

**FISH AND WILDLIFE SERVICE  
OCCUPATIONAL SAFETY AND HEALTH**

**6.1 What is the purpose of this chapter?** This chapter:

- A. Establishes Fish and Wildlife (Service) requirements for electrofishing safety, and
- B. Provides guidelines for the safe operation, construction, and modification of electrofishing equipment.

**6.2 What is the scope of this chapter?** This chapter applies to all Service personnel and volunteers who use electricity to sample or control animals in aquatic habitats.

- A. An electrofishing team, comprised in whole or in part by Service employees, must have a team leader who is certified in electrofishing.
- B. All team members must comply with the training requirements in section 6.6.

**6.3 What are the authorities for this chapter?**

- A. Federal Agency Safety Programs and Responsibilities (29 U.S.C. 668).
- B. Executive Order 12196, Occupational Safety and Health Programs for Federal Employees.
- C. Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters (29 CFR 1960).
- D. Occupational Safety and Health Administration (OSHA), Occupational Safety and Health Standards (29 CFR 1910).
- E. Federal Boat Safety Act of 1971, as amended (46 U.S.C. 1451-89).
- F. National Fire Protection Association (NFPA) 70-1999, National Electric Code (NEC).
- G. Watercraft Safety (485 DM 22).

**6.4 What is electrofishing?** Electrofishing means using electricity in water to capture or control fish or other aquatic organisms.

**6.5 Who is responsible for ensuring compliance with the electrofishing policy?**

**A. The Assistant Director – Business Operations and Management** is responsible for ensuring the Service has a policy on electrofishing safety and equipment standards.

**B. Regional Directors** are responsible for ensuring that:

- (1) Employees conduct electrofishing operations safely, and
- (2) Sufficient resources are allocated to accomplish tasks involving electrofishing in a safe manner.

**C. Chief, Division of Safety and Health** is responsible for:

- (1) Revising and updating this chapter, as necessary, in coordination with the Assistant Director - Fisheries and Habitat Conservation; and
- (2) Interpreting this chapter's requirements and serving as a consultant to resolve Servicewide issues or questions.

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**D. Regional Safety Managers** are responsible for:

- (1) Interpreting the requirements in this chapter and serving as advisors to resolve Regionwide issues and questions; and
- (2) Evaluating implementation of these requirements during Regional field station safety program evaluations.

**E. The Director, National Conservation Training Center (NCTC)** is responsible for:

- (1) Scheduling the *Principles & Techniques of Electrofishing* course sufficiently to meet Service needs. The course should be conducted at least once annually;
- (2) Offering a distance learning version of the electrofishing course—*Electrofishing* (FIS2c01);
- (3) Offering a distance learning version of an electrofishing safety course—*Electrofishing Safety* (FIS2202);
- (4) Preparing electrofishing examinations so employees can demonstrate knowledge of the principles and techniques of electrofishing;
- (5) Issuing course completion certificates for people achieving a score of at least 80% on the course exams; and
- (6) Maintaining records of participants who have successfully completed the electrofishing courses.

**F. Project Leaders** are responsible for:

- (1) Providing adequate staff and resources to ensure that staff can accomplish assigned tasks in a safe and effective manner, in accordance with this chapter, at a minimum;
- (2) Ensuring that all team members are adequately trained, properly equipped, and physically able to perform their duties; and
- (3) Ensuring that safety considerations are part of electrofishing project planning and that staff follow manufacturer's equipment operating guidelines.

**G. The Electrofishing Team Leader**, as the onsite individual in charge of electrofishing operations, is responsible for:

- (1) Identifying hazardous conditions associated with proposed electrofishing operations, determining measures to protect electrofishing team members, and briefing team members (see section 6.6C).
- (2) Maintaining electrofishing equipment for his/her site in a safe condition. Visually inspecting all external wiring, cables, and connectors for physical damage before each use. Making sure that any equipment deficiency that may present a safety hazard is corrected before each field operation or when equipment damage occurs during use.
- (3) Ensuring that employees follow proper safety procedures and use the proper safety equipment, including keeping a well-equipped first aid kit available. First aid kits onboard watercraft must be watertight (see 241 FW 1, Watercraft Safety).
- (4) Ensuring that the team provides warning to the public to avoid exposure to the potential hazards of electrofishing operations. Ensuring that boats are clearly marked with "Danger Electricity" signs.

