Edward "Ed" Lethert

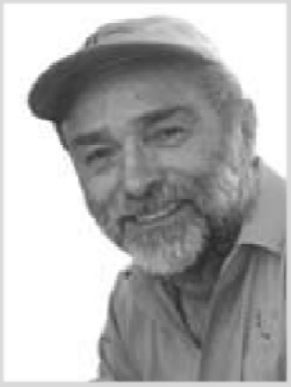
Electric Shock Drowning Safety Specialist

Member of the
Electric Shock Drowning
Prevention Association

Electric Shock Drowning Prevention Association

Awareness
Education
Mitigation

Founded on July 15th 2011



James D. Shafer

Acredited Marine Surveyor

Began investigating marine leakage currents in 1999

Shock Alert
In-Water Voltage Gradient Tester

Electric Shock Drowning

SHOCK ALERT

Electric Shock Drowning

Electric Shock Drowning

Electric Shock Drowning

Electric Shock Drowning

HOW DOES SHOCK ALERT WORK?

Shock Alert is a device used to detect the presence of electrical voltage gradients in water that may be hazardous to service personnel, swimmers, or anyone that comes into contact with that body of water. It also may be used to locate the source of voltage in water.

WHERE SHOULD SHOCK ALERT BE USED?

- Fresh or chlorinated water
- Concrete, gunite and vinyl lined pools
- Salt water pools
- Pools, around docks, or in fountains/water features
- Due to the insulating effects, Shock Alert is not for use in fiberglass pools and hot tubs

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Electric Shock Drowning

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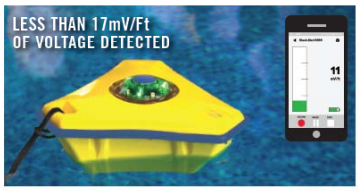
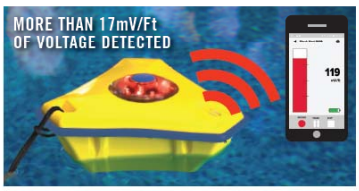
Electric Shock Drowning

Electric Shock Drowning

HOW DOES SHOCK ALERT PRO WORK?

Shock Alert PRO is a device used to detect the presence of electrical voltage gradients in water. When voltage gradients are detected the device will notify you with a visible (flashing) and audible (beeping) indicator. Shock Alert PRO may be used to help locate the source of voltage in water. Visible and audible indicators will intensify as increased levels of voltage are detected.





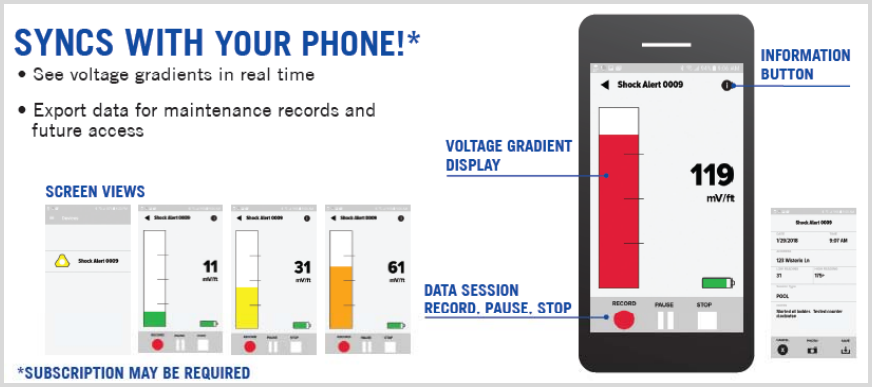
Download the app and sync the Shock Alert PRO device with your smart phone or tablet. See voltage gradient levels in real time, record data, and store, save or share your results.

WHERE SHOULD SHOCK ALERT PRO BE USED?

