GE Hitachi Advanced Recycling Center
Solving the Spent Nuclear Fuel Dilemma

Disposition of Spent Nuclear Fuel (SNF) is an important consideration given the anticipated expansion of nuclear energy generation. New plants will face difficulty in gaining public acceptance unless there is a solution for the disposition of spent nuclear fuel that will be generated during operations.

The public is driving government policy towards emission reductions of greenhouse gases. A major source of greenhouse gas emissions is the CO_2 that is released when fossil fuels are used to produce electricity.

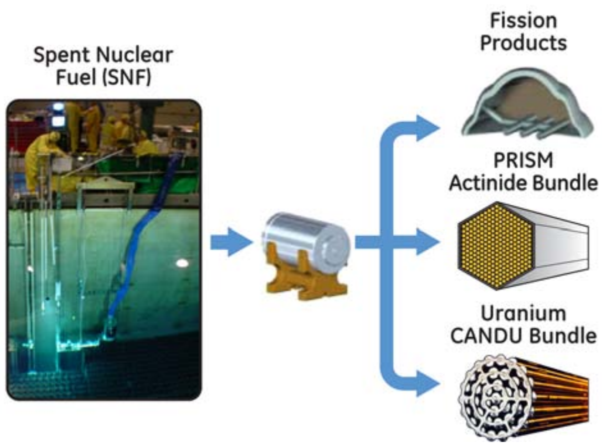

Figure 1: Spent Nuclear Fuel separation is accomplished using the dry Electrometallurgical process

Any attempt to solve these two major issues should focus on avoiding the creation of new concerns. Therefore, the solution should embrace public and worker safety, have a low impact on the environment and be economically viable. Safety, in the case of spent nuclear fuel, also includes limiting the possibility of diversion of materials that can make nuclear weapons (system must be proliferation resistant).

The Advanced Recycling Center (ARC) proposed by GE Hitachi Nuclear Energy (GEH) and its team of industrial companies including, Burns and Roe, Fluor, IBM and Lockheed Martin, will address the issues of spent nuclear fuel through recycling while reducing greenhouse gases emission from power production.

The ARC combines electrometallurgical processing and one or more sodium cooled fast burner reactors on a single site. This process produces power while alleviating the spent nuclear fuel burden from nuclear power generation.

The ARC starts with the separation of spent nuclear fuel into three components: 1) uranium that can be used in CANDU reactors or re-enriched for use in light water reactors; 2) fission products (with a shorter half life) that are stabilized in glass or metallic form for geologic disposal; and 3) actinides (the long lived radioactive material in SNF) which are used as fuel in the Advanced Recycling Reactor (ARR).

GEH has selected the electrometallurgical process to perform separations. The electrometallurgical process uses electric current passing through a salt bath to separate the components of Spent Nuclear Fuel. A major advantage of this process is that it is a dry process (the processing materials are

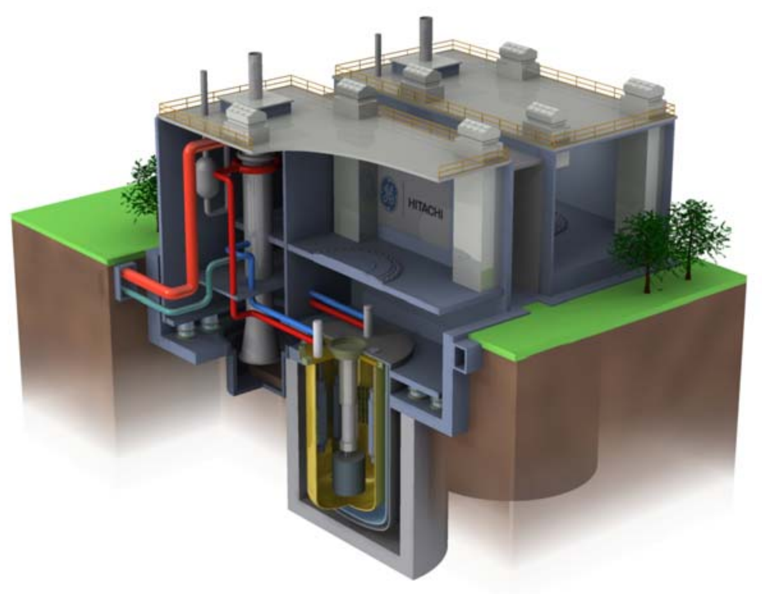

Figure 2: PRISM Reactor power block used to produce electricity from spent nuclear fuel.

solids at room temperature). This significantly reduces the risk of inadvertent environmental releases. Additionally, unlike traditional aqueous MOX separations technology, electrometallurgical separations does not generate separated pure plutonium making electrometallurgical separations more proliferation resistant. Electrometallurgical separations technology is currently widely used in the aluminum industry and has been studied and demonstrated in US National Laboratories as well as other research institutes around the world.

The actinide fuel (including elements such as plutonium, americium, neptunium, and curium) manufactured from the separations step is then used in GEH's PRISM (Power Reactor Innovative Small Modular) advanced recycling reactor to produce electricity. PRISM is a reactor that uses liquid sodium as a coolant. This coolant allows the neutrons in the reactor to have a higher energy (sometimes called fast-reactors) that drive fission of the actinides, converting them into shorter lived "fission products." This reaction produces heat energy, which is converted into electrical energy in a conventional steam turbine. Sodium cooled reactors are well developed and have safely operated at many sites around the world.

The ARC produces carbon-free base load electrical power. An ARC consists of an electrometallurgical separations plant and three power blocks of 622 MWe each for a total of 1,866 MWe. The sale of electricity will provide the revenues (private sector) to operate the ARC while supplemental income will be obtained from the sale of uranium (private sector) and the payment for SNF treatment (currently Government controlled).