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- (5) Shutting down electrical power if a member of the public approaches closer than 100 feet to electrofishing operations.
- (6) Ensuring that the team takes precautions to avoid harm to domestic animals or wildlife.
- (7) Ensuring that all electrofishing operations stop and all crew members go ashore in severe weather such as electrical storms.
- (8) Limiting participation in electrofishing to only those trained people necessary to conduct a safe and efficient operation.
- (9) Ensuring that at least one other member of the team, in addition to the team leader, is certified in cardiopulmonary resuscitation (CPR) and first aid.
- (10) Ensuring that all team members undergo a safety orientation. The safety orientation must be provided at least once per season before the start of electrofishing activities (see section 6.6C).
- (11) Providing periodic safety briefings to team members as appropriate. Briefings:
  - (a) Must be provided when there are, for example:
    - (i) Changes in sampling protocols or equipment,
    - (ii) A move to a new sampling site,
    - (iii) A significant change in environmental conditions or hazards,
    - (iv) A recent occurrence of a close call or risky work practice,
    - (v) Introduction of new personnel,
    - (vi) Availability of new safety information, or
    - (vii) Reactivation of an electrofishing crew.
  - (b) May include, among other things, reminders of safe electrofishing, vehicle, and boating practices; information on new equipment or processes; discussion of team member roles; and details of upcoming operations.
  - (c) Must include how to summon emergency help to that location and sample site hazards.
- (12) Fostering an environment where employees feel free to voice safety concerns without fear of repercussions.

**H. Crew Members** are responsible for:

- (1) Adhering to electrofishing safe practices as outlined by the team leader and Service and station policy, and
- (2) Reporting potential work hazards, accidents, incidents, and job-related illnesses/injuries to their team leader or supervisor immediately.

**6.6 What are the training requirements for team leaders and other crew members?**

**A.** Team leaders must have a current certification in electrofishing.

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**(1)** Certification consists of:

**(a)** Successful completion of NCTC's *Principles & Techniques of Electrofishing* course (classroom or distance-learning version). A course completion certificate is obtained by scoring an 80% or above on the exam. (Staff may prepare for the exam by taking any electrofishing course at their discretion. Course topics include:

**(i)** The basic principles of electricity and the generation of electric fields in water;

**(ii)** The basic concept and design guidelines for electrofishing equipment;

**(iii)** Types of electrofishing equipment and capabilities, limitations, safety features, and maintenance;

**(iv)** The safety precautions and personal protective equipment to employ while using electrofishing equipment;

**(v)** Awareness of and methods to reduce fish trauma due to electrofishing; and

**(vi)** Principles of sampling standardization and efficiency.

**(b)** Successful completion of a course in adult CPR and first aid offered by the Red Cross, American Heart Association, or other organization that follows OSHA guidelines for first aid programs (OSHA 331706N 2006). The course must include an instructor-led skills training session.

**(2)** The team leader must pass the NCTC *Principles & Techniques of Electrofishing* written exam at least every 5 years and have current CPR and first aid certificates to maintain electrofishing certification.

**B.** At least one other crew member of an electrofishing team, in addition to the team leader, must have a current certificate in CPR and in first aid.

**C.** All members of the electrofishing team must receive an electrofishing safety orientation at least once per season and prior to the start of electrofishing activities or when they join the team during the field season.

**(1)** The safety orientation must include the NCTC *Electrofishing Safety* course (FIS2202).

**(a)** This course includes information on:

**(i)** Overview of electrofishing equipment components and procedures,

**(ii)** Hazards involved in electrofishing,

**(iii)** Safe operation and emergency shutdown of electrofishing equipment,

**(iv)** Proper use and maintenance of personal protective equipment, and

**(v)** How to report safety issues and any injuries.

**(b)** Crew members must give a copy of the *Electrofishing Safety* course completion certificate to their team leader to document that they have completed the course.

**(2)** The team leader may add site- and equipment-specific topics to the orientation.

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**D.** Personnel operating motorized watercraft in the line of duty must complete the Department of the Interior Motorboat Operators Certification Course (see 241 FW 1). See additional requirements in section 6.11.