POOLS

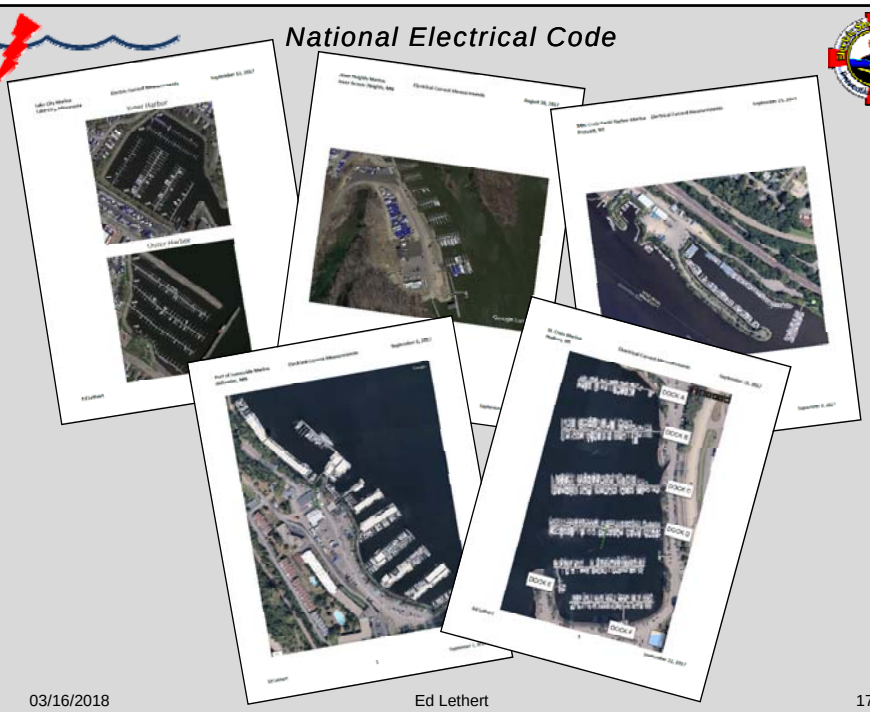
DOCKS

FOUNTAINS



Marina Ground Fault Current Measurements

National Electrical Code



National Electrical Code

		Ground-Fault Current		
Location	Feeders Measured	Feeders Exceeding 30 mA	Feeders Exceeding 100 mA	Feeders Exceeding 1.0 A
[redacted]	6	5	2	0
	9	9	6	2
	18	12	11	2
	15	7	6	0
	16	15	15	6
Totals	64	48	40	10
Majority of feeders are 120/240 Volts - 200 Amps.				
Measurements averaged over 2-3 minutes.				

National Electrical Code

ELECTRICAL CURRENT MEASUREMENTS

FOSS HARBOR MARINA
821 DOCK ST.
TACOMA, WA 98402

LOCATION	# OF SLIPS	FEEDER SIZE	L1 + L2 + L3 + NEUTRAL	L1 + L2 + L3 + NEUTRAL + GROUND	GROUND ONLY	WOULD 100 mA BREAKER TRIP?	WOULD 30 mA BREAKER TRIP?
B-DOCK #1	4	125A	**1,510** mA	190 mA	130 mA	YES	YES
B-DOCK #2	4	125A	**8,400** mA	400 mA	8,720 mA	YES	YES
B-DOCK #3	5	150A	**8,930** mA	1,100 mA	6,470 mA	YES	YES
B-DOCK #4	4	125A	**2,600** mA	340 mA	2,430 mA	YES	YES
C-DOCK - ODD	13	100A	**1,300** mA	400 mA	1,960 mA	YES	YES
C-DOCK - EVEN	13	100A	**540** mA	600 mA	650 mA	YES	YES
D-DOCK - ODD	14	125A	**920** mA	2,250 mA	2,000 mA	YES	YES
D-DOCK - EVEN	10	125A	**2,600** mA	3,300 mA	1,640 mA	YES	YES
F-DOCK - ODD	14	125A	**700** mA	830 mA	650 mA	YES	YES
F-DOCK - EVEN	13	125A	**9,800** mA	2,850 mA	7,950 mA	YES	YES
G-DOCK - ODD	12	125A	**7,030** mA	1,180 mA	3,820 mA	YES	YES
G-DOCK - EVEN	12	125A	**2,320** mA	840 mA	4,950 mA	YES	YES
H-DOCK - ODD	15	125A	**0** mA	800 mA	270 mA	NO	NO
H-DOCK - EVEN	15	125A	**9,500** mA	3,800 mA	2,900 mA	YES	YES
I-DOCK - ODD	13	125A	**120** mA	930 mA	120 mA	YES	YES
I-DOCK - EVEN	13	125A	**11,280** mA	1,450 mA	10,200 mA	YES	YES
J-DOCK - ODD	13	125A	**350** mA	300 mA	380 mA	YES	YES
J-DOCK - EVEN	13	125A	**110** mA	110 mA	590 mA	YES	YES
K-DOCK - ODD	15	125A	**160** mA	3,330 mA	3,330 mA	YES	YES
K-DOCK - EVEN	15	125A	**6,140** mA	390 mA	6,000 mA	YES	YES
L-DOCK - ODD	15	125A	**130** mA	460 mA	230 mA	YES	YES

