Maximize Process Speed Using Motor Thermal Model in the SEL-710 Relay

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INTRODUCTION

The integration and communications features in the SEL-710 Motor Protection Relay provide a method for you to include motor performance information in adaptive process control strategies. This example discusses how to use the output of the AccuTrack™ Thermal Model in the SEL-710 to not only help provide motor protection but also to optimize production for a crusher and conveyor application.

PROBLEM

Large crusher and conveyor systems frequently experience cyclical motor loads due to product weight and density variations. Motor relays, such as the SEL-710, protect induction drive motors from overheating in these applications, but control systems engineers have not had a method to integrate the relay thermal calculations with overall process control architectures. Without continuous thermal feedback from the drive motor, the operator manages the production process below its maximum capability in order to avoid production delays due to motor trips. In fact, operators frequently calculate a process set point based on previously experienced motor overloads.

SEL SOLUTION

While other motor relays use an overcurrent method to calculate conductor temperature, the SEL-710 dynamically calculates motor conductor temperature using the AccuTrack Thermal Model. One output from the model is stator thermal capacity used (reported as a percentage), which you can send as feedback to the process control system, thereby providing a means to optimize process speed while avoiding motor overheating.

AccuTrack Thermal Model

The SEL-710 correctly represents stator temperature in induction motors by calculating conductor temperature in real time. The thermal model continuously adjusts heat estimates based on the positive-sequence and negative-sequence current flowing in the motor and the motor's physical characteristics. Test data show how the AccuTrack Thermal Model correctly tracks motor heating for cyclical loads, as shown in Figure 1 and Figure 2.

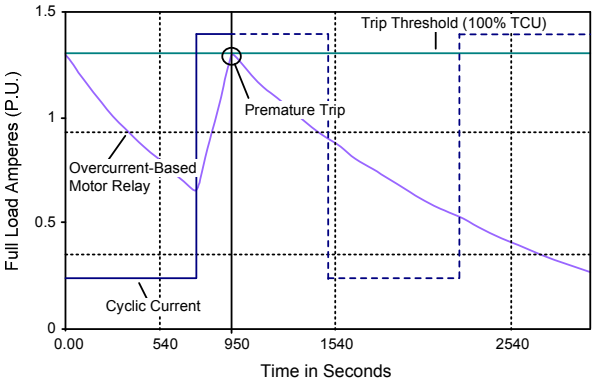

Figure 1 Overcurrent-Based Relay False Trip

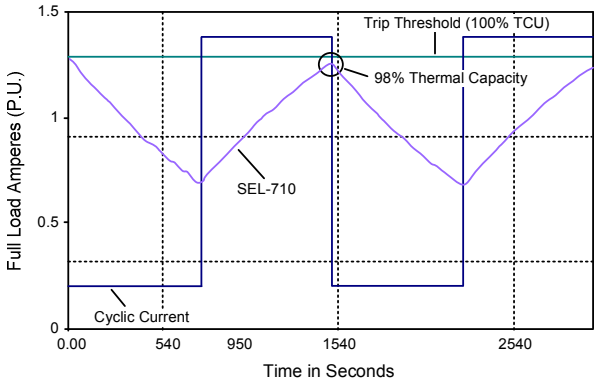

Figure 2 SEL-710 Relay Proper Operation

Control System Integration

The SEL-710 includes communications protocols such as Modbus® RTU and DeviceNet™ so that you can integrate motor data into a control system with little difficulty. Map the stator thermal capacity used (reported as a percentage) as a value that is sent to your PLC (programmable logic controller) or DCS (distributed control system). For example, stator thermal capacity (label = TCUSTR) is register #729 in the SEL-710 Modbus map. Use a read holding register (03h) or read input register (04h) request from the process control PLC in order to include the thermal information in a speed control algorithm.

Apply stator thermal capacity in the PLC as a modifier for process speed reference to automatically adjust for process load variations. When the SEL-710 reports that the motor is approaching an overload, you can automatically reduce the process speed to avoid a fault. This control strategy allows the operator to preset the maximum desired process speed without concern for thermal overloads. The AccuTrack Thermal Model allows you to maximize process throughput and avoid false relay trips or motor damage.

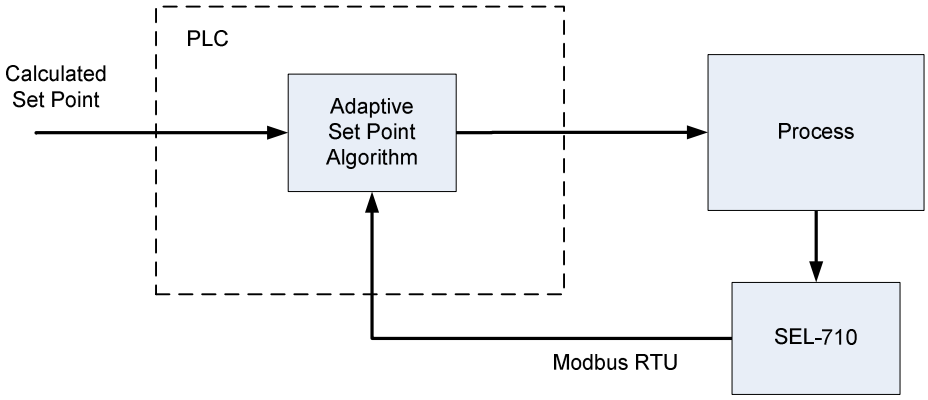

Figure 3 Adaptive Controls Using the SEL-710

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