



Maffett Loftis Engineering, LLC

1 South Jefferson Ave, Suite 101

Cookeville, TN 38501

Tel: (931) 526-5143, Fax (931) 526-5153

www.maffett-loftis.com

Technical Bulletin

2017 National Electrical Code Changes for Marinas

Written by: Gary D. Loftis, PE

Abstract

- Explains the process of how and when new codes are added to the National Electrical Code
- Provides history of the National Electrical Code Article 555.3 Ground-Fault Protection of Equipment requirement for marinas and boatyards
- Explains the intent behind the code requirement for turning off power to a marina when leakage current is present
- Answers the question; “Does code required Ground-Fault Protection of Equipment at the shore power pedestal location?”
- Answers the question; “Are existing marinas required to add Ground-Fault Protection of Equipment?”
- Leakage current test results are provided
- Explains the changes to the National Electrical Code Article 555.3 Ground-Fault Protection of Equipment requirement for marinas
- Explains the changes to the National Electrical Code Article 210.8 Ground-Fault Circuit-Interrupter requirement for marinas
- Additional National Electrical Code changes are explained

Contents

NEC Code Changing Process	2
History of NEC Article 555.3	2
Shore Power Pedestal – GFPE	3
Existing Marinas	3
Leakage Current	3
NEC Article 555.3 Ground-Fault Protection of Equipment	4
NEC Article 210.8 Ground-Fault Circuit-Interrupter	5
Additional Code Changes	5
Author’s Technical Biography	6

References

Technical papers and standards referenced in this bulletin are:

- US Coast Guard report “In-Water Shock Hazard Mitigation”
- 2011, 2014, and 2017 NFPA 70 (National Electrical Code – NEC)

Portions of these reference documents are directly quoted within this bulletin. Credit is given to the respective authors.

NEC Code Changing Process

The marina electrical system is very challenging to design and is one of the most difficult electrical systems to install correctly. In addition, most that are reading this article know that the marina electrical system is one of the most costly installations when compared with other types of facilities. Therefore, correctly installing the marinas electrical system the first time is imperative. Some of the complexities and cost increases are the result of recent changes in the National Electrical Code (NEC).

Every three years, the NEC evolves with the addition of new code requirements. Most of these modifications and additions are instigated from proposed code changes submitted from public comment. When a comment is submitted, it is sent to one of nineteen Code Making Panels (CMP). If a comment then applies to a marina, RV park, or floating building, it is sent to CMP-19, where it will be reviewed. If this panel deems the comment worthy to cause a change in the code, then new code language will be drafted for panel comments and then voted into the next code edition.

History of NEC Article 555.3

The code changing process took place in 2009 and 2010 with the submission of a public comment recommending the installation of a 100mA Ground-Fault Protection of Equipment (GFPE) device on marinas to protect the public and marina employees from leakage currents in the water. The comment was substantiated by the recommendation made in a report paid for by the US Coast Guard titled “In-Water Shock Hazard Mitigation” which was published on October 1, 2008. In this report, it was recommended to install a ground fault protection device with a maximum trip level at 100 mA.

The CMP-19 added a new section to Article 555 – Marina, Boatyards, and Commercial Docking Facilities of the NEC 2011 Edition. This new section was 555.3 which stated the following:

“The main Overcurrent protective device that feeds the marina shall have ground fault protection of exceeding 100 mA. Ground-fault protection of each individual branch or feeder circuits shall be permitted as a suitable alternative.”

(note: this language did not change for the NEC 2014 Edition)

The intent of this code is to turn off power of a circuit when leakage current exceeds 100 mA. This code allowed three options where the GFPE device could be located: Option 1, on the main breaker feeding the marina; Option 2, on a feeder conductor (i.e. the wire that feeds another electrical panel); or Option 3, on a branch circuit (i.e. the wire that feeds the shore power pedestal). The new code caused much discussion in the marina industry as to how this would affect operation of the marinas’ electrical systems, as well as the best means and most economical method by which to implement this requirement.

