

What's the marina's responsibility in providing power to boats

Steps to prevent injuries and damages to personal property

BY JIM SHAFER

Boats mooring in a marina and connecting to shore power present a unique electrical safety hazard – one that is often not well understood by either the marina staff or the boat owner. Prompted by the announcement of a recent and rather substantial settlement against a marina (due to an electric shock drowning caused by faulty wiring on a moored boat), Harbor Marine Consultants, Inc., re-examined its file of marina electrical accidents accumulated over the last eight years.

The following paragraphs analyze the results of these marine electrical accidents in an attempt to better define the marina's responsibility, including both the inherent [moral] obligation as a business and the implied obligation coming from the marina electrical safety standard, NFPA-303-2006. The article then describes specific actions that marinas can take to prevent accidents and reduce marina liability. In undertaking these actions, marinas not only can virtually eliminate the two main causes of electrical accidents but also can initiate a proactive stance that greatly reduces liability, should "Murphy's Law" sabotage the marina's best efforts.

The inconspicuous problem

Electric power quietly and unobtrusively provides comfort and services to marina customers, marina staff, and boat owners. They might not be able to recognize the symptoms of a serious potential problem until it is too late to prevent injury or property damage. This is certainly the case in the more than 100 accidents and 40 fatalities that this Harbor Marine Consultants has examined over the years.

Analysis of marina electrical accidents indicates that there are two common elements in every incident. The first element is defined as a "ground fault,"



Marinas can use a newly developed technique, Mk-3 Bonding Test, to determine the integrity of the deck and boat-bonding system.

that is, a short circuit, wherein the insulation has failed on the energized (hot) conductor, thereby allowing it to come in contact with a bonded (grounded) metal chassis or component on the boat or dock. The second element, and the more critical one, is defined as a failure of the bonding connection between the shore ground and this component, which then allows the surface potential (voltage) to rise to dangerous or lethal levels.

To understand what this means, let's use the analogy of automobiles. No matter how well everyone takes care of their cars, the possibility exists that a tire or steering failure could occur at 70 mph on the freeway and would most likely result in a serious accident. It is also well known that seatbelts play no part in the mileage or performance of the car, yet they are the key factors in preventing personal injury as the car slides toward the guardrail out of control.

In a marina electrical system and on a boat, the bonding [grounding] conductor

is the "seat belt," and it plays no part in the normal operation of the electrical system. Although a fault may occur because of an insulation failure in some appliance, the bonding conductor saves the day by opening a circuit breaker, preventing a voltage rise to lethal levels.

The reason why a greater number of dangerous incidents do not occur at marinas is because the statistical unlikelihood that both of the key elements will fail at the same time. When they do fail together, however, the result can be a serious accident.

Most electrical fires are caused by ground faults that did not trip circuit breakers. It has been stated that less than 30 percent of ground faults trip a circuit breaker because the fault current level is too low. This reality is why many fires and injuries occur at marinas.

Root causes

Keeping electricity contained in its insulated conductors while it goes about its tasks is an uphill battle. In the tough marine environment, there is vibration,



The ground fault monitor pictured here is used to monitor multiple connected boats from a central location.

water intrusion, mechanical damage, insulation aging, and sometimes poor workmanship. Because marinas cannot rely on circuit breakers to halt “undetected ground faults,” that is, low-level insulation failures, these may occur at any time without warning.

Because undetected insulation failures are serious and the cause of well documented problems at marinas, the electrical standards (both onshore and for boats) require that every metal component that is likely to become energized should be bonded back to the source. The “seat belt” must always be in place, and there are no exceptions, which includes interconnection to the boat’s DC bonding system.

Although the other factors previously mentioned in this article may contribute to the faulty bonding problem, the most common cause is poor workmanship and just plain ignorance, as the list of fatalities and actual observations at marinas shows. Fortunately, once a bonding system is properly installed, it is the least likely system component to fail. (For more technical descriptions and diagrams on how the bonding system functions, please e-mail the author.)

Solution

Analysis of 100 electrical accidents at marinas shows that it would have been possible to prevent nearly all of the accidents from occurring if either one of the two key elements had not been a factor, particularly the lack of adequate bonding. Moreover, non-technical personnel from the marinas, that is, dock hands and others, can easily deal with these two elements without the involvement of the boat owner and prevent marina electrical accidents.

So what should marinas do to virtually eliminate marina electrical accidents that can cause damage to property and people? Here are some of the recommended methods and actions that marinas can and should undertake to prevent electrical ground fault accidents:

- Visually inspect all electrical cords and outlets for any discrepancies listed in NFPA-303-2006.
- Install a ground fault circuit interrupter (GFCI) on a boat or pedestal.
- Install a ground fault detection system.
- Determine the integrity of the bond-



One thing all marina personnel can do to prevent marina electrical accidents is to visually inspect all electrical cords and outlets for any discrepancies listed in NFPA-303-2006.



