

Tucker Leavitt

*Liberating Energy from Water? Investigating Anomalous Water Arc Explosions*

This project is an investigation into the phenomenon of “water arc explosions,” in which an electrical arc is used to trigger the violent expansion of a small amount of water. Prior research has shown that firing a high-current pulse (on the order of several kiloamps) through liquid water releases electrochemical energy stored within the water. This manifests as kinetic energy and results in a veritable explosion, tearing the water apart into tiny fog droplets. Amazingly, empirical measurements have shown that the kinetic energy of the explosions can exceed the electrical energy of the pulses that initiate them. Neither the source of the explosions’ energy nor the mechanism by which it is released is well understood.

The purpose of this project was to verify that a water explosion’s kinetic output energy can exceed its electrical input energy and to determine the nature and source of the energy released during the explosion process. Water explosions were created by discharging a high-voltage capacitor bank through 3-8 mL of water. The explosions’ energies were measured by using them to launch a projectile into the air and extrapolating the explosion’s average velocity from the height to which the projectile ascended. It was found that water explosions can in fact have efficiencies of greater than unity and that the energy released during the explosions is likely due to the discrepancy between the heat capacities of bulk water and fog. These results allude to the possibility of harnessing water explosions to perform useful work.