



Municipal Affairs and Environment

*2019 Clean and Safe Drinking Water Workshop  
@ Hotel Gander*

# *Electrical Safety*

*Presenter: Dave Galbraith*



# Electrical Safety !?



Do we know if we are really working safely?

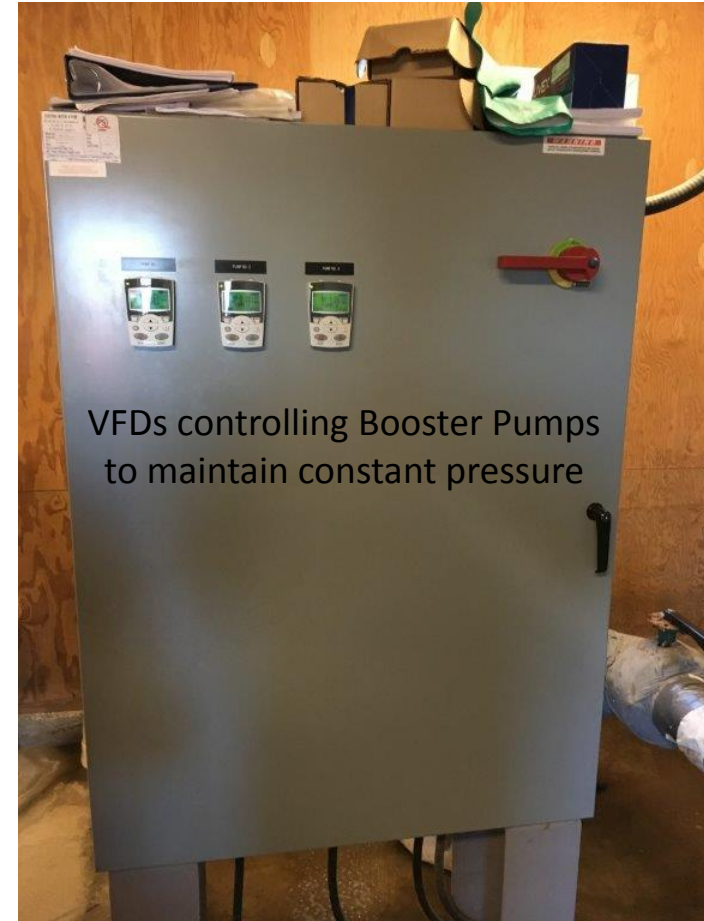
### Quick Notes:

- We will try not to make this too technical – but a little technical for the people smarter than me...
- Operators of treatment plants will find a variety of power sources at a Treatment Facility
  - It might be single phase 240VAC or three phase 208VAC ... or it might be 600VAC three phase
- A simple chlorination facility for a small community may single phase or 3-phase power – it depends on what is available in the community.
- With VFDs we can change single phase into three phase power – to operate 3-Phase motors
- Deep Well Water Pumps – are very often three phase power due to the long cable runs and depths of well.
- The higher the voltage the less the Amps – 3-Phase Motors use less Amps than single phase motors.
- The less the Amps, the smaller the wire size.
  - A 7 ½ Hp 600VAC 3-Phase pump may use 9-11 Amps
  - A 7 ½ Hp 208VAC 3-Phase pump may use 27-31 Amps
  - A 7 ½ Hp 240VAC Single Phase motor may use 30-51 Amps
- Chlorine Injection Pumps are typically 120VAC Single Phase and low power consumption.

Original use for the Rum Pump



Liquid Chlorine Injection System



VFDs controlling Booster Pumps  
to maintain constant pressure

# Channel-Port aux Basques

# Pigeon Cove

Booster Stations  
with VFDs to maintain  
constant pressure



Incoming Power, Disconnects, Meter Base, etc.



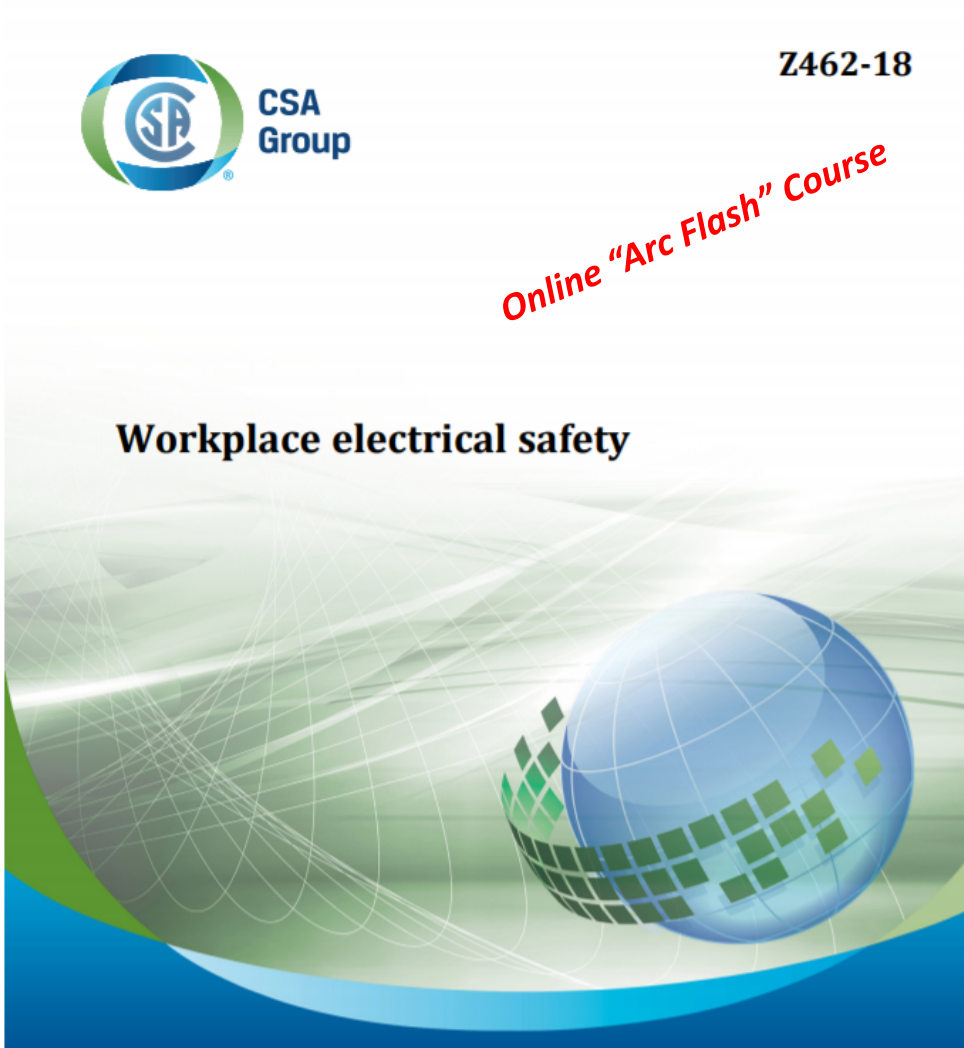
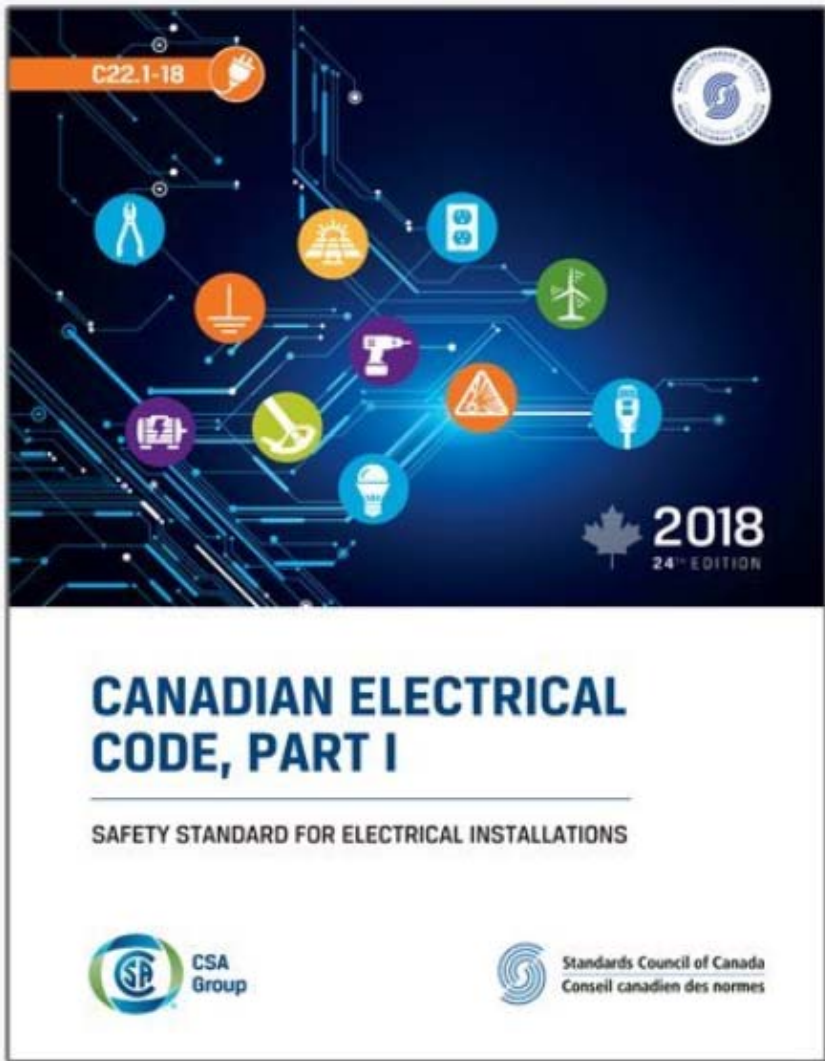


