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**Net reduction in Nuclear Waste to produce limitless, carbon free energy, from Moltex**

Moltex has invented an extraordinary new method for economically converting spent conventional nuclear waste into fuel for its fast spectrum molten salt reactor, known as WATSS (WAste To Stable Salt). The Moltex Stable Salt Reactor Wasteburner (SSR-W) utilises spent CANDU fuel (or any oxide fuel) converted to chloride form to produce low cost electricity.

Moltex Energy is developing the capability to power reactors by extracting the remaining fuel from the thousands of tons of spent fuel around the world using WATSS. Conventional radioactive waste is radioactive for circa 300,000 years if the plutonium and higher actinides are left in the spent fuel. To handle this huge and toxic liability, governments have set aside tens of $billions, but this liability can be reduced or even turned into an asset, once converted into SSR fuel. This asset will be able to create vast amounts of incremental energy and produce waste that will then take only 300 years to decay, reducing the scale of geological repository sites.

Fuel produced in this way is expected to be cheaper than conventional nuclear fuel produced by mining and enrichment of uranium. It also removes the plutonium in the spent fuel permanently from the risk of it being stolen and used for nuclear weapons. This reduces the overall proliferation risk of nuclear power.

Conventional reprocessing of spent nuclear fuel was developed to produce high purity plutonium and is thus a serious nuclear proliferation risk. It is also so expensive that it is never done for commercial reasons. The WATSS fuel conversion technology transforms this picture. It vastly simplifies the process, so a single apparatus the size of a billiard table is predicted to process as much spent nuclear fuel as the THORP plant at Sellafield - which is the size of a soccer pitch (and even more expensive than the players who play on it). Importantly, the SSR fuel output of this process does not approach anything close to the purity needed for weapons use. This level of purification would require a traditional multibillion dollar reprocessing plant.

This is a unique opportunity for Canada as traditional reprocessing methods are not economically viable with CANDU fuel as clarified in the recent CNL study on reprocessing methods for CANDU fuel, 2016.

The SSR-W and associated fuel production process have at their heart a strategy of actually reducing the net amount of radioactive waste within the total system. There are three substantially separate activities that must be considered in the context of radioactive waste.

1. Production of fuel from spent CANDU fuel. The planned process takes spent CANDU fuel, high level waste, and converts it into four output streams which are:

    a. Fuel for the SSR. This is not a waste stream but is used to generate carbon free electricity.
    b. Higher actinide depleted uranium/iron. This product has low heat generation and radioactivity and could be disposed of as low/intermediate level waste depending on storage time. However, it too is regarded as being a resource rather than a waste stream and would be stored pending future use as is the case elsewhere internationally.
    c. Noble gas fission products, vented continually to atmosphere as per industry standards.
    d. Spent calcium chloride based electrolyte containing the majority of the fission products. This is a highly concentrated output stream with high levels of heat production.

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2. Recovery of spent SSR fuel and reactor operation. The planned process recycles all actinides into fresh SSR fuel. The waste streams are:

    a. Condensate from treatment of the containment gas in the reactor, which will be low level waste.
    b. Actinide free sodium chloride based fission product waste containing most fission products. This is initially high-level waste but being actinide free can be stored at near surface locations to decay to intermediate level waste. This waste stream will also make permanent disposal in a high chloride environment desirable.
    c. Metal waste from fuel assembly cladding and wrappers. This will be compacted and/or melted into compact blocks of predominantly stainless steel. They will become low level waste after a period of storage.

3. Decommissioning. Decommissioning follows complete defueling with the fuel treated as above. Fully and partially burned fuel will produce similar waste streams. Actinides will be recycled into fuel for other SSR reactors.

    a. The major radioactive waste stream during decommissioning will be the reactor coolant. After 10 years of storage, the activity of the major radioactive species will have decayed to the point where the waste would be low level waste.
    b. Reactor structural materials (steel, concrete) are not expected to be substantially radioactive due to the neutron screening by the coolant and should therefore be classifiable as low level waste.

In addition to the transformation of the massive liability that is nuclear waste, into an enormous asset, which is fuel for an intrinsically safe, low cost reactor, the Moltex process for extracting plutonium from spent fuel has another, and quite important, advantage. The remaining fission products that emerge from the conversion plant (see above, 1.d.) are in a concentrated and very stable form which produces useful amounts of heat for up to 100 years after production. A patent has been filed covering the use of this waste form in a simple apparatus that can produce safe, clean heat and electricity for remote communities at a far lower cost than expensive and polluting diesel generators. Very Small Modular Reactors (vSMR) are suitable for towns that require 4-10MW of power. **This source of energy would be suitable for smaller towns in the region of 300kW – 1MW**. It does not require nuclear power plant regulation and requires minimal to no maintenance.

This is attractive in Canada, where plans to use vSMRs for remote heat are already being advanced. This technology is well suited to support that deployment and enable a larger reduction of greenhouse gas emissions.

The opportunities presented by Moltex's WATSS fuel conversion process have the ability to reduce the net amount of nuclear waste through the production of:

- Fuel to produce carbon free, low cost electricity.
- Heat sources for remote communities.
- Manageable waste streams,

Please also see the Moltex papers on intrinsically safe nuclear energy, cost competitive with fossil fuels, and Grid scale nuclear energy that enables Renewables, from Moltex.

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