D.F. ELECTRIC, INC. 12/4/17

National Electrical Code

ELECTRICAL CURRENT MEASUREMENTS

FOSS HARBOR MARINA
821 DOCK ST.
TACOMA, WA 98402

Total Feeders	**35**			
Total Slips	**411**			
Totals		**4350**	**131960**	**131.960**
Averages			**3770**	**3.770**
Average/Slip			**321**	**0.321**

Leakage:	**Feeders:**	**Slips:**
> 30 mA (0.03 A)	**33 (94%)**	**24 (69%)**
> 100 mA (0.1 A)	**33 (94%)**	**18 (51%)**
> 500 mA (0.5 A)	**24 (69%)**	**12 (34%)**
> 1.0 A	**19 (54%)**	**3 (9%)**
> 5.0 A	**12 (34%)**	**—**
> 10.0 A	**2 (5.7%)**	**—**

K-DOCK - EVEN	15	125A	**6,140** mA	390 mA	6,000 mA	YES	YES
L-DOCK - ODD	15	125A	**130** mA	460 mA	230 mA	YES	YES

D.F. ELECTRIC, INC. 12/4/17

NEC Update

NFPA 70 — NEC

ABYC E-11

NFPA 303

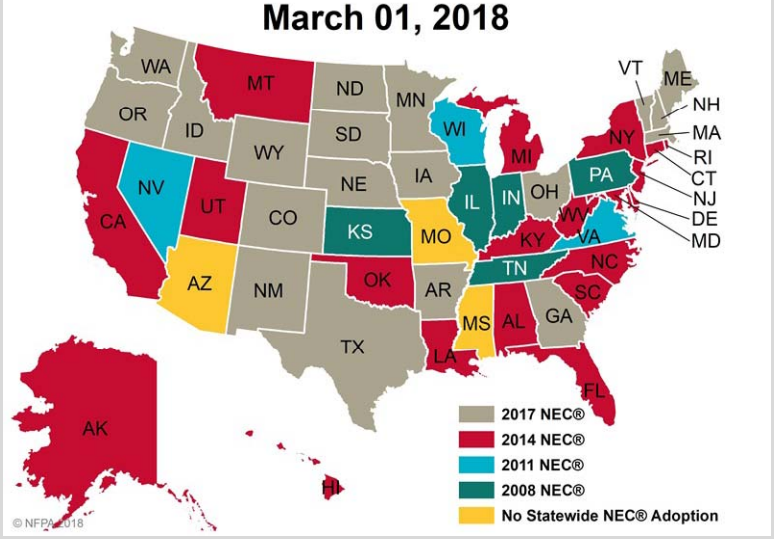
NFPA 302

Shore Cord

Marina Power

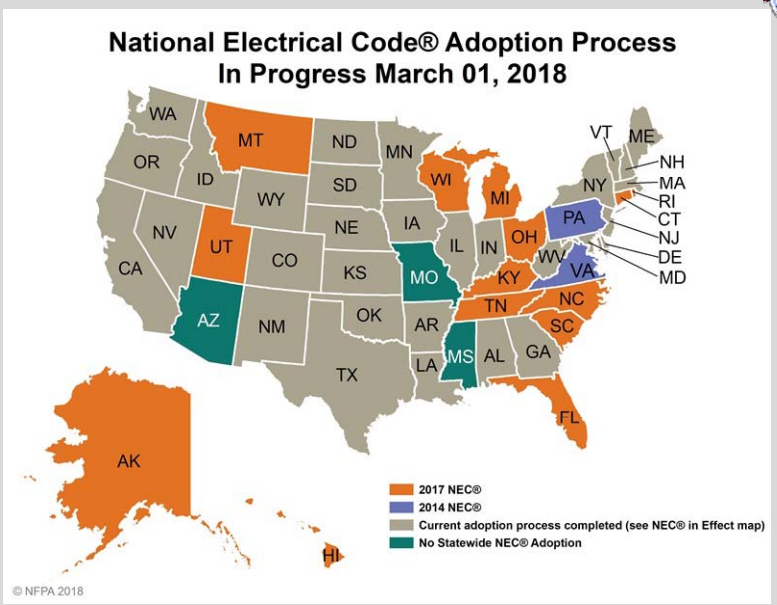
Electric Shock Drowning

National Electrical Code® in Effect March 01, 2018



Electric Shock Drowning

National Electrical Code® Adoption Process In Progress March 01, 2018

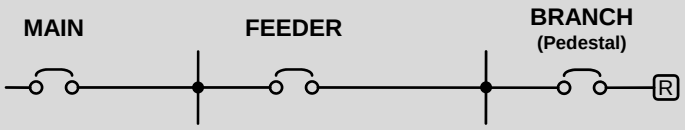


Electric Shock Drowning

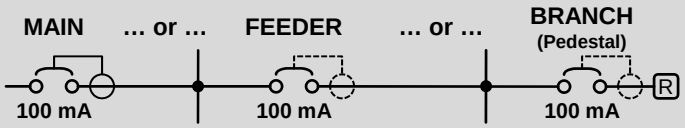
State	Currently Adopted Edition Of The NEC (Effective Date)	2017 NEC Adoption Status (Effective Date)	Other Editions Of NEC Adoption Status (Effective Date)
Wisconsin	2011	Adoption process underway (effective date not established)	

Electric Shock Drowning

