Rappahannock Electric Cooperative
A Touchstone Energy® Cooperative

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ELECTRIC MOTORS and Protective Devices

Electric motors are used in every sector of the economy. They perform a wide range of duties throughout the residential, commercial, industrial and agricultural sectors. More than half the electricity generated in the United States is consumed by an electrically driven motor system. Some examples are fluid handling, material handling and material processing.

Commercial & Industrial - Cooling is the primary motor load in the commercial business sector, accounting for more than 43% of motor use. Other leading applications include space heating and ventilation (33%), and refrigeration and water supply (24%). Motor systems are the largest industrial loads, on average accounting for more than 70% of all electricity consumption. Most industrial motor loads can be characterized as high duty cycle systems.

FLUID HANDLING

- chillers
- ventilation fans
- cooling towers
- water pumps
- fans
- air compressors
- gas compressors

MATERIAL PROCESSING

- printing presses
- punch machines
- shears
- extruders
- mixers
- grinders
- crushers

MATERIAL HANDLING

- elevators
- conveyors
- hoists
- cranes
- robots

TYPICAL MOTOR APPLICATION

A typical motor application can be defined as electrical energy used to run an electric motor drive system. This system will generally consist of the following components:

- Electrical power supply
- Electric motor
- Motor drive system & controls
- Mechanical transmission/end process

MOTOR SELECTION

Selecting the correct motor for a particular application involves many details, but can be simplified by answering a few important questions. The five key factors are:

Local Requirements - loads must be clearly defined so that a motor capable of producing sufficient torque without exceeding equipment design limitations can be selected.

Electrical Power Distribution - the size and type of motor will influence the characteristics of the electrical power supply and vice versa.

Operating Environment - an important consideration in that some motors must be designed to operate in a hostile environment.

Control Equipment - must be able to start and operate the motor and provide reasonable protection.

Efficiency and Cost - modern electric motors can be very efficient; efficiency and life-cycle cost should be seriously considered.

ELECTRIC SERVICE

Electric motors can be powered by either single-phase or three-phase electric service. Three-phase electric motors provide many advantages. Along with these advantages come additional risks that the user must consider. Unlike single-phase service which is supplied by one "high voltage phase wire", three-phase service is supplied by either two or three phase wires.

When interruptions in single phase service occur, the service goes completely off and the motors are not damaged. Certain unavoidable problems which occur on three-phase systems can cause portions of the service to go off while partial service remains on. It is when a portion of three-phase service goes off, which is referred to as single-phasing, that improperly protected motors can be damaged.

MOTOR PROTECTION

There are several methods of providing added protection for electric motors. Two protection schemes are outlined below:

- Phase and voltage sensing equipment can be installed to completely disconnect the entire service or specific loads whenever single-phasing or abnormal voltage occur.

- Dual element fuse protection can be installed in each phase wire supplying a motor. These fuses must be properly sized to the motor being protected in accordance with the National Electrical Code (NEC) to protect the motor from overload.

Properly sized and maintained load sensing elements should be installed in each phase of a motor circuit as added protection. These are commonly referred to as heaters, and are usually located in motor starter enclosures. Older motor starters used heaters in only two phases, which left one phase unprotected. The combination of either the above options and these heaters should provide reasonable protection against single-phasing.

MOTOR CIRCUIT PROTECTION DEVICES

The following protection devices may be used in conjunction with a motor's control system. Their purpose is to safeguard the motor starting equipment and the circuit itself from short circuit damage.

Motor Circuit Protector (MCP): a magnetic-only instantaneous trip circuit breaker.

Current Limiting Module (CLM):an accessory device supplied with a MCP to open a motor circuit faster under a severe short circuit.

Motor Starter & Protector (MSP): abreaker having both thermal and instantaneous magnetic trip characteristics, combined with a motor overload protector.

Motor Short Circuit Protector (MSCP): not a circuit breaker, but a fast acting fuse of special design.

A small investment in proper motor protection should be regarded as inexpensive insurance against damage to expensive motors. If you have any questions or comments regarding this information please contact our office at 800-552-3904.

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