

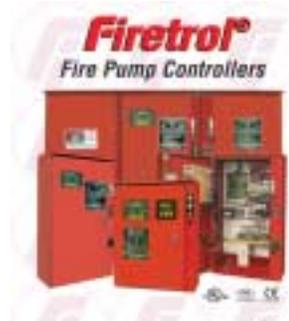
Wisconsin Fire Protection Symposium  
September 18, 2007

## Fire Pump Controllers

Presentation by

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## Outline Fire Pump Controllers

- Why are they unique?
- Recent Design Changes
- Transfer Switch Issues
- NFPA-20 2007 Repairs
- Questions?



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Why are Fire Pump Controllers unique?  
Design Criteria

Controller per NFPA-20

- Life Safety Equipment
- System operation is primary
- Protection of connected motor is secondary

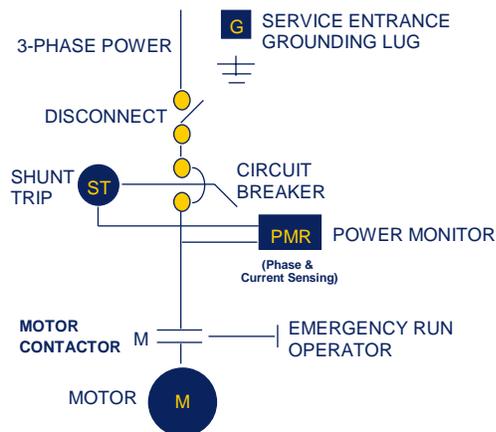
Standard Motor Starter

- Non-Life Safety Equipment
- System operation is secondary
- Protection of connected motor is primary



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Basic Controller Components



## Why are Fire Pump Controllers unique? Component Differences

- Service Entrance Ratings
- Short Circuit Current Ratings
- Circuit Breakers
- Motor Contactors
- Emergency Starting Circuits
- Pressure Sensing Devices



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## Why are Fire Pump Controllers unique? Service Entrance Rating

### Controller per NFPA-20

- Utility Power **DIRECTLY** Connected to Controller

### Standard Motor Starter

- Utility Cannot Connect Directly to the panel
- A Load Distribution Center Required



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### Short Circuit Current Rating

#### Controller per NFPA-20

- The ability of the controller to withstand an internal short circuit of a given magnitude (industry standard is 100,000 amperes)

#### Standard Motor Starter

- Not Required

Note: NFPA-70E details the PPE (personal protective equipment) necessary to work on or around energized controllers.



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### Why are Fire Pump Controllers unique? Circuit Breaker Basic Design

#### Controller per NFPA-20

- Set to Allow Operation, not to Protect the Connected Electric Motor. Carries 300% of the motor full load amperage indefinitely.
- Trip at locked rotor in 8-20 seconds
- **NO** Thermal Elements are Permitted
- Instantaneous Reset



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## Why are Fire Pump Controllers unique? Circuit Breaker Basic Design

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## Why are Fire Pump Controllers unique? Circuit Breaker Basic Design

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- Set to allow operation, not to protect the connected electric motor. Carries 300% of the motor full load amperage indefinitely.
- Trip at locked rotor in 8-20 seconds
- **NO** Thermal Elements are Permitted
- Instantaneous Reset

### Motor Starter

- Set to protect the connected electric motor.
- Thermal-Magnetic Type Device allowed.

## Why are Fire Pump Controllers unique? Motor Contactor

*The motor contactor is the device that connects the incoming power to the motor*

### Controller per NFPA-20

- NO Thermal Overload Relay
- Contactor Coil at **LINE Voltage**



### Standard Motor Starter

- Thermal Overload Relay Installed, set at 115% Motor FLA
- Contactor Coil operates at Control Voltage

## Why are Fire Pump Controllers unique? Emergency Starting Circuit

### Controller per NFPA-20

- If the contactor coil does not function for any reason an emergency mechanical means is available for closing the contactor.

