

# Testing Farms

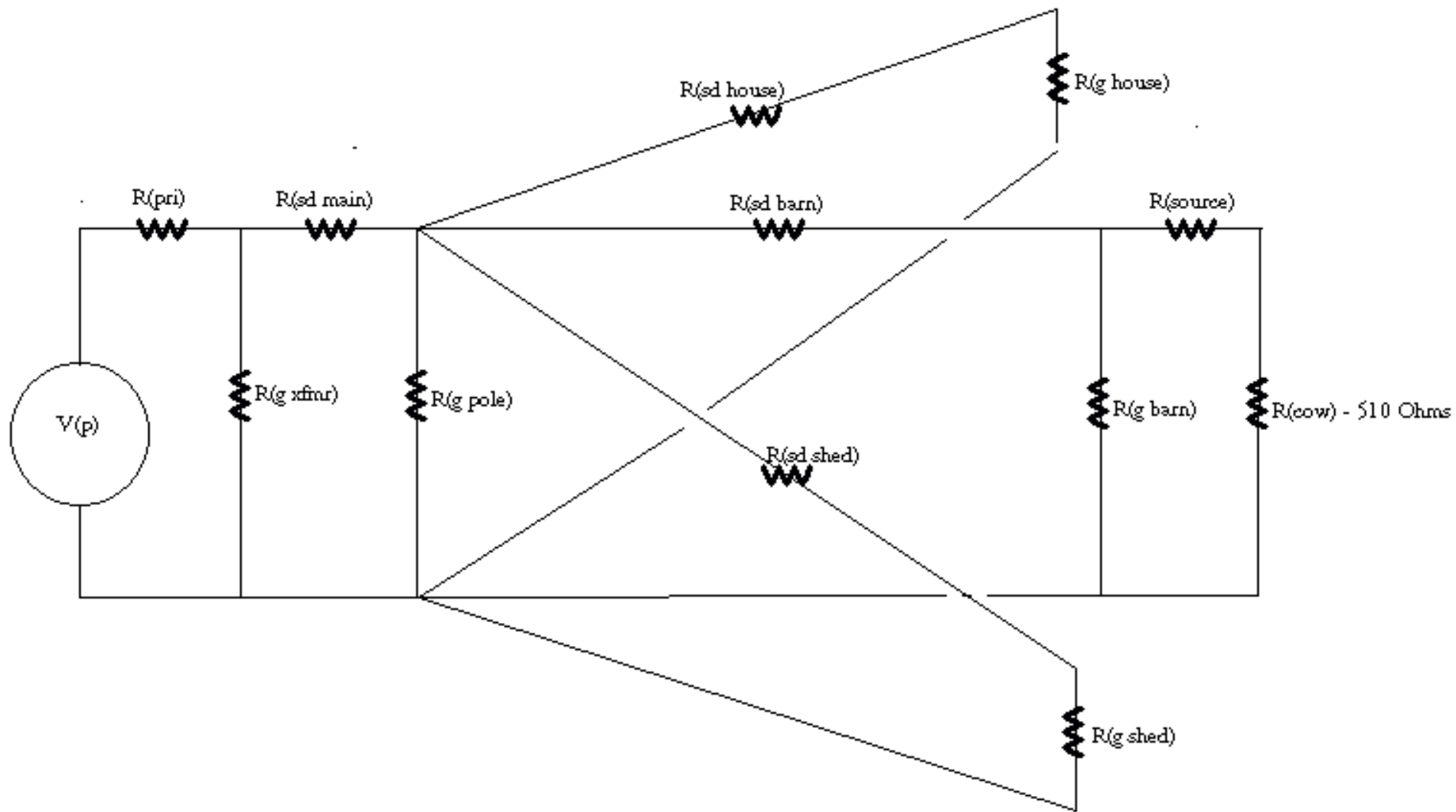
## Served at 480 GrY/277 Volts

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We Energies

# Stray Voltage Testing

- The farm and utility ground systems connected together comprise a circuit, regardless of the voltage.
- Stray voltage testing is intended and designed to perform a circuit analysis on that circuit.