**E.** The crew member is responsible for maintaining records of course completion certificates (e.g., hard copies in a personal folder and electronic copies on a computer). The Department also maintains records on the Department's learning management system).

**6.7 What terms do you need to know to understand this chapter?**

**A. Alternating Current (AC).** Alternating current is any electrical waveform that exhibits alternating (reversing) current polarity. In electrofishing, the electrodes alternate as anode and cathode at the waveform frequency (Hertz or cycles per second).

**B. Anode.** An anode is the electrode exhibiting positive polarity in direct current (DC) and pulsed DC electrofishing systems, or the momentary positive electrode with alternating current (AC).

**C. Bonding.** Bonding is the permanent mechanical joining of conductive materials to ensure a reliable, low-resistance electrical connection.

**D. Branch Circuit.** The branch circuit consists of the main conductors located between the pulsator (or generator if there is no pulsator) and the electrodes. Electrical energy is transmitted through the branch circuit to the electrodes.

**E. Cathode.** The cathode is the electrode exhibiting negative polarity in DC and pulsed DC electrofishing systems, or the momentary negative electrode with AC.

**F. Circuit Breakers.** A circuit breaker is a device that monitors electrical current and automatically opens the circuit when the current exceeds an acceptable magnitude. Circuit breakers protect the equipment, not the operator.

**G. Conductor.** A conductor is capable of sustaining a voltage gradient and allowing the flow of electrical current. Wire, cable, and other metal hardware (e.g., boat hulls, bolts, screws, guard rails, insulated wires, engine cowls, fish-holding tanks) are examples of conductors.

**H. Condulet.** Part of an electrical conduit wiring system, a condulet is a container for electrical connections, meant to deter accidental touching of the connections and to protect the wiring from mechanical damage and weather. Condulets usually connect to conduit or electric cables.

**I. Direct Current (DC).** Direct current is an electrical waveform with unidirectional (non-reversing) polarity and either constant or variable amplitude.

**J. Electrical Continuity.** Electrical continuity refers to being part of a complete or connected system that is able to conduct an electric current. Electrical continuity is important in electrofishing boat/raft safety. All significantly sized metal surfaces in the boat should be in electrical continuity by using wired or bonded connections.

**K. Electrocution.** Electrocution is death caused by an electric shock.

**L. Electrodes.** In electrofishing, electrodes are metal objects used to deliver the electrical energy from the electrofishing unit circuitry into the water. Common materials used for electrodes include stainless steel and other steel alloys, aluminum, and galvanized steel. Electrodes come in a wide variety of shapes and sizes. When using direct current, the electrofishing unit contains an anode electrode(s) and a cathode electrode(s).

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**M. Electrofishing Unit.** An electrofishing unit is the gear used for electrofishing. At a minimum, the unit consists of an energy source, emergency stop switch, conductors, and electrodes. The unit also may include a pulsator, metering, and auxiliary circuits for lighting, live well pumps, etc. Two general categories of electrofishing units are (1) watercraft (boat/raft) and (2) portable. We operate portable units while wading.

**N. Electroshock.** Electroshock or electric shock is the perception of electrical current.

**O. Emergency Stop Switch.** An emergency stop switch shuts off system power when pressure is applied to the switch. "Mushroom" or "slap-switch" style switch configurations make it easier to activate an emergency stop. (Also known as a "kill switch.")

**P. Ground.** A ground is an electrical connection between an electrical circuit and the earth or to some other conducting object, such as a boat hull.

**(1)** For boat/raft electrofishing, the metal boat hull or rowing frame (raft) are the primary ground connections to which all other significant metal surfaces (generator, pulsator, metal rails, metal cord reels, etc.) are securely wired or bonded so that there are not any differential voltages to create a shock hazard. Small isolated pieces of metal (such as metal brackets on the operator seat) do not need to be wired or bonded

**(2)** For boats with non-conductive hulls, a metal strip/plate is used as the primary ground connection.

**Q. International Electrotechnical Commission (IEC).** The IEC sets international standards for electrical products.

**R. Isolation Transformer.** An isolation transformer is a transformer that has no wired circuit between its primary and secondary windings, i.e., infinite resistance. We use isolation transformers to allow the generator's frame to function as the primary ground for the electrofishing system independent of a neutral connection. Incorporating an isolation transformer in the circuit between the generator and pulsator allows you to use a generator with the neutral connection intact.