Typical Dock Electrical Distribution

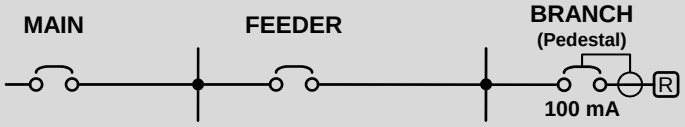


Typical Dock Electrical Distribution
2011 / 2014 NEC



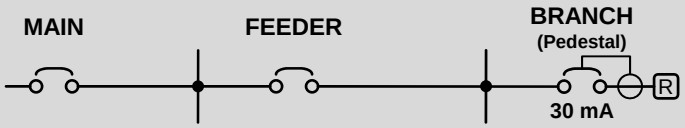
Electric Shock Drowning

Typical Dock Electrical Distribution
2011 / 2014 NEC



Electric Shock Drowning

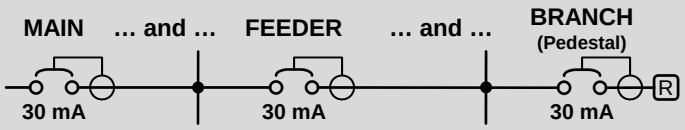
Typical Dock Electrical Distribution
2011 / 2014 NEC



03/16/2018 Ed Lethert

Electric Shock Drowning

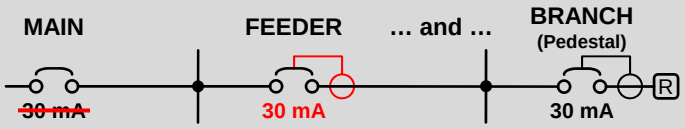
Typical Dock Electrical Distribution
2017 NEC



03/16/2018 Ed Lethert

Electric Shock Drowning

Typical Dock Electrical Distribution
2017 NEC



Tentative Interim Agreement 1348
(TIA 1348)

Electric Shock Drowning

Reaction to the 2017 NEC

Electric Shock Drowning

Marina Ground Fault Leakage Current and the NEC

Ed Lethert

January 3, 2017

Article 555 of the 2014 National Electrical Code, "Marinas and Boatyards", has been re-titled in the 2017 edition to "Marinas, Boatyards, and Commercial and Noncommercial Docking Facilities". Along with the new title, there are important changes and additions including a very important revision. The revised rule, Section 555.3, has reduced the maximum permitted ground-fault protection from 100 mA[1] to 30 mA and applies that requirement to all overcurrent protective devices (OCPDs) installed in any facility or installation covered by Article 555.

