

# STRAY VOLTAGE

*“ELECTRICITY’S DIRTY LITTLE SECRET”*



PREPARED FOR: Kellogg Rural Leadership Programme 2001

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## 1.0 EXECUTIVE SUMMARY

The problem of Stray Voltage in Farm Dairies is not new. In the past extensive research was done on voltage and animal behaviour. This resulted in the formulation of construction guidelines for farm dairies. The dairy industry now hosts a new generation of dairy farmers that may not have the same level of knowledge and understanding of stray voltage. In addition the industry is currently in a phase of rapid expansion where qualified builders are in short supply in some areas.

This project demonstrates how severe the problem can be, and aims to raise the awareness of stray voltage and how this impacts New Zealand Dairy Farmers today. My main objective is to provide the Dairy Farmer with a resource should he/she be faced with stray voltage in their farm dairy.

This project includes:

- a case study of our own experience with stray voltage
- an explanation of what stray voltage is
- a list of symptoms covers production, health and behaviour aspects
- details of four separate causes of stray voltage in the farm dairy
- remedies for managing stray voltage in an existing farm dairy and the golden rules with new farm dairy construction.

The study concludes with "What to do and where to go for help". This section includes a farmer self audit checklist, and details the types of assistance available to the dairy farmer.

Incorrect installation and operation of electric fence systems has been proven to be the main contributor to stray voltage problems in New Zealand. To rectify this, Manufacturers and farm merchandise stores at point of sale need to be more proactive to ensure that the purchaser fully understands the vital importance of correct earthing and installation.

## 2.0 INTRODUCTION

I have chosen my Kelloggs project: "Electricity's Dirty Little Secret" to cover stray voltage in farm dairies. This study will:

- present a case study of first-hand experience spanning a period of ten years
- explain what stray voltage is
- outline the causes and effects
- suggest how to remedy the problem,
- suggest options in enlisting specialist help.

The dairy industry in New Zealand during the 1960's and 1970's undertook significant research on Stray Voltage and Animal Behaviour. This resulted in the formulation of farm dairy construction guidelines for the dairy and building industries. We now have a new generation of Dairy Farmers who have had little experience or knowledge with stray voltage. Results of studies carried out in the 1980's (Fox, J.) indicate that a large proportion (>50%) of farm dairies have some level of stray voltage.

This project will demonstrate how severe the problem can be, and aims to raise the awareness of stray voltage and how this impacts New Zealand Dairy Farmers today. My main objective is to provide the Dairy Farmer with a resource should he/she be faced with stray voltage in their farm dairy.

My research scope encompassed the United States, Canada, Australia and New Zealand. Mr. Stanek of The American Society of Agricultural Engineers describes Stray Voltage as "the most financially debilitating, misunderstood and frustrating problem that livestock farmers in general are faced with."

### 3.0 WHAT IS STRAY VOLTAGE?

Stray voltage is a small voltage often less than ten volts that can be measured between two contact points such as where the cow stands, walks, drinks, is milked, drenched and fed. If a person or animal such as a dairy cow touches these two points a current will flow. The level of current that occurs depends upon the voltage and the resistance of the pathway.

Cattle are more susceptible to stray voltages primarily because cow body impedances are much lower than human body impedances. In addition this lower resistance to current flow is intensified for the cows which, unlike the farmer in his rubber boots, have no insulation from the wet environment of manure, mud and water in which they live. Therefore more current is delivered to a cow than to a human at equal voltages.

Cows can receive electric shocks in the milking shed or yard area. Commonly the small voltages generated on the earthing system can cause milk yield losses of up to fifteen per cent. Greater voltages may lead to production losses of up to fifty per cent.

Cows feel voltage at a threshold twenty times lower than humans. Cows exposed to voltages as low as 0.5 volts or less often experience distress.

## 4.0 CASE STUDY

### Diary of Events

- 1987 (March) Edgecumbe Earthquake damages our dairy  
MAF condemns dairy
- (June) Milking platform replaced. Expert builder of cowsheds contracted. Everything bonded and earthed correctly.
- 1988 New rectangular yard constructed. Expert builder of cowsheds contracted. Everything bonded and earthed correctly.
- The cows never settled properly into the new dairy.**
- Contacted Bay of Plenty Electricity. They checked their lines, transformer and its earth and could not find any problem
- 1988/89 Our electrician John Burton (Wairaka Electrical) "lived" at our dairy. Virtually every pipe, electric motor and rail was bonded together.
- Our dairy earthing system was upgraded to the extent that it was dragging stray voltage in from outside sources.  
Our dairy was a spider web of cable and wires**
- 1991 Dr. Harry Dewes (Hamilton Analytical Services Ltd) was called in to assess the problem. (Our electrician had exhausted his ideas.) Dr. Dewes found 8 volts entering our dairy system through the ground. Source: Our neighbouring farm had a mains unit installed in a house garage. The earth peg was 2 metres from his house earth peg. The mains unit had one earth peg when it should have had up to ten or twelve.
- The mains peg was putting leakage into the house earth (two metres away) system that was tracking back through the neutral line to our transformer then 100 metres across to our dairy.  
"Green" concrete in the newly constructed dairy acted as a magnet for ground voltage.**
- (December) Cut concrete grooves on milking platform and pit floor and installed Equipotential Floor (EPF) system that consisted of 88 metres of copper wire into concrete and bonded this to pipework. This was designed to combat 0.4+ volts in the concrete.
- 1992 (February) We went to eight neighbouring farms and with their permission checked their mains earth systems. Every single one was inefficient. Three of them were leaking voltage into our dairy. All

were upgraded. Timer switches were installed so no units were on during our milkings.