# Circuit Analysis Techniques

- Simplify
- For multiple voltage and current sources, short the voltage sources and open the current sources, and apply one at a time.
- Apply Kirchoff's Current and Voltage Laws.
- Apply Ohms Law.
- Thevenin and Norton Equivalent Circuits.
- Superposition.

# Tests

Load Box Test

Voltage drop test

Signature test

Profile test

24 Hour recording

“How is the investigative procedure affected by the farm being served at 480 GrY/277 Volts”?

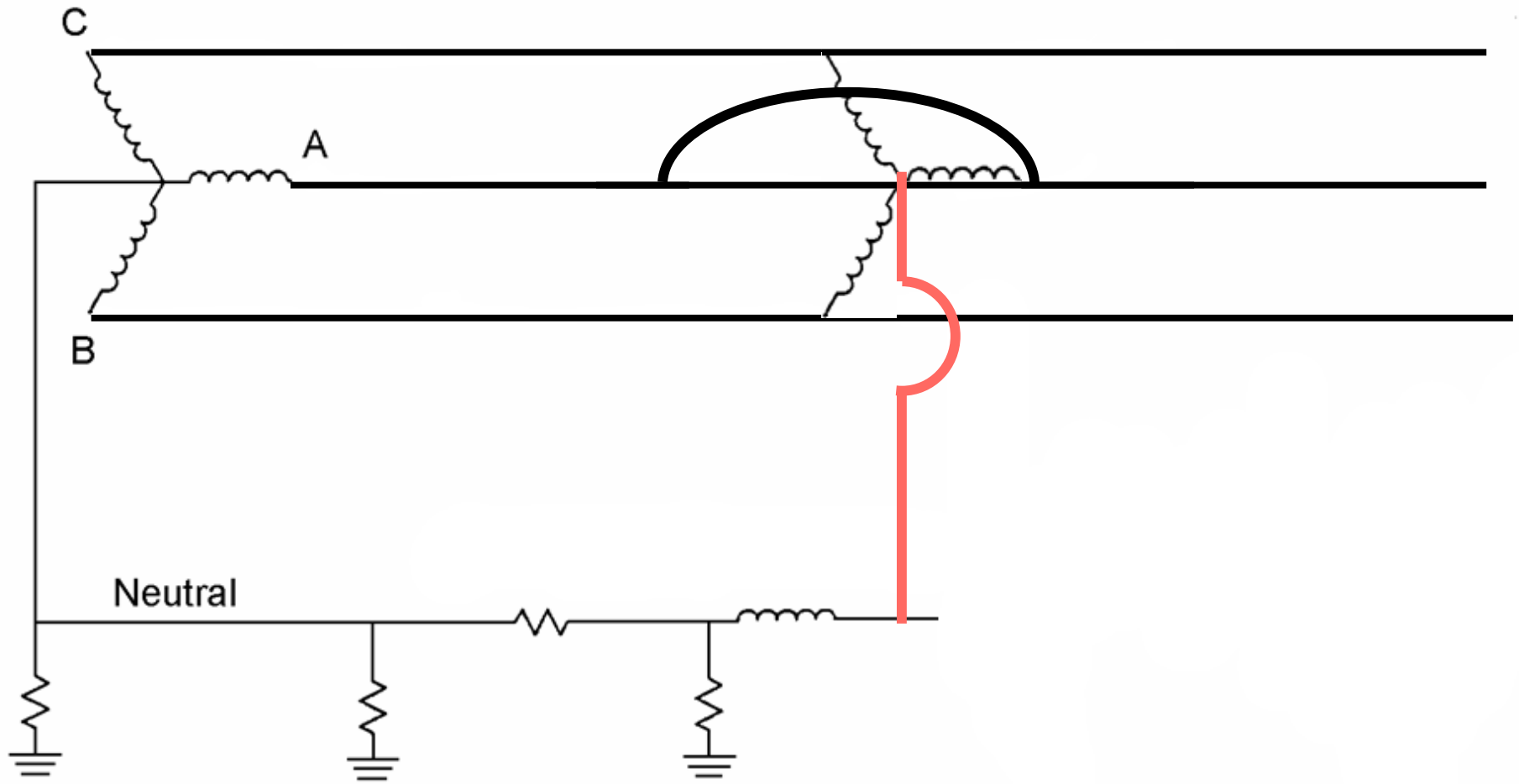
# To Answer that question, let's first examine how:

- the impact of load on the utility system is different for a 480 GrY/277 Volt three phase service.....
- and how distribution of power on the farm differs from that of a single phase service.

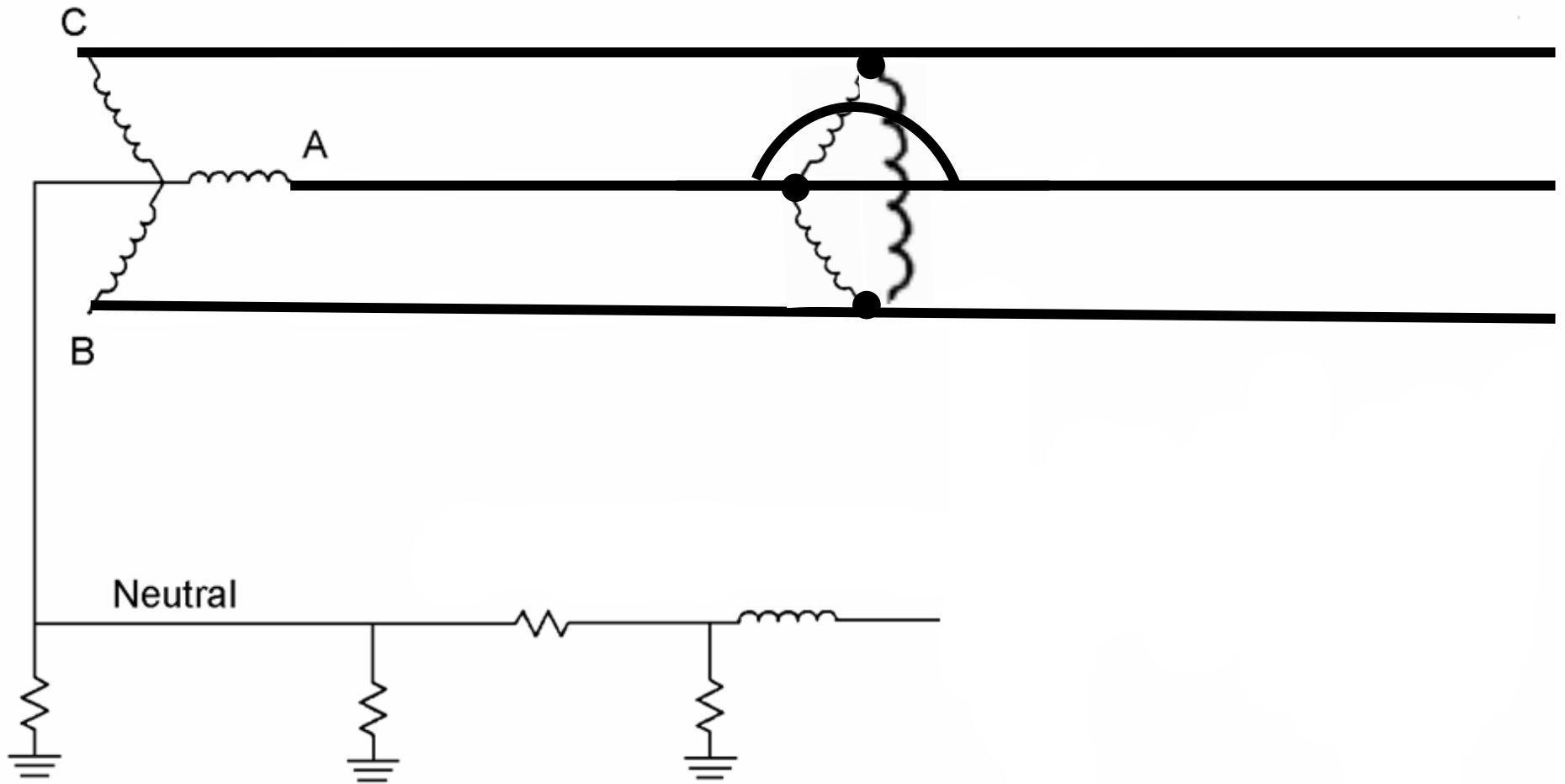
# Four Wire Multi-Grounded System

- Grounded Wye Primary Transformer Bank
- 
- Delta Primary Transformer Bank

# Grounded Wye Transformer



# Delta Connected Transformer

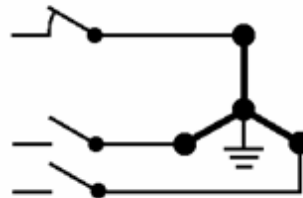
