Unfounded Promises

Small Modular Reactors (SMRs) solve none of the challenges of nuclear power and make climate change and proliferation worse

Nuclear power faces five primary and unsolved challenges: Cost, timeline, safety, waste and proliferation. New nuclear reactor designs will not solve these multiple challenges despite government and industry claims.

Cost

- SMRs will be expensive. For example, NuScale's all-in estimated cost for its 462 MW 6-unit light water reactor project in the United States is already 80 percent higher, in terms of the cost per installed kilowatt, than those same estimates at the start of the large twin AP-1000 reactor project at Vogtle, Georgia. New non-light water designs will cost far more and take even longer to develop.
- There is little financial incentive to replace closed or closing nuclear or fossil plants with SMRs. Doing so, would increase electricity bills for customers, which would be lowered by choosing renewable energy instead.
- NextEra Energy, which owns US nuclear power plants, predicted costs of $105-135/MWh for SMRs compared to "near-firm" (i.e. with four-hour battery storage) costs of $25-32/MWh for wind and $32-37/MWh for solar.
- The relatively small amounts of electricity produced by SMRs per unit – which can range from just a few megawatts (MW) to not small at all at 450 MW – creates an economic disadvantage compared to traditional large-scale reactors (typically between 800 and 1600 MW).
- While producing less power than a current conventional size reactor, the cost of constructing an SMR is not proportionately reduced. SMRs will therefore cost more than large reactors for each unit (MW) of generation capacity. This makes electricity from small reactors even more expensive than already costly nuclear power from large reactors.
- Nuclear power has demonstrated a poor 'rate of learning' – the more recent reactors have been more expensive to build than reactors built in the early decades of nuclear power. They also become more expensive than initially projected: on average, nuclear projects have final costs that exceed the initial budget by 117%. The actual costs of SMRs are likely to be far higher than estimated because most designs are still quite preliminary.
- To achieve the savings argued by proponents, SMRs would have to be manufactured by the hundreds, if not thousands, with high upfront factory costs that are unappealing to investors. Nuclear corporations have already demanded – and received – substantial government subsidies as a precondition for developing SMRs.

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Timeline

- The Intergovernmental Panel on Climate Change has warned that there must be a drastic global reduction in carbon emissions by 2030 at the latest. With almost no SMRs under construction in the world, their contribution to this effort will be close to zero.
- The track record for time to completion of existing "new" reactors is extremely poor with repeatedly extended timelines. This is unlikely to change for the better because reactors are smaller.
- The SMR being built in Argentina and the ones underway or completed in China and Russia are, or were, well behind schedule. The delay in China, where the project is already taking twice as long as anticipated, is particularly striking given China's track record of on-time project completions.
- In the case of planned SMR projects in France, India and the US, we are now well beyond the originally predicted dates of operation with still no construction underway.
- In 2008, NuScale, the leading SMR design in the United States, predicted it could produce electricity from its SMR by 2015-2016. As of 2022, NuScale has slipped to a 2029-2030 start date, likely still overly optimistic.

Safety

- All reactors, including SMRs, can undergo accidents resulting in widespread environmental radioactive contamination. Japan's destroyed Fukushima-Daiichi Unit 1 was small, only 460 megawatts, about the same size as the proposed Rolls Royce SMR.
- There are dozens of designs for "advanced" and "small" reactors. None of these designs are new and none have solved all of the many longstanding safety challenges.
- Sodium cooled fast reactors have lamentable safety histories including core meltdowns, serious fires and radioactive leaks. This is the non-light water reactor design favored by Bill Gates.
- Mass production will have its downsides. Generic flaws could lead to simultaneous problems in multiple units.
- Counterfeit and substandard parts are likely to remain a recurring problem for SMRs as they have been in previous generations of reactors.
- SMR proposals typically envision multiple reactors at a single site, lowering costs by sharing infrastructure. However, multiple small reactors would hold the same collective radioactive inventory as a large reactor.
- A cluster of SMRs at a single site increases the risk that an accident at one unit might induce accidents at the others or make it harder to prevent accidents at others, as demonstrated by the Fukushima-Daiichi nuclear disaster.
- To save on costs, SMR vendors in the US want to reduce the number of control rooms and licensed operators that the US Nuclear Regulatory Commission would ordinarily require for a certain number of units. For example, the NuScale design could have a single control room operator in charge of as many as 12 units, heightening the risk for human error.
- Emergency evacuation zones at SMR sites could be limited to inside the plant boundary. But SMRs are not "meltdown-proof" and a radiological accident involving multiple units at a single site still puts the offsite population at risk.

Waste

- Nuclear fission will always produce extremely radioactive waste no matter the design or size of the reactor. Despite decades of research, no satisfactory long-term solution has been found to reliably isolate and manage the biological hazards presented by these wastes.
- In comparison with large reactors, SMRs will produce more radioactive waste per unit of electricity generated. One study that examined three SMR designs found they would produce up to 5.5 times more high-level radioactive waste, 30 times more long-lived low- and intermediate-level waste, and 35 times more short-lived low- and intermediate-level waste.
- Far from solving the nuclear waste problem or avoiding its generation altogether, as some non-credible assertions claim, SMRs will increase both the volume and the complexity of the long-term radioactive waste challenge.

Proliferation

- Many SMR designs would use nuclear fuel that requires either higher enriched uranium or plutonium, both of which can be used to make nuclear weapons.
- Some SMR designs will produce greater quantities of plutonium per unit of electricity relative to current reactors.
- A uranium enrichment facility designed to make High Assay Low Enriched Uranium fuel for "fast" SMRs– already enriched up to nearly 20% u-235 – can be clandestinely reconfigured to produce material usable in an atomic bomb.
- At least two of the companies striving to develop SMRs have direct links to the nuclear weapons sector. Bill Gates's TerraPower – whose reactor can be modified to "dual purpose" for weapons and power – has research and development partnerships with Los Alamos National Laboratory and the Y-12 National Security Complex, both of which design and test nuclear weapons. NuScale is majority owned by Fluor Corporation, which operates the U.S. Pantex and Y-12 nuclear weapons complexes.
- If SMRs are to play a role in climate mitigation, they would have to be built in large numbers in many developing countries that currently do not possess nuclear technology. In the unlikely event that a global market for SMRs is actually realized, then such countries, too, will acquire some of the technical means to make nuclear weapons.

Conclusions

- Small Modular Reactors cannot improve upon the already flawed full-size reactors, especially in the area of cost. In fact, they promise to be even more expensive than traditional 1,000 MW reactors.
- The enormous lead time needed for nuclear projects of any size means new reactors can contribute essentially nothing to mitigate our climate emergency. SMRs face even greater time barriers since they lack infrastructure (factories, fuel) as well as hands-on experience.
- Many proposed designs for SMRs are well studied and have serious safety flaws.
- SMRs will not only produce highly radioactive waste that remains hazardous for tens of thousands of years, but actually far more waste per unit of electricity generated than current full-size reactors.
- The highly enriched uranium fuel needed for most SMR designs makes them a proliferation risk, especially if they are exported to countries currently lacking nuclear weapons capability.
- Small modular reactors will therefore both impede efforts to mitigate an accelerating climate crisis while simultaneously increasing the risk of global nuclear proliferation.

These talking points were drawn largely from the work of **M.V. Ramana**, *as well as* **Arjun Makhijani**, **Zia Mian**, **Edwin Lyman**, *and others. Further reading and source materials are found online at this link: https://beyondnuclearinternational.files.wordpress.com/2022/10/smallmodularreactors_furtherreading_bn_oct2022.pdf*

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