### Motor Starter

- Not Permitted

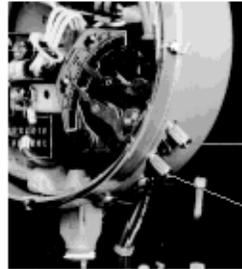


Wye Delta Open Transition Type  
Fire Pump Contactor Arrangement  
with [Emergency Run Bar](#)

## Why are Fire Pump Controllers unique? Pressure Switch

### Controller per NFPA-20

- Must Have Independent High and Low Settings
- Be Able to Visually Determine Switch Position
- No Pressure Snubbing Permitted



STOP PRESSURE  
SET POINT

START PRESSURE  
SET POINT

## Why are Fire Pump Controllers unique? Summary

### Fire Inspectors and Contractors

**Safety** - The unique characteristics of fire pump controllers make them one of the most dangerous pieces of electrical equipment commonly accessed in a building. Treat them with respect. Always follow safe work practices when operating or working around these panels.

### Fire Protection Consultants

**Short Circuit Requirements** - Coordination of Short Circuit requirements of the fire pump controller is a necessity. Work with the electrical engineer to insure short circuit ratings are properly selected and specified.

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**Outline**  
**Fire Pump Controllers**

- Why are they unique?
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- Power Transfer Switches
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**Fire Pump Controllers**  
**Then and Now**

Digital controls and computer based systems with message displays are now the standard.



Digital User Interface

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## Fire Pump Controllers

### Then

- Pilot lights
- Control relays
- Hardwired
- Mechanical pressure switch
  - Toxic mercury
  - Wide differential
  - Cumbersome to adjust
- Ink and paper recorder
  - Recorded pressure only
  - Regular maintenance (change the paper)

### Now

- Digital Display with messages
- LED's
- Generally computer based
- Pressure transducer
  - No Mercury
  - Tight differential
  - Easy to adjust and set
- USB Flash Drive Recorder
  - Records pressure and events
  - No maintenance
  - Download to PC

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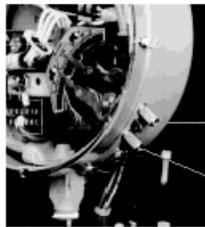
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## Then and Now Pressure Sensor

### Mercury Based Pressure Switch



STOP PRESSURE  
SET POINT

START PRESSURE  
SET POINT

### Pressure Transducer



The transducer converts pressure to an electrical signal which is translated back to pressure by the controller operating system.

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## Then and Now Pressure Sensor

Pressure settings are now made via a digital display and keypad.

An LED indicates the “switch position” above or below the set point meeting the requirements of NFPA-20.

Display showing start pressure



## Then and Now Voltmeter and Ammeter

Voltage and Amperage are easily accessed from the front of the controller without opening the controller door.

**NFPA-20 2007 Change**  
*10.3.4.4 Means shall be provided on the exterior of the controller to read all line currents and all line voltages with an accuracy within (+ or -) 5 percent of motor nameplate voltage or current.*



Press Meter button

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Then and Now  
**Pressure Recording**

*NFPA-20 2007 10.5.2.1.6.1 A listed pressure recording device shall be installed to sense and record the pressure in each fire pump controller pressure sensing line at the input to the controller.*

Old Pressure Recorder



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USB Flash Drive  
for Pressure and Event Recorder

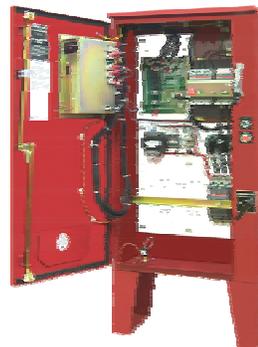


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- Why are they unique?
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**NFPA-20 Arrangement I - Integral Transfer Switch**



Fire Pump  
Controller

Power Transfer  
Switch

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**NFPA-20 Arrangement II  
Fire Pump Controller with  
Separately Mounted Transfer Switch**



