LFTRs *vs.* Renewables or LFTRs *and* Renewables?

A response from the Wyoming LFTR Energy Alliance to the Sierra Club Fact Sheet *Small Modular Reactors*, which is part of their Nuclear Free Campaign.

"*The great problem that the environmental, the ecologic movement has is its failure to recognize how deep it has to go to be authentic.*"

– Fr. Thomas Berry

Consider a program to provide electric power while meeting the challenge of climate change. If a goal is to go green by increasingly incorporating renewables into our electric power mix (to reduce GHG emissions), reliance on these *intermittent* sources of electric power absolutely requires provision of *continuous* back-up electric power. Today, heat sources for such large-scale continuous electric power generation comprise coal/gas/oil-fired boilers and nuclear reactors. If an additional goal is to quit burning hydrocarbons (to eliminate GHG emissions from that source), then nuclear reactors must fire our power plants for the program to work. If a third goal is to rid the planet of nuclear reactors (to eliminate their many problems and dangers), then the program fails: its goals cannot be met concurrently; it cannot work.

Our topic here is an alternative to the Sierra Club position that Small Modular Reactors (SMRs) are nuclear reactors and therefore must be eliminated, period! We don't like our conventional reactors any more than the Sierra Club does, but we certainly *do* like a *totally different* type of reactor, superior by every measure to any conventional reactor. Below, we discuss the **L**iquid **F**luoride **T**horium **R**eactor (LFTR, "lifter") as a small modular reactor. We support the LFTR as a viable way to make the program work. We urge the Sierra Cub to reconsider its blanket dismissal of nuclear reactors: The Club could do tremendous good by evaluating each of the various types of reactor on its own merits and on its suitability as source of continuous, reliable power to back up renewables.

We quote the consecutive sections of the Fact Sheet and follow them with our ◆responses.

"Squandering Money and Resources"

1. "The Obama administration has committed to providing more than $500 million for research, development, and licensing support for Small Modular Reactors (SMRs). High-risk, high-cost, and highly questionable, small modular reactors are an unsustainable outlay of resources that are needed for real solutions: renewable energy and efficiency."

◆ There are several types of small modular reactors, most of them varieties of conventional reactors. Of radically different type is the LFTR. Although risks accompany any type development, risks in remaining LFTR development are low, not high. We now believe that the entire final cost of LFTR development would be less than construction cost of *one* conventional reactor. Highly questionable? By what standard? LFTRs are so radically superior to today's conventional reactors that their development would not be questionable, but rather a great boon. Renewables, because their output is intermittent, are increasingly difficult to integrate with other sources for large-scale power as their percentage of total deployment increases. Absolutely, renewables are unable to stand alone as sole power providers at any but small scale. Wind and solar-only advocates seem blind to these objections.

2. "As proposed, SMRs would be a fraction of the size of conventional-scale reactors. They would be manufactured by assembly line and transported by truck, ship, or rail to their destinations. SMRs would also produce significantly less power — 300 MW or less compared to 1,000 MW for a typical commercial-scale reactor."

◆ Small reactors produce less power than large reactors. Well, that is true, but we believe that that could be an advantage. LFTRs would be deployed right where they are needed, at optimal size, requiring much less extensive grid (at great saving) and having much less line loss. Is this a disadvantage? And, although we are discussing them as SMRs, LFTRs can be scaled to any size or output, up to the size of conventional reactors. As SMRs, they can be ganged to meet any demand, progressively ganged over time to meet growing demand rather than built too large initially to anticipate increased future demand.

3. "RADIOACTIVE PIE IN THE SKY With 4 nuclear reactors (power plants) closed in 2013, the "nuclear renaissance" is clearly in retreat. The nuclear industry is desperate to keep itself afloat and to keep taxpayer dollars flowing its way. The U. S. Department of Energy's (DOE) budget is 62% nuclear—of that 66% is weapons-related.* The DOE and the nuclear industry are anxious to present a "peaceful atom" face to the world. As a consequence, many types of uneconomic and impractical nuclear power proposals are now being bandied about. Powerful, entrenched forces have an inertia that the public must fight to overcome. Removing taxpayer funding is an important way to do this. *Robert Alvarez, Senior Scholar, Institute for Policy Studies, Washington, DC."

◆ The "nuclear renaissance" of conventional reactors *should* be in full retreat, because, from the very first, we've been using the wrong kind of reactor for generating electric power. But, again, LFTRs are different. No matter who develops LFTRs, they will require no subsidies, unlike today's nukes *and* renewables. They will provide electricity cheaper than coal. ◆ Our conventional nuclear reactor providers are no friends of LFTR development: the LFTR is so much cheaper to build and operate that LFTR development would shatter their industrial business model. There is a growing body of LFTR supporters who have no connection with today's powerful, entrenched nuclearati. And, for world-class pie-in-the-sky, try powering the planet solely with renewables, no hydrocarbons, no nucs, and conservation.