Marinas should install a ground fault detection system to prevent electrical ground fault accidents.

ing system and repair as needed.

- Continuously monitor for ground faults.
- Attend the Marina Electrical Safety Seminars to keep abreast of the latest advancements.
- Designate a swimming area with no electrical service.

A review of these items shows that they range from simple and inexpensive to more complex and more effective. Using any combination of them will be effective in greatly reducing accidents and liability.

Although this article refers to some sections of NFPA-303-2006 that are not considered mandatory, marinas should not be lulled into the belief that they do not have to be considered. This standard describes “best practices” that were authored by knowledgeable people in the industry and addresses issues that are known causes of injury and property damage. Ignoring these sections is really not an option.

Implementation

Here’s how to implement the recommended actions.

One simple thing marinas can do is become familiar with the demands of NFPA-303-2006, Sec 5.20—Maintenance of Electrical Wiring and Equipment. This section states that shore cord splices, cords without proper weather sealing, and those repaired with electrical tape are not permitted. Marinas can easily recognize these and other discrepancies with routine visual inspections. If this code section had been properly followed, at least four fatalities on Harbor Marine Consultant’s list would have been prevented.

In a few freshwater marinas, the marina operators have successfully installed GFCI’s (ground fault circuit interrupter, class A – trips at 5 ma) on the dock pedestal’s twist lock receptacle. Although not mandatory, the GFCI has a rather low trip level that is designed for single branch circuits and may be subject to nuisance trips because of the multiple branch circuits on a boat. The GFCI will detect ground faults but is probably not a practical option in many situations.

Because an AC fault on a boat will result in some “water path” current, clamping on the shore cord with a sensitive AC ammeter will disclose a ground fault. This test does have some limitations and is only a “snapshot-in-time.” However it works quite well, and marinas have found some serious conditions when using this method. Moreover, non-technical personnel can easily accomplish this task from the dock.

The next level of fault detection is to establish continuous ground fault monitoring of multiple connected boats from a central location and make sure it is on duty around the clock. It has been a very effective tool to find faults in both the

marina and the boat wiring. It does require some capital investment, but it is listed in the NFPA-303-2006, section A5.18.2., and non-technical personnel can use it. This continuous monitoring is probably the most effective tool marinas can use to find undetected ground faults that may lead to both fires and injury.

Another thing non-technical personnel can accomplish from the dock is to determine the integrity of the dock and the boat bonding system (as required in NFPA-303-2006 section 5.20.2). In just a few minutes using a newly developed technique (MK-3[®] Bonding Test), marina personnel can determine the condition of this most important key element that would have prevented virtually all of the listed boat-related fatalities.

Marinas looking for a cost-effective and very important tool for educating both technical and non-technical personnel about marina electrical safety should consider attending the Marina Electrical Safety Seminar. It provides a comprehensive classroom and dockside introduction to the actions listed above. It has been presented to nearly 200 marinas and has been very well received by both managerial and service personnel.

Finally one of the simplest and least expensive actions marinas can take to promote electrical safety is to designate a swimming area in the marina that is at least 50 feet from any connected boat, or better yet, in an area that does not have any power service. This has been done by some marinas, especially in freshwater but does not solve the problem of individuals accidentally falling into the water from the dock or a boat, and it must be enforced.

Marina responsibility

To understand the marina's responsibility for providing marina electrical safety to boats and boaters, it is important to recognize its inherent and moral obligations.

When an electric utility prepares to connect power to a facility onshore that is new or has undergone renovation, it will want to see a third party sign-off. The utility must have assurance that the building is safe to receive power. This seems to make good sense, prevents injury, and seems to clearly be the responsibility of the provider to take this precaution—a common law concept used

in the referenced case. But most marinas do not follow this logic when, for example, a boat pulls into a dock, and the shore power cord is connected (sometimes by the marina staff) without any hesitation and without any consideration of whether the vessel can safely accept the power. Based on the cited case (a summary of which is available by request), along with others, this common practice has led to incidents of personal injury and subsequent litigation.

Although the previously cited actions may help give the marina the ability to meet its responsibility to reduce risks and provide a safe environment for its customers, it is just a beginning. Every marina should have a copy of NFPA-303-2006 and become familiar with the electrical sections.

Conclusion

Under a yearlong grant from the U.S. Coast Guard, the author was involved in a study to determine, as far as possible, the nature of the faults and the current levels involved in fatalities. Based on this study, the grant conclusion recommended to the American Boating and

Yachting Council (ABYC) that it incorporate a GFCI-type of device at the boat's power panel and set it at a trip level that will help prevent injury and yet not be troublesome.

At press deadline, the most recent change to the ABYC standards now has a requirement for such a device. Although implementation on new boats must occur by July 2009, it is yet to be seen if existing installations will be upgraded anytime soon. On the other hand, marinas may implement the suggestions made in this article here and now. ↓

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