

Electric Shock Drowning

Electric Shock Drowning — A Silent Killer

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Electric Shock Drowning

"Ed" Lethert

Electric Shock Drowning Safety Specialist



Volunteer:
Electric Shock Drowning
Prevention Association

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Lake Minnetonka Boater



Member:
Minnetonka Power Squadron

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Electric Shock Drowning



District 10 Electric Shock Drowning Awareness Initiative for 2016

Minnesota, Wisconsin, Michigan UP



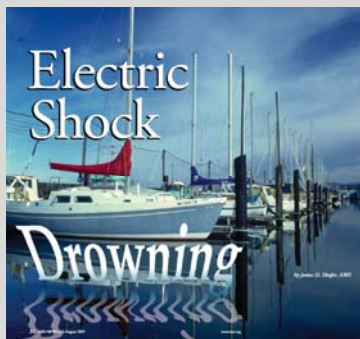
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Questions and comments are welcome

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IAEI NEWS July-August 2007

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TOUR BOATING COLLAS AT RISK
USCG FY2006 Grant
In-Water Shock Hazard Mitigation
Strategies
Final Report October 1, 2008

USCG / ABYC October 2008

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Electric Shock Drowning

Assessment of Hazardous Voltage/Current
in Marinas, Boatyards and Floating Buildings

Final Report

Prepared for:
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THE FIRE PROTECTION RESEARCH FOUNDATION
FIRE RESEARCH

THE FIRE PROTECTION RESEARCH FOUNDATION
ONE BATTLEMENT ROAD
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FPRC Foundation November 2015

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Electric Shock Drowning

ESD is getting a lot of attention in both television and print media

Frank Vascellaro Amelia Santaniello

WCCO-TV CH 4, 10 PM News, June 28, 2016

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Electric Shock Drowning

Popular cheerleader killed in tragic electrical shock drowning when her father lowered metal ladder into water to help her out

- Carmen Johnson, 15, died last month while swimming in Smith Lake in Winston County
- A metal ladder lowered into the lake caused an electrical shock in the water
- Father Jimmy jumped into save her but he blacked out
- Mother managed to turn off electrical supply, saving Jimmy, their son Eric who had also jumped in, and Carmen's friend Reagan who was in the water
- But Carmen had disappeared under the water

By ALANANDREA GONZALEZ FOR DAILYMAIL.COM
PUBLISHED 16:27 BST, 21 May 2016 | UPDATED: 06:47 BST, 22 May 2016

UK Daily Mail, May 21, 2016

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Lost to ESD

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Lost to ESD

Marcus Colburn, age 21, died on Father's Day, June 21, 2015 as a result of ESD

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Lost to ESD

March 27, 2016

Electric shock in pool kills man, injures 5 kids



A father is dead and his daughter is hospitalized in critical condition after suffering an electric shock in a Palm Springs swimming pool on Easter Sunday

Four others were treated and released and a fifth remains hospitalized in stable condition

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Lost to ESD

April 16, 2016

Carmen Elizabeth Johnson

15-year-old girl drowns at Smith Lake



Coroner: Electrocution may have caused Priceville cheerleader's drowning, along with a 2nd injury

Family members had earlier reported feeling tingling sensations in the water

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Electric Shock Drowning

ESD "Near Miss"

Man Critical after Electrical Shock in NJ Motel Pool

WILDWOOD CREST, N.J. (WPVI-TV) — A man is in critical condition after an electrical shock in a motel pool in Wildwood Crest, New Jersey. Witnesses say 34-year-old Greg Subiszak was spotted face down in the Aztec Motel pool Saturday night in the town of Wildwood Crest.

Unaware what had happened 17-year-old Ivan Christopher Martinez of Camden, jumped in the water to save the man. He tells WPVI-TV that his body tensed up and began shaking after jumping in. A maintenance worker eventually turned off the electricity and pulled Subiszak from the pool. A motel guest administered CPR until paramedics arrived. Subiszak is hospitalized in Philadelphia.

Motel owner Adamo Pipitone says the pool will stay closed until it's cleared to reopen by county health officials. He speculates a short in a lamp post is to blame.

Police are investigating.

Mike Holt's Comment: Before you consider checking a swimming pool for proper bonding and grounding, please ensure that you understand electrical fundamentals, grounding versus bonding, NEC requirements related to swimming pool bonding, Neutral-to-Earth (NEV) voltage related to utility wiring, and how to troubleshoot to ensure swimming pools are properly bonded. All of these topics are available for free on our Swimming Pool Bonding page ...



May 2016

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ESD "Near Miss"

8-Year Old Girl Shocked in Backyard Pool

The girl shocked in a backyard pool in Silver Spring Township Sunday evening remains in critical condition, police said Monday.

The accident happened at a home on Rockledge Drive in Silver Spring Township. There were eight children in the pool at the time.

Police said one of the children flipped on a switch to turn on the pool lights when there was a malfunction. All of the children in the pool felt a shock, but the 8-year-old could not get out and went into cardiac arrest. Firefighters performed CPR and used an AED to revive the child. She was flown to Penn State Hershey Medical Center where she remains in the Intensive Care Unit.