**Maintaining checks on these timers became a nightmare as neighbours lost interest in our problem and became indifferent to events such as power cuts and flicks and daylight saving.**

(May) Installed a temporary copper cable connection above ground from transformer to our dairy earth system.

- 1994 Bay of Plenty Electricity put permanent copper wire on power poles from transformer to dairy power pole and upgraded ground earth at their pole.
- 1995 48hr graph metered power flows in dairy.
- 1997 Discussed problem with dairy auditor Tom Fisher. He queried the power line and cable feeding power to the dairy. Was it of a heavy enough grade?
- 1999 We threatened local power authority with legal action. We were at our wits end. We felt everything we had done was only a band-aid. We still did not know why stray voltage was entering our dairy. We were seriously considering selling up and leaving.

**After reading yet more material from conference proceedings, from more experts we stumbled on a paper from a technician from Ashburton Electricity. After 2 telephone calls and 1 week, we installed a "Ring of Life" ring earth around our total farm dairy and yards. This consists of 8mm copper cable clamped to 1.5 metre earth stakes placed 3m apart and 200mm under the ground surface; connected to our dairy main earth system. Cost of materials and installation: \$3000**

**Within 1 week we had:**

- **Contented cows**
- **Pleasurable milkings**
- **Happy farmers**

**If this ring earth system is severed we will be back to the original problem.**

- 2001 (June) Expanded our No.1 dairy operation to 300 cows and extended the dairy from 20 aside to 30 aside.

**Also extended our ring earth to encompass extended dairy and yard. Also installed new direct feed underground cable from transformer to dairy at a cost of \$8200.**

**Costs incurred during investigation and management:**

**Milk Losses (1991) est \$33 000**

**Investigation/Expenditure \$22 000**

**Note: Cost estimates do not include losses with empty cows, mastitis, milk quality, milk production, and stress.**

**Even today, our Electrician regards our case as the worst he has ever been involved in.**

There were times during this period that the problem seemed to die down. Months could pass, then all of a sudden without reason or warning, milkings would become a battle again. This proved very demoralising for all members of our team.

**Another example of Stray Voltage from Ashburton Electricity:**

A 600 cow herd in mid-Canterbury milked in a rotary dairy. At the end of the 1988/89 season, 95 cows (15.8%) vetted empty; then a further 120 cows were induced in the Spring. Milk production was declining.

Auditing the dairy detected three sources of voltage.

They were: 1 Fence Energiser discharging 5V into the dairy  
2 A second Fence Energiser discharging 12V into dairy  
3 The platform drive motor and centre gland were inadequately earthed.

The stray voltage problem was resolved by bonding the platform to pipework, earthing the drive motor bridging the centre gland, putting a timer switch on one fence energiser, and upgrading the earthing system on the second energiser.

Within two years, empty cow rate was between 3 – 5%, and milksolids production was up 34% compared to the 1988/89 season.

## 5.0 WHAT ARE THE SYMPTOMS OF STRAY VOLTAGE?

Depending on the voltage level, symptoms fall into three categories: Milk Production, Animal Behaviour and Animal Health

### **Milk Production**

- Milk losses from 10%-50%
- Milk quality may also be affected by high SCC results

### **Animal Behaviour**

- Cows hard to handle - Slow to enter cow yard  
- Don't want to enter dairy
- High levels of manure and urine in yard and dairy which makes milking unpleasant and prolonged and risks milk quality
- Cows milk out unevenly and slowly
- Cows sniff the ground and concrete
- Cows kick cups and milkers
- Cows resist drenching
- Cows dislike crossing certain points i.e. yard to dairy, gateways
- Cows lap at water instead of drinking properly
- Cows walk to dairy in Indian file
- Cows turn away from bail entry
- Morning milkings or wet day milkings noticeably worse
- Cows tense and not cudding in dairy

### **Animal Health**

- Mastitis incidence increases
- Fertility effects i.e. cows not holding or showing up empty
- Milkers receive electric shocks

## 6.0 CAUSES OF STRAY VOLTAGE

Dr. Harry Dewes (Hamilton Analytical Services Ltd) and Ashburton Electricity Ltd consider that the most important single source of stray voltage in New Zealand is the **electric fence energiser**. His work showed the following:

Electric fence energisers as a source of stray voltage:

Australia – average of 3 districts	58%
Waikato 1988	73%
Waikato 1995	62%

Other causes of stray voltage are:

- Electronic pulsators
- Drenching equipment
- Variable speed pumps and meters e.g. milk lift pumps
- Flaws in the bonding system in farm dairy construction i.e. entry and exit from bail area, yards, rails pit and floor concrete meshing (see figure 6a)

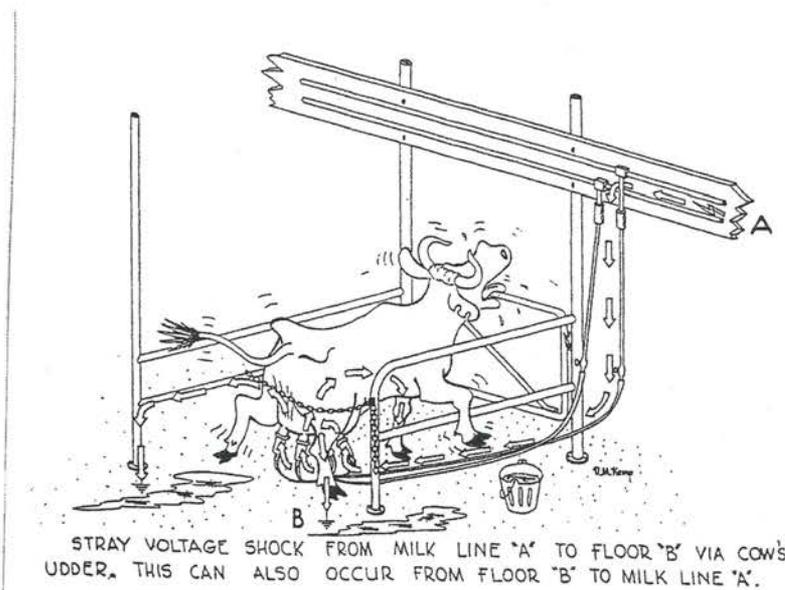


Figure 6a

- Unsatisfactory earthing
- Switching transients arising at the dairy or generated by switchings in other buildings supplied by the same transformer
- In some dairies the backing gate has wires connected to the 'hot' end of the energiser. This practice should be avoided as it inevitably generates stray voltage
- Faulty earths
- Transformer/neutral

- Transformer too far from dairy shed
- Transformer faulty earth mat or grounding electrode
- Neutral – overlong, undersized, faulty joints, cracked insulators
- The majority of farm dairies have more than one source of stray voltage.
- Australian farms experience special problems due to ground currents
- Most of USA and Canada reports relate to Neutral to Earth (NE) voltages whereas in NZ and Australia most frequent in order are:
  - i) **Electric fence energisers.**
  - ii) **Spike voltages associated with load switching**
  - iii) **AC Voltages**
  - iv) **Flaws in the bonding system of the dairy and unsatisfactory earthing**

## 6.1 Dirty Secret No. 1: Electric Fence Energisers

The fencing systems used on most Dairy Farms today rely on mains electric fence energisers to control livestock. This has revolutionised both fencing and pasture management but there are some negative aspects to be considered.

Electric fences put out one pulse of 5kV and approximately 300 microseconds long each second. It is not at all uncommon for there to be an electrically conducting path from the “hot” side of the electric fence to areas where it can affect the animals. Some insulators are of poorer quality than others. Insulators get damaged; deposits of dirt, moss and moisture form. Wires can slip off or be knocked out of insulators. Grass or plants can grow on to the live wires while sticks, dirt and debris can inadvertently be left in contact with “hot” fence wires. Therefore it is practically very difficult to avoid some degree of leakage from the “hot” side of the electric fence.

The leakage leads to voltage differences between different areas or components in contact with the cows to adversely affect them. Also, even if the problem is not there on a particular day, it may arrive on another day, due to rain, growth, gradual deterioration of parts of the system or as a result of minor changes or damage that may not be noticed.

If the live line of the electric fence is shorted to ground, or arcs to ground by way of a fault, this gives another route for additional currents in the earthing system of the energiser to follow. The result is to increase the total current flowing in the energiser earthing system.

So in all cases there are also high voltage gradients in the ground in the vicinity of the earthing systems of electric fence energisers. The more powerful the energiser, the

lower its internal impedance is likely to be. Therefore the greater the resulting stray voltage problem. It is critical that farmers:

- Use only good quality fencing material and insulators (see appendix 4)
- Maintain farm systems to a good standard, (including underground cables)
- Ensure the earthing system is as per manufacturers recommendations (see appendices 1, 3)
- Ensure the earthing system is efficient (see appendix 2)

By adopting these recommendations, farmers will achieve the following:

- Optimum performance from electric fence system
- Long life fences
- No voltage leaks
- No pollution of telephone lines
- No pollution of internet connections.

