

This article appeared in our ABYC News in the Summer 2005 edition. We feel it is so important that we wanted to make sure it was read by more than just our members.

As the 2005 swimming season moves into the peak summer months, ABYC News wants to remind our members of the danger of swimming in marinas. The following account was written by ABYC member, Kevin Ritz of Scappose OR, whose son Lucas was killed in a tragic accident 6 years ago.

The solution offered by Kevin is easy, inexpensive and effective. Please remember Lucas' story as you sell, survey, repair, etc. boats and/or operate marinas. Boating is a wonderful activity and growing ever safer due to the diligence of the industry, in other words because of the care and concern of people like the ABYC members.

Saturday, May 20, 2000

Following is a summary of the facts surrounding my son's electrocution and my findings from the subsequent research that brings us to where we are today.

First, you should know that this type of accident has happened before and will happen again unless something is done to stop it.

The Accident:

On August 1st 1999, my eight-year-old son Lucas N. Ritz was killed while swimming in the marina where we live. It was a hot summer day and the kids had worked and played hard. Other kids were already swimming, so Ian, our other son, and Lucas asked to swim with their friends. All of the kids were under close adult supervision and Lucas was wearing a Type II PFD life jacket. Swimming in the cove was a common practice by adults as well as kids.

As the kids were floating down on the inside of the dock on an inner tube, Lucas moved away from the others and towards his mother, Sheryl, who was walking along the dock keeping in time with the kids. As he approached the dock to get out of the water, witnesses said that he let out a loud gasp and immediately rolled onto his back, apparently unconscious. His life jacket functioned perfectly and his face never was in the water. Sheryl yelled to the other kids to help him and jumped in herself. As the kids approached Lucas, they felt a slight tingle and immediately backed off. Sheryl's extremities went numb upon hitting the water and she had difficulty even moving. She felt at the time that it must be from fear and had no clue as to the real culprit. Sheryl was able to pull our son to the

dockside where others assisted in getting him out of the water and onto the dock. I arrived moments later after hearing some commotion and, along with another onlooker, started CPR. We continued CPR until the paramedics took over approximately 15 to 20 minutes later. Lucas was pronounced dead at 6:30pm at Emanuel Hospital.

Investigation

The first assumption by many was that he had drowned. But we could not understand how, as his face never was in the water. He had the best life jacket money could buy; the type that keeps your face out of the water even if you are unconscious. He was pulled out of the water only moments after rolling onto his back and CPR was started immediately. At no time during CPR could we detect a heartbeat and his color was good. Neither of these observations would indicate drowning. It was not until the next morning that I was really able to start asking questions of Sheryl and Ian. As Sheryl was telling me what had happened, she said to me that she had never been so fearful in her life as to have her extremities tingle and go numb to the point that she could hardly move. As she said this, Ian related to me for the first time that he also felt a tingling. Upon hearing this it was clear to me that somehow, some way, AC electricity was in the water. I first called the County coroner's office and told them that if they were not already going to do an autopsy, I was requesting that one be done because I was very suspicious that Lucas had been electrocuted and had not drowned. They argued with me that there were no burns on his body and that therefore my theory could not be correct. I argued back that Lucas was completely submerged in an electrolytic solution, therefore eliminating the resistance of the skin (burns are caused by the resistance of the skin and because of his almost total emersion the resistance would not be there.) The office reported that they would not even know how to test for something like that. I told them that I did and that I was going to test the water in the area. I then called the local Sheriff's Department and left a message telling them of my suspicion. I went to the area with my digital voltmeter and put the negative lead to a good ground and dropped the positive lead into the water. I immediately got AC voltage confirming my suspicion. I then called the Sheriff's Department again and reported what I had found and that I wanted to get an electrician out to test this. The Sheriff's Department agreed to send out some deputies. I then called in a professional electrician. He arrived later that morning with equipment and started testing. The electricity was traced to a power boat.

More investigations and investigators followed. More deputies were called, the local utility company sent a team, the owner and manager of the marina, and all became involved in determining the source of the current. After further investigation it was found that a 12V wire was lying

on top of an AC wire and had gotten hot to the point of melting its own insulation and that of the hot (Black) AC wire.

