

CIRCUIT BREAKER NUISANCE TRIPPING

BACKGROUND

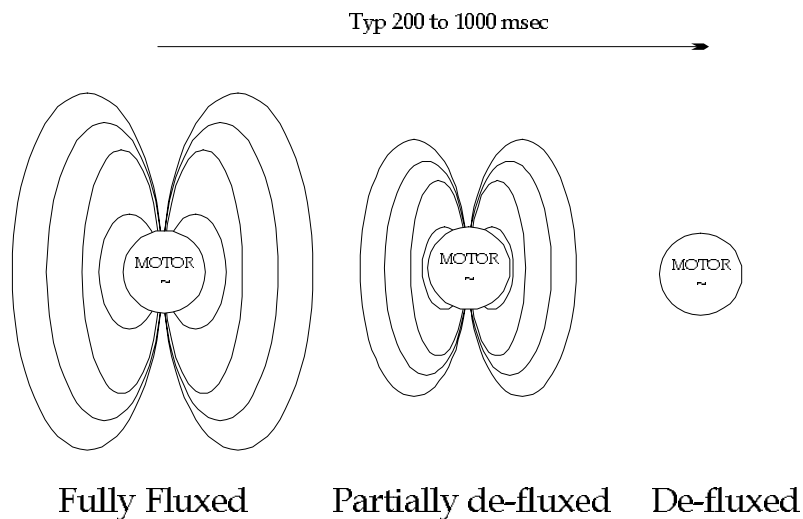
The Techsys Corporation pump control systems all utilize the same operational procedure. The first pump accelerates up to full speed on the VFD, if after reaching this full speed the system pressure is still below the set point then the first pump is swapped to a fixed speed, DOL, contactor and the second pump is then accelerated to the desired speed.

This change over from VFD to DOL contactor is the point where nuisances tripping can occur.

THEORY

When a motor is operational a magnetic field is present in the windings. When we change from VFD to DOL a delay time must be forced to allow for the decay of the residual magnetic field. This must occur, as while this field is present the motor is in fact a generator and will be producing a current of its own. Connecting during this time will feed back into the system and the circuit breakers will see this as a dead short.

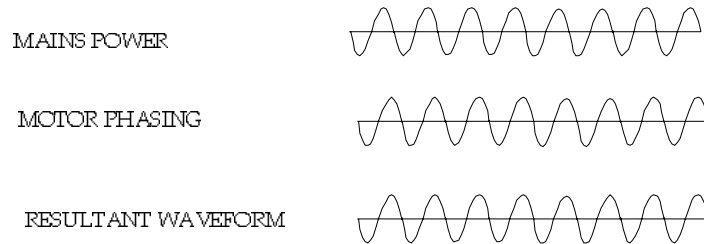
MAGNETIC FLUX DECAY TIME



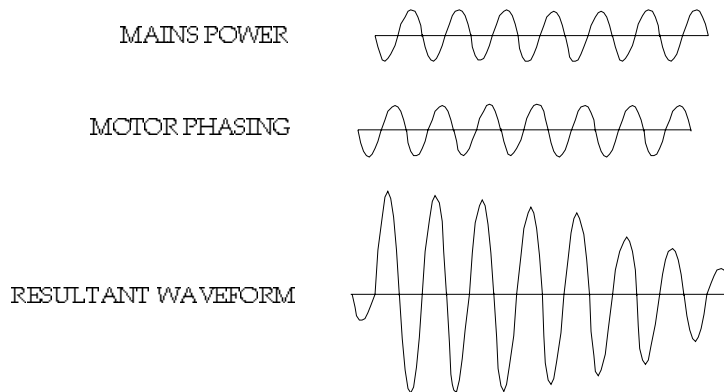
Once this field is decayed then the only consideration is phase synchronization.

PHASE SYNCHRONIZATION

Phase synchronization is the aligning the Voltage and current sine waves when the motor is changed from VFD to DOL contactors.



In ideal changeover the phases are matched and there will be no combined spike in current at changeover. This will be the case in approximately 20-30% of changeovers. However if the phases are out of synchronization then there will be spike in the system.



This spike can be a maximum of 4 X FLA for the motor. This residual is active for a maximum time of 250msec which falls well within the capacities of all motor circuit breakers which range from 8 to 10 X Rated capacity of the circuit breaker.

Some larger motor installations will employ a phase synchronization unit to ensure phases of both supplies are synchronized prior to DOL contactor engagement. This is an option and additional capital cost is attracted.

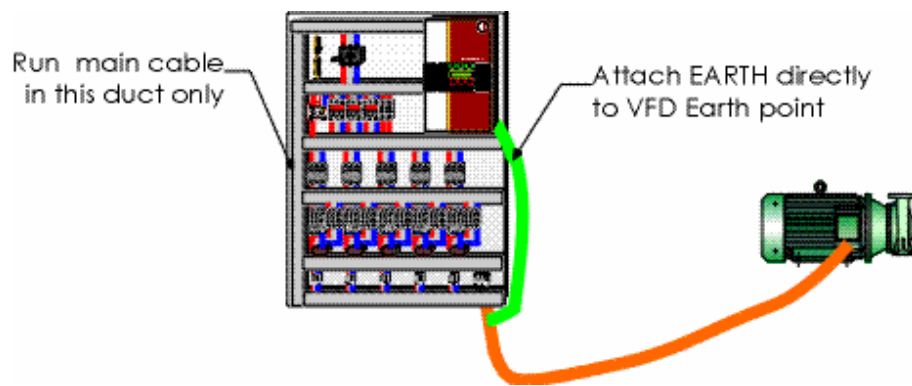
All Techsys Corporation control system have an adjustable delay timer called the Contactor Delay timer. If tripping occurs simply extend this time until tripping does not occur. The range for this is from 0.3-1.4 seconds.

OTHER CONSIDERATIONS

The layout and routing of cables can effect the occurrence of nuisance tripping of circuit breakers. The following tips are a guide for the proper routing of cables within the switchboard:

Run the mains power cables directly to the main switch where possible. If this is not possible use the cable duct on the left-hand side of the switchboard (the one furthest from the VFD). Do not run mains cables through horizontal cable ducts above the terminals.

Always attach the motor earth *DIRECTLY* to the VFD earth point, *NOT* to the common earth bus.



Internal switchboard temperatures can reduce the short circuit capacity of the circuit breakers so it is important to keep these temperatures in mind when sizing the circuit breakers. The design temperature for standard circuit breakers is 50 deg C and the de-rating of circuit breakers with temperature should be checked for each brand or model used. Having cables coiled in ducts adjacent to the circuit breaker can increase circuit breaker temperatures. This will heat up wire and conducted heat will cause the circuit breakers to overheat. Try to always run straight cable routes with mains and VFD cables limited from running parallel for long distances.

SUMMARY

Fast transition switching from VFD operation to a DOL supply can give rise to very high current transients which can be significantly higher than locked rotor currents (4X FLC), resulting in the unnecessary operation protective circuit breakers.

A timer unit or delay should be added to delay the transition from VFD supply to DOL supply, this will avoid high transient current surges. (Contactor delay timer)

Care should be taken in the selection of suitable circuit breakers and contactors which are suitable for the high surge currents.