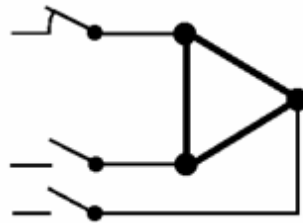


**The secondary (low voltage) side of the three phase banks can be interconnected in a variety of manners, independently of the connection on the primary (high voltage) side.**

# Connection

Primary

Secondary



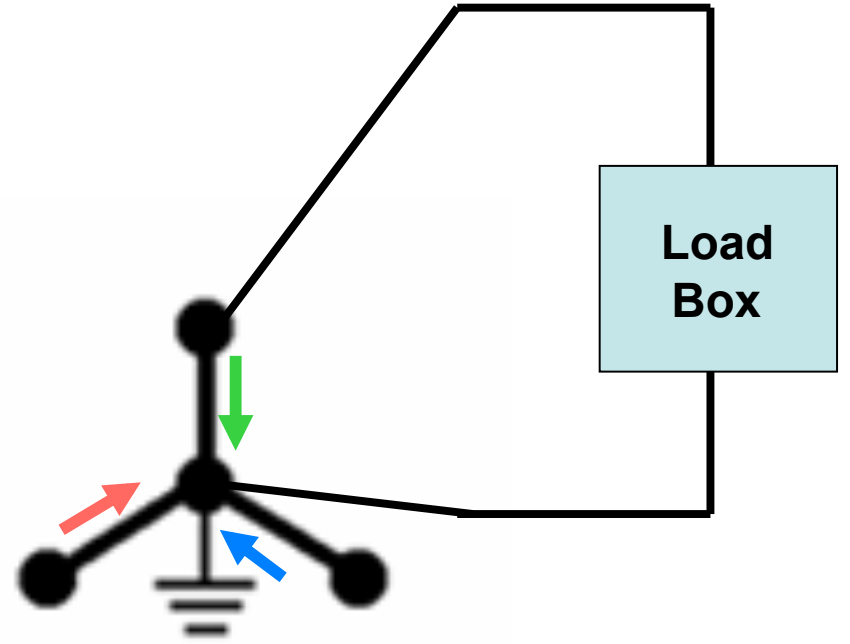
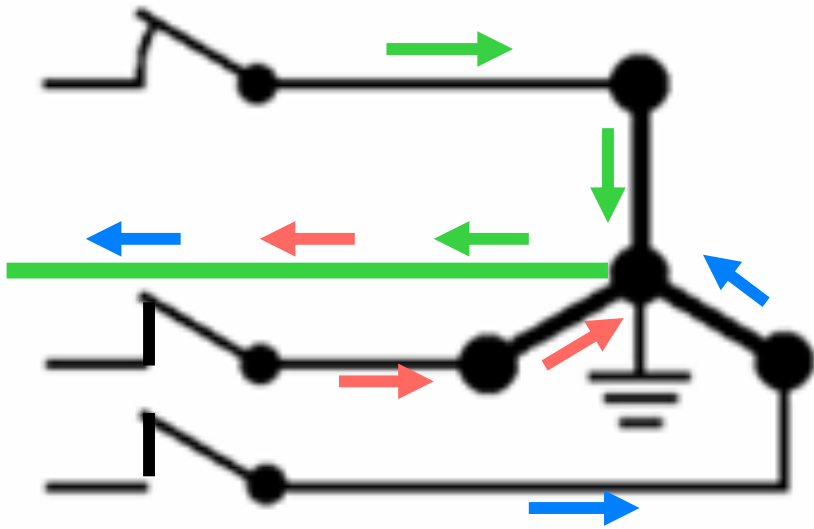
# LOAD BOX TEST