<https://www.youtube.com/watch?v=JzQqmsxEXe4>

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"The safety training video just arrived."



- PPE (Protective Personal Equipment)
- **L.O.T.O.** Lock **O**ut and **T**ag **O**ut procedures
- GFCI - ground-fault circuit interrupters.
- The effects of electric current on the human body.
- Common facts – short cuts



**THINK**  
**SAFETY**  
**FIRST**  
**WEAR**  
**PERSONAL**  
**PROTECTIVE**  
**EQUIPMENT**



# General Safety Rules

- **THINK FIRST! This is the most important safety rule!**
- CSA Approved and Electrically Rated Work Boots, Eye/Face/Hearing/Head Protection, Gloves and Clothing  
As appropriate for the task at hand.
- Never work on an energized circuit...
- Always disconnect the power.
- L.O.T.O. procedures prevent accidental energizing of circuits.
- Use only CSA Approved Tools and Multimeters.
- Do not work alone... (if possible)
- Work with one hand when possible.
- Learn first aid and CPR.
  
- When in doubt... ask a licensed trades person for assistance.
- Just owning a Multimeter does not make a person qualified...

## ONE Hand Rule



- Stand out of the “line-of-fire.”
- Turn head away.
- Take a deep breath & hold it.
- DO NOT reach across door.



# L.O.T.O. Lock Out and Tag Out



A safety tag used to tag out equipment...

Lock out and tag out procedures prevent electrical accidents

# LOTO

The Lock Out/Tag Out procedure prevents the unexpected start up or release of stored energy that could cause injury to employees by placing a lock and/or warning tag on an energy isolation device.

Can you Name Hazardous Sources of Energy ???

- Electrical
- Mechanical (i.e. motors, drive belts)
- Chemical (i.e. natural gas, propane, chlorine – gas or liquid)
- Thermal
- Pneumatic
- Hydraulic

# LOTO

- Lock out will be accomplished using a lock and key. Chains, or other hardware, may be used in conjunction with the lock to isolate the energy source.

## Best practice

**“one person – one lock”**



## *Prep For Shutdown*

- Know the types and amounts of energy that power specific equipment
- Know the hazards of that energy
- Know how the energy can be controlled – review equipment specific procedures if necessary
- Direct any questions to immediate supervisor
- Verify your LOTO requirements from your employer...



Electrical sources are divided into two basic types:

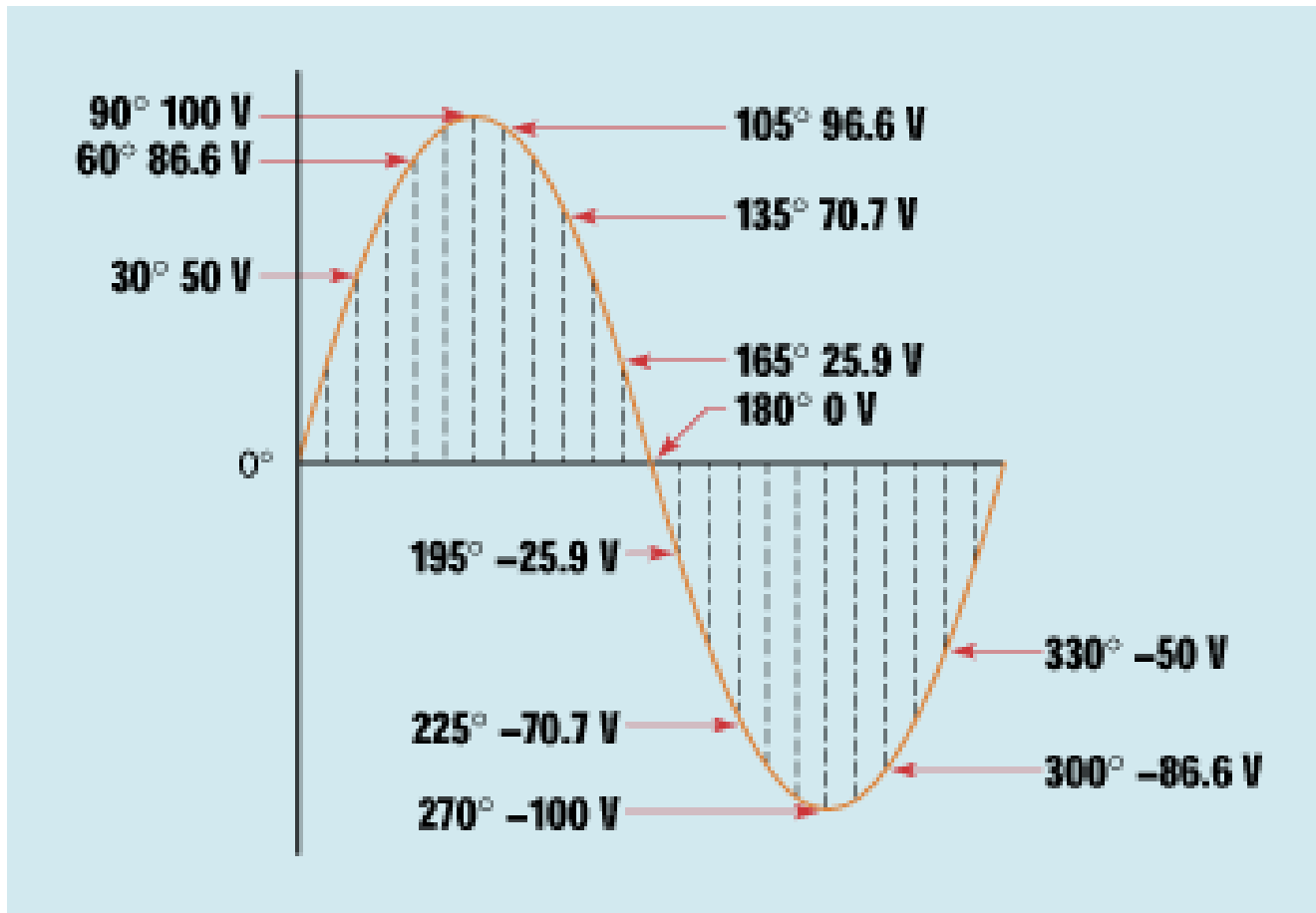
- Direct Current (DC) which is **unidirectional** (one way).



- Alternating Current (AC) which is **bidirectional** (two way, or back and forth).



Power from Hydro is “AC” alternates the current @ 60Hz  
... in other words 60 cycles per second...