Mike Holt's Comment: This is why you should NOT have a powered light in your pool. If you do, then you should have it disconnected by a qualified Electrical Contractor, or replaced with a Fiber Optic Light (no electric power).



May 2016

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ESD Incidents

76 Known Incidents

44 "Near miss" Incidents

as of 06-20-16



June 20, 2016

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It is believed that the actual number of ESD fatalities is much higher than reported or documented – very possibly hundreds more

Paralysis due to small electric currents passing through the body is not typically identifiable post-mortem as the cause of a drowning

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**Water + Electricity
= A Dangerous Mix**

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Shore Power



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Boat Lifts



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Fountains

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Aerators

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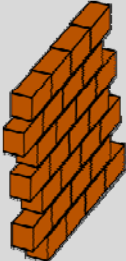
"Weed Eaters"

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Cultural Firewall in the Brain
Water + Electricity

Indoors
Be Safe!

Outdoors
???



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Electric Shock Drowning

The use of electric power at lakes and rivers, and in ponds, has increased exponentially in the past few decades.

This has introduced a new danger into our daily lives.



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And yet, few are even remotely aware of Electric Shock Drowning ...

Say WHAT?



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... or the need for important precautions

Question to Lakeshore Property Owner:

"Is the circuit that powers your electrically operated boat lift protected by a Ground Fault Circuit Interrupter?"

Response:

"I have no idea."

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FACT: ESD is a serious concern in **ALL** situations where electric circuits and equipment operate in, on, over, or near a body of water, large or small

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Electric Shock Drowning

What is Electric Shock Drowning?

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Electric Shock Drowning

Electric Shock Drowning (ESD) is a unique form of drowning caused by the presence of AC electrical currents in freshwater lakes, rivers, pools, ponds, etc.

These in-water currents can flow through the bodies of individuals immersed in the electrically charged water

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Electric Shock Drowning

The current, where sufficiently intense, can partially or completely paralyze the body's skeletal muscles, inhibiting the ability to swim or even move one's limbs

The outcome in many such cases is the drowning death of an otherwise healthy individual

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Electric Shock Drowning

Thru-the-body AC currents can, depending on their magnitude:

1. Paralyze skeletal muscles
2. Cause respiratory paralysis (shut down the lungs)
3. Initiate ventricular fibrillation
4. Result in full cardiac arrest

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Typical ESD Scenario

A victim in electrically charged water ...

- May become partially or totally disabled
- May or may not call for help
- May or may not remain conscious
- May or may not remain on the surface
- May make situation worse seeking a "safe haven" by moving toward the source, rather than away, from it

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"The Electric Shock Drowning of Samantha Chipley"



Article by Attorney B. Clark Batten II

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Electric Shock Drowning

Electric Shock Drowning is not the same as death by electrocution, which usually results from direct contact with energized metal objects or surfaces

In-water electrocutions are included in ESD statistics because they are caused by the exact same conditions that cause an ESD injury or fatality

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Medical research has shown that an AC current of **6** milliamperes through the body can begin to affect muscle control

The ESDPA recognizes **10** milliamperes of AC current through the human body as the threshold for a possible ESD incident

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A 60 watt, 120 volt incandescent light bulb draws 500 milliamperes of current ... **50** times more than the 10 mA that can paralyze an individual in the water

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ESD is a Fresh Water Phenomenon

	In-Water Leakage Current	Through-Body Current
Salt Water	6 Amps	1.1 mA
Fresh Water	0.3 Amps	23.8 mA

1/20th the leakage current – 20 times the body current

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What about pets and other critters?

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Animals are not immune to the effects of these in-water currents

ESD has claimed family pets that have entered electrically charged waters

and

Individuals have fallen victim to ESD when they enter the water attempting to rescue their pet

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Electric Shock Drowning

A Terrible ESD Tragedy in 2012



Blackfoot, Idaho

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Electric Shock Drowning

A Terrible ESD Tragedy

Friday Aug 31, 2012

Track coach [woman], two men [one a relative], one dog [family pet] electrocuted in Idaho irrigation canal



Another family member attempting a rescue was shocked but survived

Police say: "The electrified canal could have killed more"

They [canal experts] say it is virtually impossible to know if water is electrified by sight or sound

Idaho Power shut off the power in the area so rescuers could recover the bodies

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There is no visual or audible indication that dangerous currents could be present in the water

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Why all the concern about ESD?

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Electric Shock Drowning

- Increase in the use of electrically operated equipment in and around recreational and non-recreational waters
- Increase in Do-It-Yourself electrical work by unqualified and untrained individuals
- Use of non-approved materials, wiring methods and equipment on docks and boats

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- Lack of electrical inspections [initial and recurring]
- Lack of monitoring for dangerous conditions
- Postponing of repairs due to cost
- Less caution exercised by the general public

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In-water shock hazards (i.e. electrical currents in the water)

- may already exist
- can occur suddenly
- can continue indefinitely

without any notice, indication or warning wherever AC powered equipment or wiring is located in, on, over, or near the water

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Electric Shock Drowning

- **Marinas**
- **Private docks**
- Recreational vehicle parks
- Decorative ponds and pools
- Swimming and wading pools
- Swimming beaches
- Other

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Electric Shock Drowning

The ESD condition in marinas can be caused by faulty equipment or wiring in or on ...

