

safety practices gets delayed or omitted in lieu of other pressing matters. However, if GFCIs are used, marina management must commit to:

- planning, managing and supervising a program of regular and systematic testing of the devices;
- training staff to use approved testing equipment and procedures;
- procuring and using appropriate testing equipment that will actually create a ground fault to determine if the device is working properly, and trip at the design ground fault amperage of not more than 5.0 milliamp;
- using, maintaining and updating correct procedures;
- maintaining accurate inspection and maintenance records; and
- informing, encouraging and requiring boat owners to inspect, correct and maintain the electrical systems on their boats.

#### ..... E5.9 Sub-Metering of Marinas

##### **Commentary:**

The installation and use of kilowatt hour sub-meters in marinas has a dramatic impact on electrical power consumption. A documented field study funded by DBW, executed by ADCO Electric, Inc. of Santa Cruz, CA, and published in 1995, shows that sub-meters will reduce actual power consumption by nearly 50 percent. The field study is titled Report on Documented Field Study of Actual Electrical Power Use in California Small Craft Harbors, dated May 1995.

Utilization of sub-meters in a marina has a significant effect on high peak use as well. The field study revealed that the highest recorded peak amps, which reflect worst condition use, were also reduced by nearly 50% when sub-meters were in operation.

Another benefit of sub-metering is a significant conservation of energy, along with a reduction in monthly operation costs. It is typical for an existing non-sub-metered marina to realize a 60-70 percent reduction in annual electrical utility costs after sub-meters are installed.

**Example:** The public marina in Antioch, California installed sub-meters in the 1990s, and quickly realized a 66 percent reduction in power consumption. The marina's electrical bill dropped from \$36,000 per month to approximately \$20,000, of which \$14,000 is recoverable from the boaters under CPUC rules for sub-metering marina boat slips.

Prior to installation of the sub-meters, the cost of electrical power was included in the monthly berthing fees. If such monthly berthing fees are based solely on the length of the berth, inequities occur. For example, it is well known that larger boats use disproportionately more electrical power than smaller boats as they typically have more and bigger equipment. But does a **typical 60 foot boat** use twice as much power as a **typical 30 foot boat**? Obviously, there are variables involved here. But what does not vary is the length of berths and the marina

basin water surface areas required for berths of various lengths. A single berth for a 30 foot power boat requires a total area of 960 square feet, including the water area in the berth, the fairway in front of the berth, and the main walkway and fingerfloat deck areas that define the berth. However, a single berth for a 60 foot powerboat requires a total area of 2,628 square feet, more than 2.7 times the required area of the 30 foot berth (see Table B-7). The utilization of sub-meters removes the cost of electrical power from the inequitable berth length/area equation, identifies actual power consumption, allocates costs to the actual users, and encourages significant savings of electrical power and money for both marina operators and their customers.

Sub-metering will also result in a decrease in fire hazards by encouraging boaters to unplug or turn off unattended/unnecessary heaters, lights, air conditioners, refrigerators, freezers, trash compactors, battery chargers, radios, TVs, computers, and other power equipment and devices.

Another positive impact of sub-metering is the potential increase of the effective capacity of older electrical systems on existing marinas. Aging marinas experience the growing demand for more power as more electrically demanding boats occupy the berths. Marinas that allow liveaboards and overnight/weekend occupation of berthed boats experience increased power demands. This results in a growing frequency of circuit breaker tripping, maintenance, repair and/or replacement. The installation of sub-meters has an immediate impact on the boater's perspective on the cost of power and its impact on their wallets. Typically, wasteful use of power is greatly reduced, making capacity available to meet legitimate increases in demand and extending the useful life of existing electrical systems.

In California, prior to 1993, only private marinas could install and operate sub-meters. However, Assembly Bill 2108, signed into law on October 11, 1993, specifically allowed public marinas to sub-meter as well. Along with this legal approval came the requirement to comply with rules and regulations dictated by the California Public Utilities Commission (CPUC). Strict adherence to the rules is mandatory, requiring marina operators to collect monthly fees, independent of the monthly berthing fees, to offset the costs of installing, maintaining, replacing, reading and billing related to the sub-meters and other related electrical equipment. The monthly fees are based on single-phase service, polyphase service, and energy charges per kWh during summer and winter periods. Check with your local electrical utility provider to obtain a copy of their rate schedule.

Authorization to sub-meter a marina is conveyed through a document known as Rule 18. All electrical power utility companies in California have a Rule 18, or variation thereof. As an example, the following excerpt is taken from the Pacific Gas and Electric Company Rule 18, page 3:

**"C. FURNISHING AND METERING OF ELECTRICITY**

**3. MARINAS AND SMALL CRAFT HARBORS**

Notwithstanding any other provision of this rule, PG&E will furnish electrical

service to the master-meter customer at a privately or publicly owned marina or small craft harbor. The master-meter customer may sub-meter individual slips or berths at the marina or harbor but may not sub-meter any land-based facility or tenant.

If the master-meter customer sub-meters and furnishes electricity to individual slips or berths, the rates and charges to the user must not exceed those that would apply if the user were purchasing such electricity directly from PG&E."

To illustrate the actual benefits of utilizing marina electrical sub-meters, the field study included a marina that had two separate berthing areas: one sub-metered, the other not metered; one with recreational boats only, the other with commercial fishing boats only. Over a period of one year, the two berthing areas had nearly 100% occupancy, and were monitored using separate utility company meters. Over the study period, ***the unmetered 144 recreational boat berths used 246% more electrical power than the sub-metered 228 commercial fishing boat berths.*** Even considering that there may be different patterns of electrical power consumption between recreational boats and commercial fishing boats, the fact that 37 % fewer recreational boats used 246 % more power than 228 commercial fishing boats is still a very significant indication of the impact and positive benefits of sub-meters in a marina.

If sub-meters are installed in a marina, they must meet the requirements of CCR Title 4, Division 9, Chapter 1, Article 2.2. Two of the more important requirements address the location and height ranges of the sub-meters with regard to personnel who read, calibrate, maintain, repair and replace sub-meters. For details, see the above cited code or contact staff at the Division of Measurement Standards, California Department of Food and Agriculture.

#### ..... E5.11 Electrical Power Centers (boxes, pedestals and towers)

##### **Commentary:**

Individual power centers are usually low in profile, 12" to 16" high, have two electrical outlets, two breakers, one low voltage (7-watt) fluorescent deck/outlet light with a photo-electric cell, fuses if required, and perhaps telephone and cable TV jacks. The power centers can be mounted on posts or power pedestals to raise the outlets to more convenient heights for boater use and staff maintenance. They are often mounted in the front face of a dock storage box used to store supplies, materials and equipment for operating and maintaining a boat.



Power Center and Separate Water Supply