> **555.3 Ground-Fault Protection.** The overcurrent protective devices (OCPDs) that supply the marina, boatyards, and commercial and noncommercial docking facilities shall have ground-fault protection not exceeding 30 mA. [2]
>
> [2]2017 National Electrical Code, ARTICLE 555 — Marinas, Boatyards, and Commercial and Noncommercial Docking Facilities

The 2014 code rule requires that the ground-fault protection not exceeding 100 mA be applied at the main service feeding the marina, but permits placement at each individual branch circuit breaker (typically at the pedestal) or the feeder circuit breaker as a suitable alternative. The new 2017 code rule requires that *ALL* overcurrent protective devices in marinas, boatyards, and at commercial and noncommercial docking facilities include ground fault protection not exceeding 30 mA. Reading further in the article, one finds that this requirement does not override the requirement for Class A GFCI protection (5 mA) for almost all marina and dock convenience receptacles. This reduction in the ground-fault trip level was driven in large part by the The Fire Protection Research Foundation. The rationale for their conclusions and list of participants is found in their report *Assessment of Hazardous Voltage/Current in Marinas, Boatyards and Floating Buildings.*[3]

Anyone involved with marina electrical installations and their operation must consider the potential negative consequences that could result if this new rule is not applied thoughtfully and reasonably in the field, especially as it relates to shore power service to watercraft. It is also important to note that Article 555 makes no distinction between freshwater and saltwater marine environments, even though there are significant differences, electrically speaking.

[1]milliampens
[3]Assessment of Hazardous Voltage/Current in Marinas, Boatyards and Floating Buildings, Final Report, November 2014, Fire Protection Research Foundation

National Electrical Code

THE STATE of ALASKA
GOVERNOR BILL WALKER

Department of Labor and Workforce Development
Labor Standards and Safety

April 21, 2017

The Honorable Representative Sam Kito III
Alaska House of Representatives
120 Fourth Street, Room 403
Juneau, AK 99801

Dear Representative Kito,

This letter is in response to concerns received by your office about a provision in the upcoming 2017 edition of the National Electrical Code. An erroneous interpretation of this code would create an unrealistic requirement for dock, marina, and boatyard owners. The Department of Labor and Workforce Development interprets the National Electrical Code according to the developers' intent, and hopes to allay any concerns that it might do otherwise.

Under AS 18.60.580, the National Electrical Code (NEC), developed and published by the National Fire Protection Association (NFPA), constitutes the minimum electrical safety standards of the state, applying to new installations and alterations to existing installations. The Alaska Department of Labor and Workforce Development may adopt the most recent version by regulation. The department may only adopt amendments issued by the American National Standards Institute, the body that approves the NEC. Any other amendments must be made in Alaska statute.

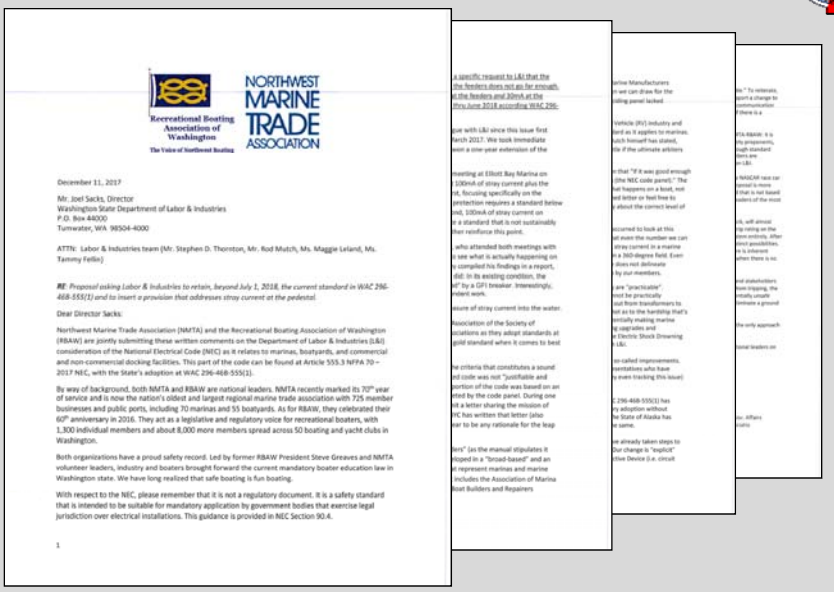
The department updates to a new NEC edition on a three-year cycle. The 2014 edition is the current version adopted in 8 AAC 70.025. The process of adopting the 2017 edition will begin in the spring of 2018, with an expected effective date near the end of 2018. This timeframe allows public and industry analysis of the new version, with ample time for legislation if amendments are necessary to adapt the code to Alaska's environment.

