LUMOS INDUSTRIES

Solar Thermal Radionuclide Updraft Tower

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The Lumos Mission

Lumos Industries is trying to kill two birds with one stone, both interim storage, and harnessing energy from a historically useless byproduct of energy production, nuclear waste. The technology developed by Lumos was coined "Solar Thermal Radionuclide Updraft Tower (STRUT)", perfected from an older technology through utilizing the power of thermal heat from nuclear waste, and both solar and wind energy.

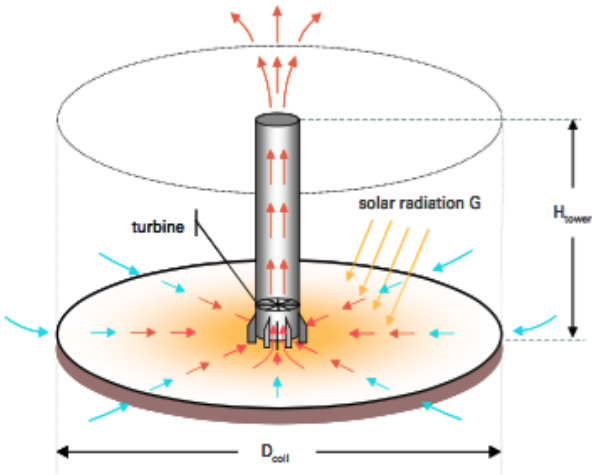
Current Technologies and Limitations

The concept of harnessing the energy from Nuclear Waste is not a new idea. Currently, commercialized reactors use less than 10% of the total potential energy in their fuels, and the energy-dense remainder is currently discarded as [hot, radioactive] waste. Companies like TransAtomic Power, Terrestrial Energy, Advanced Reactor Concepts, and Terra Power are planning to utilize the energy through "fast breeder reactors". Those next generation reactor concepts have the potential to harness a large portion of this energy. Further, the majority of their waste products can be managed in human timeframes, but even these advanced reactors will still create some hot, long-lived, radioactive waste that needs to be stored. Lumos is flexible enough to help with the storage of both this waste and the waste from current commercialized reactors. In terms of storing nuclear waste, the United States has no current plans or systems in place for the storage of spent nuclear fuel.

The Lumos Approach

Currently, nearly 100% of all nuclear byproducts in the U.S. are stored on site at the reactors that produced them. The used fuel is stored in actively cooled pools and later moved to passively cooled dry casks. Because used fuel generates a lot of heat that the reactor operator is responsible for expending energy and money to cool these pools and monitor these casks to make sure the waste is kept at a safe temperature.

Figure 1: Solar Thermal Updraft Tower



. The proposed technology that Lumos is attempting to develop uses safe, renewable and passive systems that not only safely stores and cools the waste, but also generates electricity. As seen in figure 1, the technology works on the principle that hot air rises. Accordingly, this design incorporates wind turbines along the tower to generate electricity from heat rising from the dry-casks. The design also makes use of secondary heat from incident solar radiation as well as increased temperature differential due to cold air at higher altitudes. While generating electricity, the tower also acts as a cooling storage location for the nuclear waste in the dry-casks. The cooling and energy generation are both boosted as wind is generated from the temperature differences between the base of the tower and the top.

Importance of Technology & Societal Impact

In certain states, like in California, there is a moratorium on the production of new nuclear reactors unless a solution for the disposal of their waste is implemented. September 14th, 2016 U.S. Secretary of Energy, Ernest Moniz, told a senate appropriations subcommittee on Energy and Water Development that the Department of Energy sees an opportunity in privately owned interim storage facilities to overcome political impasse over nuclear waste. Therefore, the nuclear industry cannot move forward unless there is innovation and implementation of new technologies for nuclear waste storage solutions. The Nuclear Waste Policy Act was enacted in

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1982 with the promise that the US DOE would become responsible for storing the waste, funded by a tax levied on nuclear reactor operators. Currently, the U.S. DOE has no plan in place for what will be done with the waste.

The government has already spent 10 billion dollars on the Yucca Mountain project, as a solution for storage of spent nuclear fuel in America, which failed due to political backlash driven primarily by a lack of consent in the siting process. Currently there is $24 billion waiting in a nuclear waste management fund held by the DOE for a final solution on the matter.

What are the risks and the payoffs?

The risks predominantly involved in this are not storage, environmental, transportation or even non-proliferation issues, as these are very well studied subjects. The main challenges are derived from licensing, state and local governmental issues. The science of nuclear waste management is a *very* well studied field, but some of the major factors in the failures of nuclear waste management in the past (with regard to the failure of the Yucca Mountain Project), are more of a political issue than a technical one. Success in the field of nuclear waste management has been achieved by the SKB (Swedish Nuclear Waste Management Company), where they were able to begin construction on the first geological repository for spent nuclear fuel in the world through a consent based siting project. In consent-based siting, a community will volunteer to be the host site for the fuel, and it won't be pushed on a municipality, as was the case with Yucca Mountain, which is why it received so much political backlash. The success in Sweden came mostly from volunteering communities that already held nuclear reactors in their areas, as the locations were more comfortable with the thought of nuclear energy and is the approach Lumos believes is right to take.

Cost? Time?

According to our research done on the construction costs of solar thermal updraft towers, this facility would cost on the order of $75 million. Licensing costs were advised on the order of $20 to $50 million. The time constraint is expected predominantly derived from the continuation of the development on the technology, which is expected to be less than 5 years with funding. The licensing process is expected to take between 2 and 5 years according to the Lumos Advisory Board. Costs of traditional interim storage facilities, like the Swedish CLAB (Central Interim Storage Facilities for Spent Nuclear Fuel) were on the order of $2 billion, and then continued expenses were procured from the need for continuous cooling of the spent nuclear fuel during its operation. Compared to a total of less than $200 million for the initiative that Lumos is trying to push. The cost of electricity produce by STRUT is expected to be on par with current renewable technologies

Figure 2: Solar Thermal Radionuclide Updraft Tower next nuclear reactor. (Figure not drawn to scale)