Powell Technical Brief #81

Direct Control of Motor Contactors via PLC's and Distributive Control Systems

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As we automate the process systems more and more we are looking for direct control of the motor starters with PLC's and Distributive Control Systems (DCS). A commonly asked question is whether the interposing relay situated between the two systems is really needed or not. I have gone through and looked at the more common systems and put together this technical brief to highlight some of the concerns involving the interposing relay.

Digital Outputs Modules

The electro-mechanical and the solid state (triac) output modules are commonly available for either PLC's or DCS's. Both of these digital output modules are listed in the vendor literature as having a 120 Vac rating of such and such current. Two amps seem to be the most popular for the electro-mechanical value and ¼ amp for the solid state output. The thing I had difficulty finding was the expected power factor of the load. A power factor of 0.5 seemed to be the most common although I did find one manufacturer who based his rating on a power factor of 1.0. The expected power factor obviously changes from one manufacturer to the next for both PLC and DCS. The normal contactor coil has a power factor of 0.1, at this level the output rating should be derated by 50%. This is without the consideration of the wire impedance connecting the two systems.

In addition to confirming the make and break capability, the application engineer should realize that the turn off of the standard starter results in an inductive kick that sends a significant voltage spike though the system. The output relay ends up with contact pitting and the contactor coil receives a steep fronted voltage spike which shortens the life of the insulation. The spike can be limited by installing a snubber circuit across the output contacts. For solid state outputs the snubber is a 0.1 microfrad capacitor and a 100 ohm resister series together. The cap should have about a 400 Vdc rating for a 120 volt control system. For the electromechanical output internal protection is usually provided for loads up to 1 amp after that you need to provide it separately. In most cases the manufacturer has a kit available as an option.

The triac outputs add an additional level of possible problem due to the triac's leakage current during turn off and forward bias requirements. The forward bias means that the triac must maintain some minimum current flow to keep the device in the on state. The leakage current is a small quantity of current that trickles through the device even after turn off. This few milli amps will be in parallel with the distributed wire capacitance of the wire between the control system and the MCC to make the turn off a significant problem. This appears to make the triac an undesirable combination with the standard contactor.

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Smart Motor Control

When using *many* of the new smart motor control centers the control circuit is no longer interrupting the coil current directly, if it is wired properly! So the concerns relative to interrupting a large inductive load are eliminated. The electro-mechanical relay output is less likely to have problems getting the two systems to match-up.

The reliability of the triac output module will allow it to do more operations successfully than the electro-mechanical, but since the coil is not operated directly, you may have to add a swamping resistor in parallel with the MCC input to make sure the circuit draws sufficient current to keep the triac forward biased. In addition, the high relay input impedance of the smart MCC and the distributed wire capacitance may begin to play a part in the functionality of the stop circuit. The longer the length of the control circuit the higher the leakage current and the more likely resistance may need to be added to assure that the circuit will recognize a stop command.

A separate concern about doing away with the interposing relay you may want to discuss with the end user is the safety aspects of bringing 120 volt control power from the MCC starter drawers into the PLC or DCS. The way most plant treat the insides of their PLC and DCS is as though there is no voltage level greater that 50 volts to ground. At 50 volts and below OSHA Standard 1910 and NFPA 70E's Electrical Safe Work Practices & Working Space Requirements need not apply. But by bringing the 110 Vac into the control system the rules identified in OSHA 1910 are applicable. In some cases this can have a tremendous impact on the cost of doing work.

Based on the legwork I have done the interposing relay still makes good sense until the confidence in the twisted pair communication allows us direct communication between the smart MCC and the PLC or DCS, with a stop station in the field next to the load.

If we can help with this or any other topic please do not hesitate to call.

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