Several local organizations have expressed concern about a provision of the 2017 edition. Section 555.3 defines ground-fault protection requirements for marinas, boatyards, and commercial and noncommercial docking facilities. It reads:

> "555.3 Ground-Fault Protection. The overcurrent protective devices that supply the marina, boatyards, and commercial and noncommercial docking facilities shall have ground-fault protection not exceeding 30 mA."

There is concern that the department may interpret this provision as requiring 30 mA ground-fault protection for all overcurrent protective devices in an affected facility, up to and including the main feeder. According to industry representatives, a 30 milliamp protection requirement at

National Electrical Code



Recreational Boating Association of Washington
The Voice of Northwest Boating

NORTHWEST MARINE TRADE ASSOCIATION

December 11, 2017

Mr. Joel Sacks, Director
Washington State Department of Labor & Industries
P.O. Box 44000
Tumwater, WA 98504-4000

ATTN: Labor & Industries team (Mr. Stephen D. Thornton, Mr. Rod Mutch, Ms. Maggie Leland, Ms. Tammy Fellin)

RE: Proposal asking Labor & Industries to retain, beyond July 1, 2018, the current standard in WAC 296-468-555(1) and to insert a provision that addresses stray current at the pedestal.

Dear Director Sacks:

Northwest Marine Trade Association (NMTA) and the Recreational Boating Association of Washington (RBAW) are jointly submitting these written comments on the Department of Labor & Industries (L&I) consideration of the National Electrical Code (NEC) as it relates to marinas, boatyards, and commercial and non-commercial docking facilities. This part of the code can be found at Article 555.3 NFPA 70 – 2017 NEC, with the State's adoption at WAC 296-468-555(1).

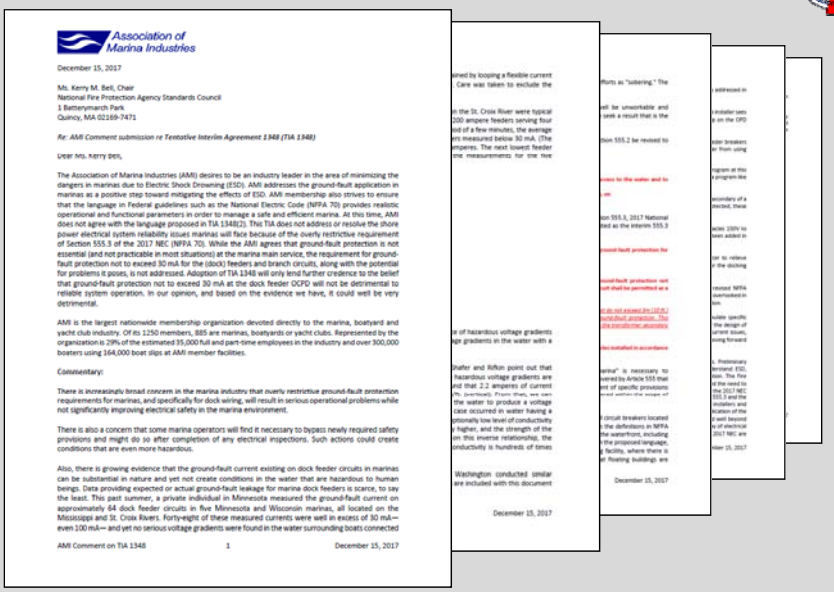
By way of background, both NMTA and RBAW are national leaders. NMTA recently marked its 70th year of service and is now the nation's oldest and largest regional marine trade association with 725 member businesses and public ports, including 70 marinas and 55 boatyards. As for RBAW, they celebrated their 60th anniversary in 2016. They act as a legislative and regulatory voice for recreational boaters, with 1,300 individual members and about 8,000 more members spread across 50 boating and yacht clubs in Washington.

