Doepke

Does your HVAC installation comply with Electricity at Work Regulations ?

HVAC Equipment containing 3 phase frequency inverters (VSD) for fan speed control can affect the operation of RCDs installed in other parts of the installation, resulting in increased risk to staff from electrocution or fire hazards. **Figure 1** is based on the recommendations of EN50178 detailing the correct division of circuits containing VSDs and is covered by regulation 314 and 331 in the latest edition of the IET Regulations. Type 'A' RCCBs should not be used for this application, due to the smooth DC residual currents that flow under certain fault conditions – explained later in the article*.
Using a Type B RCCB for this application is a fundamental safety requirement recognised in EN standards to ensure that DC earth fault currents are detected and not allowed to circulate within the installation.

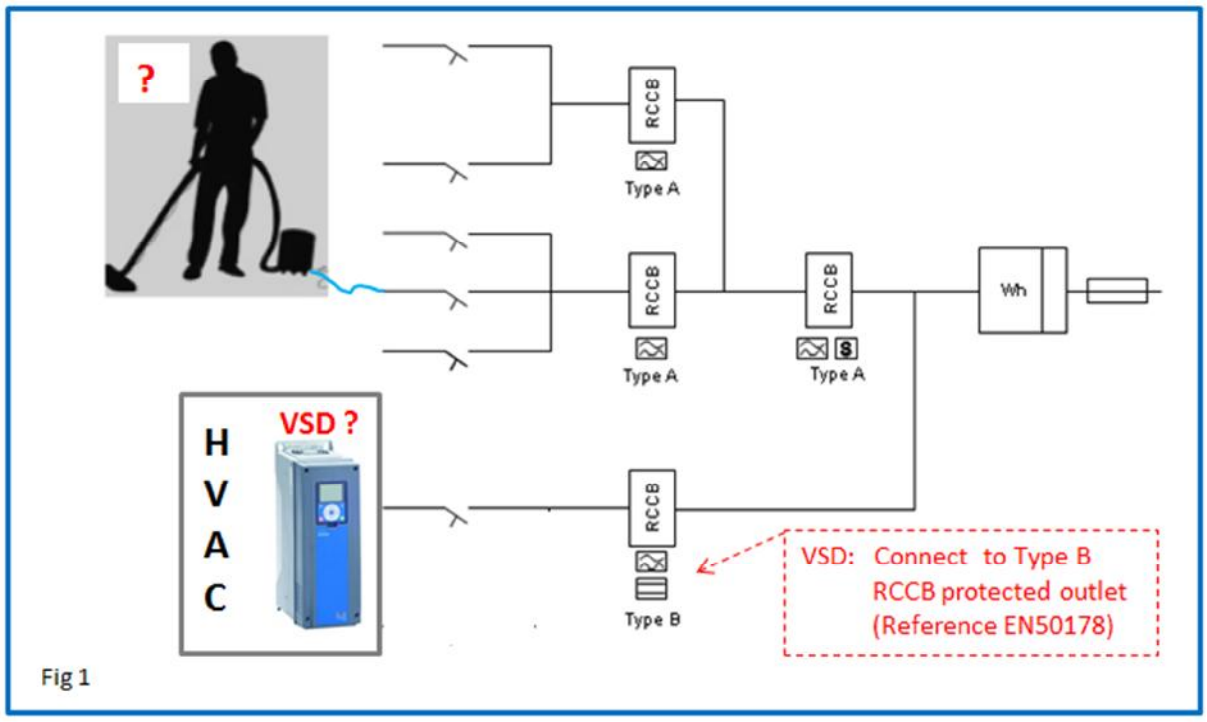

Fig 1

Electricity at Work Regulations

EWR 4 places a duty of care on the Duty Holders for the Site, with regard to the Electrical Systems and the components making up that system: ***Regulation 4(1)*** *65 The safety of a system depends upon the proper selection of all the electrical equipment in the system and the proper consideration of the inter-relationship between the individual items of equipment.*

RCCB Protection with VSDs

To comply with Regulation 4(1) 65 - Where the precautions taken include an RCCB to reduce the risk of death or injury (Regulation 8), the RCCB must be suitable for use with VSDs. The Duty Holder to comply with current laws on H&S must make reference to the VSD manufactures recommendations relating to the type and characteristics of the RCCB required. If this is not clearly stated in the operating instructions, obtain the VSD manufactures recommendations in writing. Depending on the topology of the VSD and certainly with 3 phase units it would not be safe to use an AC or A Type RCCB.

AC operational leakage currents: 3 Phase Inverters used for speed control and the associated EMC filters and motor cables, generate leakage currents at nominal supply frequency (50Hz) and at various harmonic frequencies. Leakage currents in the higher frequency ranges can be significant and from a safety perspective cannot be ignored, as can be seen from the following example. **Figure 2** gives an example of the

frequency range of various leakage currents present in a system containing a 32 amp VSD; at 50hz the leakage current is less than 3mA , however the actual maximum leakage current occurs at 7815 Hz and is approaching 2000mA. This installation had to be taken out of service by the user, and the Drives Manufacture contacted to look at ways to reduce the leakage currents to meet fire protection requirements of 300mA for this site. Fortunately for the user, the standard RCCB they tried to use in the installation tripped on start-up due to the inrush current associated with the capacitance of the EMC filter (Doepke Type B RCCB's withstand 3 kA - 8/20µS pulse or 5 kA -8/20µS for Selective version). Also it is worth remembering that standard RCCBs are only designed to operate at the nominal supply frequency, for example 50Hz in the UK. The commissioning engineer should have access to a residual current analyser to gain a complete picture of the installation's leakage currents to check the suitability of the protection devices required for the installation.