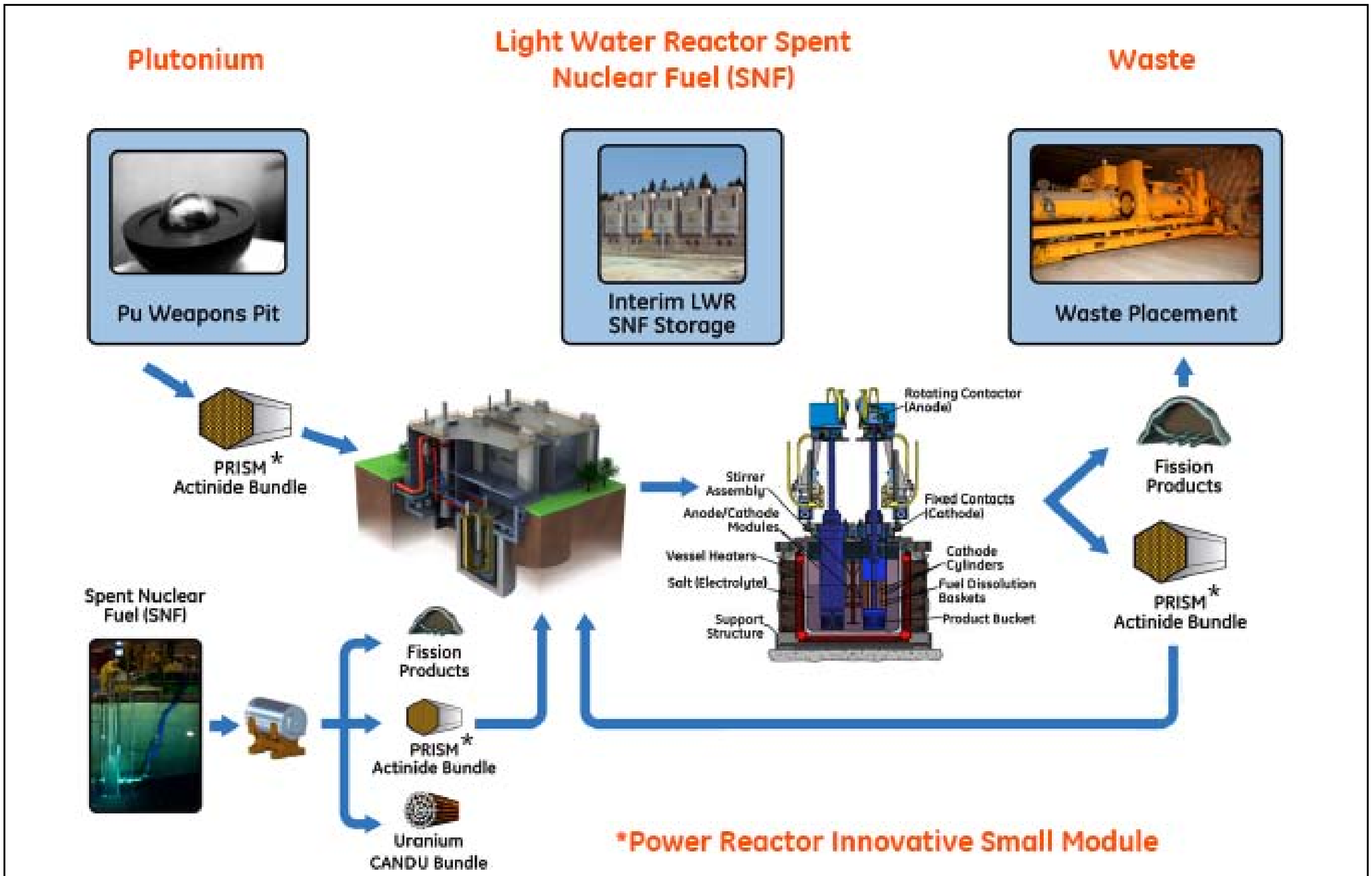

Figure 3: Implementation of a Fuel Qualification Reactor that uses excess weapons material as the initial core and recycled light water reactor spent fuel in subsequent operations.

Today, in the US there are approximately 100 nuclear power reactors in operation. Assuming that they each produce 20 tons of SNF a year for 60 years of operation, then the current fleet will produce 120,000 tons of SNF. 26 ARCs are capable of consuming the entire 120,000 tons of SNF. Additionally, they are capable of producing 50,000 MWe and avoiding the emission of 400,000,000 tons of CO_2 every year.

In order to gain the confidence of utilities and financial markets that the regulatory and resource issues (personnel and materials) can be solved, a first of a kind ARC must be built at "full-scale." A full-scale facility is a single reactor and 50 tons per year separations facility. This facility could be available as early as 2020. A well-managed US government sponsored program using US technology, US national laboratories and universities, and US companies can lead this process. The project will take approximately 10 years to complete. We estimate the total first of a kind cost for the Nuclear Fuel Recycling Center and a PRISM reactor (design, technology development, licensing, constructions, safety testing, etc.) is $3.2B thus requiring an average spend of $320M/yr with peak construction period requiring $700M. The first PRISM reactor could be fueled by excess Pu from the weapons stockpile, thus further reducing proliferation risk. This program will enable the US to lead the world nuclear community in demonstrating a sound approach to solving the problem of SNF, a solution that our national laboratories pioneered decades ago. The US taking action to build the GEH Advanced Recycling Center allows the US to capitalize on existing US funded technology and demonstrate US leadership in providing a safe, proliferation resistant method to close the nuclear fuel cycle.