- The marina/dock electrical system
- Electrically operated boat lifts
- Your own boat
- Neighboring boats

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Electric Shock Drowning

Similar conditions can exist or occur at private docks where electric equipment and wiring are installed and faults exist

- The dock electrical system
 - Boat lifts, lights, receptacles, etc.
- Neighboring dock or docks electrics
- Your own boat (shore-powered)
- Neighboring boats (shore-powered)

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Causes of In-Water Shock Hazards

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Two conditions must be met to establish dangerous levels of electrical current in the water

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1st – there must be some form of electrical fault (hot to ground) at some point in the AC system or AC powered equipment

2nd – There has to be a failure of the safety bonding/grounding system, i.e. the equipment bonding/grounding path/conductor

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Electric Shock Drowning

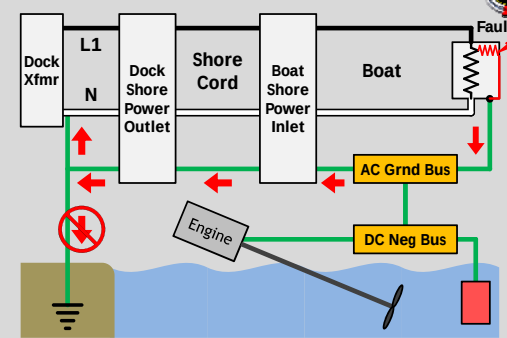


High level fault currents will flow back through the safety ground conductor – if present – and trip the circuit breaker

Low level fault currents will flow back through the safety ground conductor but will NOT trip the circuit breaker

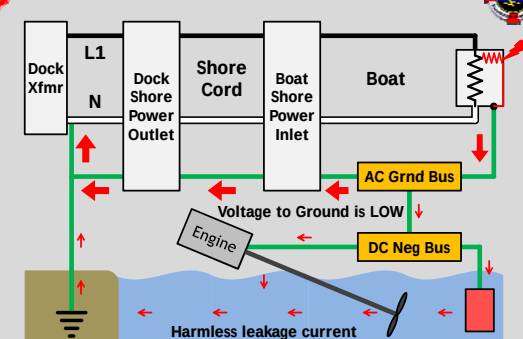
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An ESD condition in the water is caused, in part, by an electrical fault current that is too small to trip the circuit breaker

This then is an 'undetected' fault
[unless GFCI or ELCI protection is installed]

An undetected fault can continue for long periods of time, even indefinitely

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Causes include (but are not limited to):

- Incorrect installation of equipment or wiring
- Improper use of equipment or wiring
- Malfunction or failure of equipment, wiring, plugs, connectors, etc.
- Wiring errors (commission or omission)
- Failed or nonexistent safety ground path (conductor)

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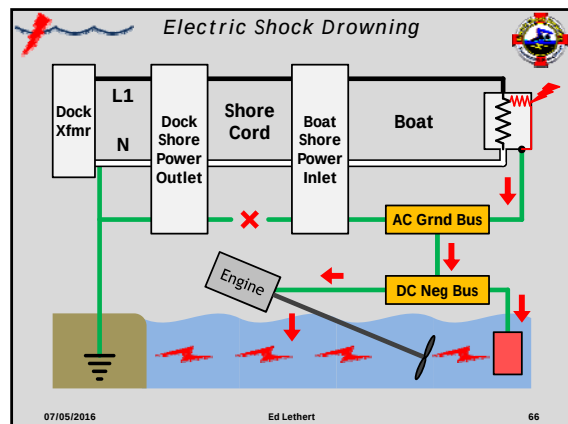
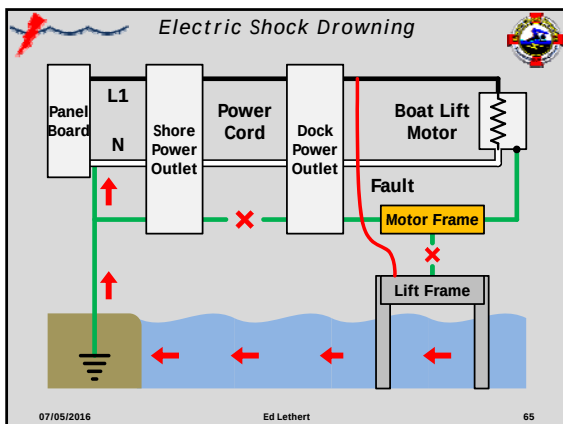
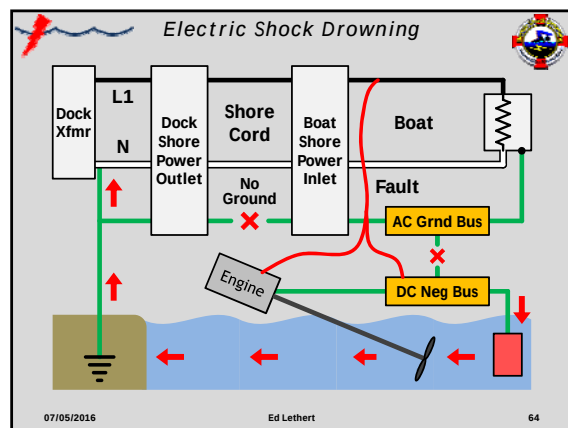
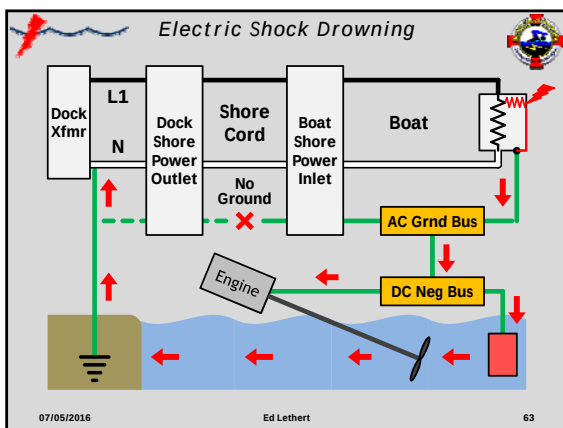
Electric Shock Drowning