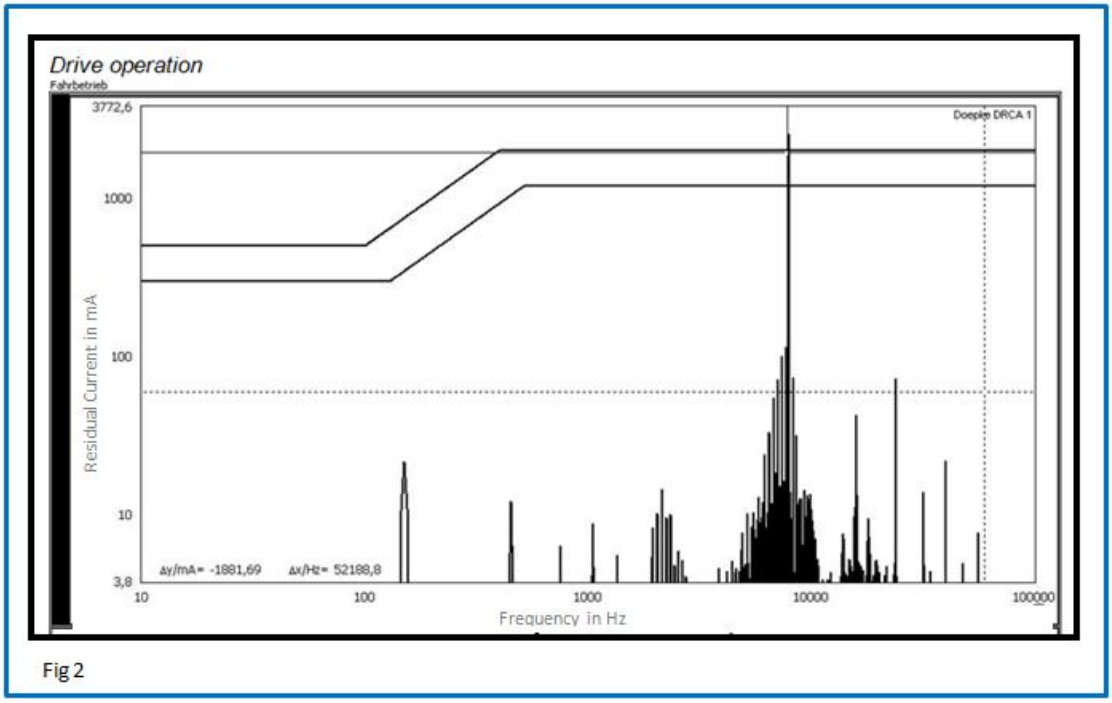

Fig 2

***DC Residual Currents:** Under certain fault conditions 3 phase inverters produce smooth DC residual currents (see fig 3), this current cannot be detected by conventional RCCBs. In addition this DC current if allowed to circulate within the installation would produce magnetic saturation within the AC trip coil of the conventional RCCB or RCBO (e.g. the device would not be able to sense AC leakage currents). A product applied outside of its original design tolerance cannot be and should not be relied on to perform a safety function – see IET wiring regulation clause 133.1.3

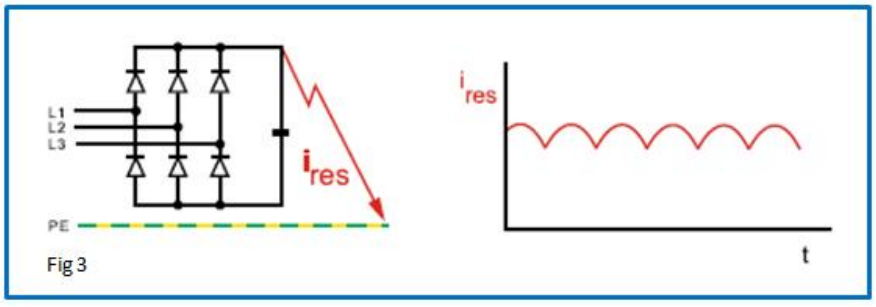

Fig 3

Doepke

Safe application of HVAC VSD's using B Type RCCBs

The Electricity at Work Regulations makes reference to the IET Regulations as a guidance document (unless the site is specifically covered by another code of practice such as Mines & Quarries), existing Regulation 331.1 is quite clear in its requirement *"An assessment shall be made of any characteristic of equipment likely to have harmful effects upon other electrical equipment"*. A simple assessment carried out under Regulation 331.1 in accordance with existing Health & Safety legislation, on a system containing VSDs and requiring RCCB protection, will quickly identify that you cannot use a conventional RCCB.

Only B Type RCCBs can be used safely with VSDs incorporating the appropriate trip characteristic, compatible with the operational and safety requirements of the installation for People and or Fire protection. To safely commission an installation containing a VSD follow the manufactures instructions. A residual current analyzer (such as DRCA1) can be used to determine the actual maximum level and frequency of the leakage currents present in the installation. Having this information available will enable the engineer to validate the RCCB selection, reducing the risk of nuisance trips, but more importantly make certain that the RCCB is selected correctly for the safety requirements associated with the installation.

Chaz Andrews – Technical Manager, Doepke UK Ltd

If you would like more detailed information relating to this subject, Doepke UK have a free 60 page Technical Application Guide Available. Log on to WWW.doepke.co.uk to download the guide or obtain further information on RCCBs. For technical support please e mail sales@doepke.co.uk