Both organizations have a proud safety record. Led by former RBAW President Steve Greaves and NMTA volunteer leaders, industry and boaters brought forward the current mandatory boater education law in Washington state. We have long realized that safe boating is fun boating.

With respect to the NEC, please remember that it is not a regulatory document. It is a safety standard that is intended to be suitable for mandatory application by government bodies that exercise legal jurisdiction over electrical installations. This guidance is provided in NEC Section 90.4.

1

National Electrical Code



Association of Marina Industries

December 15, 2017

Ms. Kerry M. Bell, Chair
National Fire Protection Agency Standards Council
1 Batterymarch Park
Quincy, MA 02169-7471

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

Dear Ms. Kerry Bell,

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

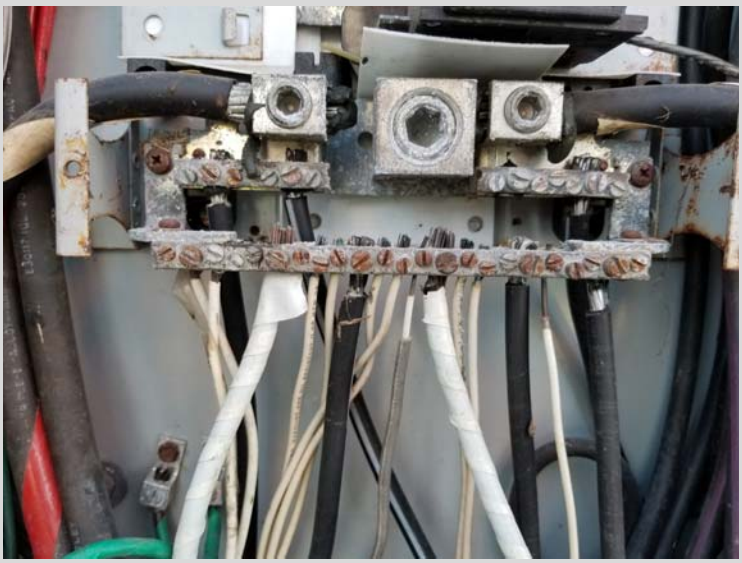
AMI Comment on TIA 1348 1 December 15, 2017

Inspect Dock Wiring

Electric Shock Drowning

- Condition of Receptacles
- Circuit Breakers
- Wiring and Connections
- Electrical Ground Integrity
- Line Voltage

Electric Shock Drowning



Test The Boats

- AC Neutral to AC Ground Connection
- AC Ground to DC Negative Bond
- Leakage Current into the Water

Electric Shock Drowning

Pass/fail test of boats returning to marina following installation of new docks:

- 86 Boats Tested
- 69 Boats Failed the Test
  (no longer than 22 minutes)
- 61 Failed Immediately

Cliff Norton, Bellingham Marine Industries, 2018

Electric Shock Drowning

Electric Shock Drowning

The MK-5 Tester verifies:

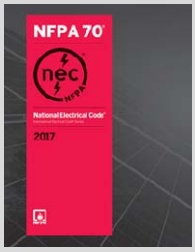
- The AC ground is not bonded to the AC neutral
- The existence of the AC ground to DC negative bond
- The integrity of the AC ground path (the only practical way when GFP is installed)

Electric Shock Drowning

ESD Warning Signs

Warning Signs required stating

"WARNING - POTENTIAL SHOCK HAZARD - ELECTRICAL CURRENTS MAY BE PRESENT IN THE WATER."



555.24 Signage. Permanent safety signs shall be installed to give notice of electrical shock hazard risks to persons using or swimming near a boat dock or marina and shall comply with all of the following:

(1) The signage shall comply with 110.21(B)(1) and be of sufficient durability to withstand the environment.

