NEWTON SELECTION

Project Descriptions

ARGONNE NATIONAL LABORATORY – Argonne, IL

Liquid Lead Suspended Fuel Subcritical Fission Blanket for Nuclear Waste Transmutation – $7,000,000

Argonne National Laboratory is developing a novel transmutation system based upon the recoil distance and centrifugal separation of fission products from the fission of minor actinide nanoparticles from a liquid lead blanket. The transmutation system consists of a proton accelerator, a subcritical fission blanket containing liquid lead, fission product targets, nanometer-size suspended minor actinides transmutation targets, and an innovative separation system based on centrifugal force.

ARGONNE NATIONAL LABORATORY – Lemont, IL

Nb_3Sn Proton Driver Linac for Accelerator Driven Systems – $3,240,000

Argonne National Laboratory is developing a practical approach to reduce the size and cost of superconducting accelerators in particle accelerators while simultaneously improving their reliability. The project team will leverage smaller, better-performing superconducting cavities based on an emerging technology known as thin-film niobium-tin (Nb_3Sn) that is produced in a process called vapor diffusion. Niobium-tin technology enables the elimination of the single point of failure associated with the cryogenic plant by replacing it with a distributed set of fault-tolerant cryocoolers.

ELECTRIC POWER RESEARCH INSTITUTE – Charlotte, NC

Techno-Economic Assessment of Transmutation Impact on Minimizing disposal Expenditure – $1,904,363

The Electric Power Research Institute will develop a techno-economic assessment methodology of potential transmutation technology options as part of an integrated fuel cycle back-end. The project team will identify the influential factors in successful implementation and seek to deliver a pathway to commercialization for these technologies. This will result in a paradigm shift in the cost, complexity, and timescale of the ultimate disposal of the United States' commercial spent fuel.

UT-BATTELLE LLC – Oak Ridge, TN

SMART-OPS: Self-learning Machine intelligence for Accelerator Reliability, Trip Optimization, and Performance Stabilization – $2,626,200

Oak Ridge National Laboratory is developing an artificial intelligence-powered beam stabilization and trip mitigation system, SMART-OPS, to improve efficiency and reliability of particle generation and acceleration for accelerator-driven subcritical systems. SMART-OPS will leverage knowledge-informed machine learning algorithms that utilize underlying physics of the accelerator to predict and mitigate beam trips in real time, significantly enhancing the reliability and efficiency of the beam line. By continuously analyzing data from various accelerator components in real-time, SMART-OPS will anticipate potential instabilities and take proactive measures to prevent beam trips.

OMEGA-P R&D – New Haven, CT

Compact deuteron accelerator to produce neutrons for transmutation of used nuclear fuel – $2,600,000
Omega-P R&D aims to design an innovative compact particle accelerator called a deuteron Cyclotron Auto-Resonance Accelerator (dCARA) with a neutron-generating target. Notable features of dCARA include continuous acceleration without bunching for good beam stability, high efficiency, and wide beam aperture. This work has the potential to open a disruptive approach for transmutation of long-lived, high toxicity isotopes found in used nuclear fuel.

SHINE TECHNOLOGIES, LLC – Janesville, WI

REDUCE: Recover Elements - Destroy Undesirables - Create Energy – $4,030,306
SHINE Technologies is developing an innovative approach to reduce used nuclear fuel (UNF) and the disposal impact through its Recover Elements - Destroy Undesirables - Create Energy (REDUCE) method. The proposed approach will reduce the volume, longevity, and hazard level of reactor waste, and will improve reprocessing/transmutation economics. After recovery of uranium and plutonium (for advanced reactor fuel) and other valuable elements, the remaining UNF constituents will be incorporated into a molten salt transmutation target designed to be coupled to an external neutron source. This program will design, simulate, and laboratory test game-changing technologies that reduce the environmental impact of nuclear energy generation through the recycling and transmutation of used nuclear fuel.

THE RESEARCH FOUNDATION FOR THE STATE UNIVERSITY OF NEW YORK – Stony Brook, NY

Technical approach to achieving attractive ads economics based on near-term high current cyclotrons – $2,295,000
Stony Brook University is forwarding research on a cyclotron-based accelerator driven system technology along with advancements in spallation target development, sub-critical reactor optimization, and a systems level techno-economic analysis. The project team will optimize high-current cyclotron designs as low-cost, high-performance drivers. The project will explore novel spallation targets centered around tungsten-based alloys for enhanced radiation resistance and superior thermal properties to state-of-the-art liquid targets.

JEFFERSON SCIENCE ASSOCIATES, LLC – Newport News, VA

High-Efficiency Continuous-Wave RF Sources for High-Power Particle Accelerators – $3,957,203
The Thomas Jefferson National Accelerator Facility is developing high-efficiency magnetron radio frequency (RF) sources to enable transmutation of all classes of used nuclear fuel isotopes and support reliable, high-availability particle generation. The project leverages the use of magnetrons, which have several advantages compared to competing RF sources in terms of efficiency, cost, and output power. However, magnetrons have not been widely used for accelerator applications due to challenges with random startup conditions and noisy spectra, which hinder required operational stability. These issues are addressed by proposed designs and power-combined modules resulting in dramatic advantages over competing high-power RF systems.

JEFFERSON SCIENCE ASSOCIATES, LLC – Newport News, VA

Superconducting Nb3Sn Cavities for Efficient and Reliable 10 MW Proton Linacs – $4,217,721

The Thomas Jefferson National Accelerator Facility is developing two types of superconducting radio frequency (SRF) cavities designed to enable the economical transmutation of all classes of used nuclear fuel isotopes. Spallation Neutron Source-type elliptical and newly designed single-spoke niobium cavities will be coated with superconducting Nb_3Sn coating via a vapor diffusion process. Successful implementation of this technology in high-power SRF linear accelerators for Accelerator Driven Systems could reduce the power consumption and increase the reliability of accelerator facilities significantly through the elimination of the 2K cold box from their cryoplants.

TRANSMUTEX SA – Los Alamos, NM

Highly Reliable Ion Source and Injection Beamline to Maximize Proton Beam Availability – $4,293,007

Transmutex is developing a highly reliable ion source by enhancing existing commercial technology through innovative engineering. Transmutex will modify a commercial ion source to reach the reliability required for efficient operation of the accelerator and the overall system. The project includes broad engineering improvements, followed by an extensive testing campaign to identify potential sources of failures. Using advanced data analysis, the team will continuously monitor and optimize the system's performance. The project's overarching goal is to enable nuclear waste transmutation to transform long-lived radioactive elements into shorter-lived ones, reducing their hazardous lifetime from 1 million years to a few hundred years.

UNIVERSITY OF ILLINOIS, URBANA-CHAMPAIGN – Urbana, IL

EINSTEIN: Enhanced Integrated Nuclear Systems for Transmutation and Efficient Isolation of Nuclides – $1,025,405

The University of Illinois, Urbana-Champaign is developing advanced nuclear fuel transmutation technologies by addressing key challenges in the partitioning, recycling, and transmutation of uranium, plutonium, and minor actinides in used nuclear fuel (UNF). The Enhanced Integrated Nuclear Systems for Transmutation and Efficient Isolation of Nuclides (EINSTEIN) project will create a comprehensive data-informed life cycle analysis framework that integrates nuclear and technological data to assess the entire UNF transmutation process, from input stream to target output. Experimental validation of key neutron transport and material compatibility data will be conducted through high-energy proton and neutron irradiations.