## 6.2 Dirty Secret No. 2: Spike Voltages Associated With Load Switching.

Another form of stray voltage is switching spikes generated primarily by rapidly changing transient currents on the neutral line. These can be caused by any installation on the transformer circuit e.g. a light, a motor, a stove, a heater being switched on.

This problem is most serious for motors and loads within the milking shed that are regularly switched on and off during the milking period. An example is the variable speed milk pump associated with a receiving can within the herringbone area.

Many trials and measurements have confirmed that it is this switching on of loads that inject spikes into the ground and so into the milking system, water system and other areas of the farm dairy.

## 6.3 Dirty Secret No. 3: AC Voltages

This voltage arises from voltage drops across the neutral line supplying the farm dairy being injected into the ground from the Multiple Earth Neutral (M.E.N.) system. (This is the New Zealand Electrical Supply System). Some of this voltage can reach a farm dairy linked to a different transformer.

Other sources include faults (e.g. faulty insulators, faulty neutral joints) tracking on switch boards, water or moisture in the wrong place, trees growing into power lines, dirt, vermin or water getting into meters, faulty insulation in water heaters and wiring errors or damaged wiring.

## 6.4 Dirty Secret No. 4: Flaws in the bonding system of the dairy and unsatisfactory earthing

This problem is most commonly found in older dairies where reinforcing mesh has rusted away inside concrete. This produces gaps in the bonding system. A similar effect occurs in poorly constructed newer dairies where bonding has been inadequate.

Dairies that have been altered or extended are also at risk where the builder has failed to tie in or bond the new with the old. In all situations the result is the failure to achieve an Equipotential Floor (EPF) system in your dairy.

This is termed "step voltage" and occurs between races and concrete, or yard and milking platform, or where cows exit the dairy. This is because of a voltage differential which the cows are reluctant to cross.

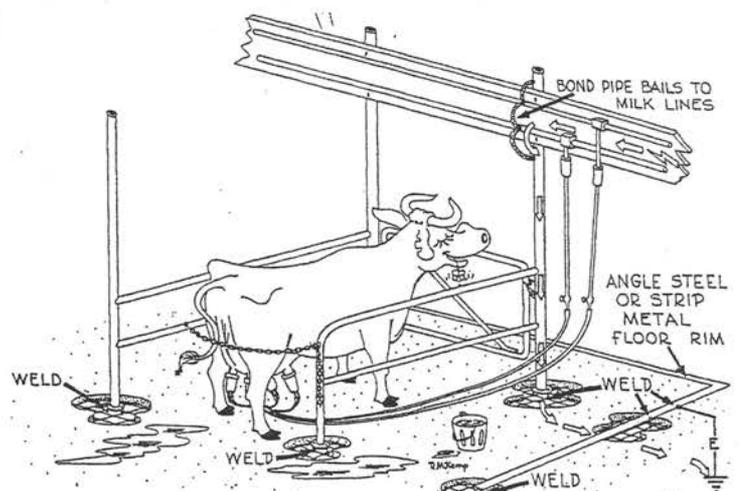
If this problem is suspected, place the leads of a voltmeter across the divide between the affected areas. Switch on heavy duty machinery and appliances. Differences in AC readings up to 4V may be measured when appliances like the water heater are switched on.

## 7.0 REMEDIES

### 7.1 Managing Voltage in an Existing Farm Dairy

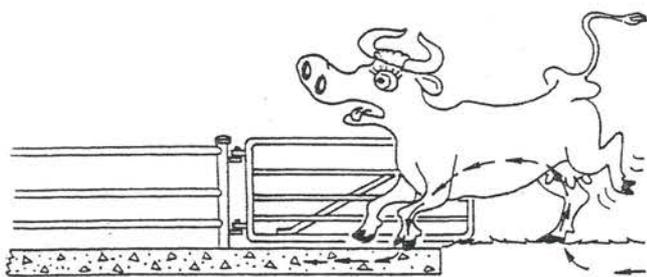
To reduce stray voltage in the farm dairy the following recommendations are made:

- Install a properly sized neutral wire with a minimum number of splices and connections
- Minimise unbalanced loads
- Reduce the resistance of the service entrance ground
- Bonding all metal work to the ground peg (see figure 7.1a)



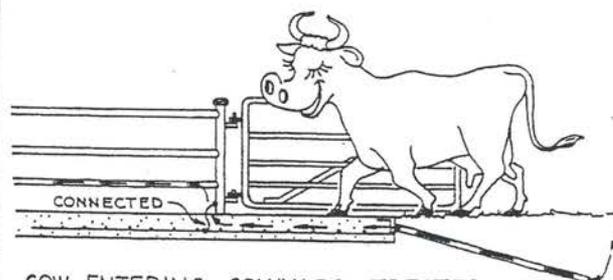
STRAY VOLTAGE GOES STRAIGHT TO EARTH BY-PASSING THE COW COMPLETELY WHEN MILK LINE AND PIPE BAILS ARE BONDED TO THE CONCRETE FLOOR REINFORCING AND TO THE STEEL STRIP ON SURFACE. *Figure 7.1a*

- Install grounding wires to form a voltage ramp at entry to farm dairy (see figures 7.1b, 7.1c)



COW ENTERING COWYARD MAY RECEIVE STRAY VOLTAGE SHOCK FROM GROUND TO COWYARD FLOOR OR FROM COWYARD FLOOR TO GROUND BETWEEN BACK AND FRONT LEGS.