**Instantaneous values** of voltage along an AC sine wave.

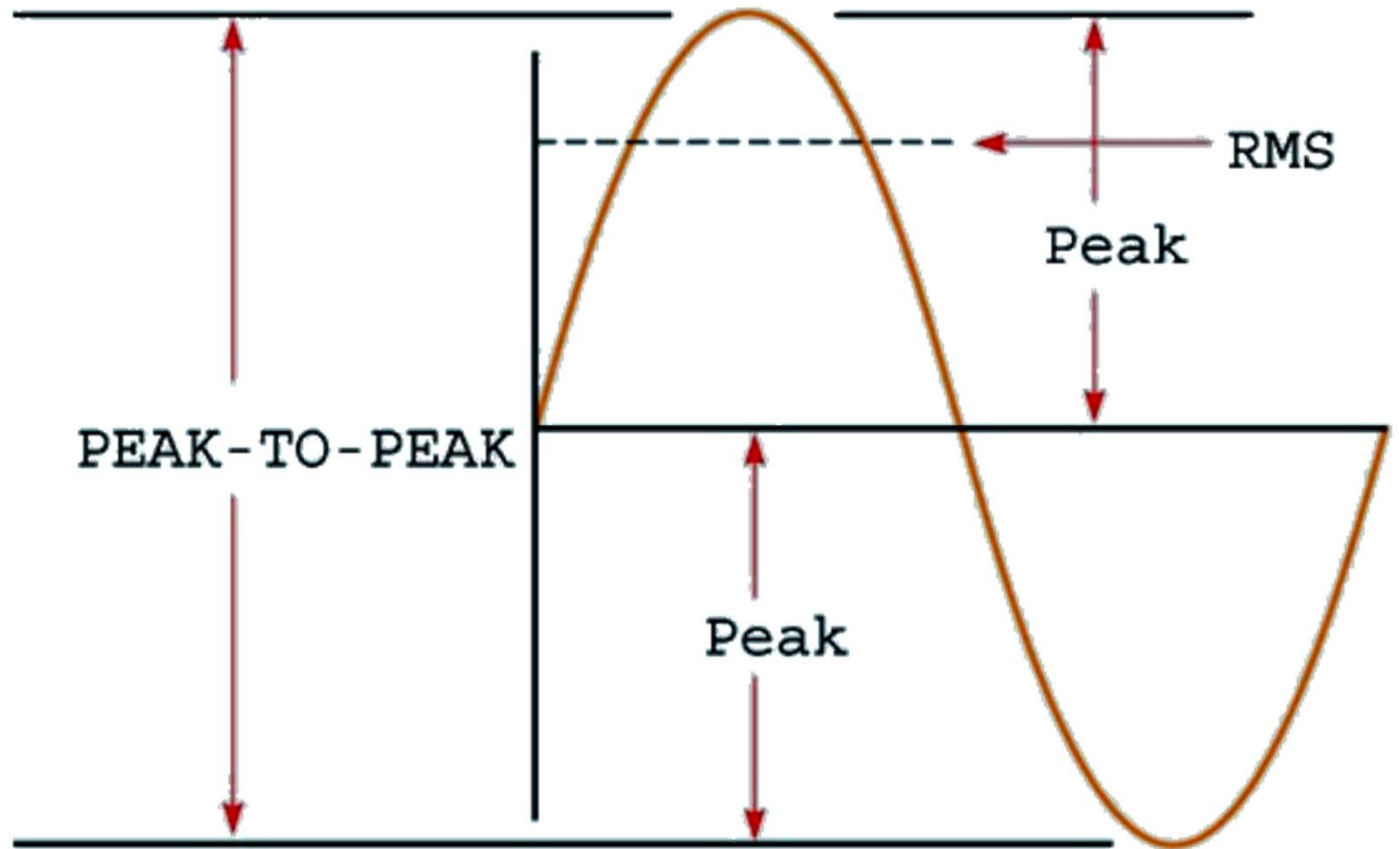


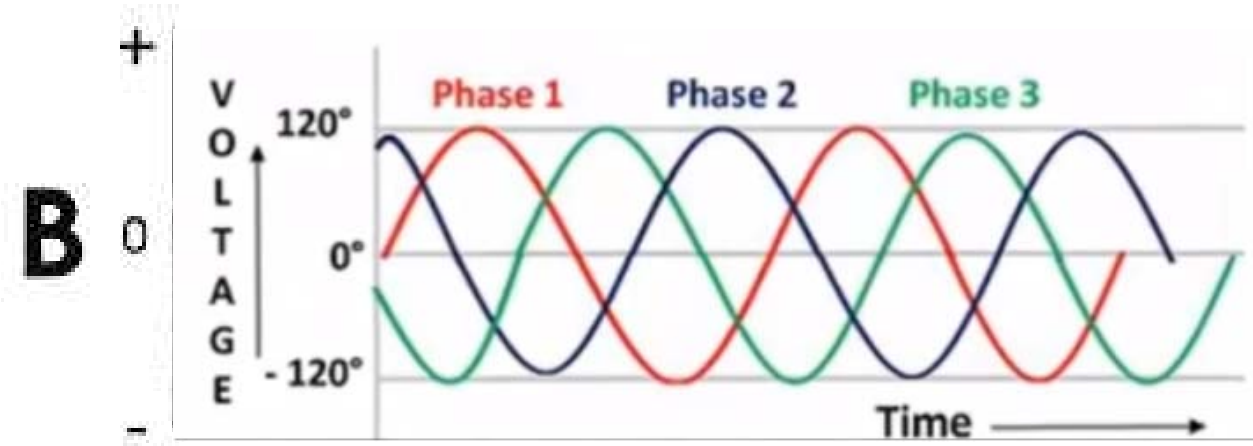
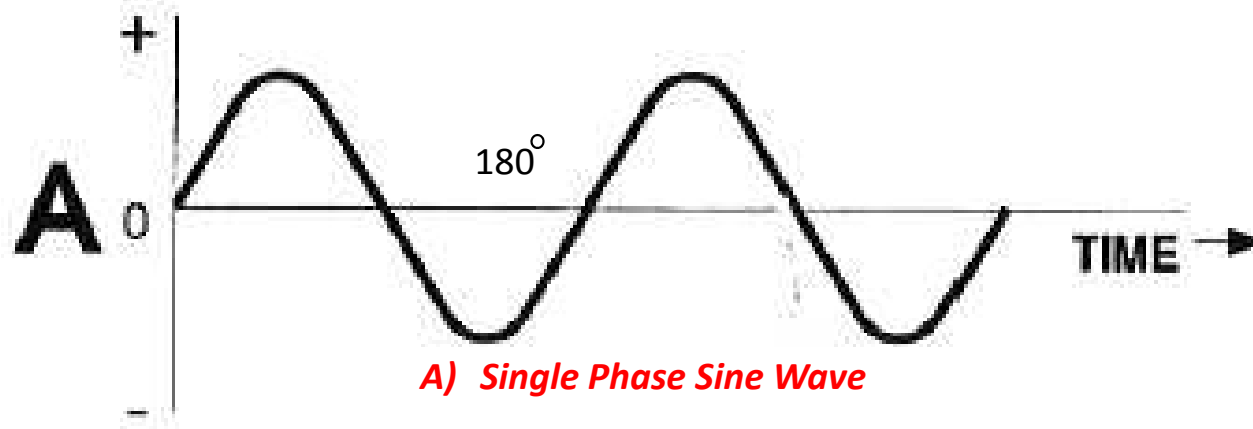
$\text{RMS} = \text{Peak} \times 0.707$   
 $\text{Peak} = \text{RMS} \times 1.414$

$\text{RMS} = 575 \text{ V}$     $\text{PEAK} = 813 \text{ V}$

$\text{RMS} = 120 \text{ V}$     $\text{PEAK} = 170 \text{ V}$

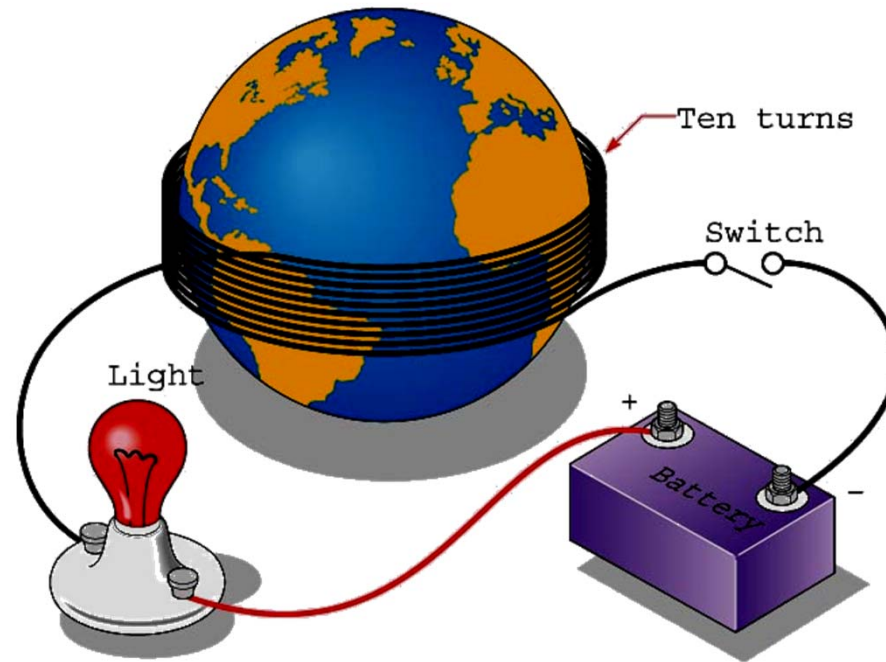
$\text{RMS} = 240 \text{ V}$     $\text{PEAK} = 340 \text{ V}$



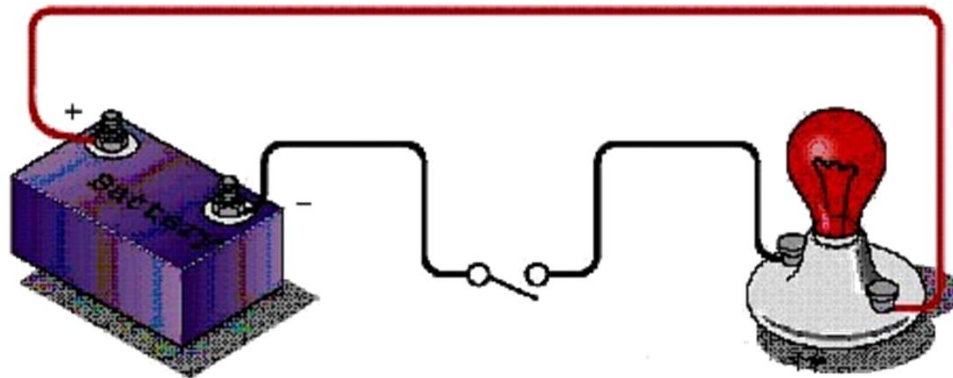
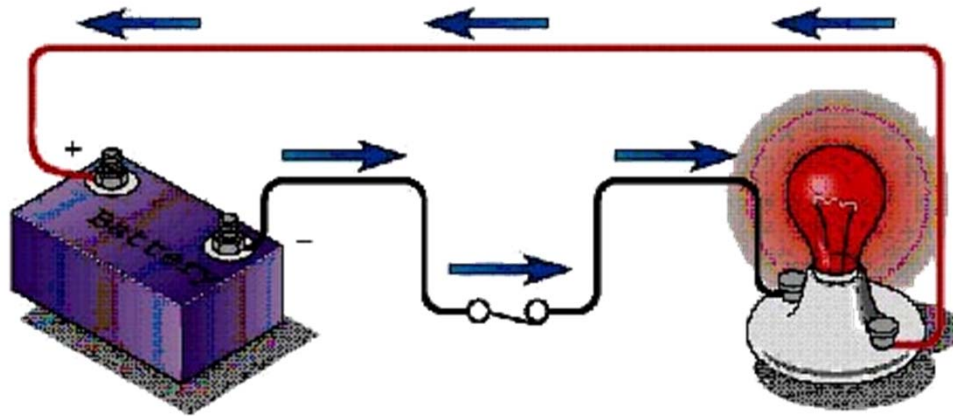


