Association of Marina Industries

December 15, 2017

National Fire Protection Agency Standards Council
1 Batterymarch Park
Quincy, MA 02169-7471

Re: AMI Comment submission re ***Tentative Interim Agreement 1348 (TIA 1348)***

The Association of Marina Industries (AMI) desires to be an industry leader in the area of minimizing the dangers in marinas due to Electric Shock Drowning (ESD). AMI addresses the ground-fault application in marinas as a positive step toward mitigating the effects of ESD. AMI membership also strives to ensure that the language in Federal guidelines such as the National Electric Code (NFPA 70) provides realistic operational and functional parameters in order to manage a safe and efficient marina. At this time, AMI does not agree with the language proposed in TIA 1348(2). This TIA does not address or resolve the shore power electrical system reliability issues marinas will face because of the overly restrictive requirement of Section 555.3 of the 2017 NEC (NFPA 70). While the AMI agrees that ground-fault protection is not essential (and not practicable in most situations) at the marina main service, the requirement for ground-fault protection not to exceed 30 mA for the (dock) feeders and branch circuits, along with the potential for problems it poses, is not addressed. Adoption of TIA 1348 will only lend further credence to the belief that ground-fault protection not to exceed 30 mA at the dock feeder OCPD will not be detrimental to reliable system operation. In our opinion, and based on the evidence we have, it could well be very detrimental.

AMI is the largest nationwide membership organization devoted directly to the marina, boatyard and yacht club industry. Of its 1250 members, 885 are marinas, boatyards or yacht clubs. Represented by the organization is 29% of the estimated 35,000 full and part-time employees in the industry and over 300,000 boaters using 164,000 boat slips at AMI member facilities.

Commentary:

There is increasingly broad concern in the marina industry that overly restrictive ground-fault protection requirements for marinas, and specifically for dock wiring, will result in serious operational problems while not significantly improving electrical safety in the marina environment.

There is also a concern that some marina operators will find it necessary to bypass newly required safety provisions and might do so after completion of any electrical inspections. Such actions could create conditions that are even more hazardous.

Also, there is growing evidence that the ground-fault current existing on dock feeder circuits in marinas can be substantial in nature and yet not create conditions in the water that are hazardous to human beings. Data providing expected or actual ground-fault leakage for marina dock feeders is scarce, to say the least. This past summer, a private individual in Minnesota measured the ground-fault current on approximately 64 dock feeder circuits in five Minnesota and Wisconsin marinas, all located on the Mississippi and St. Croix Rivers. Forty-eight of these measured currents were well in excess of 30 mA— even 100 mA— and yet no serious voltage gradients were found in the water surrounding boats connected to the respective shore power receptacles. (All measurements were obtained by looping a flexible current probe around the L1, L2, and Neutral conductors of the dock feeder. Care was taken to exclude the equipment grounding conductor from the measurement.

Feeder ground-fault currents (GFC) at one Wisconsin marina situated on the St. Croix River were typical of those found at all the marinas. In this case, fourteen 120/240 volt, 200 ampere feeders serving four docks had an overall average GFC of 1.8 amperes. Measured over a period of a few minutes, the average GFC surge on these feeders was 4.0 amperes. Only one of the 14 feeders measured below 30 mA. (The average GFC was 0.025 amperes, however the surge GFC was 0.117 amperes. The next lowest feeder average GFC was 0.340 amperes. The following table summarizes the measurements for the five Minnesota and Wisconsin marinas.

		Ground-Fault Current		
Location	**Feeders Measured**	**Feeders Exceeding 30 mA**	**Feeders Exceeding 100 mA**	**Feeders Exceeding 1.0 A**
Miss Croix Yacht Harbor	**6**	**5**	**2**	**0**
River Heights Marina	**9**	**9**	**6**	**2**
Port of Sunnyside Marina	**18**	**12**	**11**	**2**
Lake City Marina	**15**	**7**	**6**	**0**
St. Croix Marina	**16**	**15**	**15**	**6**
Totals	**64**	**48**	**40**	**10**
Majority of feeders are 120/240 Volts - 200 Amps.				
Measurements averaged over 2-3 minutes.				

It is both interesting and informative to note that there was no evidence of hazardous voltage gradients in the water in any of the above cases. This included checking for voltage gradients in the water with a voltage gradient probe and with a Shock Alert alarm device.

In their 2008 study "In-Water Shock Hazard Mitigation Strategies," Shafer and Rifkin point out that significant amounts of current must be injected into the water before hazardous voltage gradients are detected. In one of the more extreme cases (Case 6-1-1), it was found that 2.2 amperes of current produced voltage gradients of 7.35 volts/ft. (horizontal) and 7.7 volts/ft. (vertical). From that, we can determine that it would take almost 600 mA of current leaking into the water to produce a voltage gradient of 2 volts/ft. (the generally accepted danger threshold). This case occurred in water having a conductivity of 60 µS/cm (micro-Siemens per centimeter). This is an exceptionally low level of conductivity for a freshwater lake. In most cases, water conductivity is considerably higher, and the strength of the voltage gradient is inversely proportional to the conductivity. Based on this inverse relationship, the voltage gradients in saltwater would be extremely low because the conductivity is hundreds of times greater than that found in freshwater.

Just this past week, electricians from D. F. Electric in Tacoma, Washington conducted similar measurements to those previously described. Their measurement data are included with this document as an attachment. The author of that document describes the results of their efforts as "sobering." The AMI agrees.

