Less is More: The Impact of Small Modular Reactors

Golda Nguyen

Davidson Fine Arts School

Less is More: The Impact of Small Modular Reactors

A thunderstorm is passing through the neighborhood, and the power cuts out. No lights, no television, no computer. Thank goodness the water is still running, but alas the typical American household must succumb to nature. Approximately 1.5 billion individuals across the globe, however, must succumb to the lack of electricity, regardless of whether it is rain or shine, and another billion are left with shoddy, unreliable energy sources that go on and off as easily as the flick of a light switch (Technology Quarterly). The need for reliable, long-term, relatively inexpensive, and preferably clean energy sources is ever-increasing as the rate of growth of populations continues to shoot up worldwide, particularly in developing nations that are overcrowding. An energy source, though, that has been on the scene since the mid 20th century and keeps gaining momentum is nuclear energy. When this term comes to mind, most individuals picture gigantic cone-shaped cooling towers with plumes of water vapor billowing out of the tops. These large reactors can pump out over 1200 MegaWatts of electricity (MWe), but require nearly a decade of planning and construction to complete (Rhyne, Rysavy, Shaw). This issue makes it obviously not feasible to implement such mammoth projects on weak economies and nations that are already financially strained in other pressing arenas aside from energy. Enter into the equation the reprisal of smaller plants called Small Modular Reactors (SMRs) that actually preceded the large reactors often seen today. These miniature reactors, so to speak, are dwarfed by their modern counterparts which are over three times the size of SMRs, but the giants cannot compete in regards to aspects such as efficiency of construction, lower costs, and a seat in the international market particularly eyed by developing nations.

The title “small modular reactor” pays heed to the fact that, as these are smaller in capacity, they produce lower electricity output. The International Atomic Energy Agency

(IAEA) classifies “small” as outputting less than 300 MWe (2012). The self-descriptive name also emphasizes a key component to explaining how these reactors gain efficiency, in that they are modular. In laymen’s terms, modular means that the major components of the reactor can be built off-site in a factory and transported to the site, often via ship or rail (Wald), for construction. The relative ease with which SMRs could be assembled has earned them the moniker of “plug and play” reactors (Navetta). With large reactors, transportation of those massive cooling towers is essentially an impossible feat, thus requiring all construction to happen on-site. Building on-site actually slows the entire process down because materials must be hauled continuously to the site and built from the ground up, whereas SMRs are given the luxury of a factory production with equipment and machinery to produce already in place. Individual pieces are assembled and then shipped to the site for the final piecing together, hence the quick “plug and play.” For developing nations, building the large reactors verges on implausible given the higher costs and longer construction schedules involved; producing an SMR would be a feat in itself, granted it would be easier and happen faster, for the less developed nations on the UN list of countries considered “developing nations.” Nonetheless, their smaller size and more efficient production will make SMRs more of an option for energy for growing nations likely within the next several decades.

In regards to costs, with any major project that would require government funding, the cheaper it is, the more likely it will be seen through to completion. In a 2010 report by the American Nuclear Society, findings showed that smaller reactors did not require the same safety provisions as large reactors (World Nuclear Association). The explanation behind this can be found in the fact that SMRs can be built below grade, requiring less security and lowering the chances of sabotage of the reactor (US DOE). The reactor is constructed in such a way that

attempting to remove any radioactive materials from it would more than likely be deadly to the individual attempting to breach it, comparable to “removing barbecue from the grill with your bare hands” (Rosen, Vidal). These lowered safety precautions are not to imply that companies are neglecting necessary safety procedures. In fact, in the wake of the Fukushima fallout just short of two years ago (Silverstein), the desire to take all measures necessary ensure safety has increased. That is why companies are testing SMR that utilize passive cooling systems, which use convection currents of air and water as opposed to pumps and valves that could malfunction in emergencies (Wald). The notion of “decreased safety” more so refers to the possible lowered amount of physical guarding of the reactor, such as the amount of operators and security guards if these reactors are implemented below grade.