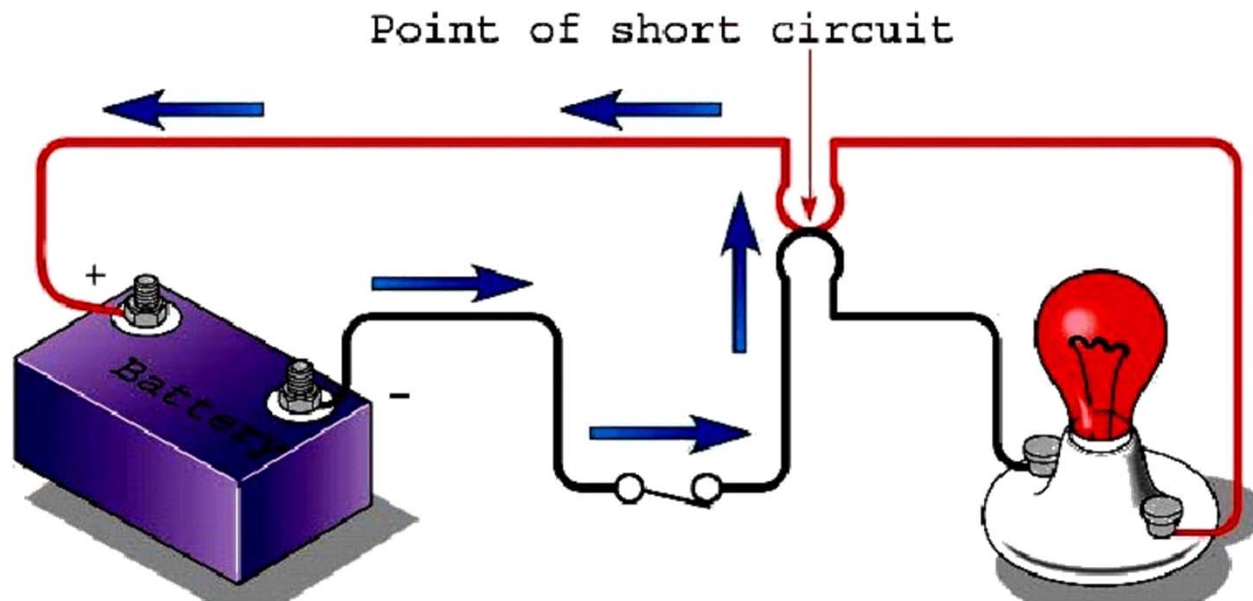
*B) Three Phase Sine Wave*

The impulse of electricity can travel faster than the speed of light.  
It would take a light beam 1.3 seconds to travel around the earth 10 times.  
If a wire were wrapped around the earth 10 times, when the switch was closed the light would come on almost instantly.



A simple **switch** closes and opens an electrical circuit.



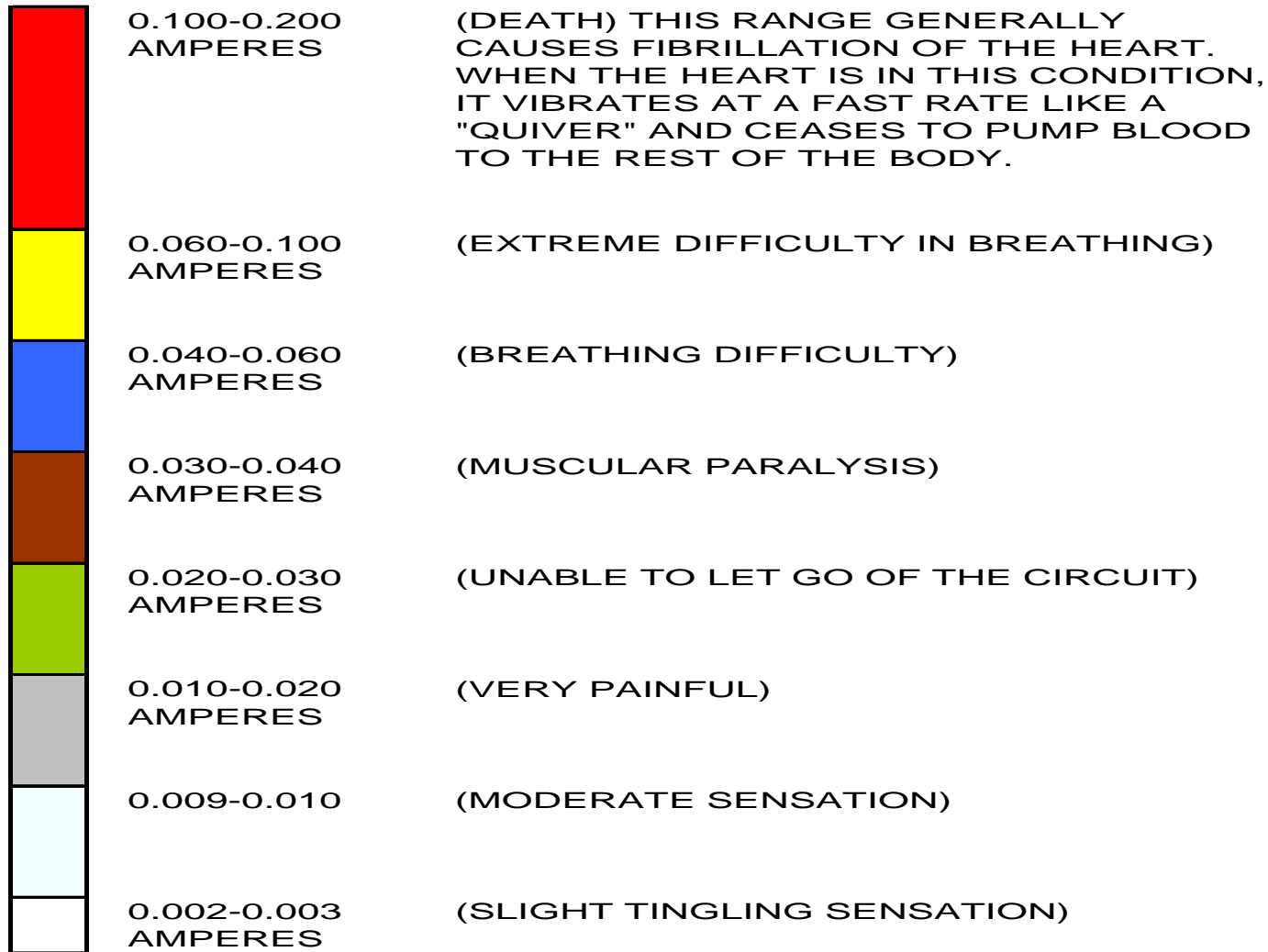


A **short circuit** has an unintended shorter pathway.