**S. National Electrical Manufacturers Association (NEMA).** NEMA sets common standards for electrical products.

**T. Netter.** The netter is the person who nets the fish or other aquatic organisms during electrofishing operations.

**U. Neutral Connection.** A neutral connection is an electrical connection between the generator windings and the generator case (generator exterior). Most generators provide access to the internal windings that allow you to ground the output terminals to the generator frame. This internal wiring is called the neutral connection. Depending on the generator's design, this connection may be a single jumper between two wire lugs or a complex, multi-wire interconnection. It is often necessary to remove the neutral connection or purchase a generator without a neutral connection ("floating neutral generator") to avoid the malfunction of certain types of pulsators. Do not confuse the neutral connection with the equipment grounding circuits that must never be removed. If you must remove the neutral connection, seek professional assistance.

**V. Pulsator (control box).** The pulsator is the control unit that converts the input power (AC or DC) to appropriate waveforms of DC, pulsed DC, or AC for delivery to the electrodes. The pulsator is also called the control box.

**W. Pulsed Direct Current (PDC).** PDC is a modification of DC in which the waveform transitions from zero to a maximum (voltage, current, or power) at regular intervals.

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**X. Root-Mean-Square (RMS).** RMS is a precise measurement of AC voltage or current that allows for direct calculations of power. It is not a DC average of an AC waveform.

**Y. Safety Switch.** A safety switch (also called a deadman switch) is in a low-voltage (less than 24 volts), secondary circuit that requires constant manual pressure to close the circuit. It allows electrical current flow in the main electrofishing circuit.

**Z. Throwable Anode.** A throwable anode is a portable, hand-held electrode typically used in conjunction with tow-barge or boat electrofishing that may be thrown into habitats and retrieved via the power cord. The effectiveness of throwable anodes depends on the attraction (galvanotaxis) response. See special safety precautions in section 6.10D(5).

**AA. Watertight (weatherproof).** An enclosure more protected than weather-resistant. NEMA type 4 and 4s, IEC IP56.

**BB. Weather-resistant.** An enclosure that protects against weather hazards such as rain and sleet. NEMA type 3 and 3s, IEC IP54.

**6.8 What electrical design specifications are applicable to all electrofishing operations?**

**A. Neutral Connection Removal in the Generator.**

(1) We want to avoid malfunctions in certain types of pulsators (consult manufacturer's specifications) that occur when current output from the generator is not isolated from the ground. We isolate generator current output from the ground by:

- (a) Removing the neutral connection from within the generator,
- (b) Purchasing a generator without a neutral connection ("floating neutral generator"), or
- (c) Incorporating an isolation transformer.

(2) A qualified electrician must verify that electrofishing generators and pulsators not sold as a matched set are compatible for the case neutral.

(3) We may use a generator with the case neutral removed, while on land, only to power plastic encased power tools.

**B. Wiring**

(1) **Conductor Type.** Only copper wire is acceptable in electrofishing units.

(2) **Conductor Voltage.** The insulation value for all wiring in electrofishing units must meet or exceed the maximum voltages generated by the power source or pulsator. In general, the branch circuit conductors require the highest breakdown voltage capacity to sustain the peak magnitudes of the voltage pulses. For insulated wires that are specified with a V RMS rating, you can estimate the peak breakdown voltage (AC, DC, or PDC) to equal 1.4 times the V RMS rating. For example, if you have a 300 VRMS-rated wire, a PDC peak voltage of up to 420 V is permissible.

(3) **Conductor Size.** Table 6-1 shows the minimum conductor size (i.e., for copper wire) for rated RMS amperage of equipment. Always check the manufacturer's specifications for conductors.

