Mixing Electricity and Water

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SLAC physicist Andrew Fisher holds a section of heavy copper winding used as a conductor in electromagnets, hollowed out to carry low conductivity cooling water.

Every hair dryer in America is tagged with a large warning label not to use it near water for one obvious reason: mixing the two could result in electrocution and even death. But did you know that it is not actually the water that presents the threat?

Water in its purest form is not conductive. Instead, it is the impurities in the water—salts, dust, and so on—that enables it to conduct electricity.

In fact, low conductivity water (LCW)—which is purified and deionized—has been used for decades to cool high-voltage equipment such as magnets and klystrons.

LCW commonly flows through accelerator magnets to cool them. These rectangular, copper or aluminum wires measure up to two inches per side and are coiled in various arrangements to produce magnetic fields of different shapes and strengths. A hole in these copper wires carries LCW to remove heat generated by the electric currents.

"SLAC makes a lot of hot water," said SLAC electrical engineer Martin Berndt, who has designed magnets and power supplies that use LCW at SLAC for over 30 years. "It is a great way of removing heat from high-power electrical devices."

The PEP ring, the SSRL ring and various beam transport lines contain many magnets that use LCW. Unlike hair dryers, the concern with mixing water and electricity in the magnets is not electrocution, but corrosion. Lowering the water's conductivity effectively minimizes this corrosiveness.

Without LCW, the magnets would slowly be eaten away from the inside out and engineers would have to find another way to dissipate as much as 30 megawatts—16,000 hair dryers worth—of power every day.

Source: by Ken Kingery, SLAC Today