Ever had this happen to you???

## *Effects of electric current on the human body.*



## Three types of GFCI...



Wall Outlet



Circuit Breaker



Portable

The **GFCI** will “sense” the difference in the amount of electricity flowing into the circuit... with amounts of current as small as 4 or 5 milliamps (.004 or .005)

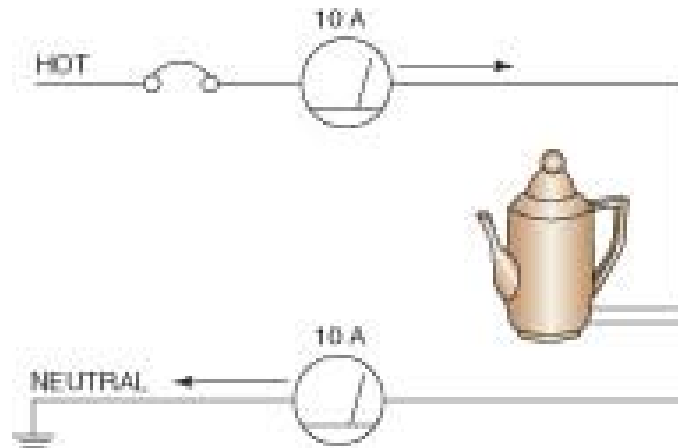
The **GFCI** reacts **quickly** (less than one-tenth of a second) to trip or shut off the circuit

GFCI (Ground Fault Circuit Interrupters) are for “People Protection” not Equipment.

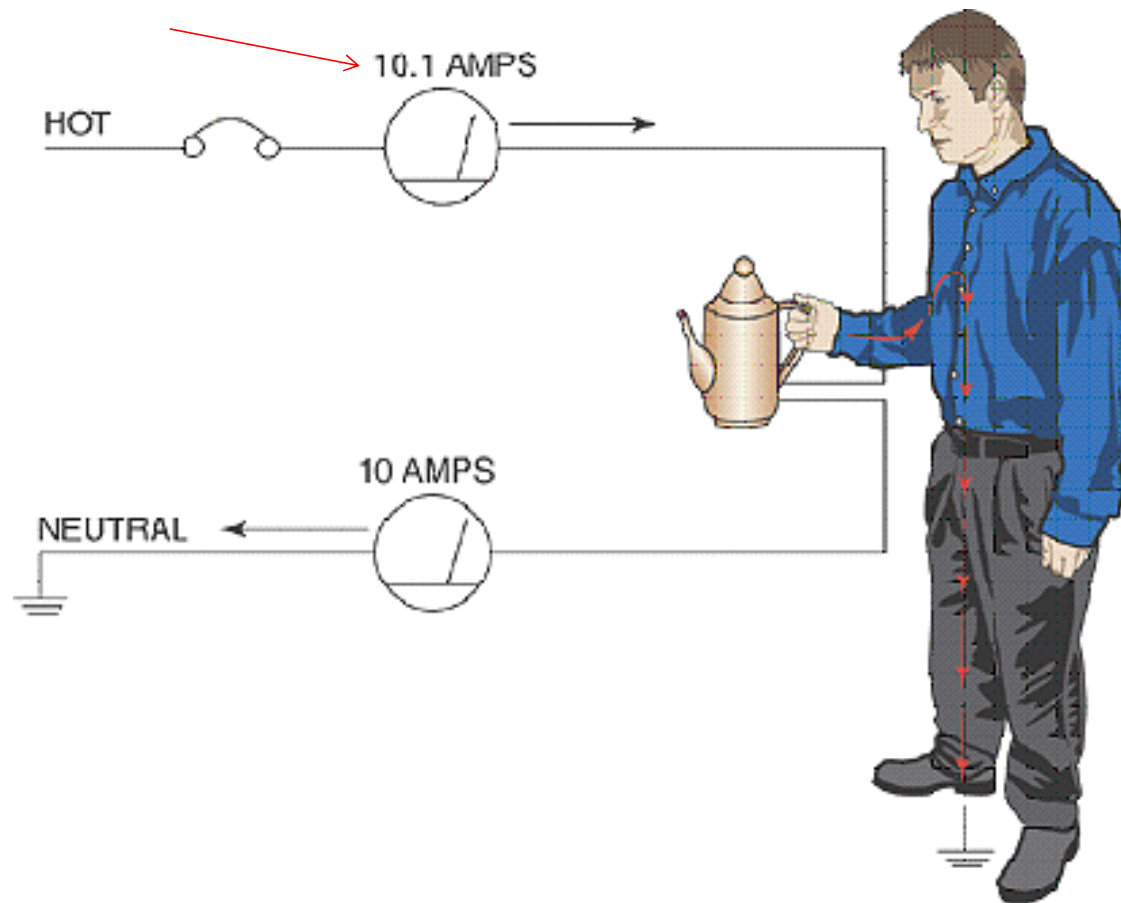


## GFCI...

Ground-fault circuit interrupters are used to protect people from electrical shock.