*Figure 7.1b*



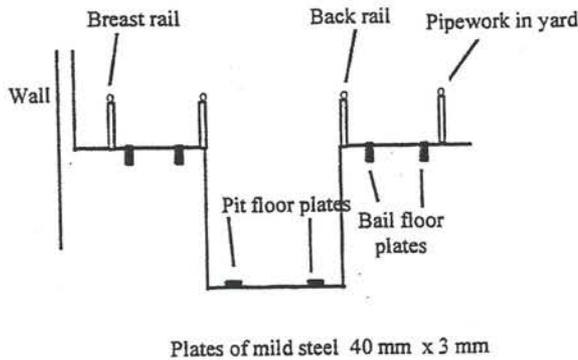
COW ENTERING COWYARD TREATED AS RECOMMENDED. COW FEELS NO SHOCK AS THE COWYARD AND SURROUNDING GROUND ARE AT THE SAME POTENTIAL.

*Figure 7.1c*

- Install deep well pumps well away from farm dairy
- Improve switchboard earth connections by increasing the number of stakes
- Install grounded plates or copper wire into or on the surface of bail and pit concrete (see figures 7.1d, 7.1e)

Figure 7.1d

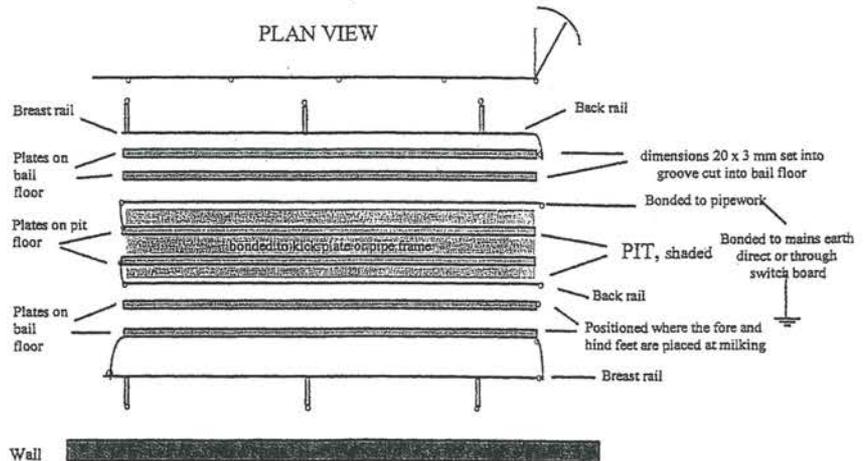
ELEVATION VIEW



Note: The milker or dairyman has one foot on the plate while the cups are being applied and removed. The weight of the plates is sufficient in themselves to stay in place.

Herringbone farm dairy,  
placement of plates and connections  
to pipework to eliminate stray voltage

PLAN VIEW



Note: The placement of plates in the bail area encourages cows to angle and position to milk and also to eliminate current transfer from milker in the herringbone pit to the cow as the cluster of cups are applied or removed.

Figure 7.1e

- Drive earth stakes of copper to delay corrosion (in salt laden soil)
- Ring earth farm dairy (see figure 7.1f)

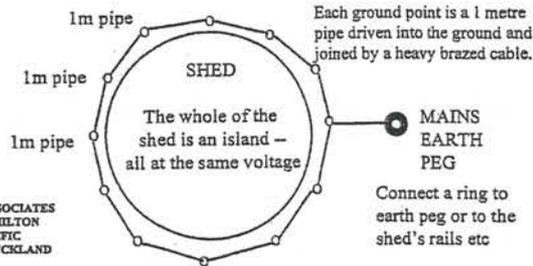
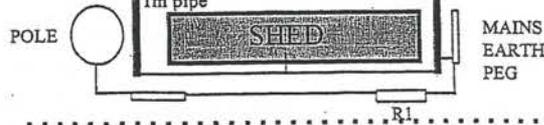
### THE RING EARTH METHOD

Sometimes we can't stop mains neutral currents from flowing through the shed and causing voltage differences. Then we have to make the whole shed into a floating 'island.'

**BEFORE:** Current from the earth peg then flows through the shed as it returns to the power pole.



**AFTER:** Current bypasses the shed



Courtesy of  
SCIENTIFIC ASSOCIATES  
PO Box 4136 HAMILTON  
ENSOR SCIENTIFIC  
PO Box 52959 AUCKLAND

Figure 7.1f

- Run a parallel of heavy copper cable between the board bus bar and the transformer earth.
- Earth mains electric fence energiser to manufacturer recommendations and keep minimum of 20-30 metres from power earth

Many older farm dairies have no reinforcing mesh in the concrete floor or have mesh with uncertain connections. In these cases it is best to resurface the appropriate areas with mesh and concrete. A concrete overlay of depth 50mm have proved satisfactory with the mesh located at 25mm depth. It is important to ensure that multiple welds between mesh sheets and pipes are carried out.