Shore Power Pedestal - GFPE

There has been some misunderstanding on the implementation of the GFPE requirement of NEC 555.3 (2011 and 2014 Editions). Some have wrongfully interpreted this language so as to allow the GFPE device to be installed within the marina pedestal. Doing so is not a code violation of itself, but this method doesn't satisfy the requirement to protect (at minimum) the branch circuit that feeds the marina pedestal as noted in the 3rd option above.

Just recently in the latest edition of the NEC (2017 Edition), CMP-19 has revised the language of 555.3. The new language clears up this misunderstanding by requiring "The overcurrent protective devices that supply the marina" to be GFPE protected. The new code removes the second and third options that were allowed in the 2011 and 2014 editions.

Existing Marinas

Most existing marinas today are not required to have GFPE installed. The reason for this is that the new NEC 555.3 code only applies to new construction. This is true for all electrical code changes. When a marina's electrical system is installed, it must be installed under the adopted code at time of installation. When a new code edition is issued, the marina is not required to update its electrical system to the new code standards. However, there are some states that are trying to make it a requirement for marinas to upgrade their electrical systems to the currently adopted code, which changes every three years. If approved, this will put a heavy financial burden on marinas.

Leakage Current

Over the years, I've had the opportunity to inspect many of these existing marinas where I have measured thousands of vessels for leakage current. When doing so, I stress to the marina owner or manager that this measurement is only a "snapshot" in time. The issue is that a onetime measurement is not sufficient to determine if a vessel has a substantial leakage current. Without knowing the state of the vessel's electrical system, the measurement may not be taking into account the entire vessel's electrical system. The best time to measure leakage current is when all electrical equipment is energized on the vessel (i.e. air conditioner, water heater, battery charger, refrigerator, etc.). This allows a more accurate measurement of leakage current, but is still only a single "snapshot measurement". Unlike the "snapshot measurement", the 555.3 NEC code requires leakage current to be monitored at all times, and when the leakage current exceeds the maximum allowable limit, the power will automatically be turned off.

Of the thousands of vessels I have measured for leakage current, almost all of them had leakage. Typical leakage currents range from 5 to 20 mA, however, many vessels have leakage currents much higher. I estimate 15 - 20% of the vessels I have measured have had leakage currents in the range of 30 mA to 100 mA. There are a handful of vessels that had 1,000 mA or more of leakage. One vessel had over 10,000 mA of leakage! This is very alarming to me and should be to the marina industry as well.

NEC Article 555.3 Ground-Fault Protection of Equipment

There is also another big change in the 555.3 NEC 2017 Edition. The 100 mA maximum has been reduced to 30 mA. The following is the language as it is written:

“The overcurrent protective devices that supply the marina, boatyards, and commercial and noncommercial docking facilities shall have ground-fault protection not exceeding 30 mA.”

The reduction to 30 mA may be the most significant change to marina code in recent history. In addition, this code requires the installation of a 30 mA GFPE on every breaker that supplies power to the marina, including the main service breaker. Marinas will find this code much more challenging to implement than the previous requirement. As noted above, many of the measured vessels have leakage over 30 mA. Therefore, one vessel could easily trip power to the entire marina!

Another issue marinas will face is that leakage current is additive. For example, even at a low leakage current of 3 mA per vessel, it will only take 10 vessels to trip a 30 mA GFPE main breaker. It will be interesting to see how this requirement is accepted in the marina industry. However, the CMP believes this is a move in the right direction to protect those that work at and frequent marinas. Referring to leakage current, one NEC code panelist quoted saying “it’s time to clean up the marinas”.

NEC Article 210.8 Ground-Fault Circuit-Interrupter

Several have asked if this new code change will require 30 mA GFPE at the marina pedestal. The short answer is no. A marina pedestal doesn’t “supply the marina”, it supplies power to the vessel. However, there is another code change that has been missed by the vast majority of the marina industry. New to the NEC 2017 Edition is GFCI protection on all outdoor and wet location receptacles rated 240 volt - 50 amps and less. The code reference is NEC 2017 210.8 (B) which states:

“All single-phase receptacles rated 150 volts to ground or less, 50 amps or less and three-phase receptacles rated 150 volts to ground or less, 100 amp or less installed in the following locations shall have ground-fault circuit-interrupter protection for personnel.”

