"Advanced" Isn't Always Better

AN ANALYSIS BY EDWIN LYMAN

Why pursuing "advanced" nuclear reactors is too slow, too resource-intensive, too dangerous and won't result in improvements over traditional light water reactors

"Advanced" reactors is a misnomer since none of the non-light-water reactors (NLWRs) under consideration are genuinely new or improved. All present unique, numerous and increased safety problems that deliver no significant improvements over traditional light-water reactors (LWRs) to justify their development, given their considerable costs and risks.

Safety and Security

- **Sodium-cooled reactors (SFRs)** could explode like a small nuclear bomb under severe accident conditions. Sodium can burn if exposed to air or water and an SFR can experience rapid power increases that could be hard to control, potentially leading to core damage.
- **High Temperature Gas-Cooled Reactors (HTGRs)** use fuel that is not, contrary to claims, "meltdown proof". HTGRs are vulnerable to accidents in which air or water leaks into the reactor, and are being designed without the conventional leak-tight containments of LWRs.
- **Molten Salt-Fueled Reactors (MSRs)** routinely release large quantities of gaseous fission products, which must be trapped and stored. Claims that the MSR cannot melt down are an over-simplification of the safety issues they raise. Under some circumstances, the hot liquid fuel can heat up and destroy an MSR in minutes.

Time and Resources

- The SFR and HTGR demonstration reactors are projected to cost up to $3.2 billion each, a wasteful expenditure of resources on high-risk concepts when the need to address the climate crisis is urgent.
- NLWRs would require expensive new facilities and infrastructure to produce and transport their different kinds of fuel, as well as to manage irradiated fuel and other nuclear wastes.
- At least 25,000 MWe of NLWR capacity would have to come online globally each year between now and 2050 – five times the recent global rate of new LWR construction – to play a significant role in reducing carbon emissions and avoid the worst effects of climate change, an unrealistic proposition.

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Regulation

- The U.S. Nuclear Regulatory Commission (NRC) is a weak regulator. Yet the regulatory framework for NLWRs should require extra levels of safety to compensate for the uncertainties inherent in their designs, for which there is little or no operating experience.
- The NRC is likely to license the SFR and HTGR designs chosen by the US Department of Energy without requiring prototype testing first, running the risk of unanticipated reliability problems and serious accidents.

Efficiency and Waste (Sustainability)

- To significantly increase sustainability, most fast reactors would require spent fuel reprocessing and recycling and would need to operate continuously at extremely high levels of performance for hundreds if not thousands of years.
- HTGRs that use a fuel called high-assay low enriched uranium (HALEU) would not be more uranium-efficient than LWRs and would generate a much larger volume of highly radioactive waste.
- The claim that a nuclear reactor could "burn" or "consume" nuclear waste is misleading. Reactors can only use a fraction of irradiated fuel as new fuel, and separating that fraction – through reprocessing – increases proliferation and terrorism risks.

Proliferation and Terrorism Risks

- Fast reactors such as the SFR, typically require plutonium or highly enriched uranium-based fuels that are readily nuclear weapon-usable and therefore entail unacceptable proliferation and terrorism risks.
- HTGRs using HALEU fuel are more proliferation-prone than LWRs due, in part, to the additional monitoring challenges presented by their fuel fabrication system.
- Some MSR designs require on-site, continuously operating fuel reprocessing plants – pathways for diverting or stealing nuclear weapons-usable material.

Dr. Edwin Lyman *is the Director, Nuclear Power Safety, at the Union of Concerned Scientists. These Talking Points are drawn from his paper, "Advanced" Isn't Always Better. Assessing the Safety, Security, and Environmental Impacts of Non-Light-Water Nuclear Reactors. It can be found on the UCS website here: https://www.ucsusa.org/resources/advanced-isnt-always-better*

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MAY 2021