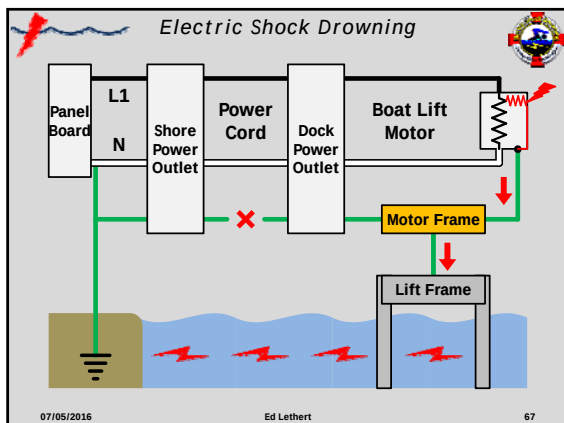
When a fault exists and the safety ground is missing or ineffective, the only fault current path is through water



Dangerous levels of alternating current could now be flowing in the water

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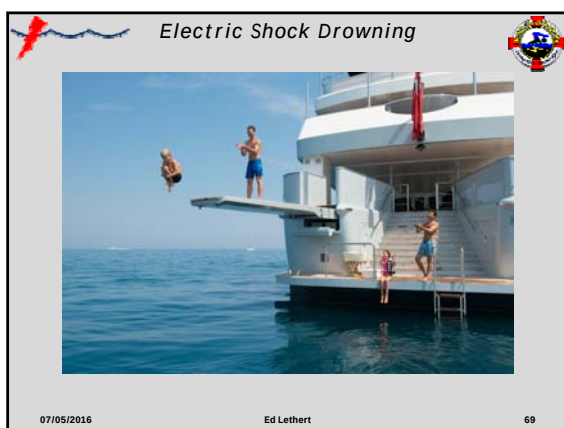
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A person finding themselves in such waters will likely experience a dangerous AC current passing through their body

If this current through the body is high enough—10 or more milliamps—paralysis or worse is likely

The result will be the inability to remain afloat, followed by drowning

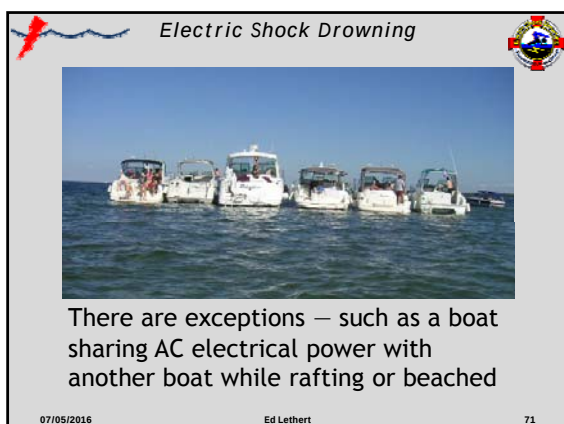
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On-board generators and inverters, as a general case, do not create an ESD hazard when the boat is operating on the water and is not connected to a shore-based grounded electrical supply or other off-boat systems or equipment

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Electric Shock Drowning

Direct Current (DC) is generally not a concern, although it can be a fire or burn hazard under certain conditions

The primary electrical systems aboard boats are typically 12 or 24 volts DC

It takes from 2 to 5 times as much DC to cause the same bodily effect as the equivalent AC

The heart is far more susceptible to disruption or injury by AC than by DC

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Detection of In-Water Currents

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In-water electrical currents are similar to carbon monoxide

They are invisible, silent, and odorless

One cannot see, hear, or smell them

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There are electrical tests that can be performed on a regular basis to minimize (but not eliminate) the risk of in-water shock where electrics are installed

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These tests requires specialized testing equipment and training



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Signs That There Is — or Could Be — A Serious Problem