4. "**NOT ECONOMIC (with or without subsidies)** In 2011 the Union of Concerned Scientists published *Nuclear Power, Still Not Viable Without Subsidies*. This report shows that in some cases subsidies were greater than the value of the electricity produced. SMRs have not changed this picture. In February 2014 Westinghouse announced they are backing off SMR development, saying 'It would be difficult to justify the economics of small modular reactors at this point, especially without government subsidies.'"

◆ We do not call final LFTR development cost a subsidy, and LFTRs would *not* require operating subsidies. We do not know why The Union of Concerned Scientists is saying that LFTRs would require subsidies. ◆ And again, we can understand why Westinghouse would shun LFTR development: they would either have to radically change or to abandon their highly profitable attachment to conventional reactors.

5. "**NOT 'SCALEABLE'** Even creating a prototype SMR won't build the infrastructure necessary to manufacture prefabricated SMRs on a large scale. If SMRs can't be built on a large scale, their unit cost skyrockets."

◆ Not scalable? How not? LFTRs certainly can be built on a large (volume) scale. A factory manufacturing a modular LFTR a day is certainly feasible. Costs would steadily diminish with experience, just has have the cost of wind and solar. Factory-built LFTRs would be vastly less expensive than today's built-on-site conventional reactors of equivalent output. A pre-licensed LFTR ordered from a factory could be installed in weeks rather than years. Is American industry incapable of imagination and innovation? We believe otherwise.

"SAME OLD PROBLEMS"

6. "**Radioactive Waste** SMRs, like their full-size counterparts, would produce lethal radioactive waste, toxic for hundreds of thousands of years. SMRs offer no change to the problem of safely storing radioactive waste. Vast amounts of energy will be needed to isolate these dangerous wastes for generations to come. The proponents of SMR hope to build them in remote geographic areas that need new power sources, essentially introducing highly radioactive nuclear waste across the nation."

◆ These statements may be correct for some SMRs, but are incorrect for LFTRs. A LFTR would produce less than $1/30^{th}$ the nuclear waste having $1/10{,}000^{th}$ the radioactivity of a conventional reactor with equivalent output. Many fission products from LFTRs are valuable in their own right for medical and industrial use. What is left would require storage for no more than 300 years. And again, LFTRs can be safely and beneficially sited anywhere.

7. "**Accident Vulnerability** Fukushima demonstrated how rapidly a nuclear accident can progress to a core meltdown. A terrorist attack on an SMR could cause damage worse than the Fukushima catastrophe, possibly in less time. The nuclear industry is urging the Nuclear Regulatory Commission (NRC) to adjust and modify safety requirements for SMRs. Proposals include reducing the required number of plant operators on site, decreasing the size of the emergency planning zones, and reducing security checkpoints."

◆ The first of these statements simply does not apply to LFTRs. There can be no core meltdown because the LFTR is a *molten-salt* reactor. LFTRs are not under

elevated pressure, and there is no core water-cooling; if the core ruptures, molten salt spills onto the floor, solidifies at room temperature, and is readily and safely recovered. Terrorist attack or no, how could that possibly be worse than Fukushima, or anywhere near as bad? The NRC will have to modify safety requirements for LFTRs because they are so radically different, being *inherently safe* rather than periodically engineered saf*er*, at great cost, as conventional reactors are.

> 8."**ROLLING BACK SAFETY** The nuclear industry is urging the NRC to "adjust" safety requirements for SMRs. Proposals include reducing the required number of plant operators on site, decreasing the size of the emergency planning zones, and reducing security checkpoints."

◆ Would you need the same safety requirements for a tricycle as for a locomotive? Would you need as many operators for a nuclear plant that could shut itself down safely while the operator watches and needs do nothing? Would you need as many check points for an area of one acre vs. three square miles? Folks seem to think that "nuclear" implies a standard set of safety requirements: That is a serious misconception. LFTR safety requirements would be radically less onerous because LFTRs are *inherently safe.* They are not under elevated pressure, require no cooling water or massive containment domes, and do not need vast exclusion zones. LFTRs are radically different from and far, far safer than conventional reactors; one needs to think way outside the conventional-reactor box to properly evaluate LFTRs.

> 9. "**MISSING REGULATIONS** The Nuclear Regulatory Commission has not yet produced a regulatory framework for licensing SMRs."