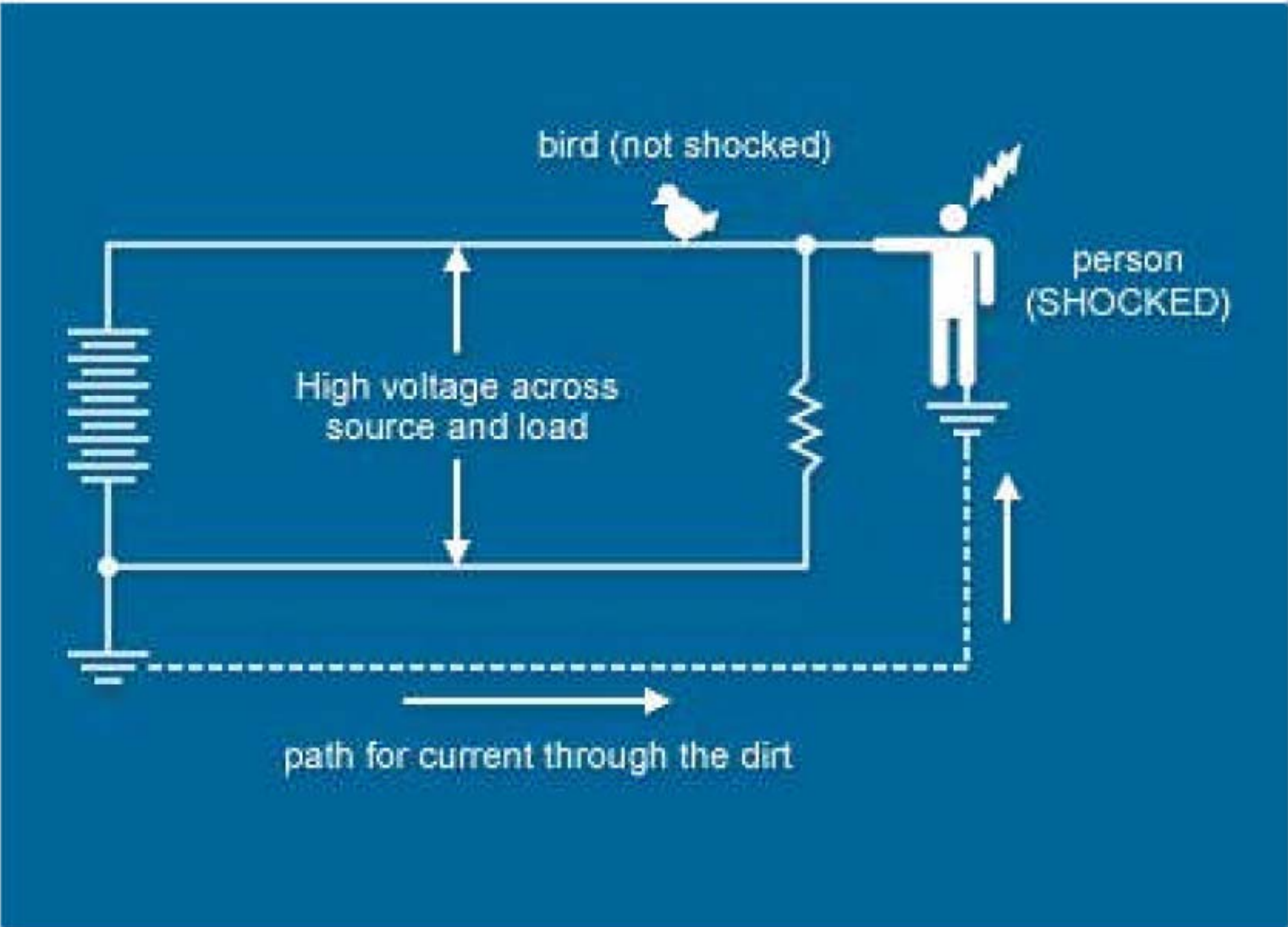


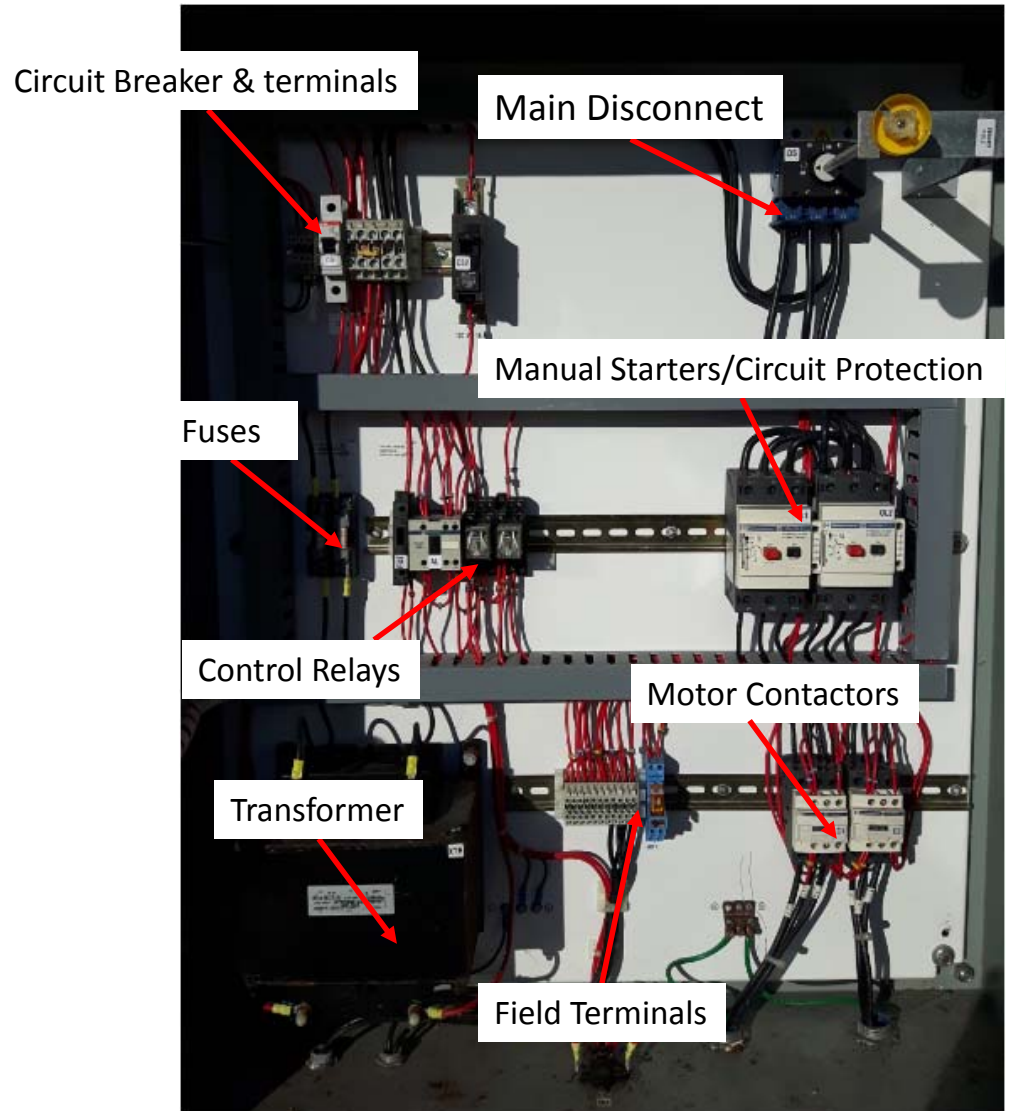
A GFCI device monitors both the hot and neutral currents.  
These currents should be equal!

