

Summary:

Stray 50Hz voltages that upset cows in the dairy have in the past been rectified by ensuring adequate power supply and earthing. The more recent installation of Variable Speed Drives (VSDs) on the various cowshed electric motors has created much higher frequency currents with different characteristics that cause similar problems with stock. The stray voltages are difficult to detect but relatively easy to rectify. A draft Code of Practice for the supply, installation and operation of variable speed drives, which includes a section on farm dairies, is being prepared by a Ministry of Economic Development working group. Steve Corkill is a member of the group.

Background:

Stray voltage is the broad term given to small electrical currents that make contact with cows through metal pipes and rails in the dairy shed. The tingle or sensation it creates can agitate cattle sufficiently to delay or prevent let-down and make them reluctant to come into the dairy for milking. It can cause high somatic cell counts in milk, which leads to downgrades, and mastitis that creates discomfort for cows, considerable stress for milkers, and financial loss for farmers.

Vern Coxhead is the sales manager for Corkill Systems Ltd and is chief trouble shooter for farmers who suspect they have stray voltage problems. He says that in older dairies the cause is usually poor or unbalanced 50Hz power supply with poorly bonded and earthed metal and pipework.

“You might have a farm with an older 20-a-side herringbone plus associated buildings and nearby is a lifestyle block subdivision with the power supply to them all coming from the same transformer as the cowshed. That tends to create unbalanced or low voltage which lifts the neutral currents and creates earthing problems. The result is unhappy cows,” says Vern.

“Modern sheds generally have their own transformer and all steel and pipework is welded together so the 50Hz problems don’t occur, but they can have stray high frequency voltages around 50MHz that are usually caused by variable speed drives.”

Variable speed drives or VSDs (also known as Power Drive Systems or PDSs) control the speed of an AC electric motor by varying the voltage and frequency of power supplied according to the load on the motor. Their advantages are considerable savings in electricity consumed and a reduction in noise and wear and tear on the motor and the machine it drives. Most modern dairies have VSDs on milk pumps, vacuum pumps and rotary platform drives, and sometimes on water pumps and backing gates.

Steve Corkill, managing director of Corkill Systems Ltd, says he helped introduce VSDs for vacuum pumps and milk pumps in the late 80’s without realising the potential downside.

“VSD’s had been used on platform motors for several decades and I had heard that some sheds seemed to upset cows while others didn’t. About 10 years ago we were alerted to possible effects of controllers. I had developed the Varivac™ for vacuum pumps and because it was a large controller handling large motors its effect was more pronounced,” says Steve.

“We had some people saying that their somatic cell counts dropped dramatically within days

of VSD installation while others thought they had gone up dramatically, and I started to wonder why this would be. As we investigated and experimented further we found the installations where SCCs had dropped had a few things in common, and there were different things in common where they had gone up.”

Steve found that the pulsed current supplied to motors by VSD’s contained high frequencies of 50 MHz or higher. These harmonic stray voltages were impossible to detect with conventional equipment and behaved differently to the 50 Hz voltages, so many people didn’t believe they were a problem. However, cows proved very susceptible to the high frequencies and reacted noticeably when they were introduced or eliminated.

Avoiding the high frequencies involved selecting the right controller for the job and ensuring that it was installed in a particular way. Steve found that when it was done correctly SCCs would always drop, so much so that he guaranteed it would happen.

That was a decade ago. Today VSD’s are in use in many industries and can cause a variety of electromagnetic problems. Steve is part of a working group brought together by the Ministry of Economic Development, which is about to issue a Code of Practice for the installation and use of VSD’s. A section of the Code deals specifically with farm dairies. The acceptable level of harmonic stray voltages in dairies has been reduced from 800mV to 300mV, and more stringent shielding and connection criteria are specified.

What to do to avoid problems:

Stray voltages are not the only thing that cause cows to be jumpy and kick – another reason can be vibrations from vacuum pumps and regulators being conducted through air lines to stock being milked. So when a farmer contacts Vern Coxhead for advice that’s one of the things he checks out. However, very often it is a VSD installation problem, he says.

“High frequency voltages from VSD’s are hard to measure because they ‘load’ into the steel close to the source. You can have one continuous piece of steel with a high voltage at one end but towards the other end it will disappear. It doesn’t behave like a 50Hz electrical current and you can’t get rid of it by earthing – it just hangs around,” says Vern.

“The cows are very sensitive to it, way more sensitive than anyone ever realised, so what we aim to do is reduce that high frequency voltage down to the same as our bodies, which is much lower than the 300 mV currently being used as a safety level, and then the problems disappear.”

The answer, says Vern, is to have the correct drive and make to make sure it is wired correctly. VSDs must be C-Tick certified to show that they meet electromagnetic compliance requirements. They must also be “first environment” grade, which means they have a high level of electrical filtering so that they are suitable for applications in houses, hospitals and other sensitive areas.

“Originally it was thought that the ‘second environment’ or industrial level would be fine for farm dairies but experience has shown that they are not filtered anywhere near enough to be around cows, and it is the filtering it is important,” says Vern.

“The second part is the installation – you have to use the correct cable between the drive and the motor and then the correct fittings on the end of it. As you change the speed of motor it

creates an electromagnetic field in the cable between the drive and the motor, and it is that field that creates the high frequency voltage that causes the problem.”

“The cable must be VSD rated and metal mesh screened. , The screen must be connected at each end with a steel gland – you can’t just make a rats tail out of it at the end because that amplifies the problem.”

Some electricians who are unfamiliar with high frequency stray voltages believe that if the structure is properly earthed there should be no problem, but Vern says once he shows them on a scope meter what is actually going on they get the picture and can help farmers.

Steve and Vern have seen so many installations on so many farms that they can usually diagnose problems over the phone. Typically a farmer will complain that cows are unhappy, they kick when we put the cups on and are not letting down. Sometimes they have been to a neighbour's shed and realise that their cows are very unsettled by comparison, says Vern.

“I ask them what sort of shed it is, and get them to walk around and tell me what they see. There are certain key points that I know may create issues – the most common problems are the variable speed drives including the platform control, milk pump control and vacuum pump control if they have them. Sometimes they also put variable speed drives on water pumps and backing gates,” he says.

“In each case I need to know the wiring and what type they are, and then I know how it can be fixed. Most times I can explain to their electrician over the phone what needs to be done. Just occasionally there is a dairy that continues to be a problem and that may require me to visit it.”

With new dairies having up to five VSD’s, some of them have problems right from the start while others may be fine for years. Vern says that dairies change over time, and while some stray voltages may find their way through the steelwork into the ground, that can causes corrosion that eventually forms an insulating layer around the steel and increases the voltage affecting cows.

A dairy farmer himself, Vern thinks stray voltage is a major problem for the dairy industry not just in NZ but all over the world. Problems with chronic mastitis, unhappy cows and stressed farmers are obvious to farming families but equally can occur on large farms where owners may be remote from day-to-day milking and not aware of the potential problems. Where stray voltages are the cause, says Vern, eliminating them creates enormous relief.

“A lot of people in the industry don’t believe they are a problem because it is hard to find high frequency voltages unless you have the right gear, but farmers can get really upset. The stress of jumpy cows, getting high SCC docketts and having to strip so many cows individually is unbelievable, and unless you are a cow cocky you can't understand how bad it can be,” he says.

“We have had people who have been ready to sell up because they have been having so many problems with their stock, and when I sorted it out for them they were so very grateful. It’s a tragedy that the wrong sorts of VSD’s and poor installations are still creating problems.”