- An equi-potential floor (EPF) system
- Farm dairy type i.e. herringbone or rotary
- Yard construction
- Electric fence systems

#### Elevation of Area

If the shed and yard are to be built on back fill the electrical system earth may not overcome this poor earth. An earth mat should be laid down.

A 25mm bare copper wire should be buried around the perimeter of the shed and yard, connected to 1.5 – 2 metre long driven earth pegs 3 metres apart. This is then connected to the new mains earth peg. This ring main earth should be connected to the pad reinforcing mesh, bail pipe work, and metal supporting the roof and wall casing and all other metal near the dairy.

#### Availability of Three-Phase High Voltage Power Lines

The three-phase transformer should preferably be sited adjacent to the dairy. Copper main cable with a very low voltage drop is important. If the transformer is to be shared by a house or other building, have the wires run back to these, leaving the transformer at the dairy.

#### Water Supply Pumps

It is preferable to use a single pump for the water supply and primary cooling and run it continuously.

#### Equipotential (EPF) System

This is the simplest and most effective solution for most problems. Reinforcing mesh in the concrete floor surface makes it a conducting surface that is all at the same potential and connects it to all pipework in the dairy. The EPF system can be installed in existing dairies but is best implemented at the time of construction

#### Farm Dairy Type - Herringbone

Herringbone sheds lay reinforcing mesh in the concrete floor no deeper than 50mm. Continue the mesh out into the yard so when cows enter bail area, they won't get a shock. All mesh must be welded at several points and welded to upright pipes in floor. Thus all metal work including milking machines is connected electrically via pipes and mesh in floor. The mesh in the pit area is welded to mesh in the bail area and breast rails. Multiple welds should be used in all cases.

#### Farm Dairy Type - Rotary

As with herringbones the critical areas are entry and exits.

Weld two or more steel reinforcing rods between the mesh grid and the turntable track or the central bearing. This connects the metal platform, electrically to the concrete surface in the bail entry – exit area and eliminates the possibility of the cow

receiving a shock as she steps on or off the platform. As with herringbone dairies, all pipes and mesh must be welded and bonded together.

#### Yard Construction

It is important to use reinforcing mesh throughout the whole yard area. Ensure that the gate and hinge posts are connected to the concrete mesh.

#### Electric Fence Controllers

Electric fence controllers should not be located in or near the dairy and never earthed to the switchboard earth. They should have their own earth conductor (as prescribed by the manufacturer) and located a minimum of 20 metres away from the switchboard earth. Similarly use of electric fences on backing gates is not recommended.

## 8.0 WHAT TO DO & WHERE TO GO FOR HELP

### 8.1 Check your symptoms

One of the most simple and effective checks a farmer can do is audit his herd behaviour to establish if stray voltage is present in the Farm Dairy or immediate surrounds. Complete the Checklist: Have I got Stray Voltage in my Farm Dairy? See Appendix 5 for this checklist.

### 8.2 Measure the problem

Contact an electrician who has access to a Peak Recording Voltmeter. Ask the electrician to check your entire dairy electrical system, including all wiring, switches and electric motors; for the presence of load spikes; and the efficiency of your earthing system. Any person who has completed a NZMPTA (New Zealand Milking and Pumping Trade Association) course in milking machine testing is also trained to perform voltage checks on farm dairies.

### 8.3 Contact your local power authority

They will check feeder lines, power poles and insulators, transformer efficiency and earthing; and any factors on the transformer system that may introduce stray voltage.

### 8.4 Check your Earthing System

Check that your main electric fence energiser earthing system complies with the manufacturers recommendations. This information should be available from your farm merchandiser. (See appendix 2 for details on testing procedure)

### 8.5 Contact your Mains Electric Fence System Field Rep

They will audit your mains electric fence system on-farm for efficiency and will identify any problem areas needing attention. They will also audit your earthing system. Faulty earthing systems and badly maintained mains systems on farms have been identified as the biggest contributor to stray voltage.

### 8.6 Bring in a specialist

There are many private consultants who specialise in this field. Your Dairy Company Field Officer, Dexcel Consulting Officer or Farm Consultant will be able to put you in contact with a specialist.

### 8.7 Don't Give Up!

In many cases of stray voltage there will be more than one cause. It may take time to identify and remedy each one. Each day and each week may be different depending on the weather conditions and other factors. It will take time for animal behaviour to return to normal.

## 9.0 REFERENCES

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Henry Dewes & Associates Ltd.