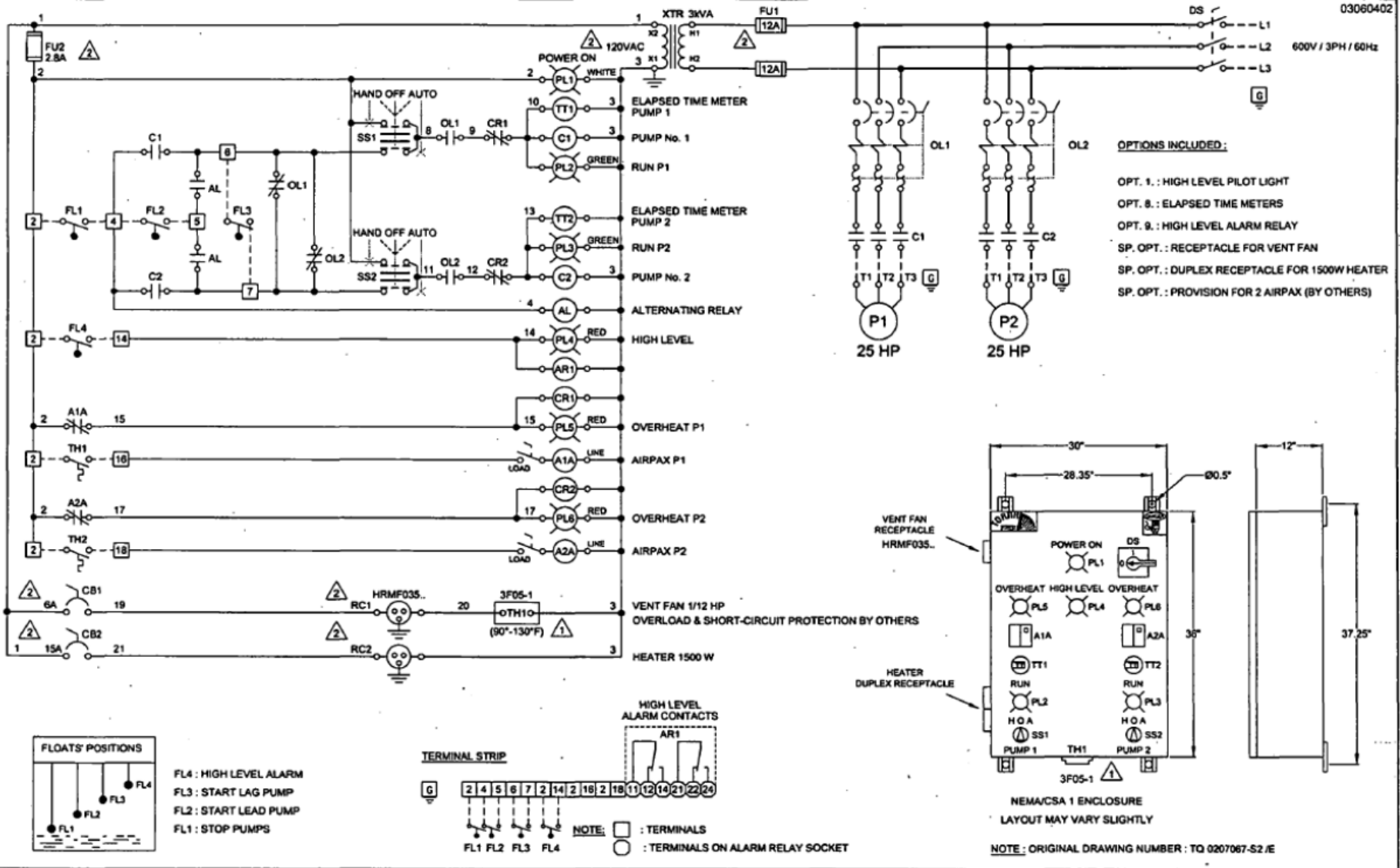


Unequal currents may mean an unwanted pathway through a person!

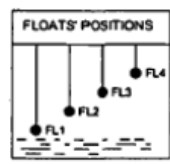
... This is a ground fault.





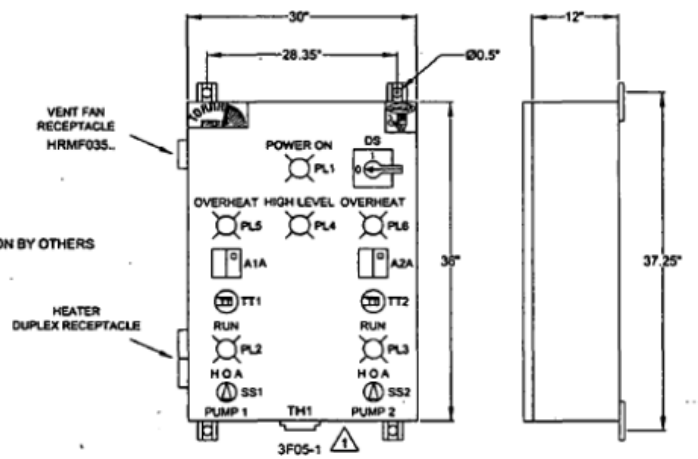
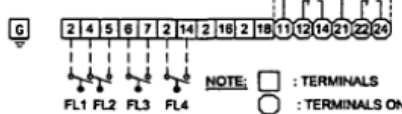


- OPTIONS INCLUDED:**
- OPT. 1.: HIGH LEVEL PILOT LIGHT
  - OPT. 8.: ELAPSED TIME METERS
  - OPT. 9.: HIGH LEVEL ALARM RELAY
  - SP. OPT.: RECEPTACLE FOR VENT FAN
  - SP. OPT.: DUPLEX RECEPTACLE FOR 1500W HEATER
  - SP. OPT.: PROVISION FOR 2 AIRPAX (BY OTHERS)



FL4 : HIGH LEVEL ALARM  
 FL3 : START LAG PUMP  
 FL2 : START LEAD PUMP  
 FL1 : STOP PUMPS

**TERMINAL STRIP**



NOTE : ORIGINAL DRAWING NUMBER : TQ 0207067-S2 /E

## Common short-cuts

At 3600 rpm, a motor develops 1.5 lb/ft of Torque per Hp

At 1800 rpm, a motor develops 3.0 lb/ft of Torque per Hp

At 1200 rpm, a motor develops 4.5 lb/ft of Torque per Hp

At 575 volts, a 3-phase motor draws 1 amp per Hp

At 460 volts, a 3-phase motor draws 1.25 amps per Hp

At 230 volts a 3-phase motor draws 2.5 amps per Hp

At 240 volts, a single-phase motor draws 5 amps per Hp

At 120 volts, a single-phase motor draws 10 amps per Hp

## Fun Facts...

Electricity travels in excess of 186,000 miles (300,000 km) per second

The Higher the Voltage the less the current required in a circuit...

Example: 10Hp three phase Motor

600VAC = ~ 10 Amps

208VAC = ~ 30 Amps

It is the Current in the circuit that can Kill you; not the voltage

Static Electricity can generate 3,000+ volts







**Thank you**

***Questions?***