

Intrinsically safe nuclear energy, cost competitive with fossil fuels, from Moltex Energy

Moltex Energy has designed an advanced form of nuclear reactor which is intrinsically safe and can produce zero-carbon energy that is cost competitive with fossil fuel energy. The fundamental but extremely simple breakthrough behind the reactor, which is covered by granted international patents, is that it is possible to replace solid nuclear fuel in conventional fuel assemblies with stable molten salt fuel.

Use of molten salts as fuel carries enormous advantages. Principle among these is that the nuclear fission reaction takes place under atmospheric pressure and the hazardous fission products, caesium and iodine, react immediately forming non-volatile salts. Even the most disastrous accident scenario, e.g. reactor explosion, would not release radioactive gasses into the atmosphere, but would result only in the need for localised clean-up within the perimeter of the reactor site. We do not anticipate the need for an Emergency Planning Zone around the reactor.

The Moltex Stable Salt Reactor, or SSR, is a modular reactor which can fulfil the criteria of Small Modular Reactor (SMR) but can scale to be a large commercial grid scale reactor. The commercial demonstration plant is envisaged to produce 300MWe (750MWth). The subsequent base model is 1GW which is simply a longer reactor with 8 modules instead of 2. This permits cheaper energy production and will be fully validated by the 300MW version.

Moltex's first reactor the SSR-W is fuelled by spent nuclear fuel (Note: See Moltex's second paper on Net reduction in Nuclear Waste to produce limitless, carbon free energy, from Moltex – known as 'WATSS'). This will substantially reduce the volume of disposal required which will increase **public acceptability** of nuclear



Figure 1: Architectural rendering of the SSR-W300

as a source of clean energy.

The safety advantages of using molten salt fuel are widely known, but the great potential of molten salts is best realised in a reactor that also uses (non-fissile) molten salt as the coolant. The SSR reactor, illustrated below, consists of a core of essentially conventional (though salt fuel filled) fuel assemblies in a tank of coolant salt. This is similar to a traditional sodium cooled reactor.

The outlet secondary coolant temperature is 570°C making it suitable for process heat as well as power generation.

The power plant is coupled to a low cost energy storage facility known as GridReserve®. This system has two major benefits, it allows shifting the reactor power output to times of peak demand and it formally separates the steam system from the reactor system, allowing direct control of the electricity generation plant by the grid operator. A large expansion of intermittent renewables is now a viable solution. See Moltex's third paper on GridReserve®.

The key advantage of the SSR is to safely provide variable levels electricity at scale but at low cost, without producing carbon and by using spent nuclear waste as the fuel source. The Overnight Capital Costs of this technology are independently estimated at a highest probability of \$2,115/kW. This equates to a cost of electricity of <\$50/MWh.

Moltex envisages deployment of the demonstration plant in Ontario as early as 2026 with the right political support and potentially six reactors in Saskatchewan by 2035 with larger deployment elsewhere in Canada if demand increases. Internationally, deployment of a 1000MW reactor per year is envisaged starting with the UK and then Asia. Design and key component manufacturing would be done in Canada. Using the same methodology as the recent SMR Feasibility Study carried out by the Ontario Ministry of Energy, Moltex calculates that this represents an economy generation for Canada of up to \$2 trillion between 2025 and 2050 and almost 400,000 direct and indirect jobs.

Please also see the Moltex papers on intrinsically safe nuclear energy, cost competitive with fossil fuels, and Net reduction in Nuclear Waste to produce limitless, carbon free energy, from Moltex.

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