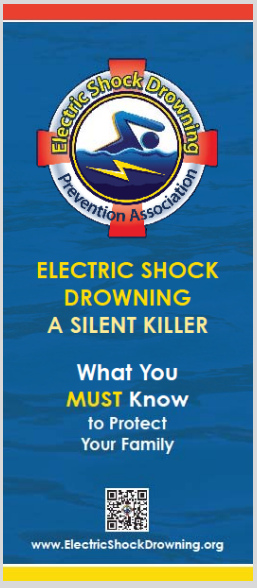
(2) The signs shall be clearly visible from all approaches to a marina or boatyard facility.

(3) The signs shall state "WARNING — POTENTIAL SHOCK HAZARD — ELECTRICAL CURRENTS MAY BE PRESENT IN THE WATER." [555.24 is a new section added to the 2017 NEC]

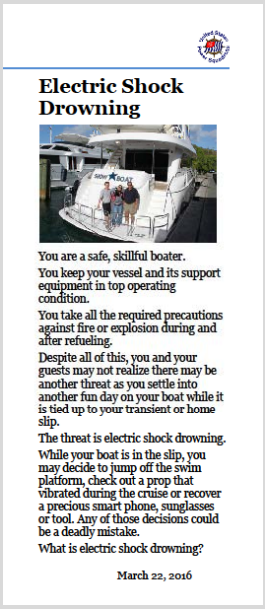

MARINA
DOCK
D
No Swimming
From Docks
NO SWIMMING!
WARNING!
Potential Shock Hazard
Required by
the 2017 NEC


NO SWIMMING!
Electric Shock Drowning
Prevention Association
WARNING!
Potential Shock Hazard
Electrical currents may be present in the water. These electrical currents can be harmful or lethal.
www.electricshockdrowning.org

ESD Fliers


Electric Shock Drowning
Prevention Association
ELECTRIC SHOCK
DROWNING
A SILENT KILLER
What You
MUST Know
to Protect
Your Family
www.ElectricShockDrowning.org

Electric Shock Drowning



Electric Shock Drowning

You are a safe, skillful boater.

You keep your vessel and its support equipment in top operating condition.

You take all the required precautions against fire or explosion during and after refueling.

Despite all of this, you and your guests may not realize there may be another threat as you settle into another fun day on your boat while it is tied up to your transient or home slip.

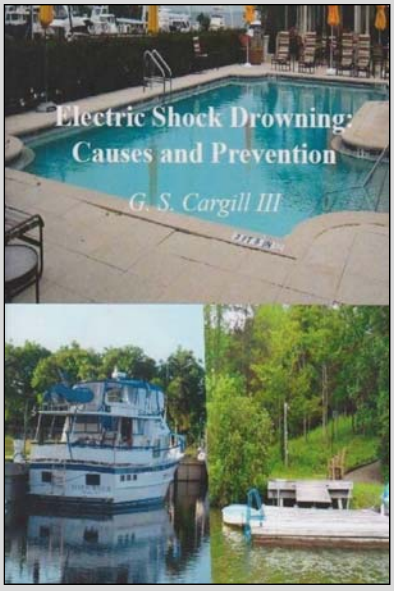
The threat is electric shock drowning.

While your boat is in the slip, you may decide to jump off the swim platform, check out a prop that vibrated during the cruise or recover a precious smart phone, sunglasses or tool. Any of those decisions could be a deadly mistake.

What is electric shock drowning?

March 22, 2016

Electric Shock Drowning



Electric Shock Drowning

Ed Lethert
Electric Shock Drowning Safety Specialist
elethert@gmail.com 612-670-9801

Electric Shock Drowning Prevention Association
www.electricshockdrowning.org

Ed Lethert's MN ESD Web Site
www.electricshockdrowningmn.com

Electric Shock Drowning

ELECTRIC SHOCK DROWNING PREVENTION ASSOCIATION

www.electricshockdrowning.org

BoatU.S.
Boat Owners Association of The United States

Electric Shock Drowning Resource Center

www.boatus.com/seaworthy/ESD.asp

Electric Shock Drowning