

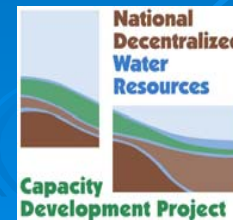
# Controls Section IV: Design Considerations for Control Devices

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# Section Objectives:

- Introduction to different safety standards
- Understand how to implement safety into Onsite design
- Introduction to various Onsite design documentation needs

# Safety

- Control devices and the electrical components that they control can pose significant safety threats to all who come in contact with them either incidentally or as a professional.
- In addition to good design, safe and reliable equipment and competent installation and maintenance there are basic standards which all who design, install or work with the electrical components of onsite systems should adhere to.

# Safety Standard Examples

- Underwriters Laboratory Listing (U/L)
- National Electrical Manufacturers Association (NEMA)
- National Electric Code (NEC)

NEMA Type 1 General Purpose	To prevent accidental contact with enclosed apparatus. Suitable for application indoors where not exposed to unusual service conditions.
NEMA Type 2 Drip tight	To prevent accidental contact , and in addition, to exclude falling moisture or dirt.
NEMA Type 3 Weatherproof	Protection against specified weather hazards. Suitable for use outdoors.
NEMA Type 3R Rain tight	Protects against entrance of water from a beating rain. Suitable for general outdoor application not requiring sleet proof.
NEMA Type 4 Watertight	Designed to exclude water applied in form of hose stream. To protect against stream of water during cleaning operations, etc.
NEMA Type 4X Corrosion Resistant	Designed to exclude water supplied in form of hose stream and used in areas where serious corrosion problem exists.
NEMA Type 5 Dust Tight	Constructed so that dust will not enter enclosed case. Being replaced in some equipment by NEMA 12 Types.
NEMA Type 6 Submersible	Intended to permit enclosed apparatus to be operated successfully when submerged in water under specified pressure and time.
NEMA Type 7 Hazardous Locations	Designed to meet application requirements of National Electrical Code for Class I, Hazardous Locations (Explosive atmospheres) Circuit interruption occurs in air.
NEMA Type 8 Hazardous Locations A,B,C. or D Class I – Air Break	Identical to Type 7, except the apparatus is immersed in oil.
NEMA Type 9 Hazardous Locations E, F, or G Class II	Designed to meet application requirements of National Electrical Code for Class II Hazardous Locations (combustible dusts, etc.)
NEMA Type 10 Bureau of Mines Permissible	Meets requirements of U.S. Bureau of Mines. Suitable for use in coal mines.
NEMA Type 11 Acid & Fume Resistant Oil Immersed	Provides oil immersion of apparatus such that it is suitable for application where equipment is subject to acid or other corrosive fumes.
NEMA Type 12 Industrial Use	For use in those industries where it is desired to exclude dust, lint, fibers & flyings, or oil coolant seepage.

# Various NEMA Ratings

# Safety Considerations

Considerations that the system designers must keep in mind in designing the electrical supply:

- Proper grounding for the entire electrical system
- Appropriate wire gage
- Appropriate fuses and circuit breakers