Fire Pump Controller



Transfer Switch

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**NFPA-20 Arrangement II**  
**Fire Pump Controller with**  
**Separately Mounted Transfer Switch**



**NFPA-20 2007 10.8.3.1 Listing**  
*The power transfer switch shall be specifically listed for fire pump service.*

Fire Pump Controller

Transfer Switch



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**Power Transfer Switches**  
**Alternate Source Circuit Breaker**

**NFPA-20 2007 10.8.2.1.5**  
*Where the alternate source is supplied by a generator whose capacity exceeds 225 percent of the fire pump motors rated full-load current, the controller shall be equipped with the alternate side circuit breaker and isolating switch in accordance with 10.8.2.1.*

*(10.8.2.1 specifies a circuit breaker with the same characteristics as the circuit breaker for the normal utility power source)*



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Power Transfer Switches  
**Alternate Source Circuit Breaker**

**Example**  
150HP fire pump motor at 460 volts  
with 500KW generator.

150HP motor at 460 volts = 180 amps

500KW Generator at 460 volts = 750 Amps

180 amps (motor) x 225% = 405 Amps

Therefore the generator capacity (750 Amps)  
exceeds 225% of the motor full load  
amperage (405 Amps) and an alternate side  
circuit breaker must be provided.



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Transfer Switch Issues  
**Summary**

**Fire Inspectors and Contractors**

Listings - Power Transfer switches which are not specifically listed for fire pump service are NOT allowed to be used in conjunction with a fire pump.

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Generator vs. Dual Utility - When specifying a power transfer switch it is important to state whether the switch is for use with a Generator or Second Utility power source.

Generator Capacity - When specifying a Generator power source, coordination with the electrical engineer regarding the generator capacity is a must to properly specify the transfer switch requirements. (additional circuit breaker).

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**NFPA-20 2007 Replacement Parts (New Table)**  
14.5.2.5 - Whenever replacement, or change, or modification to a critical path component is performed on a fire pump, driver or controller, as described in 14.5.2.4, a retest shall be conducted as indicated in Table 14.5.2.3 by the pump manufacturer, factory authorized representative or qualified persons acceptable to the authority having jurisdiction.

**Table 14.5.2.3 Summary of Component Replacement Testing Requirements**

Component	Adjust	Repair	Rebuild	Replace	Test Criteria
<b>C. Electrical System/Controllers</b>					
1. Engine controller		X	X	X	Perform Acceptance test in accordance with NFPA 20 14.2.8
2. Isolating switch				X	Perform weekly test in accordance with NFPA 25 8.3.2 and observe IUPRIS
3. Circuit breaker Circuit breaker	X				Perform six momentary starts in accordance with NFPA 20 14.2.8.9 Perform a one hour full load current test
4. Electrical connections Main contactor	X		X		Perform weekly test in accordance with NFPA 25 8.3.2 Perform weekly test in accordance with NFPA 25 8.3.2
5. Power monitor				X	Perform Acceptance test in accordance with NFPA 20 14.2.8
7. Start relay				X	Perform weekly test in accordance with NFPA 25 8.3.2
8. Pressure switch	X				Perform Acceptance test in accordance with NFPA 20 14.2.8.9
9. Pressure transducer	X				Perform Acceptance test in accordance with NFPA 20 14.2.8.9
10. Manual start or stop switch				X	Perform six operations under load
11. Transfer switch - load carrying parts		X	X	X	Perform a one hour full load current test, and transfer from normal power to emergency power and back one time
Transfer switch - non load parts		X	X	X	Perform six no load operations of transfer of power



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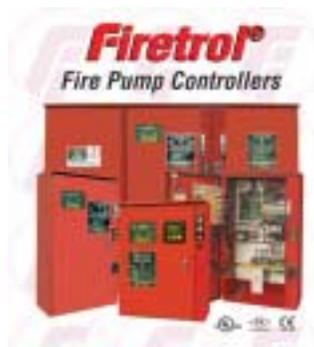
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**Thank You for Attending!**



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