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Grid scale nuclear peaking plant that enables renewables, from Moltex

Nuclear Energy has traditionally been used only for baseload power – we can change that with a proven, economically viable, energy storage technology from Moltex, called GridReserve®. Moltex's reactor technology is coupled with GridReserve® allowing nuclear power to economically act as a peaking plant. This is not possible with conventional water reactor technology. This will allow a large expansion of renewables onto the grid without affecting grid integrity or requiring substantial ancillary services.

Baseload power is an old concept that is rapidly becoming meaningless. The idea that much of our power generation could run 24 hours a day was correct when we only had to worry about power demand going up and down. But today we not only have power demand varying, but we also have renewable power generation varying – and not at the same time. Generators now actually pay their customers to take their power! As a result, a large part of our total generation capacity has to remain gas powered, because only gas can economically turn on and off quickly during the day. CO2 emissions therefore stay high despite the increase in renewable energy sources.

Why can nuclear energy not replace gas as this backup power source? The problem is economic. A nuclear power station saves almost no cost when it shuts down, so if it only operates for 50% of its capacity, its cost of electricity doubles. That is utterly unaffordable. The solution is of course obvious. Store the excess energy when it is not needed and use it during times of peak demand.

But there is no technology capable of economically storing electricity at large scale yet available. A commercially proven technology does however exist to store heat. It is used in concentrated solar power plants where the sun's heat is stored during the day and then used at night to maintain electricity production. It works and it is highly economical, adding only a fraction to the cost of electricity produced. You can see the detailed costing at http://www.nrel.gov/docs/fy12osti/53066.pdf .

The technology actually uses molten salt – similar to the approach used by Moltex in its Stable Salt Reactor (SSR) which produces intrinsically safe nuclear energy cost compatible with fossil fuels, but without producing carbon (Note: see Moltex Energy's first paper on the Stable Salt Reactor). Why do we not already use this technology to store our excess nuclear energy? Conventional nuclear reactors only produce heat at about 300°C and that is just not hot enough to be usefully stored. But the Stable Salt Reactor produces its heat at just the right temperature for this heat storage technology, around 600°C!

What this means is that we can run a 1000MW Stable Salt Reactor 24 hours a day but store its heat output for as much as 8 hours when there is no demand for the electricity. Then when electricity demand rises we can double our power output to 2000MW for 8 hours. This is a game changer for flexible electricity supply. We can continue to build a renewable power system. But the power needed to complement the renewable energy's intermittency would also be carbon free power, from our Stable Salt Reactors. This opens up the real opportunity for

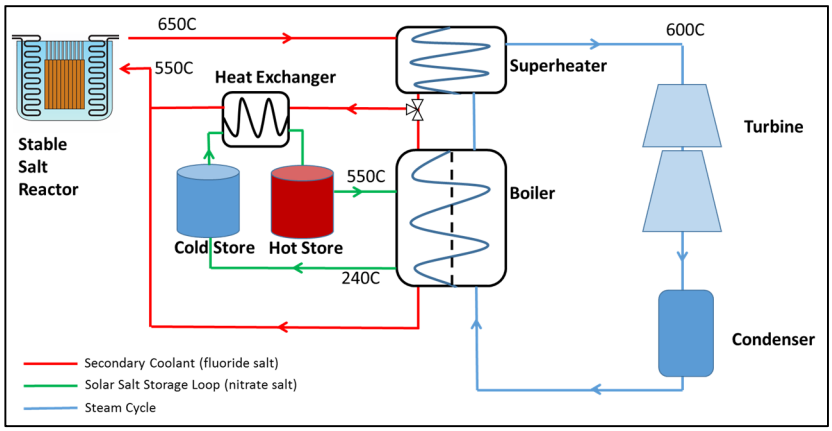

Figure 1: Schematic diagram of the generation cycle of the SSR

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a fully carbon free electricity generation system.

Below is a graph of a typical day showing electricity demand (or sale price) fluctuating throughout the day. The reactor runs continuously at full power but some of the heat is used to heat the storage tanks when demand is low; this is shown in orange. The green areas are when demand is high and the solar salt stores are used to produce electricity.

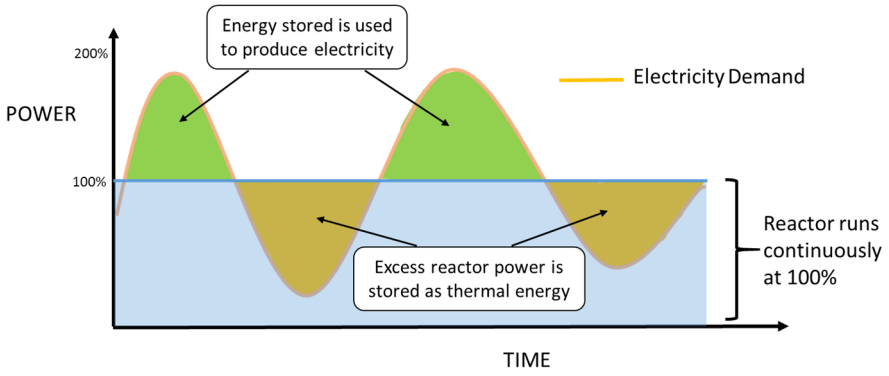

Figure 2: Illustrative graph of power over time showing the distribution of heat from electricity production to storage.

The ability to store the heat produced by the reactor at low cost is extremely advantageous for grids that have increasing needs to be more flexible. This need will increase with the expansion of renewables and huge growth planned in the numbers of electric vehicles.
An average of 300MWe could be supplied to the local grid with peaking capability up to 600MWe for 8 hours per day with the appropriate energy storage. **This capability only costs an additional 10% of the capital cost for a substantial increase in value, as electricity can be produced to match demand**. This allows flexible electricity supply and flexible use of the high temperature heat for other purposes, such as hydrogen, in the future.

Economic studies have been carried out to assess the increase in revenue when thermal storage is coupled with the Stable Salt Reactor. The result is a 56% increase in revenue for the operator and/or power utility based on a 300MWe reactor with 300MWe of storage available over a 6-hour period. Historical UK electricity rates are used to make the evaluation taking an average week in winter.

GridReserve is not available to conventional forms of nuclear power because of their low operating temperatures.

The increased safety of the SSR, especially when coupled with GridReserve® allows a simpler, more economic power plant and **reduced electricity costs**. This permits the Canadian energy sector to reduce their greenhouse gas emissions ever further as nuclear is a scalable source of clean energy which creates economic prosperity for all Canadians.
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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