**Table 6-1: Minimum Conductor Sizes**

Maximum Amperage	Minimum Conductor Size
11	20 American Wire Gauge (AWG)
16	18 AWG
22	16 AWG
32	14 AWG
64	9 AWG
73	8 AWG
158	3 AWG
181	2 AWG

**(4) Conductor Placement.** The team leader must ensure that all conductors are enclosed in watertight, rigid or flexible conduits or appropriate heavy-duty rubber insulated cables.

**C. Connections.**

**(1)** When using conduit, you may only splice wiring in condulets. A condulet is a type of junction box used in outside locations. If connections are necessary, the rating of the connector must be the same or greater than the wire.

**(2)** Connectors used with flexible cables must be of the locking, weather-resistant type. You should use a splash cover (e.g., a rubber hood) to protect the connection to the generator.

**D. Condulets (junction boxes).** All condulets must be watertight.

**E. Circuit Breakers.**

**(1)** The electrofishing system (e.g., generator, pulsator, or console) must include circuit breakers or fuses to provide circuit protection.

**(2)** If external to the generator or pulsator, circuit breakers or fuses must be labeled to show their purpose.

**F. Controls for Electrical Equipment.**

**(1)** An on-off switch on the generator power source and pulsator must be readily accessible to the operator. We recommend that the pulsator or generator is equipped with a mushroom, push-button, or slap-style emergency stop switch to quickly shut down the system. The emergency stop switch must be clearly labeled or colored red.

**(2)** A voltage meter must be installed to monitor the voltage level applied to the electrodes. An amperage meter can be useful for electrofishing standardization, so we recommend but do not require it.

**(3)** Safety circuits (switches and relays designed to interrupt the high voltage circuits) must not exceed 24 volts.

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**6.9 What personal protective equipment and safety practices are applicable to all electrofishing operations?**

**A. Gloves.**

(1) All team members must wear rubber gloves of sufficient length to isolate hands from touching external surfaces. Common glove materials include neoprene, polyurethane, butyl, silicone, natural rubber, and PVC. Rubber insulating (“linemans”) gloves are not required. Class 0 rubber insulating gloves (maximum use voltage = 1,000 VRMS) with leather glove protectors constitute a practical glove system and allow for dexterity.

(2) Team members must visually inspect gloves for punctures before each use and replace them immediately if they are torn or punctured.

**B. Net Handles.** Net handles must be constructed of a nonconductive material and be sufficiently long to avoid hand contact with the water.

**C. Polarized Sunglasses.** Team members should wear polarized sunglasses when there is glare.

**D. Noise.**

(1) If using a generator, we must perform a noise survey to document sound pressure level (SPL) exposures to electrofishing crew members. When crew members are subjected to sound levels at or above 85 dBA SPL regardless of time exposed, we must provide and crew members must use personal protective equipment to reduce sound levels (see 242 FW 3). Also, whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level of 85 decibels, we must administer a continuing effective hearing loss prevention program in accordance with 242 FW 3.

(2) You can find more information about personal protective measures for preventing hearing loss, such as using earplugs, in 242 FW 3.

(3) You may buy 2-way communication headphones using duty station funds. To be effective, this type of headphone should filter generator and motor noise significantly and provide clear FM communication among personnel. Do not buy radios designed for AM modulation.

**E. Exhaust From Power Source.** You must direct the exhaust from gasoline powered engines away from the equipment operator. Enclose exposed hot pipes in protective screening or position them so that crew members will not be burned. If possible, do not use galvanized pipe for exhaust because it may release toxic gases when extremely hot.

**F. Fuel Storage.**

(1) You must store and transport gasoline and other fuels in approved safety cans. Unless specifically designed as a fuel tank for a generator, pump, or outboard motor, safety cans that meet OSHA standards are required (29 CFR 1926.152(a), 155(a), 155(l)). OSHA recognizes safety cans approved by testing laboratories as Factory Mutual (FM) or United Underwriters Laboratory (UL). When possible, we recommend you use plastic containers instead of metal. Screw-cap type containers that do not meet safety standards are not permissible for such flammable liquids as gasoline.

(2) If rough transport would result in spillage from an approved safety can, then the team must use Department of Transportation-compliant transport and dispensing safety cans.

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**G. Refueling.**

(1) Turn off all equipment before refueling the generator and allow hot surfaces to cool. We recommend that you fill all tanks before each operation to avoid the potential for explosion or fire while refueling.

