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USA Progress on SRF Linacs Driving Subcritical GEM*STAR Reactors

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Scaling from the ORNL SNS 6% duty factor with 1.4 MW of beam on target to CW operation by appropriate upgrades of components, the traditionally considered Accelerator-Driven System (ADS) goal of 10 MW at 1 GeV is easily surpassed. However, studies have pointed out that even a few hundred trips of an accelerator lasting a few seconds could lead to unacceptable thermal stresses as each trip causes fission to be turned off in solid fuel structures found in conventional reactors. The newest designs based on the GEM*STAR [1] concept, however, take such trips in stride by using molten-salt fuel, where fuel pin fatigue is not an issue. Other aspects of the GEM*STAR concept, which address all historical reactor failures, include an internal spallation neutron target and high temperature molten salt fuel with continuous purging of volatile radioactive fission products such that the reactor contains less than a critical mass and almost a million times fewer volatile radioactive fission products than conventional reactors like those at Fukushima. GEM*STAR is a reactor that without redesign will burn spent nuclear fuel, natural uranium, thorium, or surplus weapons material. It will operate without the need for a critical core, fuel enrichment, or reprocessing making it an excellent candidate for export. While conventional nuclear reactors are becoming more and more difficult to license and expensive to build, SRF technology development is on a steep learning curve and the simplicity implied by subcritical operation will lead to reductions in costs from regulatory hurdles and construction complexity. We describe the design and discuss the prospects of funding a pilot plant for the profitable disposition of surplus weapons-grade plutonium as was proposed by a consortium of US companies, national laboratories, and universities.

[1] C.D. Bowman, R.B. Vogelaar Edward G. Bilpuch, Calvin R. Howell, Anton P. Tonchev, Werner Tornow, R.L. Walter, "GEM*STAR: The Alternative Reactor Technology Comprising Graphite, Molten Salt, and Accelerators", Handbook of Nuclear Engineering, DOI 10.1007/978-0-387-98149-9_24, Springer Science and Business Media LLC, 2010.

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