. The subsidies for SMRs are in fact used to perpetuate the position and the public funding of nuclear laboratories and institutions, and in France to finance the development of nuclear naval engines for the military.

(9) The timetable for SMR reactors would put them well beyond the deadlines for decarbonizing our economies, even if all their difficulties were lifted. They are therefore offside and are **not an option for decarbonization**.