Implementing these reactors into developing nations is not exactly a foreign or ludicrous concept. Reactor design company Hyperion estimates the price tag of one in the next decade or so to be about “$25 million each…for a community of 10,000 households, that is a very affordable $2,500 per home” (Rosen, Vidal). The International Atomic Energy Agency released reports back in 2008 and 2009 stating that SMRs would be able to find a market in thirty to forty countries (Rhyne, Rysavy, Shaw), and it was concluded that between 43 and 96 small modular reactors, all outside of the United States, would be in operation by 2030. The proliferation of these reactors can be largely attributed to the previous statistic from *The Economist* of the lack of electricity, and as a likely result running water, afflicting a seventh of the world’s population. A whopping 70% of all countries “lack the basic infrastructure to transmit electricity any appreciable distances from large LWRs (light water reactors, the large ones commonly associated with nuclear reactors) to end-users” (Navetta). Without a grid to tap into and with the financial and physical hassles of attempting to install electricity lines, developing nations must

turn to alternative energy sources like nuclear reactors and, more commonly, solar energy. SMRs continue to gain popularity in the international market and several industrializing countries have bought into it and implemented a few reactors. For example, the Chinese company Chinergy is working on a 210 MWe high-temperature gas-cooled reactor (HTR), based off of German reactors from the 1960s and 1980s. Pressurized heavy water reactors (PHWRs) are popping up in India, China, and Pakistan (World Nuclear Association). It is interesting to note that China and India in particular are well known for their overcrowded countries, thus the revival of SMRs which are "small enough" that they can be added to by grouping together reactors has allowed for an additional method to provide energy. They are of course coupling the nuclear energy with electricity and fossil fuels, but in thinking green, the carbon footprint does not grown from implementing these reactors. Developed nations have been hopping on the bandwagon, too. The US has numerous companies developing and testing designs, Siberia boasts four small reactors that have been running since 1976, and western European nations are coming along for the ride as well. Of course to dare to endeavor in such a task requires strong governmental support and funding. If not present, projects can fall through including South Africa's pebble bed modular reactor (PBMR) which was initially designed to produce 165 MWe, which was lowered to 80 MWe, and ultimately all cut out when construction was abandoned due to a lack of funds. (World Nuclear Association)

It is an almost an assured path that nuclear energy proliferation will continue in the coming years in order to combat the lack of basic electricity to billions of people, most of which reside in developing nations in Africa and Southeast Asia. Small modular reactors will be one of the developments leading the way because they enable thousands of homes located in remote areas to have access to energy sources (US DOE). The lowered costs, the more efficient

construction, and the missing carbon footprint make SMRs catch the eyes of nations worldwide and will play an integral role in leading developing nations to the light, literally, in providing people with needed electricity.

References

International Atomic Energy Agency. (2012). Common Technologies and Issues for Small and Medium Sized Reactors. *International Atomic Energy Agency*. Retrieved from http://www.iaea.org/NuclearPower/SMR/

Navetta, Michael. (2011). Small Modular Reactor Demonstration Complex. *Savannah River Nuclear Solutions, LLC*. Retrieved from http://www.srscro.org/wp-content/uploads/2010/10/Small-Modular-Reactor-Demonstration-Complex.pdf

Rhyne, S., & Rysavy, C., & Shaw, R. (2009). Small Modular Reactors. *American Bar Association.* Retrieved from http://apps.americanbar.org/environ/committees/nuclearpower/docs/SMR-Dec_2009.pdf

Rosen, N., & Vidal, J. (2008). Mini Nuclear Plants to Power 20,000 Homes. *The Observer*. Retrieved from http://www.guardian.co.uk/environment/2008/nov/09/miniature-nuclear-reactors-los-alamos

Silverstein, Ken. (2013) After Fukushima, US Seeks to Advance Small Nuclear Reactors. *Forbes*. Retrieved from http://www.forbes.com/sites/kensilverstein/2013/01/15/after-fukushima-u-s-seeks-to-advance-small-nuclear-reactors/

Technology Quarterly. Power to the People. (2010). *The Economist.* Retrieved from http://www.economist.com/node/16909923

World Nuclear Association. (2013). Small Nuclear Power Reactors. *World Nuclear Association*. Retrieved from http://www.world-nuclear.org/info/inf33.html

US Department of Energy. Small Modular Nuclear Reactors. *Office of Nuclear Energy*. Retrieved from http://energy.gov/ne/nuclear-reactor-technologies/small-modular-nuclear-reactors

Wald, Matthew. (2013) Deal Advance Development of a Small Nuclear Reactor. *The New York Times.* Retrieved from http://www.nytimes.com/2013/02/21/business/tva-and-babcock-wilcox-in-nuclear-reactor-deal.html?_r=0