AC wiring with melted 12v on top

This put 120V AC into the entire ground system of the boat. Every conductive part in the boat connected to the ground was energized with 120V AC. This included the engines and out drives. The out drives and propellers were emitting the bulk of the AC into the surrounding water. Fresh water is not a good conductor, therefore the AC was unable to reach ground and potentially short and trip the breaker. As Lucas approached the finger of the dock to get out of the water he passed into the field of AC and for a brief moment completed the circuit to ground, thus electrocuting him to death. The human body is a much better conductor than fresh water because of the high salinity.

Research

At first we thought that this was just a freak accident that had not happened before and probably would not happen again. While talking further to the electrician, he noted that had the 120V AC ground wire been bonded to the metal components on the boat (i.e. the negative side of the battery) the energizing of the 12V DC system with the 120V AC would have tripped off the shore power breaker. If a Ground Fault Circuit Interrupter (GFCI) breaker had been installed ahead of the boat's shore power, 10ma of current would have tripped it off. The bottom line was that if the boat had been properly wired or a GFCI placed ahead of the shore power cord, we would have our son today. This started my asking questions as to why GFCI's were not required. In every other place in this country, where you have this deadly combination of AC and water, it is required. Why is it not in this situation? After asking around a little, I was told that GFCI's would never work in this situation because the moisture content around marinas was too high. But this did not make much sense to me since GFCI's are always placed in damp places such as bathrooms, kitchens, hot tubs, etc. We decided to do some testing of our own. At this point I decided that I must do something so that another family does not have to go through what we have and continue to go through on a daily basis. First, we installed a 30 amp GFCI/Breaker Thomas & Betts #GFB130 into the breaker box ahead of the shore power cord of our boat. A \$30.00 part. We then duplicated electrically what had happened the day that Lucas died. The results were clear! The GFCI tripped in a millisecond, as it would have when the AC problem first developed on the power boat. We left the GFCI in to see if we would, over the next few months, develop problems and have nuisance trips. To date we have had no failures or nuisance trips but we did have a real trip and the problem was traced to a hot water heater element (see photo). The GFCI worked

perfectly. In the mean time, I started looking for information on any other similar deaths and found two articles in respected marine publication. In these articles I found this type of electrocution has happened before at least twice per season and that possibly many more have occurred, but were called drowning without ever finding the real cause. After reading these, I became more convinced than ever that something had to be done. The other point that became clear was that marinas are not safe places to swim. Had Sheryl or I ever heard of such a possibility, our kids never would have been allowed to swim in or around a marina. In researching this further, I have found that it has been a standard practice for most marinas to not allow swimming and to have signage indicating this. Our marina had no such signage.

Postscript: It is important to give a follow up on the GFCI issue. They are still in place today and working great. This is an important piece of information given that some felt that the GFCI's would never work in a marina. Too may false trips they said. Well that is just not true. New boats have come to the marina and plugged into the system and tripped the GFCI. But in every case there has been a real electrical issue on board. To date I have heard of no false trips. I truly believe that having GFCI's in place in fresh water marinas, backed up with the knowledge of this issue will save lives.

Kevin Ritz, May 12, 2005

Sidebars

The Lucas Ritz story has touched many hearts within the ABYC community, and to that end we asked several of our members that stay extremely close to the issues surrounding Lucas' (and others) untimely death to comment on Kevin's article. Their reactions follow:

From **Captain Dave Rifkin (USN, RET.)**, one of ABYC's Corrosion Certification instructors and the owner of Quality Marine Services in Jacksonville, Florida.....

'First, my heartfelt condolences to the Ritz family. This tragedy, and many others like it, demonstrates that it commonly requires two faults to send a potentially lethal current into the water. First, there must be an electrical fault to ground in a system or piece of equipment on the boat. Second, there must be a disruption of the ground path back to the source (which includes the ABYC required AC to DC ground connection which was missing in this case). The integrity of this path back to ground is essential if it is to perform its intended function of causing the actuation of a circuit

protection device to cut off power to the faulted component. The occurrence of the requisite two faults is clear in the Ritz case.