## 10.0 ACKNOWLEDGEMENTS

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Wendy Law

## **APPENDIX 1: HOW DOES THE EARTHING SYSTEM WORK?**

### **HOW DOES THE EARTHING (GROUNDING) SYSTEM WORK?**

The earth (ground) system of the Energizer is like the antenna or aerial of a radio. A large radio requires a large antenna to effectively collect sound waves and a high powered Energizer requires a large earth (ground) system to collect the large number of electrons from the soil.

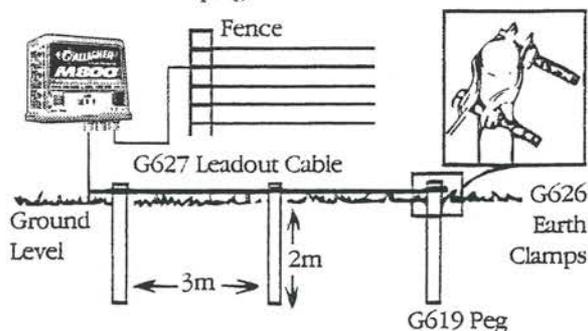
Your earth (ground) system must be perfect so that the pulse can complete its circuit and give the animal an effective shock.

Soil is not a good conductor so the electrons spread out and travel over a wide area, inclining towards moist mineral soils. Dry soils have a very high resistance. If possible, choose an area for the energizer earth site which is damp all the year.

#### ***Earth (Ground) Rule 1 2 3 3***

In areas with highly conductive moist soil all year round.

- 1** = One continuous wire to join pegs (G627)
- 2** = Galvanised earth (ground) pegs (G619) must be two metres (6ft) long
- 3** = Minimum of three x two metre (6ft) long pegs
- 3** = Minimum of three metres (10ft) between pegs.



Ensure that they are at least 10 metres (33ft) from any power supply earth (ground) peg, underground telephone or power cable.

**Note I:** Do not use thinly electroplated or painted items or ungalvanised material because

they quickly rust and create resistance.

**Note II:** Use G627 Double Insulated Leadout Cable where the wire from the Energizer to earth (ground) stakes is likely to come in contact with soil, yards, water pipes or buildings.

**Note III:** If there is a milking shed nearby, use G627 to prevent the possibility of the Energizer earth (ground) system making contact with buildings, fences, the milking shed or milking machine which could draw electrons through the milking cows to the detriment of milk production. Cows are sensitive to even a few volts delivered through the milking machine or pipework yards.

The earth (ground) system should be tested immediately after installation (and then at least once a year). Refer to "Testing the Earth (Ground)"

## APPENDIX 2: TESTING THE EARTH

### TESTING THE EARTH (GROUND)

#### Testing the Energizer Earth (Ground) System (For All Live Wire Systems and Earth (Ground) Wire Return Systems)

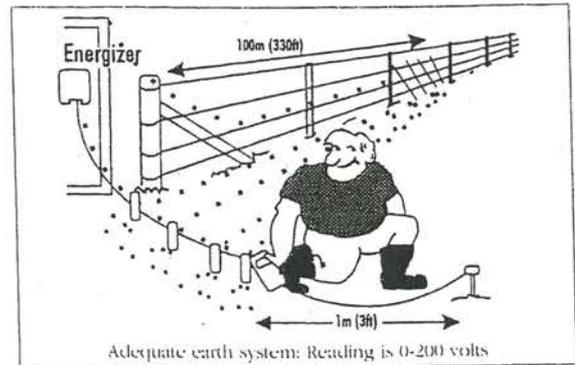
Energizer earth (ground) systems should be tested at least once a year during the height of the dry period and, if necessary, improved by adding more earth (ground) pegs.

Of course, the quickest way to test your earth (ground) is to touch the earth (ground) system with your other hand on the ground. If you feel a shock, then your earth (ground) system is inadequate!

However, if you prefer a less shocking method, then a Digital Volt Meter (DVM) G503 is essential.

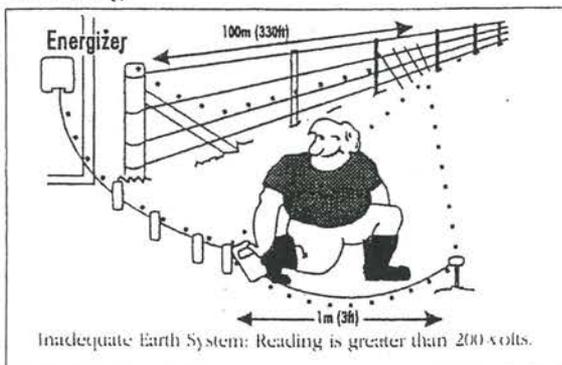
Before testing the earth (ground) system, you will need to place the earth (ground) under heavy load to simulate a fence under heavy vegetation growth. If the fence is clear of vegetation, you can load the fence by placing several steel stakes between the live fence wires and the ground, at least 100 metres (330ft) from the Energizer. The fence voltage should be reduced to 2 kV if possible.

