Medium Voltage Contactor Interrupting Ratings and Use of Instantaneous Overcurrent Protection

Special consideration should be given when an overcurrent relay trip signal is executed by a contactor, especially when an instantaneous overcurrent (IOC) function or relay (ANSI 50 Device) is involved.

NEC 110.9 discusses Interrupting Rating requirements as:

"Equipment intended to interrupt current at fault levels shall have an interrupting rating at nominal circuit voltage at least equal to the current that is available at the line terminals of the equipment. Equipment intended to interrupt current at other than fault levels shall have an interrupting rating at nominal circuit voltage at least equal to the current that must be interrupted."

Contactors are not designed to be short-circuit or high level current interrupting devices, and will typically have interrupting ratings near system overload current or motor locked rotor current, much lower than system short circuit fault levels. They will be seriously damaged when attempting to clear currents higher than their interrupting rating. For this reason, a relay/contactor combination is intended to make or break under normal load conditions and overload conditions, not fault conditions. A relay IOC element should not be enabled when using a relay/contactor setup.

A common practice for MV motors is a line-up of relay & fused vacuum contactors. Users should keep in mind that even with fuse protecting the contactor, feeder, and motor against short circuit conditions, enabled IOC settings can still expose the contactor to opening under high fault currents (Figure 1). A safe practice would be to disable the relay IOC function, and carefully select the fuse model and size so that the fuse alone clears short circuit fault while the time overcurrent and overload settings of relay protect against lower overcurrent conditions (Figure 2).

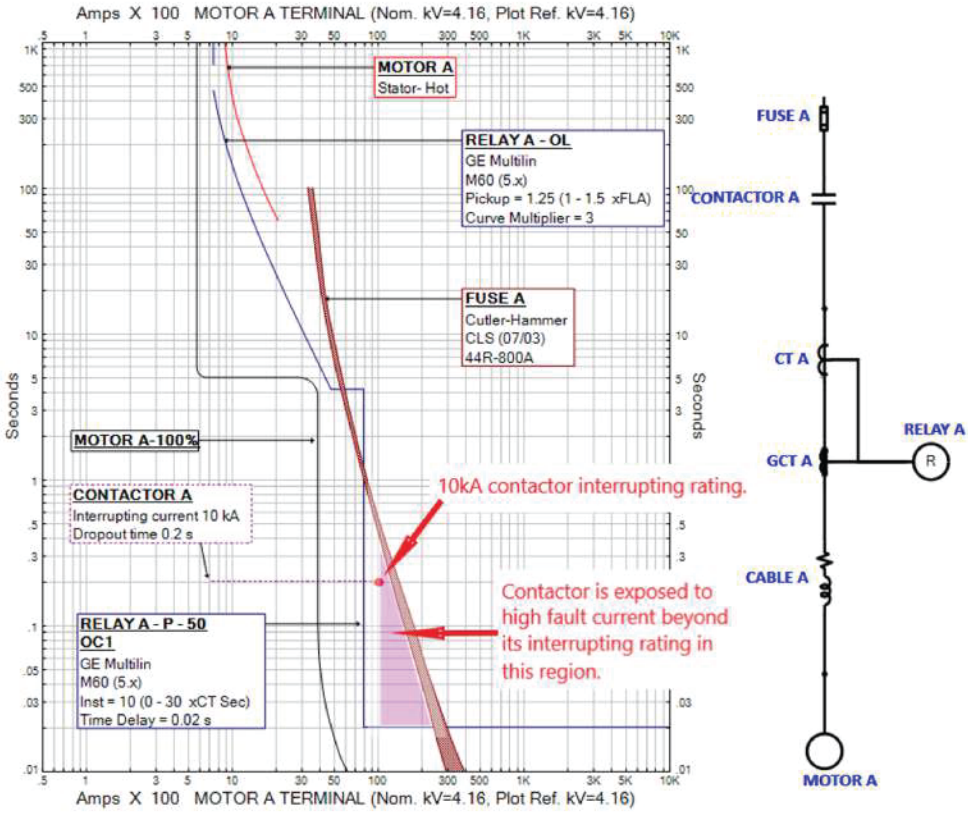

Figure 1: ***Misapplication with IOC function enabled. Contactor will interrupt current higher than its interrupting rating, causing contactor damage.***

