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Electric Shock Drowning and Electrocution Prevention

By Steve D'Antonio

Contrary to popular belief, water isn't a good electrical conductor but it's good enough, and the results are almost always undesirable. Your body is mostly (salty) water, making it possible for electricity to travel through you, sometimes with more ease than it travels though the water in which you may be swimming. Because of this, swimming in water exposed to electrical currents can have tragic consequences. With comparatively little current flow, a swimmer's voluntary muscle reflexes can be paralyzed, causing him or her to drown, which only serves to mask the underlying electrically-related cause of death. This dangerous condition is most often found around boats or docks with faulty wiring, which are plugged into shore power, or other shore power devices, such as electric boatlifts.

More recently, on April 20, 2017, 34-year-old Shelly Darling and 41-year-old Elizabeth Whipple were electrocuted while swimming in Alabama's Lake Tuscaloosa. Then, in June 2017, five more people were killed at a water park in Turkey. While not all were related to marina or boating activities, there were 13 electric shock drowning cases in the U.S. in 2017.

Each year deaths such as these, involving in water electrocution or electric shock drowning (ESD), take place and each year a cry goes out within the marine industry to educate boat owners, marina managers, marine electricians and swimmers about the dangers associated with electrical current leakage into water. If you are not familiar with electric shock drowning, now is the time to learn how to avoid these potentially disastrous scenarios yourself.

It Happens Every Year

In 2012 three unrelated cases of drowning by electrocution occurred over the Independence Day holiday, tragically resulting in the deaths of four children–siblings Brayden and Alexandra Anderson (8 and 13, respectively), Noah Winstead (age 10) and Nathan Lynam (age 11)–plus one adult, 26-year-old Jennifer Lankford. All of these events occurred on lakes, one in Tennessee and the two in Missouri. Additionally, 15-year-old Carmen Johnson drowned after being electrocuted at her family's boat dock on Smith Lake, AL, on April 16, 2016.

ELCI: Whole Boat GFCI

You would be hard-pressed to find an adult who is unfamiliar with the ubiquitous Ground Fault Circuit Interrupter or GFCI receptacle. Found in household kitchens, bathrooms, patios and garages, among other locations, GFCIs are also recommend by the ABYC (American Boat and Yacht Council) for use in heads, galleys, engineering spaces and on the weather decks of boats, and they have no doubt saved countless lives since their introduction in the late 1960s. Requirements for GFCIs have

been part of the National Electric Code for over 50 years, with the first mandate being inspired by electrocutions caused by underwater lighting used in swimming pools.

While GFCIs are fairly well understood, there is another shore power safety device that was only introduced to the marine market within the last decade that's also worthy of attention. Known as an Equipment Leakage Circuit Interrupter or ELCI (and sometimes referred to as a Residual Current Device or RCD), it offers yet another level of protection from shore power faults, fire and electrocution or ESD. Much like a common GFCI receptacle, which has a comparatively low trip threshold of 5 milliamps and represents "local" point of use protection, ELCIs remain in a state of equilibrium, allowing energy to flow as long as the current on the hot and neutral wires–the two current-carrying conductors found in most AC electrical circuits–remains the same. As soon as current finds an alternative path back to its source through a green safety ground wire, the water or a human, the imbalance trips the ELCI's circuit breaker at a 30 milliamp threshold, and the power is turned off nearly instantly, often within 30 to 70 milliseconds. (Note that contrary to popular belief, electricity does not seek ground but rather seeks to return to its origin, often through the water on its way back to a transformer at the head of a dock.)

In addition to the trip threshold, the primary difference between the ELCI and its cousin the GFCI is the location in which it is installed. GFCI receptacles are installed where power is to be used, such as in the galley or head, while ELCIs are installed where power enters the vessel, near the shore power receptacle. Think of an ELCI as a "whole boat" GFCI with some modifications. While technically deemed "equipment protection" because of their comparatively high 30-milliamps trip threshold, the goal of ELCIs is to interrupt current flow quickly enough to prevent electrocution, electric shock drowning or fire, and for the most part they do so very effectively.

A primary shore power circuit breaker is already required for every onboard shore power inlet, and in the case of an ELCI, it is often installed either in conjunction with this breaker or as a single combined unit, achieving the goals of over current protection and fault protection. It's important to note that the presence of an ELCI does not negate the need for individual GFCIs; both are still required for ABYC compliance.