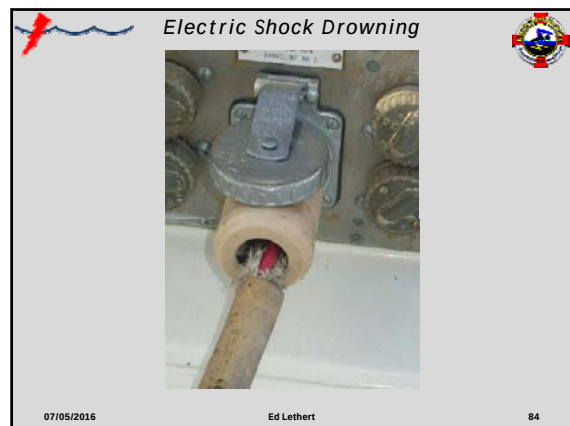
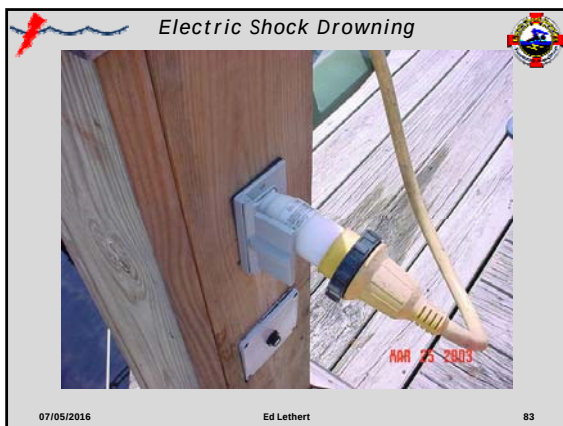
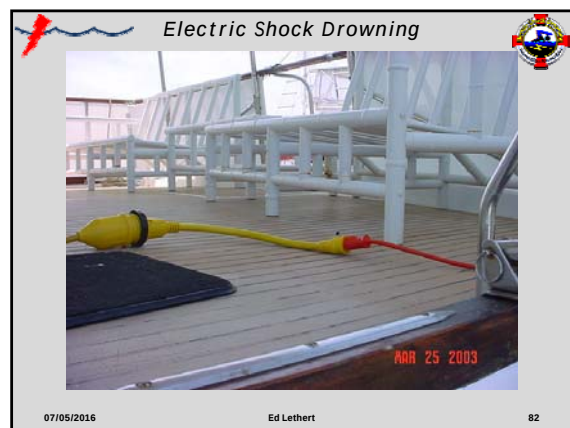
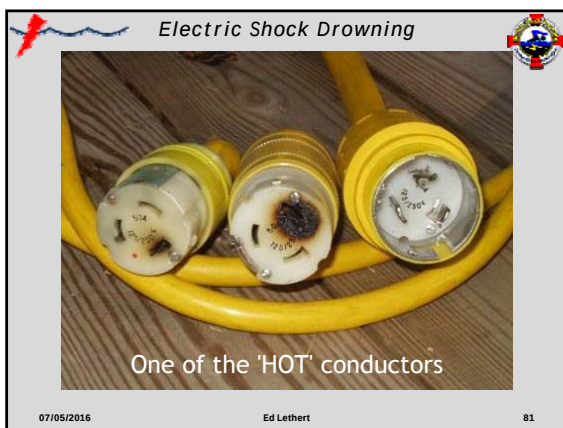
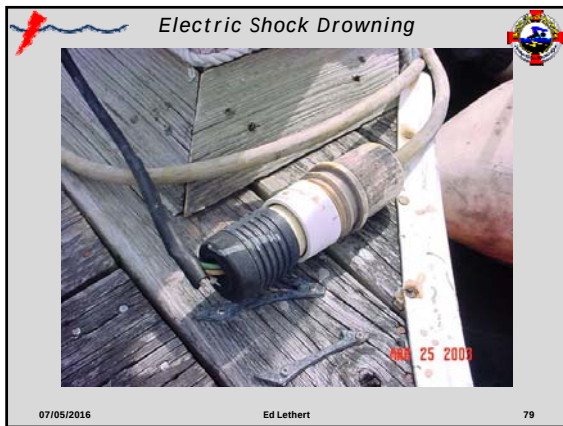
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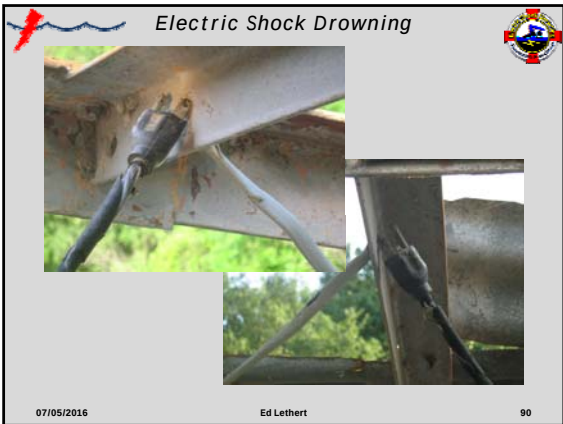
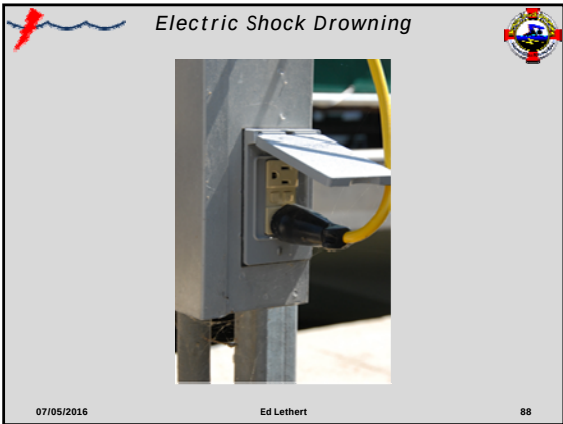
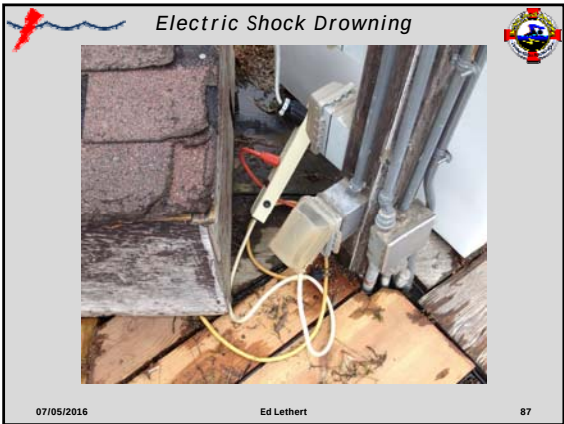
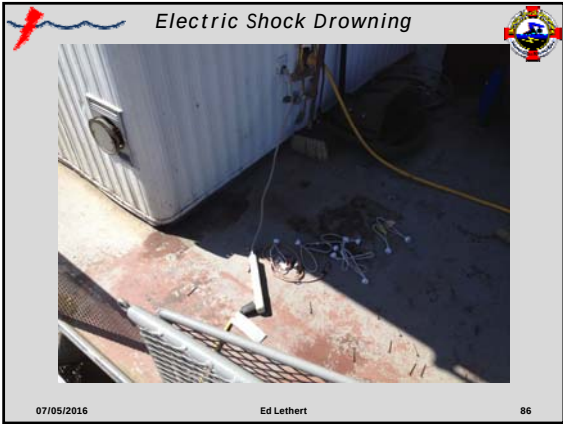
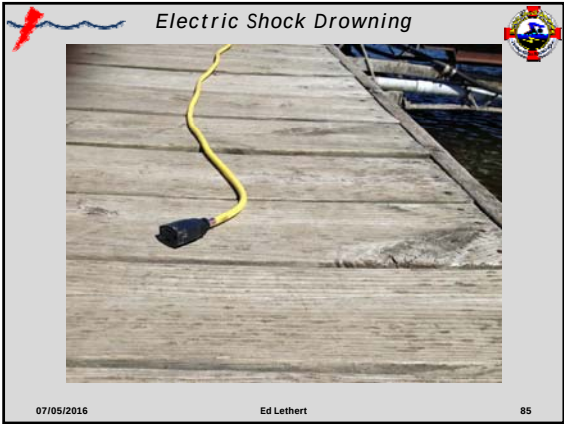
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Not Compliant
NFPA - 303
3.21.1

