THE TRAVELING WAVE REACTOR: BRINGING NUCLEAR TECHNOLOGY TO ITS FULLEST POTENTIAL

TerraPower's traveling wave reactor (TWR) is designed to be a 1150 megawatt-electric liquid sodium-cooled fast reactor that uses depleted uranium as fuel. It will greatly simplify the current nuclear fuel cycle by reducing the need for uranium mining, enrichment facilities, reprocessing plants and storage facilities. This will result in enormous cost savings, highly enhanced safety, greatly reduced toxic waste, greater ease in waste disposal and a high level of weapons proliferation resistance.

TWR theory is not new, but making it a reality is. As early as 1958, Saveli Feinberg imagined a self-fueling nuclear reactor. Over the years, researchers periodically studied the idea, but in 2006, TerraPower became the first to consider the practical engineering details of how to make a breed-and-burn TWR a reality. TerraPower has put together a unique team of nuclear specialists and government, corporate and academic collaborators, and provided them with the analytical tools, direction and funding to develop the TWR design and a path to commercialization.

WHAT IS TRAVELING WAVE TECHNOLOGY?

TerraPower's sodium-cooled TWR will improve resource utilization many times over from existing nuclear reactors which can only burn less than five percent of their uranium fuel. The key innovations in the TWR are advancements in fuel, materials and engineering, which allow TWRs to use fuel much more efficiently and over a longer period of time. These innovations will allow TWRs to utilize depleted uranium (DU), rather than enriched uranium, as their primary fuel. By using inexpensive DU, the TWR will produce its own fissionable fuel capable of sustaining a fission chain reaction for decades.

The greater utilization of fuel will allow TWRs to load enough fuel up-front to last for up to 40 years. Contrast that against current reactors that must replace and store fuel assemblies every 18 to 24 months. The TWR stores used assemblies inside the core, obviating the need for external storage, transportation and disposal. Alternatively, these fuel assemblies could be replaced after 10 years and used as starter fuel in another TWR. These capabilities enable enormous economic and environmental benefits with the highest barriers to weapons proliferation. Spent fuel from current light water reactors could also be utilized in TWRs to reduce the large number of stored fuel assemblies.

COMMERCIALIZING NUCLEAR INNOVATION

TerraPower has developed a sound path leading from its conceptual design to commercial TWR plants. This involves testing fuels and materials, building a database of experience, fabricating metallic fuel, obtaining required licenses and permits, and developing a supply chain of companies that will be able to design and fabricate all of the necessary equipment and components for the TWR. It also requires finding host country partners that will assist in identifying program funding and a site for a prototype plant. TerraPower has had positive detailed discussions with a number of countries and companies to bring this development path into reality.

The first TWR will demonstrate key plant equipment, qualify the fuel and materials for longer term use, and provide the technical, licensing and economic basis for commercial TWRs. This prototype is expected to be constructed between 2018 and 2023. After a suitable period of testing and optimization, commercial plants are expected to be licensed with start up in the late 2020s or early 2030s. This will be 10 to 20 years earlier than other Generation IV technologies.

Ninety percent of all mined uranium is discarded as "depleted" uranium, a waste product from the enrichment process. There is enough depleted uranium in the United States alone to fuel the United States for more than 700 years.

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