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Z-PINCH INERTIAL FUSION ENERGY*

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The long-range goal of the Z-Pinch IFE program is to produce an economically-attractive power plant using high-yield z-pinch-driven targets (~3GJ) with low rep-rate per chamber (~0.1 Hz). The present mainline choice for a Z-Pinch IFE power plant uses an LTD (Linear Transformer Driver) repetitive pulsed power driver, a Recyclable Transmission Line (RTL), a dynamic hohlraum z-pinch-driven target, and a thick-liquid wall chamber. The RTL connects the pulsed power driver directly to the z-pinch-driven target, and is made from a material that is easily separable from the coolant (such as carbon steel). The RTL is destroyed by the fusion explosion, but the RTL materials are recycled, and a new RTL is inserted on each shot. A development path for Z-Pinch IFE has been created that complements and leverages the DOE NNSA DP Z-Pinch ICF program. A collaboration of 19 institutions, funded by a U.S. Congressional initiative of $4M for FY05 through NNSA DP, is supporting research on Z-Pinch IFE in six areas:

(1) *RTLs:* includes optimizing/testing the structural design of RTLs; extensive study of power flow at linear current densities of 0.1 MA/cm to 5 MA/cm (magnetic insulation, plasma motion in gap, magnetic field diffusion, electrode motion, ion effects, etc.).

(2) *Repetitive LTD pulsed power drivers:* includes development of LTD architectures for Z-IFE; design/assembly of LTD cavities for 1 MA, 0.1 MV, 100 ns (the fourth cavity is under construction); research and testing of long-lifetime repetitive switches.

(3) *Shock mitigation [because of the high yield targets]:* includes experiments (shock tube, explosives) with shocked liquids, foamed liquids, and foamed metals; simulations with a variety of codes to study shocked liquids, foamed liquids, and foamed metals.

(4) *Planning for an automated proof-of-principle experiment (Z-PoP):* includes design of repetitive vacuum/electrical connections to the RTL; design of ten-cavity LTD module at 1 MV; coupling of two modules to an RTL to study magnetic null electron losses; overhead automation for the RTLs at 0.1 Hz.

(5) *IFE target studies for multi-GJ yield targets:* includes simulations of Z-IFE targets that show yields above 3 GJ with gains of the order of 100; threat spectra produced by Z-IFE targets; studies of directed venting for Z-IFE targets.

(6) *Z-Pinch IFE power plant engineering and technology development:* includes chamber design and neutronics studies of activation of RTL, coolant, and structural wall; RTL manufacturing; waste stream analysis; heat cycle; target and wire array fabrication.

Recent results in all areas, and an updated Z-IFE Road Map, will be discussed.

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