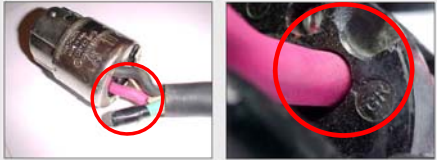
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Electric Shock Drowning

- Can you find the 2 faults here which killed a mother and daughter on Lake Cumberland in May of 2002?
- This plug was wired by the husband/father



D. Rifkin - J. Shefer

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Electric Shock Drowning



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Electric Shock Drowning



230 VAC "Shore Power"?

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Electric Shock Drowning

Electrical safety goals must include

- ✓ Enforceable safety standards
- ✓ Quality and skilled workmanship
- ✓ Inspection by competent authority
- ✓ Recurring inspection
- ✓ Continuous monitoring
- ✓ Routine testing and maintenance
- ✓ EDUCATION OF THE PUBLIC

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Electric Shock Drowning

Electric Shock Drowning Prevention Association



**Awareness
Prevention**

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Electric Shock Drowning

Electric Shock Drowning Prevention Association



**Education
Mitigation**

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Electric Shock Drowning



District 10 Electric Shock Drowning Awareness Initiative for 2016
Minnesota, Wisconsin, Michigan UP




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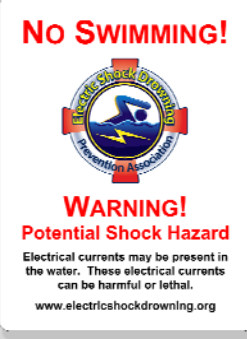
Electric Shock Drowning

Proactive education includes

- Warning signs
- Informational brochures
- Safety guidelines
- Training Sessions
- Presentations
- Other outreach

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Electric Shock Drowning



No SWIMMING!

