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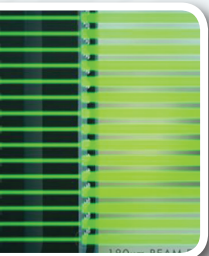
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Using simulation to guide product design

What is your cost for unplanned electric motor downtime?

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Electric motors, if not properly protected, can cause damage if overloaded. A variety of motor protection devices are available for varying applications to prevent this.

Electric motors are the backbone to today's modern industry. They provide the mechanical energy needed for most manufacturing processes—but they can also cause damage or physical harm. In response, many government agencies over the last 100 years have imposed strict requirements for implementing some form of thermal overload protection for all electric motors.

However, motor protection devices can cause an electric motor to stop working due to improper wiring, an electrical issue, a mechanical anomaly or internal motor damage. Industrial facilities can experience significant lost production when a critical motor unexpectedly stops.

To help protect motors and prevent the loss of revenue, industrial end users and machine builders can use a wide range of motor protection devices



that meet the required government regulations. These protection devices vary in size, features and price.

Selecting the appropriate motor protection device depends on the specific electric motor application and its impact to lost production revenue.

Considerations for motor protection devices

If the potential for lost production revenue is minimal, bimetallic or eutectic alloy-based motor protection might be the best fit. These



>> **Circuit breakers**, such as the Allen-Bradley Bulletin 140G molded-case circuit breakers, help protect against short circuit, overload and ground-fault conditions.

types of motor protection products meet the minimal government requirements and help prevent internal thermal damage to the electric motor. However, they do not provide any advanced warning that an event is about to occur or information about why the event occurred.

If the potential for lost production revenue is substantial, users should consider

using electronic-based motor protection. Electronic-based motor protection products meet the minimal government requirements of thermal protection and can provide electrical-based protection against phase loss, asymmetry, improper voltage, rotation mismatch and ground fault current. Many electronic motor protection devices also provide communications capabilities

to alert for possible motor problems and project motor stop times, as well as indicate the reason why the motor stopped unintentionally.

For example, in a pumping application, electronic motor-protection devices can simulate the internal temperature of an electrical motor providing mechanical power to a pump. The devices can send an



>> **Disconnect switches**, including the Allen-Bradley 1494U visible-blade disconnect switch, isolate motors, motor controllers and other loads from supply circuits.

alarm by text message, email or both if the heat rises beyond a specified level. Users can also integrate the devices into an existing SCADA infrastructure using communication networks, such as EtherNet/IP, to provide advanced warnings—helping avoid costly downtime.

Electronic motor protection devices typically cost more than a basic bimetallic or eutectic alloy-based motor protection device, but the extra cost of the electronic protection device can be significantly less when compared against the lost revenue cost due to unplanned electric motor downtime.

Choosing an overload relay

If users choose to implement an overload relay in their application, they will also need to choose between a number of different types of overload relays, including bimetallic, eutectic and electronic. To select the ideal overload relay for a full-voltage motor starter, users should consider the protection, diagnostic and integration features.

At a minimum, an overload relay must provide thermal overload protection. This form of protection measures the amount of current the electric motor consumes and applies it to a thermal overload model to simulate the heat content inside the electric motor. There are two types of overload models: I2T and Two Body Model. The I2T is the most common model and is used by most bimetallic, eutectic and electronic overload relays. A Two Body Model takes into account the starting and running characteristics of an electric motor. This model provides a more accurate simulation of the heat content inside an electric motor, especially for large- or medium-voltage electric motors.

A second protection feature users should consider is phase-loss protection. Phase loss is the leading reason for



>> **Electronic overload relays**, like the Allen-Bradley E300 model, offer diagnostics, communication options and simplified wiring for reduced engineering time and maximized uptime for motor control in automation systems.

motor failure and occurs when one phase of current equals zero amps due to a blown fuse. Long-term exposure to phase loss will damage an electric motor, but it can take 30 minutes or more for an overload protection algorithm to detect phase loss. Electronic overload relays can detect a phase loss condition within 3 sec or less.


Another design feature users should consider is the diagnostic information provided. Electronic overload relays can display or communicate information to a control system or operator. At a minimum, an electronic overload relay should communicate percent thermal capacity utilization (%TCU) and percent full load amps (%FLA). These two diagnostic parameters report the real-time heat content and current draw of the electric motor and can provide the motor operator with an indication as to when the overload might trip. When the %TCU reaches 100%, the electronic overload will force an overload trip.

More advanced electronic overload relays can also provide diagnostics on time-to-trip, time-to-reset, current RMS, ground fault current, voltage RMS, and power, historical and energy information. This diagnostic information can help predict when the overload will trip, allowing operators to make critical business operation decisions. It can also help maintenance staff minimize repair time when motor problems occur.

A final consideration for choosing an overload relay is the integration features and capabilities. Users can choose overload relays that mount directly to the load side of a contactor, saving on installation time, space and wiring. Overload relays with removable terminal blocks are also available to help minimize replacement time. Some overload relays even offer mechanical accessories to minimize the additional control wiring needed for a full-voltage starter.

For users looking to minimize parts in stock, electronic overload relays have a wide current range, which minimizes the number of part numbers needed to protect a wider range of motor types. Users can also choose electronic overload relays with modular designs, allowing them to choose the specific protection and integration features that are required for their application.

Additionally, electronic overload relays with communication and I/O options allow users to integrate them with the corresponding automation control system in just a few mouse clicks. These systems use the electronic overload relay as a distributed I/O device to control the contactor coil using a communications network command.

Motor protection devices can be a critical part of industrial operations—helping to keep electric motors running and reduce costly downtime. Users should consider potential lost revenue from electric motor downtime, levels of protection needed, and other design and diagnostic features an application may warrant to choose the motor protection device that is the best fit for them. 

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For more information, visit <http://ab.rockwellautomation.com/Circuit-and-Load-Protection/LV-Motor-Protectors>