Marketing Newsletter – Boreholes

Object: Guidelines to use Lowara submersible motors under VFD (to be added to the existing indications at the end of Borehole motors)

Variable Frequency Drives (inverters) together with submersible pumps are today often being used when water demand varies over time. The pump will run with the VFD at a speed optimal to the actual demand, leading to possible energy savings. There are a wide number of different frequency drives available on the market and they often have different characteristics. Therefore it is important to choose a VFD and other electric components that will work satisfactory together with the motor. VFDs generate voltage peaks and if the peaks are too high and too steep they will damage the windings in any submersible motor. The submersible motors can be used with Variable Frequency Drives if the following guidelines are respected.

Motor frequency limits

Maximum Frequency	Recommended Minimum Frequency (*)
Nominal frequency written in the motor nameplate	≥30Hz

(*) Always make sure that at the nominal frequency of the motor the minimum speed of the water around the motor is enough to cool the motor at all the duty points of operation. Values for the flow can be found in the submersible motor technical catalogue.

Acceleration & Deceleration Ramp time

The acceleration (from 0 Hz to the recommended minimum frequency) and deceleration (from the recommended minimum frequency to 0 Hz) ramp time must be as quick as possible to ensure the correct lubrication of the thrust bearing of the motor as indicated in the below table.

Maximum Acceleration ramp time (0 Hz – Recommended minimum frequency)	
4DS	≤ 3 s
L4C – L6C – LW	≤ 1 s

Maximum Deceleration ramp time (Recommended minimum frequency – 0 Hz)	
4DS	≤ 4 s
L4C – L6C – LW	≤ 1 s

Lowara submersible motors voltage limitations under VFD

Motor limitations are described in the table below:

Motor version	Voltage spikes on motor terminals	dV/dt	Suitability for VFD applications	Max recommended switching frequency (**)
LW - Standard version	≤ 690 V	≤ 500 V/µs	Suitable (for further information see filters chapter)	≤5 KHz
LW - HT version	≤ 1000 V	≤ 500 V/µs	Recommended (for further information see filters chapter)	≤5 KHz
L4C	≤ 800 V	≤ 2000 V/µs	Recommended (for further information see filters chapter)	≤5 KHz
L6C	≤ 800 V	≤ 2000 V/µs	Recommended (for further information see filters chapter)	≤5 KHz
4OS	≤ 1200 V	≤ 600 V/µs	Recommended (for further information see filters chapter)	≤5 KHz

(**) Switching frequency must be set on the inverter. If the Sine wave filter is installed (see below chapter) the switching frequency must be according to the filter requirement.

Motor filters on VFD applications

If the VFD cannot fulfill the motor voltage limitations (in particular voltage spikes on motor terminals and dV/dt) by itself, proper filters must be applied in order to comply with the motor voltage limitations. Filters models should be specified by the VFDs manufacturers according to the motor voltage limitations. Assuming that all the above indications are respected, the following indications are also recommended:

Motor version	Motor cable length ≤ 20 m	20 m < Motor cable length ≤ 100 m	Motor cable length > 100 m
LW - Standard version	Sine wave filter	Sine wave filter	Sine wave filter
LW - HT version	Not needed	dV/dt filter	Sine wave filter
L4C	Not needed	dV/dt filter	Sine wave filter
L6C	Not needed	dV/dt filter	Sine wave filter
4OS	Not needed	dV/dt filter	Sine wave filter

Sine wave filter - Positioned between the variable frequency drive and the motor, sine wave filters provide a sinusoidal phase-to-phase motor voltage. They reduce motor insulation stress and switching acoustic noise from the motor. Bearing currents are also reduced, especially in larger motors.
dV/dT filter - Provide a slower voltage rise rate on the motor terminal phase-to-phase voltage, which is particularly important when using shorter motor cables.
The higher the level of impedance of the system (inductance and capacitance), the higher the voltage peaks, which can cause flashover, a condition that results in premature breakdown of the winding insulation of the connected motor.

VFD - Motor size selection

For a correct selection of the VFD, refer to the nominal current of the motor rather than the power size.

The nominal current of the VFD must be higher than the nominal current of the motor at full load condition.

Example:

	Type	Nominal current	Coupling suitable?
Motor	LGW110T405 HT (11 kW)	In = 24,4 A	**NO (In Motor > In VFD)**
VFD	Hydrovar HV4.110 (11 kW)	In = 23 A	

In the above example the next size of inverter must be used, taking care to limit the output current of the inverter in order to match the motor current limits (In motor + tolerance):

	Type	Nominal current	Coupling suitable?
Motor	LGW110T405 HT (11 kW)	In = 24,4 A	**YES (limiting the VFD current according to motor data)**
VFD	Hydrovar HV4.150 (15 kW)	In = 30 A	

In the above example, set Hydrovar parameter 0275 at 85% in order to have an output current of about 25 A.

End notes

If the installation requires operation other than stated in the guidelines or if questions arise that are not covered in the guidelines please contact Lowara AED department for guidance. Please note that Lowara reserves the right to disclaim the warranty also in case of:

a) The product is out of standard warranty period;
b) The defect is a consequence use or installation in a manner contrary to the Supplier's instructions;
c) Technical analysis show that the above VFD guidelines or general motor guidelines have not been followed.

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