Clearly, more work is required before we arbitrarily set limits that may well be unworkable and unachievable. Additional measurements and further analysis is needed. We are seek a result that is the best compromise between safety and reliable system operation.

Recommended Change. Therefore, it is AMI's strong recommendation that Section 555.2 be revised to read as follows (this is the current language of TIA 1348):

Add new definitions to 555.2 to read as follows:

555.2 Docking Facility. A covered or open, fixed or floating structure that provides access to the water and to which boats are secured.
Marina. A facility, generally on the waterfront, that stores and services boats in berths, on moorings, and in dry storage or stack storage.

Recommended Change. Therefore, it is AMI's strong recommendation that Section 555.3, 2017 National Electrical Code (NFPA 70) be suspended, and that the language below be accepted as the interim 555.3 for the 2017 NEC.

555.3 Ground-Fault Protection. For other than floating buildings covered by 553.4, ground-fault protection for docking facilities shall be provided in accordance with (A) and (B).

(A) Feeder and Branch Circuit Conductors.
The main overcurrent protective device that feeds the marina shall have a ground-fault protection not exceeding 100 mA. Ground-fault protection of each individual branch or feeder circuit shall be permitted as a suitable alternative.

Exception: Transformer secondary conductors of a separately derived system that do not exceed 3m (10 ft.) and are installed in a raceway shall be permitted to be installed without ground-fault protection. This exception shall also apply to the supply terminals of the equipment supplied by the transformer secondary conductors.

(B) Receptacles Providing Shore Power. In lieu of the requirement of 210.8, receptacles installed in accordance with 555.19(A) shall have a ground-fault protection not exceeding 30 mA.

Substantiation: The addition of definitions for "docking facility" and "marina" is necessary to appropriately apply and enforce the safety provisions established for the areas covered by Article 555 that are not currently defined in the NEC. Without these definitions, the enforcement of specific provisions within the article may extend well beyond the intended or necessary areas covered within the scope of NEC Article 555.

The language in NEC 555.3 can be interpreted to require 30 mA protection on all circuit breakers located not only on the docking facility but also throughout the entire marina based on the definitions in NFPA 303. A review of the definition of a marina includes a facility that may not be on the waterfront, including dry and stacked storage facilities. The terms marina and boatyard are removed in the proposed language, focusing the requirement for ground-fault protection at 30 mA on the docking facility, where there is "access to the water and boats are secured." It must also be recognized that floating buildings are addressed in Article 553 and ground-fault protection for the floating building is specifically addressed in 553.4.

The recommended revised language of 555.3 clarifies that protection be provided where the installer sees fit for a particular design situation. However, it does require, at a minimum, a 30 mA trip on the OPD controlling current to each receptacle used to power a boat.

The revised language relieves the concern that cumulative leakage found at mains or feeder breakers could interrupt power to all consumers downstream. But it does not restrict the installer from using ground-fault protection at any OPD location in the system.

The recommended language removes the consideration for using a coordinated tripping program at this time. Testing and analysis data are necessary to more accurately define the parameters of a program like this before becoming part of article 555.

The recommended language also includes an exception for ground-fault protection of the secondary of a transformer whose conductors are protected as indicated in the exception language. If protected, these conductors are a very unlikely ground-fault source.

Finally, 210.8(B) in the 2017 NEC introduced a general requirement to protect all receptacles 150V to ground with a ground fault circuit interrupter. In the revised language, paragraph (B) has been added in 555.3 to permit receptacles providing shore power to be protected at 30 mA.

All these revisions provide significant clarification for the designer, installer and enforcer to relieve challenges potentially imposed by the existing language while retaining the protection for the docking facility.

Emergency Nature: The proposed TIA intends to correct a circumstance in which the revised NFPA Standard has resulted in an adverse impact on a product or method that was inadvertently overlooked in the total revision process or was without adequate technical (safety) justification of the action.

This is an interim measure only. More data, study and conferencing are needed to formulate specific requirements for ground-fault protection at main and feeder breakers. New strategies for the design of marina electrical systems are being considered. These designs can resolve many of the current issues, including the problems with cumulative tripping effects, and should be considered when moving forward with changes to 2020 code.

The electrical industry introduced enhancements in safety in the 2017 NEC for marinas. Preliminary information from the Fire Protection Research Foundation activities, working to understand ESD, supported the code panel action to establish an enhanced ground-fault protection solution. The Fire Protection Research Foundation has published a report detailing the issues around ESD and the need to address protecting the public. State and federal agencies are working to adopt and enforce the 2017 NEC requirements established in Article 555. However the clarity of the revised language in NEC 555.3 and the general requirement in NEC 210.8(B) for outdoor receptacles have created confusion for installers and users of docking facilities. The addition of these definitions will ensure the appropriate application of the requirements. Without these definitions, the requirements for the article can be extended well beyond the intended areas. The 2017 NEC 555.3 language is confusing and has resulted in the delay of electrical upgrades for existing and new marinas across multiple states. Immediate revisions to the 2017 NEC are necessary to enable state and federal agencies to invest confidently in appropriate protection provisions that will enable the electrical system to operate in a safe manner for docking facilities.

AMI recognizes that the window for proposals for the 2020 NEC has already closed. This suggests we may be looking for ways to amend the code language for some time to come. We recommend that all interested and qualified parties address this issue in more detail. Thank you for taking the time to review our comments.

Sincerely,

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