A Primer on Low Voltage Motor Control Centers

By Bernie Wright
GE Specification Engineer

A Motor Control Center is a factory assembled grouping of motor starters and controllers in a common structure. It is made up of bussed vertical sections connected together by a common horizontal main bus. Each section may contain compartmentalized starters, feeders, transformers, adjustable frequency drives and panelboards just to mention a few. Depending upon the size, most starters and feeders may be plug in type.
These units are typically rated up to 600 volts AC.

This article will focus on Nema and will walk you through some of the various elements and tips when you are choosing or specifying an MCC.

A. Things to look for when choosing a MCC

1. IEC vs Nema
   Nema rated motor control centers are usually the standard in the USA, Canada and most of Mexico.

   IEC rated motor control centers are usually found in Europe, Asia, Australia and Brazil.

   The Caribbean, parts of Mexico, Central America and South America are a mixture of Nema and IEC.

2. Enclosure for Nema
   The environment that it will be operating in will determine the motor control center enclosure. Typically –20 deg C to 40 deg C.
   Items to consider are if it is to be Indoor or Outdoor.

   A. If indoor some items to consider are:
      a. Nema 1 general for clean air
      b. Nema 2 drip proof, consider for overhead falling liquids, water spray and splashing liquids.
      c. Nema 12 dust tight and drip tight.

   B. If outdoor consider:
      a. Nema 3R – Rain proof
      b. It is important to note that some outdoor requirements for outdoor construction may require that the motor control center be built and furnished inside of an Electric Power House. Some requirements to consider for the Power House are:
         1. High Wind withstandablity
         2. Air Conditioning

3. Excessive snow
4. Nema 4 or Nema 4X enclosure.

3. Voltage
    a. The standard Nema voltage ratings for motor control centers are up to 600 volts ac.
    b. The standard IEC voltage ratings for motor control centers are up to 690 volts ac.

4. Main Bus Rating
    a. The main bus should be rated to carry 125% of the largest motor running in addition 100% of the full load rating of all the other motors operated at the same time
    b. Allowances should take into account motor duty cycle and demand factor.
    c. Other connected loads should be based upon 100%
    d. Allowances should be made toward future loads.

5. Short Circuit Rating
    a. The standard motor control center is usually braced or rated for 65,000 aic or 100,000 aic.
    b. The standard motor control center is designed for a 3 cycle withstand ability rating. Therefore, if your application requires a low voltage power air circuit breaker without an instantaneous to achieve selectivity then you will have to specify a 30-cycle bus withstand which may or not be available.

6. Seismic Ratings
    a. Make sure that the MCC seismic rating matches the seismic zone that it will be located in.

7. Wire Class/Drawings
   MCC's are defined by wiring classes. The wire classes describe how individual motor starters and feeders are inter-wired or interlocked. They are as follows:

    a. Nema Class I
       No inter-wiring or interlocking between starter/feeder units or remote mounted devices. Drawings are of the individual units only.
    b. Nema Class II
       Inter-wiring and interlocking between starter/feeder units is provided along with provisions for remote mounted devices. Drawings will show the operation of the individual units.

c. Nema Class IS and IIS
These MCCs are the same the above units except custom drawings are furnished instead of the standard wiring drawings. They may include special size drawings and terminal numbering designations.
d. Nema Class IA
In this MCC only the disconnect in the starter is connected to the power wiring. There is no control wiring connection or interlocking provided. There are no terminal boards furnished.
e. Nema Class IB
In this MCC all the power and control wires are factory wired to marked terminal blocks. The customer connects their field wiring to the opposing terminal block
f. Nema Class IC
In this MCC the factory installs a master terminal board that is pre-wired to the terminal blocks in MCC buckets all the power and control wires are marked. The customer connects their field wiring to master terminal board.
g. Nema Class IIB and IIC
h. These MCCs are the same as the above units except the factory makes up all the interconnecting wiring between the units.

B. How to choose a starter

A starter will consist of:

1. A magnetic contactor
2. A disconnect device Fuse or Circuit Breaker to provide short circuit protection as well as function as a disconnect to the circuit.
3. An overload relay which may be bi-metallic, melting alloy or solid state
4. A control circuit consisting of pilot devices, relays, timers, plcs

To size a starter consider the following:

1. Follow the guidelines listed in the NEC, Article 430-52 Rating or Setting for Individual Motor Circuits
2. The settings for the branch devices should be per table 430.52
   a. The maximum setting for Non-Time delay fuses should not exceed 300% of FLA
   b. The maximum setting for dual element fuses should not exceed 175% of FLA
   c. The maximum setting for Inverse Time Circuit Breakers should not exceed 250% of FLA
   d. The maximum setting for Instantaneous Circuit Breakers should not exceed 800% of FLA

C. Smart Motor Control Centers

The Smart or Intelligent motor control center consist of any of the following:

a. motor starter with an electronic relay or overload that has some diagnostics
b. meters with diagnostics
c. a plc

All of these units are connected via a communication network. Designing a system in this way will provide the user with information to better monitor and troubleshoot their system.

D. Helpful Hints

1. Large Ampacity motor control centers – ie. If you have a need for a 4000A MCC, consider using a switchboard with a 4000A main and (2) 2000A feeders. Transition to (2) 2000A MCC on either side of the switchboard.
2. A motor control center may be used to provide enclosed feeder breakers in their own enclosed compartment. The MCC will be front accessible and the breakers will be pluggable up to certain sizes.
3. Consider using a back to back motor control center when floor space is limited

References

1. The National Electric Code Handbook
2. General Electric Evolution Motor Control Centers DET-291