WARNING!
Potential Shock Hazard

Electrical currents may be present in the water. These electrical currents can be harmful or lethal.
www.electricshockdrowning.org

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Electric Shock Drowning

2017 National Electrical Code

555.24. Precautionary Signage for Electric Shock Hazard in Water.

(A). Permanent safety signs shall be installed to give adequate notice of electrical shock hazard risks to persons using or swimming near a boat dock or marina.

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

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

(D). The signs shall state "WARNING - POTENTIAL SHOCK HAZARD - ELECTRICAL CURRENTS MAY BE PRESENT IN THE WATER."

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

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Electric Shock Drowning



WARNING
NO SWIMMING
RISK OF
ELECTRICAL SHOCK

03/25/2009 Harbor Cove Marina, Duluth, MN

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Electric Shock Drowning



NO SWIMMING OFF OF BOATS OR DOCKS

Minnetonka Power Squadron Island Facility, Lake Minnetonka

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Electric Shock Drowning



**NO SWIMMING
NO PADDLING**

Tonka Bay Marina,
Lake Minnetonka

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Electric Shock Drowning

A Terrible ESD Tragedy in 2012

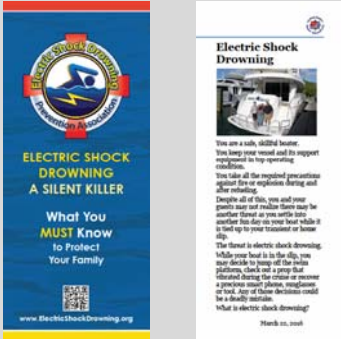


WARNING!
Potential Shock Hazard

Electrical currents may be present in the water. These electrical currents can be harmful or lethal.
www.electricschockdrowning.org

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Electric Shock Drowning



**ELECTRIC SHOCK DROWNING
A SILENT KILLER**

What You **MUST** Know
to Protect
Your Family

www.electricschockdrowning.org

Electric Shock Drowning

You are a safe, skilled 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 are not immune from the ever-present threat as you arrive into another boat due to your boat while it is tied up to your transient or house dock.

The threat is electric shock drowning. While your boat is in the slip, you may decide to jump off the ladder platform, check out a prop that vibrates during the cruise or remove a precious motor, pump, engine, or tool. Any of these devices could be a deadly mistake.

What is electric shock drowning?

March 20, 2008

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Electric Shock Drowning

Proactive mitigation is essential for

- those in the water unintentionally
- the uninformed
- the misinformed
- the disbelieving
- those careless regarding their well-being and the well-being of others
- trespassers

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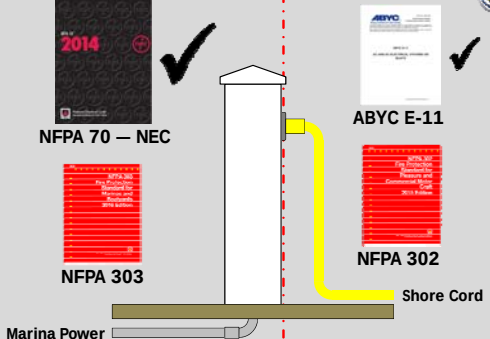
ALLIGATORS

NO SWIMMING

Alligators live in most of Florida's waterways, typically eating fish, turtles, and other small animals. Large alligators, however, occasionally attack larger animals such as deer, and may even attack humans.

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Electric Shock Drowning



2014 ✓

NFPA 70 — NEC

NFPA 303

ABYC E-11

NFPA 302

Shore Cord

Marina Power

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Electric Shock Drowning

Stricter requirements have been or are being enacted in some states

- West Virginia
- Tennessee
- Kentucky
- Missouri
- Arkansas

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Electric Shock Drowning

Ground Fault Protection



Class A GFCI Receptacle (5 mA Trip)

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Electric Shock Drowning

Ground Fault Protection



Class A GFCI Breaker (5 mA Trip)

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Electric Shock Drowning

Ground fault (GFCI) protection required for 125V, 15 and 20 amp receptacle outlets:

- Located Outdoors (1971)
- Boat Houses (1987)
- Boat Hoists - incl hardwired (2005)

The standard for GFCIs require monthly testing of GFCI receptacles and GFCI circuit breakers

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Electric Shock Drowning

Ground fault (GFCI) protection required for shore power service to boats with adoption of the 2011 National Electrical Code

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Electric Shock Drowning



Ground Fault Protection in Pedestals

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Electric Shock Drowning

On-Boat ELCI (30 mA Trip)



Required on boats built after 12-31-2012

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Electric Shock Drowning



In-Line ELCI (30 mA Trip)

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Electric Shock Drowning



EPO Switch for Marinas and Docks?

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Electric Shock Drowning

"That's a great idea to have an emergency pushbutton at all docks with electricity, ..."



