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PD/P8-03: Concept Design of Z-Pinch Pulsed Power Driver for IFE

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Based on volume ignition idea and innovative design of ignition target, which adapt to process of Z-pinch, a new fusion-fission hybrid reactor concept design was advanced by academician Peng of CAEP. Compares with pure-fission approach, the demands of pulsed power driver can reduce significantly for that, Z-pinch ICF is used only for high energy neutron source and main energy is exported in outer subcritical blanket. To fulfill the above demands, a 1000 TW level Z-pinch pulsed power driver is needed to work continuously about one year with repetitive frequency of about 0.1 Hz, and the driver should have favorable security, economy and maintainability. The paper developed a new concept design of Z-IFE driver, which compose of LTD module, water transmission line, double vacuum insulation supports with vacuum isolation section between them, coaxial MITL and junction station. Proper separate time between LTD modules and inductive imploding load is provided by water transmission line with appropriate length. Double vacuum insulation supports are far from target so that the influence of the radiations to insulation material could be reduced. The radioactive substance such as tritium can be isolated effectively by vacuum isolation section, so the driver could have better working security. The driver includes 40 identical branches, and each branch composes of 50 stacked LTD modules. There are 2000 LTD modules totally that include 12.8×10^4 capacitors and 6.4×10^4 electrically triggered gas switches. The driver stores 52 MJ energy at ± 90 kV charge voltage. The circuit simulation results show that, current up to 68 MA with 207 ns rise time (0%-100%) can be achieved at a static inductive load of 10 nH, and 58.3 MA with about 200 ns imploding time can be achieved at a wire array load with length of 2 cm, height of 1 cm and total mass of 80 mg, and 6.7 MJ imploding kinetic energy is obtained. At the end of the paper, some key points about repetitive working of this concept design are discussed briefly.

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