(2) Only fuel away from any open flame or flame-generating device.

(3) Place portable fuel tanks on dock or pavement for refueling. Do not refuel portable fuel containers on a plastic surface (e.g., a plastic lined pick-up truck bed).

**H. Handling Electrodes.**

(1) After operation of an electrofishing unit, before handling electrodes, disconnect the electrodes from the rest of the system (e.g., with backpack shockers, unplug handheld electrode from the pulsator; with boats, unplug the power output cable from the pulsator). Capacitors in the pulsator hold a charge for a period of time after the power is turned off. Capacitors self discharge, often in less than 5 minutes. Check with the equipment manufacturer to ascertain capacitor discharge times for your pulsator model.

(2) Never touch both electrodes simultaneously while the power source is running, when both electrodes are connected to the equipment circuit, or prior to capacitor discharge time after power shutdown.

**I. Servicing Pulsator.** Before opening a pulsator to service it (e.g., changing fuses), capacitors must be in a discharged state. You must not service the pulsator until the capacitor self-discharge time has elapsed (contact manufacturer for the discharge time).

**J. Making Connections or Repairs.** Prior to adjusting connections or making repairs, disconnect the power source.

**K. Gloves and Wader Repair or Replacement.** Discontinue electrofishing if you feel electroshock through gloves or waders. Replace or repair gloves or waders to eliminate electroshock.

**L. Start-up of Electrofishing Unit.** Before turning on the electrofishing unit, warn all team members and check to be sure they are aware electrofishing is about to begin.

**M. Equipment Inspection.** Maintain all electrofishing equipment in a safe condition. Visually inspect all external wiring, cables, and connectors for physical damage before each use. You must correct any equipment deficiency that may present a safety hazard before each field operation or when equipment damage occurs during actual use.

**N. Protecting Others.** Discontinue electrofishing if anyone outside of the electrofishing team approaches within 100 feet.

**O. Weather.** Discontinue electrofishing during heavy rains or electrical storms.

**6.10 What electrical specifications, safety practices, and additional personal protective equipment are applicable to portable electrofishing units (backpack, tow barge, shore-based, prepositioned, etc.)?**

**A. Portable Electrofishing Units: General.**

**(1) Electrodes.**

(a) Electrode handles must be constructed of a nonconductive material and be long enough to avoid hand contact with the water.

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**(b)** The hand-held electrode (anode with DC or PDC) used with portable electroshockers must be equipped with a safety switch that breaks the electric current. Do not bypass the manual switches with anything that holds them down (e.g., tape).

**(c)** Do not use netting on hand-held electrodes except when sampling for lamprey ammocetes. This helps ensure safety, avoid fish trauma, and allows maintenance removal of deposits. Automatic cut-off circuitry for anodes used out of the water may have a minimum amperage cut-off threshold that is above the level that has no effect on humans.

**(2) Standard Safety Equipment.**

**(a) Waders.** All crew members must wear chest or hip waders to insulate them from electrical shock. Suitable waders are generally constructed of neoprene, PVC, silicon, etc. If you use breathable waders, then you must wear long pants under the waders.

**(b) Footwear.** All footwear must have non-slip soles.

**(3) Grounding.** For electrofishing methods that employ a generator stationed on land (e.g., shore-based, electric seine), we strongly recommend you ground the generator frame to earth using a driven ground rod. You should also ground the pulsator in a shore-based operation to earth either through the generator or by a separate driven ground rod. Backpack electrofishing units cannot be grounded to earth.

**B. Backpack Electrofishing Units.**

**(1)** You must use gel-type batteries that will not leak when tipped or overturned.

**(2)** Backpacks must have a quick release belt (hip) and shoulder straps.

**(3)** All equipment must have a tilt switch that opens the circuit if the operator falls. The tilt switch must require manual reset after regaining footing.

