

1.0 **GENERAL**

1.1 **Related UBC Guidelines**

- .1 Division 20 00 05 Mechanical General Requirements

1.2

- .1 **Coordination Requirements**
- .2 UBC Facilities Electrical (Vancouver)
- .3 UBC Facility Management (Okanagan)

1.3 **Description**

- .1 This section outlines electrical requirements of Motor Control which includes Variable Frequency Drives.

2.0 **MATERIAL AND DESIGN REQUIREMENTS**

- .1 Refer to Division 20 00 05 Mechanical General Requirements for mechanical requirements of VFDs.
- .2 Variable Frequency Drives (VFD)
 - .1 VFDs shall have an adjustable carrier/switching frequency with a minimum adjustment range from 1 - 12kHz.
 - .2 VFDs operated at low carrier frequency's can lead to high motor noise. Higher frequencies can reduce noise but may require upsizing the VFD. Another strategy to reduce noise is to install output reactors/sine wave filters.
 - .3 It is recommended (at the designer's discretion) that VFDs are selected at a minimum carrier frequency of 8kHz so that the switching frequency can be adjusted upward, if required to reduce noise. However, VFDs should be operated at the lowest possible carrier frequency that produces acceptable noise levels as this will generate the least heat and be the most efficient.
 - .4 It is the designer's responsibility to select an appropriate carrier frequency and/or sine wave filters to mitigate the possibility of noise issues.
 - .5 Specify matched motors and variable frequency drives with low harmonic content and harmonic filters. Maximum acceptable harmonic content as per IEEE Standard 519 and 1100.
 - .6 All VFDs shall have an internal line reactor and DC choke. For motors sized at 5HP and greater, an additional external 3% line reactor is required if the internal line reactor is less than 3%.
 - .7 VFD Load side conductors shall always be less than 100 feet from the motor. 3% load reactors are required for all installations greater than 50 feet.
 - .8 All VFDs shall include an integral lockable disconnect that is lockable in the open position.
 - .9 Installation Requirements:
 - .1 Load side wiring of each variable frequency drives (VFD) shall utilize a dedicated raceway. Load side wiring shall not share raceways or junction boxes with other VFD's or loads. Load side wiring shall be directly connected to the

- load without a disconnecting means in the circuit. The only exception shall be air-conditioning and refrigeration equipment. Any other instance will require approval from UBC Facilities Electrical. For any instances where a disconnect is approved for use a lamicoid will be required stating the following: "MOTOR MUST BE STOPPED AT THE VFD PRIOR TO OPERATION OF DISCONNECT".
- .2 Flexible conduit shall be used for VFD line and load size conductors. EMT is not acceptable.
 - .3 Teck cable is permitted to be utilized on load side wiring under the following conditions:
 - .1 Mechanical Penthouse / Rooftop VFDs feed Rooftop Units (RTU).
 - .2 VFD and motor are located in a space that utilizes cable tray as the primary means of cable transport.
 - .3 VFD and motor are located within 5 meters and line of sight of one another.
 - .4 VFDs shall only be installed in conditioned rooms.
 - .5 VFDs shall not be mounted on surfaces that are susceptible to vibrations. The only exception is for certified engineered solutions which integrate a VFD and motor/pump together in a prefabricated package.
 - .6 VFDs mounted adjacent to sources of liquid (i.e. Piping fittings, valves) will require either a rated enclosure for the environment or a barrier such as metal flashing for protection of the VFD from potential water ingress.
 - .7 Conductors/conduits shall be bottom entry.
 - .8 Drip hoods are required for all VFDs in sprinklered areas.
 - .9 VFDs shall be installed such that no operating handle, buttons, displays or switches are greater than 1.8m above the finished floor level.

END OF SECTION