Using a DVM, measure the voltage between the earth (ground) wire, which is connected to the Energizer earth (ground) terminal and an independent earth (ground) at least one metre (or 3ft) away from any Energizer earth (ground) peg. The independent earth (ground) can be a metal rod over 200mm (8") long.



Ideally there should be no reading. However, a reading of up to 200 volts is acceptable.

For extra convenience, Gallagher has developed a built-in earth (ground) monitor which is included, for example, in the M1501 and new Smartfence Systems.



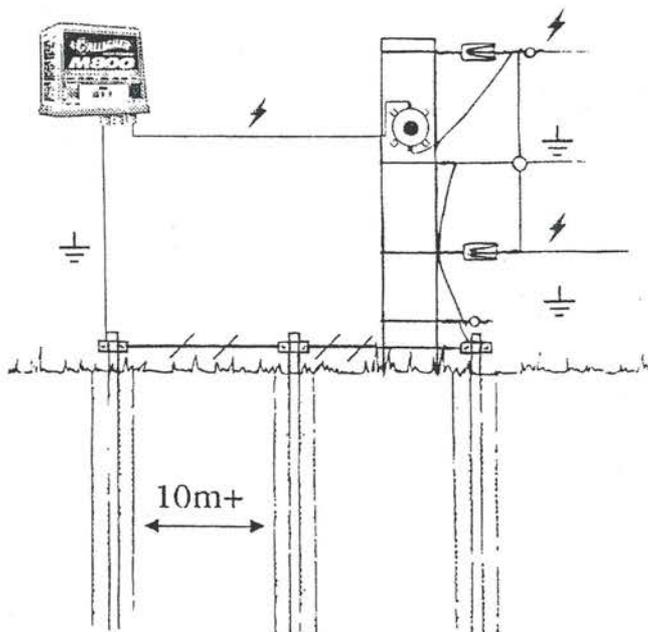
### **APPENDIX 3: SUPER EARTH KIT**

In soils of low mineral content and those which dry out severely, ie. sandy, pumice or volcanic ash soils, a G635 Super Earth Kit system should be used. Trials have shown a ten fold improvement by using this system.

- i) Dig or drill holes at least 70mm (3") in diameter, at least 10 metres (33ft) apart to at least 1.2 metres (4ft) deep.
- ii) Fill each hole with a wet slurry of the Super Earth Kit mixture.
- iii) Push a 1.2 metre (4ft) stainless steel rod down the centre of the hole.
- iv) Clamp the Energizer earth (ground) wire to the tops of the rods using G626 Earth Clamps.

**Note:** In drought conditions it may be necessary to water the earthing (grounding) system. The extra effort of putting in the Super Earth Kit can be well worthwhile.

#### G635 Super Earth Kit



*Did you read all of this section? Your electric fence system could be one of the 80% shown through survey results that suffer from an inadequate earth (ground) system.*



**APPENDIX 5: CHECKLIST –  
HAVE I GOT STRAY VOLTAGE IN MY FARM DAIRY?**

**HAVE I GOT STRAY VOLTAGE IN MY FARM DAIRY?**

Use this simple checklist to audit cow milking and yarding behaviour. Record your answers. If you tick more than one you could have a problem and may need help. There are other factors that can cause some of the points, such as milking machine/liner faults and cow flow.

**Do the cows?**

Urinate and defecate excessively?	
Milk out poorly?	
Sweat, mill round, stampede, sniff the ground, sit on the backing gate?	
Kick at the clusters and the milkers?	
Resist drenching?	
Dislike crossing certain gateways?	
Spend overlong at water troughs lapping water	
Do calves chew the nipples of calf feeders?	
Advance to or retreat from the farm dairy in Indian file.	

**Are the cows?**

Reluctant to load onto rotary or bail?	
Turning away from the bail entry?	

**Do you?**

Have to leave the pit to load each batch, especially for new cows or heifers?	
Get shocks when you touch the vat and milk stand floor	

Are there differences between night and morning milkings?	
Are milkings worse in very wet or very dry weather?	
Does the dog yelp when he pees?	

**IF I THINK THERE IS STRAY VOLTAGE WHAT SHOULD I DO?**

**CHECK FOR OBVIOUS SOURCES OF STRAY VOLTAGE**

**REMEMBER DON'T TOUCH ANYTHING THAT YOU ARE NOT QUALIFIED TO**

- Check the board earth stake that wires are clamped properly and not corroded
- Turn off your farm fence energiser - as a simple check, tune your radio to 520-522 AM radio band to find any other energisers operating nearby. Listen to 'clicks' in the static.
- Turn off water heaters throughout milking.
- Earth out milk probes in collecting vat.
- Weld yard and bail pipe work to bring them to the same voltage as the board earth.
- During milking avoid hosing down or operating the effluent pump.
- Keep the drench unit running continuously.

Assess each procedure over several days noting the effect on the frequency of faecal voidance. These are some of the most likely causes, however there are others.

**EXCESSIVE VOIDANCE OF FAECES SIGNALS DISTRESS.**