This code requires both the 30 amp 125 volt and 50 amp 250 volt shore power receptacles of a marina pedestal to be protected by a Ground Fault Circuit Interrupter (GFCI) device. A GFCI device is a Class-A device which turns power off if leakage current is detected between 4 - 6 mA. As stated above, most vessels that I have tested have leakage currents that exceed 6 mA. For many years, the 20 amp 120 volt maintenance receptacle has been required to be GFCI protected. However, the code requirement to also have the shore power receptacle to be GFCI protected will be very challenging to both the marina and boat owner.

The GFCI receptacle requirement is not limited to marinas, it also applies to RV parks. All receptacles in a RV pedestal rated 50 amps and less shall also be required to have GFCI protection.

In addition, the GFCI protection requirement applies to all receptacles rated 50 amps 240 volt or less where located outdoors and indoor wet locations.

Some have questioned if NEC 210.8 (B) applies to marinas and RV parks. In order to answer this question, one must understand how the NEC is organized. The following is a brief explanation to help understand how the NEC is to be used. There are nine chapters in the NEC. Chapters 1 – 4 are general in nature and applies to all electrical installation including marinas and RV parks. Chapters 5 – 8 are for specific electrical installations and can modify the general requirements found in chapters 1 – 4 for that specific installation. Chapter 9 includes tables and reference information. The specific electrical requirements for marinas are found in chapter 5 under Article 555. The question regarding NEC 210.8 (B) is: does Article 555 modify the requirement to GFCI protect shore power receptacles? Article 555.19 Shore Power Receptacles is silent on this issue. Therefore, a formal interpretation request has been sent to National Fire Protection Association (NFPA) that governs the NEC in order to fully understand the intent of the GFCI requirement for shore power receptacles. This process can take several months, but should clear up any misunderstanding of this requirement. As soon as the formal interpretation is made public, I will be sure to inform the marina industry on the outcome.

Additional Code Changes

Several other notable changes to the NEC 2017 Edition will affect the marina industry and should also be brought to your attention.

- One such change is found in the scope of Article 555. The scope now includes marinas and docking facilities associated with “one-family dwelling, two-family dwellings, and residential condominiums”. Therefore, private docks associated with these types of facilities will be under the same code requirements as the commercial marinas. This will be a big change to all the private lake home docks.
- Another change is the addition of 555.24 which requires all marinas to post warning signs at “all approaches to a marina or boatyard facility”. The sign is required to state “WARNING – POTENTIAL SHOCK HAZARD – ELECTRICAL CURRENTS MAY BE PRESENT IN THE WATER.” The code requires the sign to be “clearly visible” and of “sufficient durability”. This leaves much room for interpretation to marinas about the sign. However, I’m sure this code requirement will evolve as well.

It is my understanding that several states have started the process of adopting the NEC 2017. I’m sure many other states will follow. Only time will tell how these code changes will impact the marina industry.

Author's Technical Biography

Gary D. Loftis specializes in marina electrical design. Loftis is a registered professional electrical engineer with over 30 years of experience in the electrical field. He is a principal member and senior electrical engineer for Maffett Loftis Engineering, LLC located in Cookeville, TN. In 1992, Loftis earned his Bachelor of Science degree in Electrical Engineering from Tennessee Technological University. He is a certified Deputy Electrical Inspector with the State of Tennessee. He is a member of the International Association of Electrical Inspectors (IAEI) and is currently serving as the President of the TN Chapter. He is also a member of the National Fire Protection Association (NFPA). He holds a certification from the American Boat & Yacht Council (ABYC) for Marine Electrical. He is a member of the Tennessee and Kentucky Marina Associations (TMA, KMA). He has also serves as an expert witness for marinas.

Loftis speaks at numerous marina trade shows, training classes, and conferences throughout the country.

Loftis is foremost concerned about marina safety. He has the knowledge and experience of marina electrical systems required to ensure that electrical code requirements are effective, practical, and economically feasible.