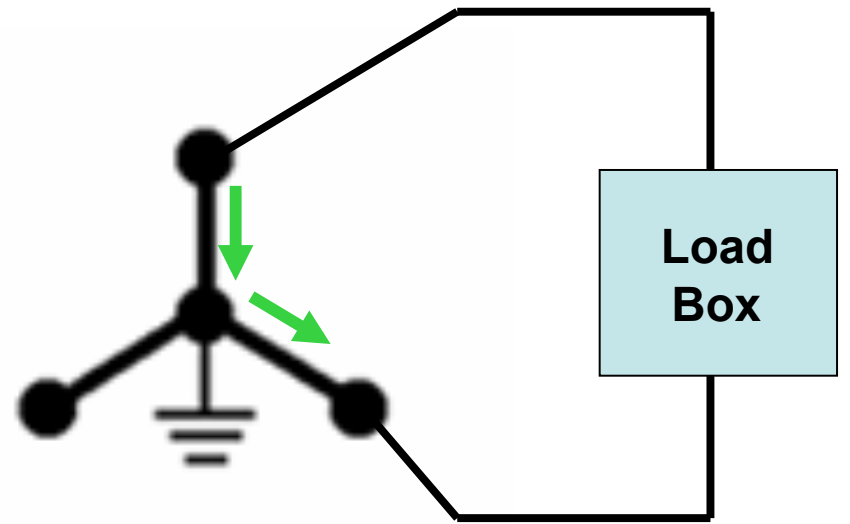
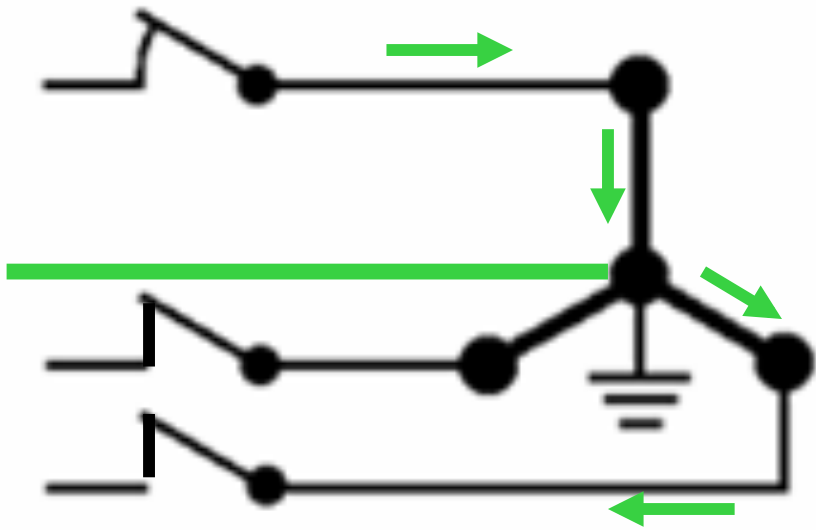
Intended to examine the condition of the distribution primary neutral and the farm grounding system by measuring the resistance of the farm and primary neutral.