◆ This is true, and is a real hurdle: the NRC has no experience with LFTRs and is forcing the innovators to foot the cost of developing those regulations. Perhaps it is even advantageous that the developers of LFTRs must guide regulation of their own invention. This is one area where developers and government could achieve mutual benefits by working together. If that is to be termed a subsidy, so be it. Fortunately, it would be a one-time expense.

> 10. "**STILL UNTRIED** The only place in the U.S. where an SMR license is actually being pursued is in Clinch River, TN, through the Tennessee Valley Authority. After over 3 years of dialogue with the NRC, even preliminary licensing questions have not been addressed."

◆ Could be! The Clinch River reactor is not a LFTR.

"RENEWABLES ARE THE REAL ANSWER!"

◆ On the contrary, renewables require scrutiny from many perspectives. Renewables are a real but alarmingly incomplete answer. No one answers, let alone asks the question: How can renewables provide reliable, continuous electric power? There is a growing body of evidence that they cannot. Renewables are *intermittent*! With a 30 percent duty cycle, they are capital inefficient and must be backed up with major, very costly storage or continuous fossil-fuel-fired or nuclear-fired electric power generation at up to 100 percent of rated capacity. Wind-and-solar-only advocates have not addressed this reality. In terms of cost per kWh of electricity: wind, solar, and biomass are by far the most expensive of available power sources; and their largest costs are currently covered by subsidies.

> 11."Mitigating climate disruption demands sound investment in economical, expedient, clean and, most of all, safe technologies. Wind and solar are getting cheaper and more efficient by leaps and bounds. Advances are being made in energy storage. Geothermal energy is being tapped extensively."

◆ That first sentence is absolutely correct, and underlies the Sierra Club's efforts and our own. No matter how cheap or efficient wind and solar may become, the sun doesn't shine at night or through clouds, and the wind doesn't blow all the time. *Large-scale* storage of electricity is untenable: today, the electricity stored *in every battery in the world* would back up the world's grid for about 10 minutes. Renewables-only advocates propose dependence on a source that is intermittent, is available on average only 30 percent of the time, but ranges from 0 percent to 100 percent of rated capacity – an erratic source backed up with very costly storage, untenable on a large scale, or with *continuous* fossil-fueled electric power. Wind and solar for large-scale power generation have never operated without subsidies and likely cannot do so.

> 12."Wind farms added about 13 gigawatts of new power in the U.S. in 2012. Solar photovoltaic (PV) plants added 4.2 gigawatts of electricity in 2013. And that's just solar PV. Solar water heaters have become very economic and popular. There are also concentrated solar power arrays that generate electricity directly from the sun's heat, so the total amount of solar power is actually higher than the PV number alone."

◆ We have no argument with the these figures; but, drop the tax credits for wind and solar, and such expansion would slow or cease. And, the higher the percentage of wind and solar in the electric power mix, the harder it is for utilities to integrate them and maintain a stable supply of power: expanding large-scale wind and solar is increasingly problematic. Small-scale application is another matter: a solar water heater is a fine example of appropriate use of intermittent energy, for the heated water is both storage *and* product.

> 13.“Amory Lovins of the Rocky Mountain Institute and Arjun Makhijani of the Institute for Energy and Environmental Research have written articles and books on how both carbon and nuclear can be replaced nationwide with renewables by 2050. Dr. Makhijani’s book Carbon Free and Nuclear Free: A Roadmap for U.S. Energy Policy can be downloaded from the internet. The phasing out of nuclear power and coal is now well underway, and the switch to wind, solar and efficiency is quickly gaining momentum.”

◆ Amory Lovins has maintained that very position for decades. His good friend the late Alvin Weinberg, who led LFTR development in the 1960s, strongly disagreed with Lovins, and so do we. ◆ We strongly support the timely development of LFTRs and their deployment worldwide. They will operate safely and cheaply 24/7/365.

14. “What you can do to prevent this waste of taxpayer dollars.

> * Tell your elected officials that you want energy dollars to go for renewables and efficiency. * Start the dialog in your community to prevent these dangerous ‘Back Yard Nukes’.
> * Check out the Nuclear Free Campaign of the Sierra Club Facebook Group.
> * Follow @NuclearFreeSC on Twitter.”

◆ If they are LFTRs, these “Back Yard Nukes” are exactly what we need. We predict that once developed and deployed, they will rapidly replace hydrocarbons as fuel, conventional reactors, *and* large-scale wind and solar as sources of energy. Development and deployment of LFTRs is hardly a waste of taxpayer dollars.; rather, it is their best use. LFTRs should become the world’s “go to” power source for this century and beyond – far cheaper than coal or gas, conventional nukes, or large-scale wind and solar. Tell your elected officials that you want energy dollars to go for LFTRs, a safe, cheap energy source to provide power to the world.