

MODELING SHRAPNEL FORMATION IN A Z-PINCH POWER PLANT*

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The mainline z-pinch IFE power plant design has a recyclable transmission line (RTL) that drives a fusion capsule with output energy in the range of about 3 GJ. The deposition of this energy will result in the RTL close to the target being transformed to high temperature plasma. The RTL farther away from the fusion capsule will be converted to liquid and shrapnel. The shrapnel is composed of droplets, aerosols, liquid, and solid metal.

We are using continuum theory and molecular dynamics calculations to determine and quantify the shrapnel production as a result of shocks with different impact velocities. This study is being a comprehensive investigation of parameters, such as system size, inter-atomic potential, and time scales involved. The study will also focus on the essential issue of the defect content in the RTL material. For example, we are investigating if shrapnel production can be controlled, or partially manipulated, by introducing or eliminating particular disorder in the crystalline structure. We will relate this study to the typical composition of RTL material to see if more ductile or brittle material can be realistically engineered to prevent harmful disintegration of the RTL. We are developing scaling laws that show where the target and RTL are turned into plasma, droplets, aerosols, liquid, and solid metal. We are also evaluating the effects of post-shot EMP, plasma, droplets, and shrapnel up the RTL.

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