U. S. Department of Labor
Mine Safety and Health Administration
Office of Technical Support
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Electrical Safety Division

EXCERPTS FROM AN
Investigative Report
On
Variable Frequency Drives
January 26, 2004
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A visit was made to Zero Ground in Wisconsin on October 29, 2002 to examine some Beta Site installations. Zero Ground claimed to have VFD installations where the grounding conductor current produced by the VFD was reduced to nearly zero (i.e. zero in the seventh place). The Beta Sites visited were installed on 480-volt automatic milking machines, cattle herding machines, etc. on dairy farms. An examination of two Beta Sites verified Zero Ground's claim of reducing grounding conductor currents to nearly zero.

Based on research conducted, it was determined that the technology is available to design, manufacture and install VFDs in underground mines that are safe and meet MSHA regulations, policies, and procedures. Ground fault relay systems have successfully demonstrated the ability to trip without nuisance at current levels as low as 7 to 10 milliamps. Drives have also demonstrated the ability to recognize existing ground faults, to shut down in response to a ground fault and not re-start until an existing ground fault is cleared or removed. Although present testing has been limited to 480-volt three-phase VFDs with Zero Ground, it has been demonstrated that VFDs can be installed such that the inherent grounding conductor current produced can be reduced to zero in the seventh place. Mr. Robert Hopkins of Zero Ground reported that in his opinion, he did not see why the technology used to reduce the grounding conductor current to zero on the 480-volt drives could not successfully be extended to drives operating at 4160-volts with nearly identical results.

This investigator believes that, based on the technology available, some grounding conductor current is unavoidable. I also believe that the grounding conductor current can and should be minimized to reduce exposure limits. Because grounding conductor currents produced by VFDs can be lethal, it is recommended that reasonable safeguards be utilized to further minimize the potential of personnel becoming a part of the VFD grounding circuit. Based on observations and test results of Zero Ground's 480-volt VFD installations, it has been demonstrated that the technology is available to reduce the grounding conductor current produced by a VFD to less than a few milliamperes.

Note: This report was provided to ZERO GROUND courtesy of Arlie Massey , Electrical Engineer, MSHA. For a copy of the entire report, please request from service@zero-ground.com