Due diligence to the published industry standards such as NFPA 303, Fire Protection Standard for Marinas and Boatyards, and ABYC E-11 is mandatory for maintaining a safe environment for personnel in the marine environment. I salute Kevin Ritz for his work since the tragedy in promoting this issue. He has since become an ABYC Certified Electrician, and works passionately with local emergency agencies in advancing the awareness and education of first responders and the public. We are standing by to assist him in his efforts and welcome the opportunity to present information on this topic to marine professionals and the public.”

From **Jim Shafer, AMS**, Harbor Marine, Inc., Stuart, FL:

“My sympathies to the Ritz family. About four years ago I became involved in electric shock injuries in fresh water marinas, and have since compiled a list of forty one incidents, including 38 fatalities. Since then I have written articles for marine trade publications and made presentations to marina operators on the lethal conditions that may exist near a shore powered boat. The word is finally getting out. The list and articles may be obtained with a note to me at kp2r@bellsouth.net

If the AC / DC grounding system, as required by ABYC and NEC, is intact and functioning, a high level ground fault will trip a breaker, or a low level fault will be prevented from causing a voltage to appear on underwater metal gear. Because the body is the conductor of choice in fresh water, even a small amount of current leakage can be fatal; paralysis at 10-15 mA, ventricular fibrillation at 50 mA.

Ground fault monitoring for low level leakage looks like a possible solution to this problem, and several systems are being evaluated at this time.

Swimming in marinas with shore power can be lethal.....please spread the word.”

Charlie Game, EC Game Engineering, Asheboro, NC, responds:

“The Lucas Ritz story is all too familiar to those of us who investigate such occurrences. The “common denominator” in this type of accident is a wiring problem on the boat that introduces 120 volts AC into the boat’s DC system. This, coupled with a problem of an inadequate (or nonexistent) circuit back to the dock’s grounding system, will predictably set up a potential gradient (voltage field) around the boat when in fresh water. The results are then as Mr. Ritz reports.

As he also observes, swimming is prohibited in most marinas for this reason, (as well as from the danger of propeller strikes). When a marina permits swimming around the docks, it is not following widely accepted safety practices.

The subject of ground fault circuit interrupters (GFCI's) on dock outlets is too lengthy to discuss here. However, one should be aware that the National Electrical Code specifically does not require them on locking and grounding (twist lock) receptacles of 30 amperes or more supplying power to boats. There are good electrical reasons for this.

There is an effort underway by many marine industry organizations along with the US Coast Guard to make the public more aware of the potential hazards associated with the use of AC electricity in the boating environment. The National Marine Manufacturer's Association has an informative pamphlet on the subject. Contact Robert Newsome (NMMA) at 312-946-6275 or go to NMMA's publications website at: www.nmma.org/certification/publications/brochures.asp to obtain a copy."

Ed Sherman, ABYC's senior instructor responds:

I first met Kevin Ritz about 18 months ago at a seminar I was conducting in San Francisco. His story sent a chill through my spine. All I could think of was how I would feel if something like what happened to him and his family happened to me. My own son Mason is the same age as Lucas. Although I've always been aware of the dangers and issues described by Dave, Jim and Charlie, it's something that doesn't really hit home until its staring straight in the face.

Since then, I've made a concerted effort to add emphasis to the issues surrounding this type of case in all of the ABYC electrical course work. It's a complicated topic and one where continual education of service and installation personnel as well as marina owner's and boaters needs to be on going.

My view on this is somewhat different than others in that I feel we as an industry could do more to ensure that this potential problem is mitigated. I think I've made my position quite clear in an article, "Grounding Revisted," I wrote for *Professional Boatbuilder Magazine* and published in their April/May 2005 issue. I encourage everyone in the industry to give it a read. It helps to explain this specific case, and some of the highly technical issues Charlie alludes to above. It's curious to me that the United States is one of the only countries in the world that does not require the use of residual current breaker devices in and around boats and the water. Are we right and the rest of the world wrong? In this instance I feel we are wrong. Read the *ProBoat* article and see why.