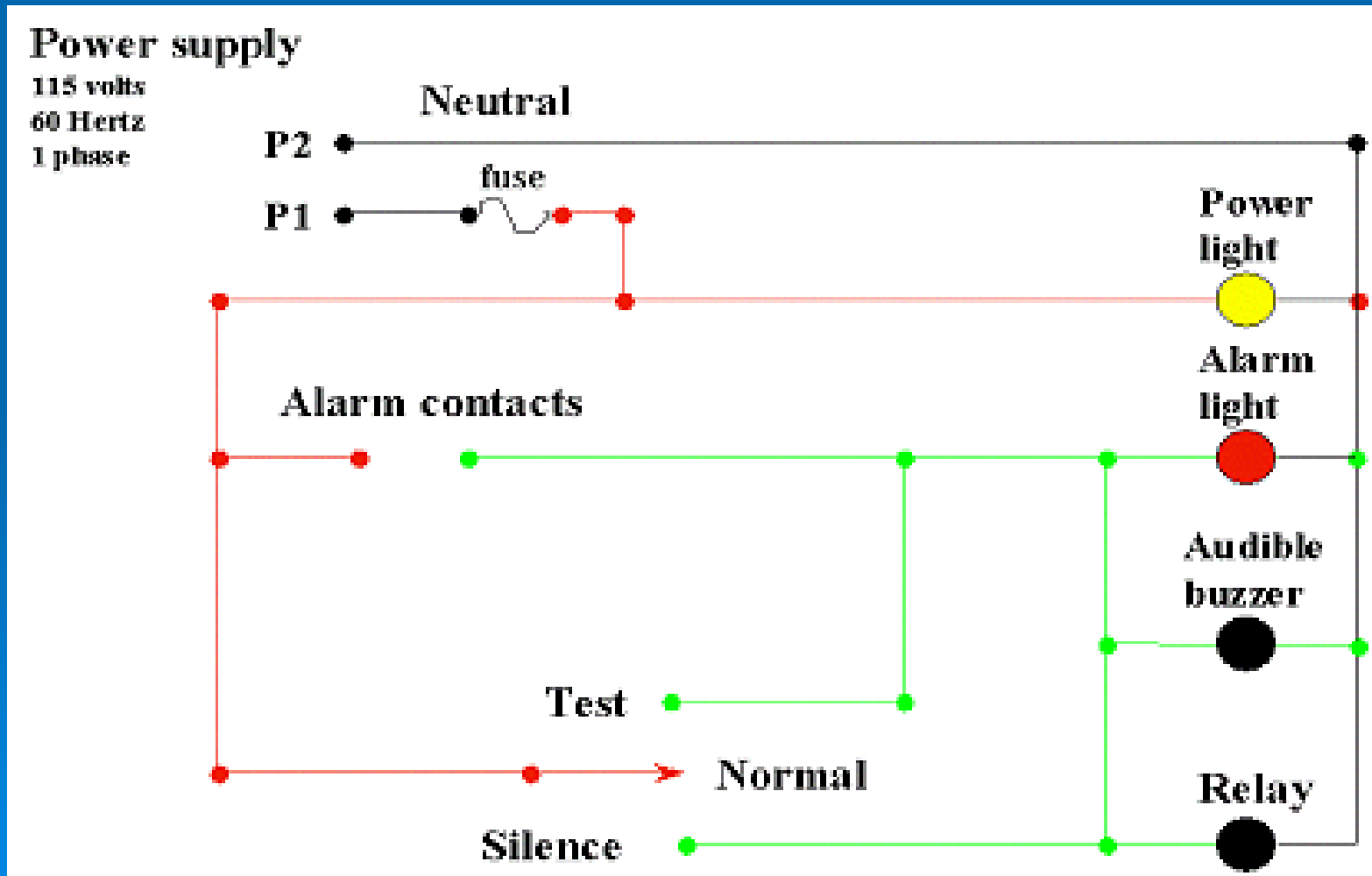
# Documentation

System documentation is essential for the continued safe and effective operation of the onsite system including its electrical and control equipment. This documentation should include:

- Operations and Maintenance (O&M)
- System schematic

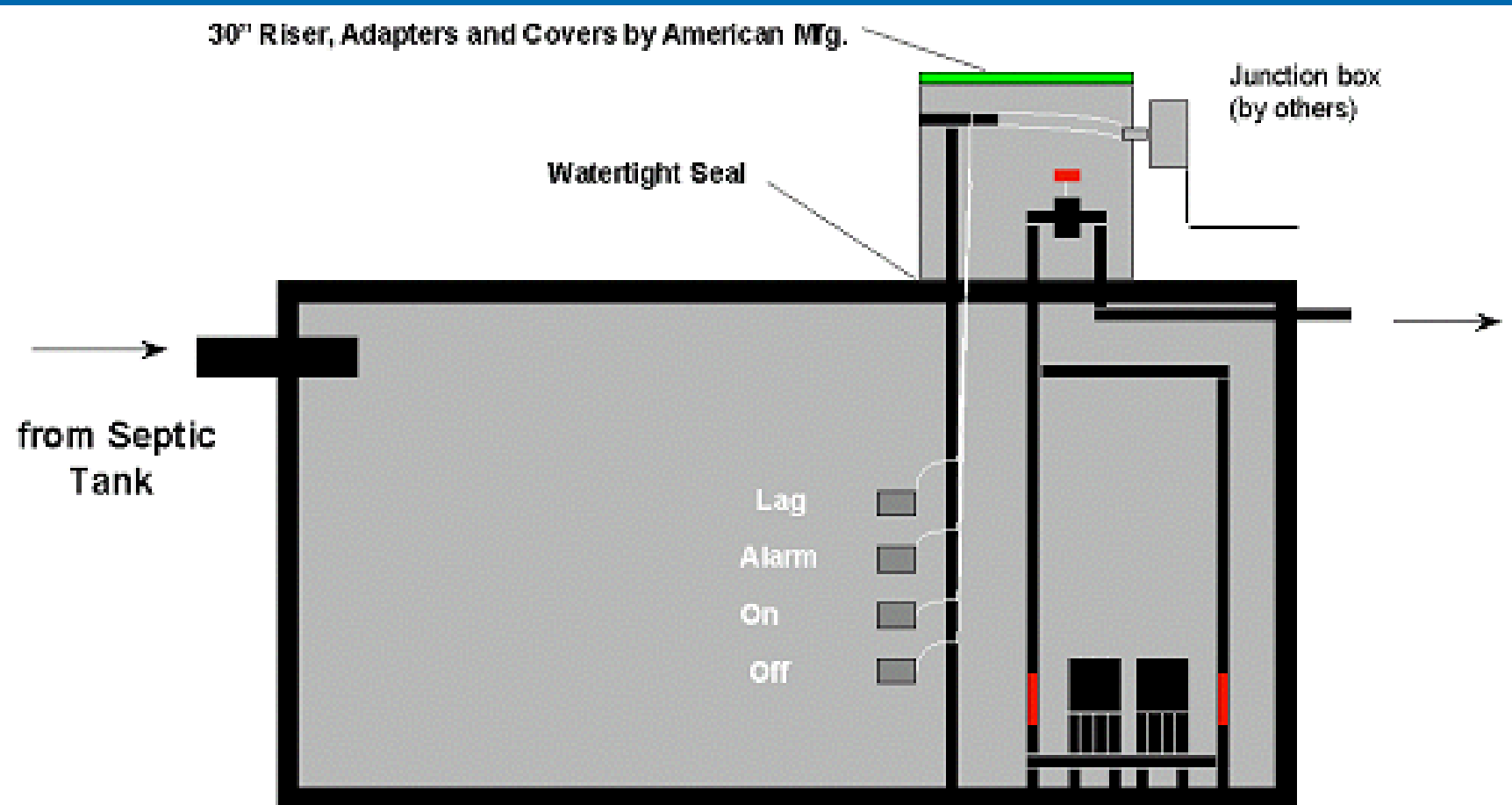
# Simplex Alarm Circuit

The alarm contacts represent the point where the float switch cable is connected to the alarm circuit. As can be seen this circuit has relatively few parts.



# Duplex 4 Float Control System As It Would Be Installed in a Pump Tank

Shown is a 4-float system controlling two pumps (duplex).



# Duplex Pump Control Circuit

Shown is the more complex system schematic for the four float, two-pump system. This circuit has motor control relays (C1, C2), an alternating relay (Alt) which will shift the pump power back and forth between the two pumps.