The ELCI got off to a rocky start when they were first introduced to the ABYC Standards and the marine industry in 2008. As is often the case, the intent preceded the hardware and, as a result, the implementation was postponed for a couple of years. Now, however, proprietary marine ELCI circuit breakers are readily available from several manufacturers in a range of configurations. With few exceptions, new vessels that are built or those that are being refit to ABYC (or European CE and other) Standards must be equipped with ELCIs, and with good reason; they save lives by preventing electrocution, ESD and fires. An ELCI can be added to virtually any vessel's shore power system provided it is free of faults.

Dockside Protection

In a growing trend, some marinas have taken on the responsibility of equipping their docks with GFPs (ground fault protectors, essentially a dockside GFCI), further reducing the likelihood of electrocution and ESD. As worthy as the effort is, due to the language used to define the code that governs these installations, frequent tripping has become commonplace in many of those marinas, which is understandably frustrating for boat owners. It's impossible to determine without carrying out an evaluation of the vessel's electrical system if these trips are the result of a genuine and potentially life-threatening fault or simply the result of either the aggregation of small, otherwise non-threatening faults or even overly sensitive equipment.

One solution to this problem involves the installation of a shore power transformer, also known as an isolation or polarization transformer. Electrically, transformers behave as if they are a source of power and because electricity always seeks to return to its source, faults travel to it instead of through the water, thereby preventing dockside GFPs from tripping. Those considering the installation of a transformer, however, must keep in mind that it can also mask a genuine underlying problem. Transformers should be installed only after the vessel's electrical system has been deemed safe and ABYC-compliant. While you are at it, the only thing better than a shore power transformer is a shore power boosting transformer–one that will correct otherwise low dockside voltage, protecting voltage-sensitive appliances such as refrigerators and air-conditioning systems.

Fresh or Salt, Does it Matter?

While it's true that virtually all documented Electric Shock Drowning cases have occurred in fresh water, the risk of swimming around docks and boats that are energized with shore power in either salt or fresh water remains high. Some erroneously say, "It can't happen in salt water," but there are several reasons this theory represents dangerous folly. One, it's impossible to determine the salinity level of a body of water before jumping in to cool off. In estuarial waters such as the ones on the Chesapeake Bay, for example, salinity changes seasonally and even daily after heavy rains. Two, it's impossible to rule out the potential for ESD or electrocution in seawater provided the current flow is high enough. So what if a vessel has an ELCI or a dock has a GFP or leakage warning system? Because faults occur in a split second–one minute the water is safe, and in the blink of an eye it's deadly–there are no exceptions. Unless you can walk on water, you can't count on being able to get out of harm's way quickly enough. Also, as effective as ELCIs, GFPs and GFCIs are, they are not foolproof.

You might ask, "What about divers?" You see them in the water in marinas all the time. Whenever I encounter a diver on a dock, which is fairly often, I make it a point of asking, "Do you ever get shocked or feel a tingle?" Without exception, every diver has said "yes" and a few have told me they can feel electricity coursing through their dental fillings! A dry suit (and even a wetsuit) does offer some protection against electrocution and ESD and most divers do their work in salt water, which to an extent mitigates the effects of current flow (Ideally, divers should depower the vessels they are cleaning). But they do this work at their own risk, hopefully knowing the hazards, which is a far different scenario from a child frolicking in the water on a seemingly carefree summer day. Simply put, never swim around docks equipped with shore power in fresh or salt water. Again, there are no exceptions to this rule.

Why ABYC Compliance and Certification Matters

It comes as a surprise to many boat owners to learn that no federal or state body governs the electrical systems aboard diesel-powered recreational boats. (Gasoline-powered vessels are subject to the *Code of Federal Regulations* for their electrical systems, however, compliance inspections are not mandated.) With few exceptions, boat builders, boat yards, marine electricians and do-it-yourselfers in the U.S. are under no mandate to follow specific electrical design or installation guidelines, and no license or certification is needed to be a marine electrician. Anyone–regardless of experience or training–can hang out a "Marine Electrician" shingle and begin installing or repairing marine electrical systems.

The ABYC publishes a phone book-like tome, the "Standards and Technical Information Reports for Small Craft," which includes several chapters dedicated specifically to marine electrical installations. As noted, these Standards are purely voluntary where many recreational craft are concerned. Keep this in mind as you choose an electrician to work on your boat.

Only those who are members of ABYC (and preferably possess an Electrical Certification) and agree to comply with the relevant published Standards should be entrusted to work on your vessel's electrical system.

Steve D'Antonio is a marine systems consultant offering services to boat buyers, owners and the marine industry, as well as an author and photographer. He is an ABYC-Certified Master Technician. Read more from Steve at stevedmarine.com.

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