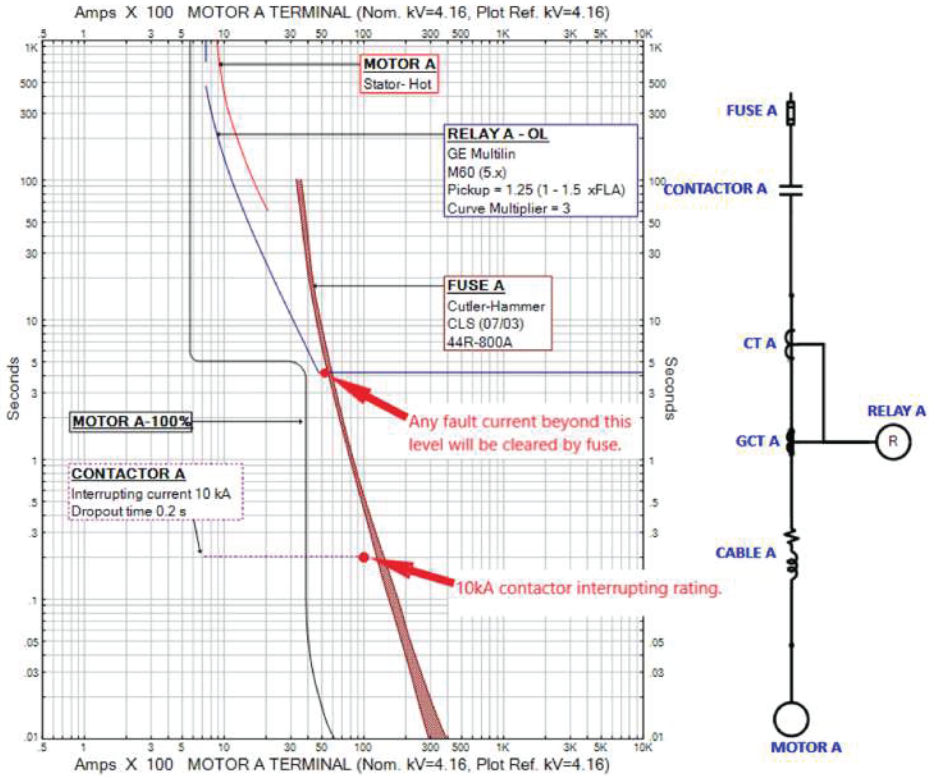

Figure 2: ***Sound design with IOC function disabled. The combined relay & fuse curve provides full protection to the motor feeder and the fuse alone will clear the short circuit current***

Sometimes if a "faster than fuse" tripping is still desired and IOC function is enabled, enough time delay should be added to ensure the contactor only clears faults before the fuse at current levels lower than its interrupting rating. A safety margin below the contactor interrupting rating, typically 20%, should be applied to set the time delay. In the following example (Figure 3), a 1s IOC time delay was set so the relay will pick up the fault lower than 8 kA (20% lower than contactor interrupting rating), while the fuse clears fault higher than 8 kA. This method can offer faster tripping at lower fault current levels and may help with arc flash incident energy mitigation. However, it should be noted that when IOC is enabled to use with contactor, it becomes extremely important to examine the accurate contactor rating and overall TCC curves. Failure to conduct a correct protection study can void the purpose of adding time delay and still potentially damage the contactor.

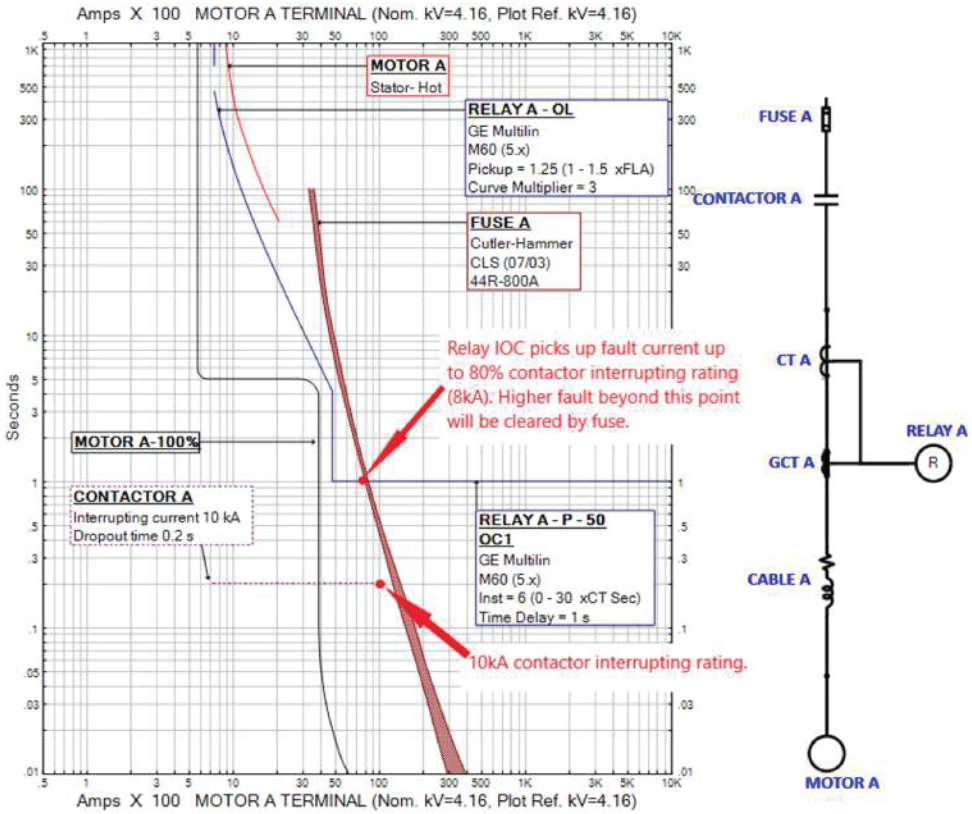

Figure 3: ***IOC function enabled with time delay. IOC only picks up faults lower than the contactor interrupting rating. This set up is allowable.***

As a final note, some types of vacuum contactors have dip switches or controllers to adjust the dropout time. If enough dropout time is added to the contactor, the fuse should clear faults faster for any value above contactor interrupting rating. However, dropout time of the contactor may vary depending on the trapped residual magnetism in the coil, it can be significantly smaller than the dip switch set value. Engineers should understand this risk, and make thorough judgement before using an increased dropout time for justification to enable relay IOC settings with contactors.