**C. Shore-based Electrofishing Units.**

**(1)** Each electrode operator must have an individual safety switch on the electrode handle.

**(2)** A crew member must continuously man the generator so it can be immediately shut down in an emergency.

**D. Tow-Barge Electrofishing Units.**

**(1)** Each electrode operator must have an individual safety switch on the electrode handle.

**(2)** The barge hull must be made of nonconductive material with an electrode attached to the hull bottom.

**(3)** A crew member must continuously man the generator so it can be immediately shut down in an emergency.

**(4)** The tow barge operator must be tethered to an emergency stop switch or operating a safety switch that interrupts the electrical power if the operator falls.

**(5)** You may only use non-fixed, throwable anodes when using a tow barge that has a non-conductive hull and a cathode located in an isolated position (e.g., a metal plate attached to the bottom of the hull). You may not use a throwable anode in typical electrofishing deployment, even if it has a safety switch.

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(6) The tow barge operator should always watch the crew while the electricity is on. Electrode operators must keep the netter within their view.

**E. Electric Seine Electrofishing Units.**

(1) Each braille (seine pole) must have an individual safety switch wired in a series to control the power applied to the electrodes.

(2) A crew member must continuously man the generator so it can be immediately shut down in an emergency.

**F. Prepositioned Area Electrofishing Units.** A crew member must continuously man the generator so it can be shut down in an emergency.

**6.11 What electrical specifications, safety practices, and additional personal protective equipment are applicable to electrofishing boats and rafts?**

**A. Design.**

(1) Boat design and equipment must be in compliance with U. S. Coast Guard and State regulations and U.S. Department of the Interior policy. Boat and raft crew must follow the additional guidelines in this electrofishing safety policy.

(2) The netting area must have substantial safety rails to help prevent netters from falling overboard. Safety rails must withstand netters leaning on them without collapsing.

(a) On solid-hulled boats, safety rails should be at least 42 inches from the top of the rail to the deck. The top of the rail should be at or above the waistline of netters.

(b) Safety rails on rafts may be lower, but netters must kneel to keep the top of the rail at or above their waistline.

(3) The team leader must ensure the boat bow deck is painted with a nonslip or skid-resistant coating or roughened in some manner to decrease the chance of slipping.

(4) Electrode booms (anodes with DC) must be mounted in a fixed position on a metal-hulled boat.

(5) All metal surfaces on a boat or raft must be electrically connected (in electrical continuity) to eliminate differences in electrical potential that may cause electric shock. You may use a metal boat hull as a cathode.

(6) An acid proof, nonmetallic enclosure and holder must be provided for wet cell batteries.

(7) All conductors must be enclosed in watertight, flexible or rigid conduits. You may use appropriately rated, heavy duty insulated cables where external connections are necessary (e.g., to the booms, pulsator, or foot safety switch). All conductors installed in a common raceway (conduit) must be continuous (without connectors, breaks, or splicing) and independently and correctly insulated.

(8) Lighting and other auxiliary circuits should not exceed 24 volts. You may use 110 volt lamps if the lamp is shielded with a protective housing.

(9) Mount fire extinguishers away from gas cans, generators, or other fire sources.

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**B. Controls for Electrical Equipment.**

(1) The boat/raft operator must have ready access to a generator or pulsator on/off, emergency stop, or safety switch to cut the power in case of an accident.

(2) At least one netter on the bow work deck must have a safety switch connected to the power control circuit.

**C. Clear Working Space.** There must be adequate working space to conduct safe operations. The team leader and all crew members must be careful to prevent clutter that may cause safety hazards.

**D. Lighting.**

(1) When operating at night, adequate on-board lighting (12-24 volts) must be provided for working areas.

(2) You must use adequate lighting outside the boat/raft to avoid safety hazards such as striking logs, rocks, and overhead tree branches.

**E. Standard Safety Equipment.**

(1) All boat/raft occupants must wear U.S. Coast Guard-approved personal flotation devices at all times in accordance with the Department of the Interior and Service watercraft safety policy (485 DM 22 and 241 FW 1).

(2) Crew members in boats must, at a minimum, wear knee high rubber boots to keep their lower legs and feet isolated from wet surfaces to protect against electric shock. Netters in rafts must wear hip waders to prevent contact with wet surfaces.

(3) Motorized electrofishing boats must be outfitted with required safety equipment (also see 241 FW 1, Watercraft Safety).

/sgd/ Paul R. Schmidt  
ACTING DIRECTOR

Date: April 30, 2010