Mike Holt, Electrical trainer, Consultant, Author, Publisher
Private communication - 05-30-2016

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Electric Shock Drowning

A Proposed Minimum Requirement

All facilities, from the largest marina to the smallest residential dock, should have instructions posted in a conspicuous location that indicate where and how to disconnect the power to all near-water equipment

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Electric Shock Drowning



Battery Powered Boat Lift w/ Solar Charger

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Electric Shock Drowning



Battery Powered Dock Lights w/ Solar Chargers

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Electric Shock Drowning

When Is It "Safe" to Go Into the Water?

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Electric Shock Drowning

'Safe' is defined in Noah Webster's 1828 Dictionary as

1. Free from danger of any kind
2. Free from hurt, injury or damage
5. Placed beyond the power of doing harm

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Electric Shock Drowning

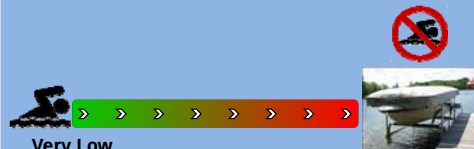
The term "**safe**" to enter the water can be misleading and should never be used in the context of water safety where electric equipment/wiring is installed

The phrase "**degree of risk**" would be more suitable and avoids any inference that absolute safety is assured

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Electric Shock Drowning

Increasing Risk of ESD Accident when approaching closer that 150 ft



Very Low Risk

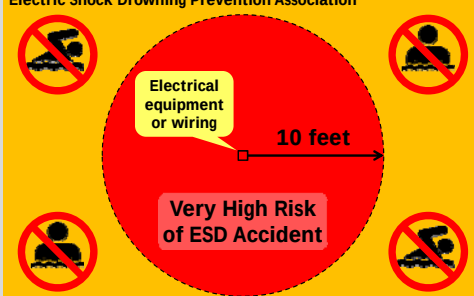
Very High Risk

Known condition / Change always a possibility

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Electric Shock Drowning

Electric Shock Drowning Prevention Association



Very High Risk of ESD Accident

Conditions are always subject to change

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Electric Shock Drowning

When is the risk of ESD "very low"?

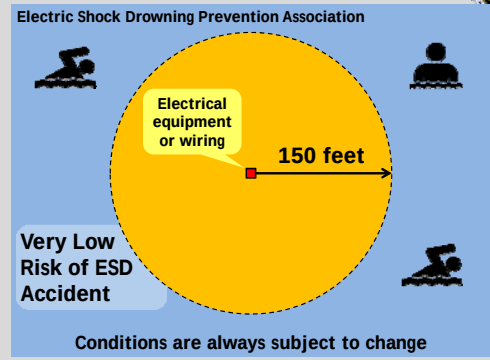
The Electric Shock Drowning Prevention Association recommends maintaining a minimum distance of **150 feet** from all AC electrical equipment and wiring

This separation should reduce the risk of an ESD accident to a very low level for any in-the-water recreational and non-recreational activities

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Electric Shock Drowning

Electric Shock Drowning Prevention Association



Electrical equipment or wiring

150 feet

Very Low Risk of ESD Accident

Conditions are always subject to change

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Electric Shock Drowning

July 4, 2014
Lake of the Ozarks, MO, 7 mile marker

Several people were swimming at a private dock when they started feeling tingles. Turning off the power at the dock did not solve the problem. A contractor found an electrical short at an abandoned boat ramp about **100 yards** away. The power was disconnected and the electricity [tingles] in the water ceased.

"Near Miss" Case No. 5

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Electric Shock Drowning



Sutton Lake Marina, Sutton, WV

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Electric Shock Drowning

It might be considered "low risk" to enter the water (for inspection, maintenance and repair purposes) where ALL nearby shore power is switched off, and locked off, at the power source

This would include securing ALL nearby on-board generators and inverters

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Electric Shock Drowning

Remember & Remind:

In-the-water shock hazards can exist—or occur suddenly without notice or warning—wherever shore-powered AC electrical equipment is located in, on, over, or near the water!



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Electric Shock Drowning

The Cardinal Rule: #1

DO NOT enter the water in the vicinity of shore powered watercraft or equipment, for any reason – **EVER!**

Stay at least 150 feet away from all electrical equipment and wiring !

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Electric Shock Drowning

"That's a great idea to have an emergency pushbutton at all docks with electricity, better yet, NO a/c power on any boat dock!"

"I would NEVER put ac power on my boat dock and I don't have a pool light in my pool."

Mike Holt, Electrical trainer, Consultant, Author, Publisher

Private communication - 05-30-2016

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Electric Shock Drowning

More Information

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Electric Shock Drowning

Please take a brochure

Take some for friends and neighbors

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Electric Shock Drowning

Please take a brochure

Take some for friends and neighbors

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Electric Shock Drowning

Responding to an ESD incident

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[illegible]



Electric Shock Drowning





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Electric Shock Drowning



**ELECTRIC SHOCK DROWNING
PREVENTION ASSOCIATION**

www.electricshockdrowning.org/

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Electric Shock Drowning

 **Boat U.S.[®]**
Boat Owners Association of The United States

Electric Shock Drowning Resource Center
www.boatus.com/seaworthy/ESD.asp

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Electric Shock Drowning



Questions ?

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Electric Shock Drowning



Thank You !

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