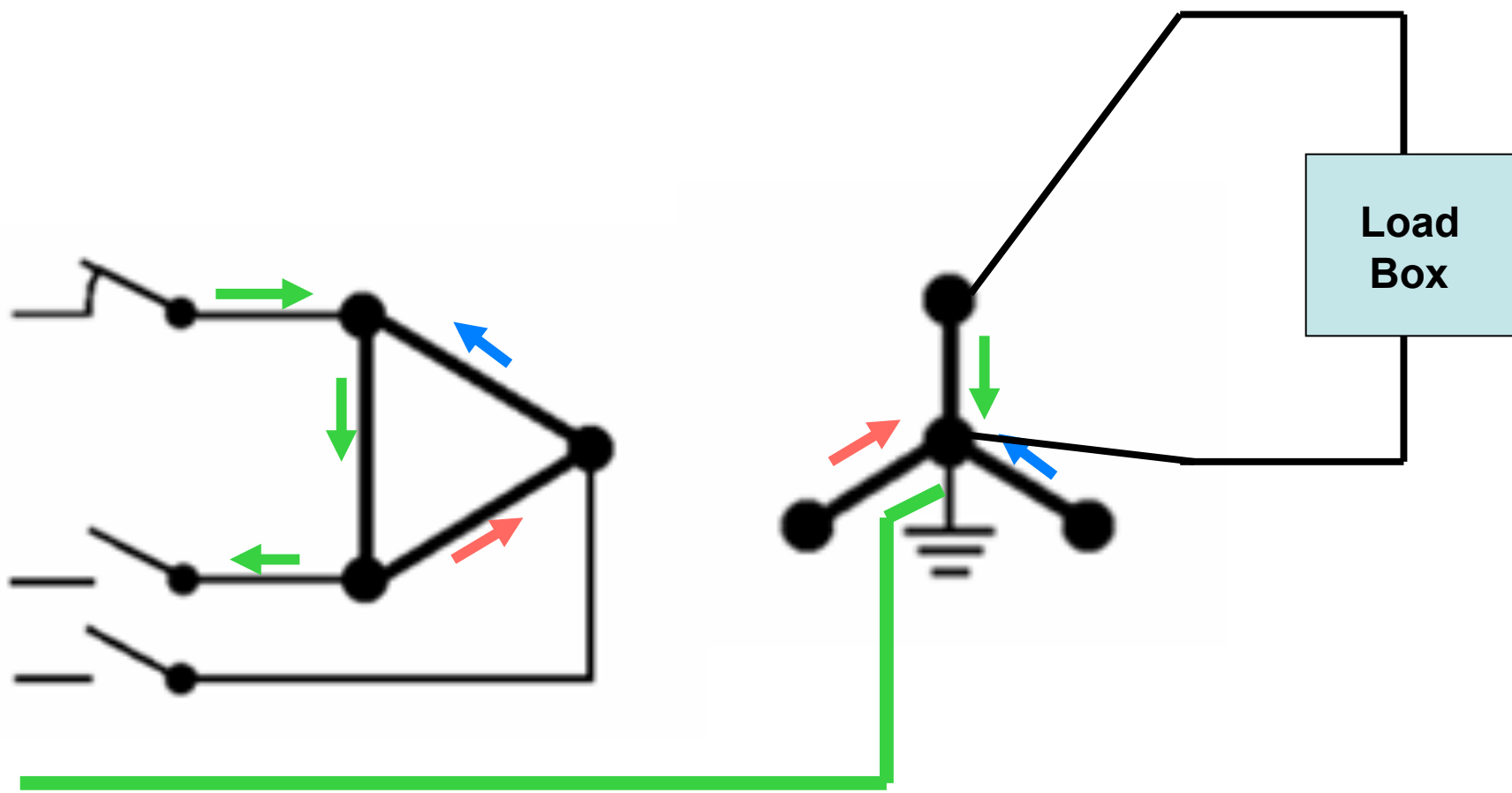
# Load Box Test

Inject a current into the neutral system, measure the voltage rise, measure the current into the farm and the primary, and determine the resistance of each with the formula

$$R = V / I$$



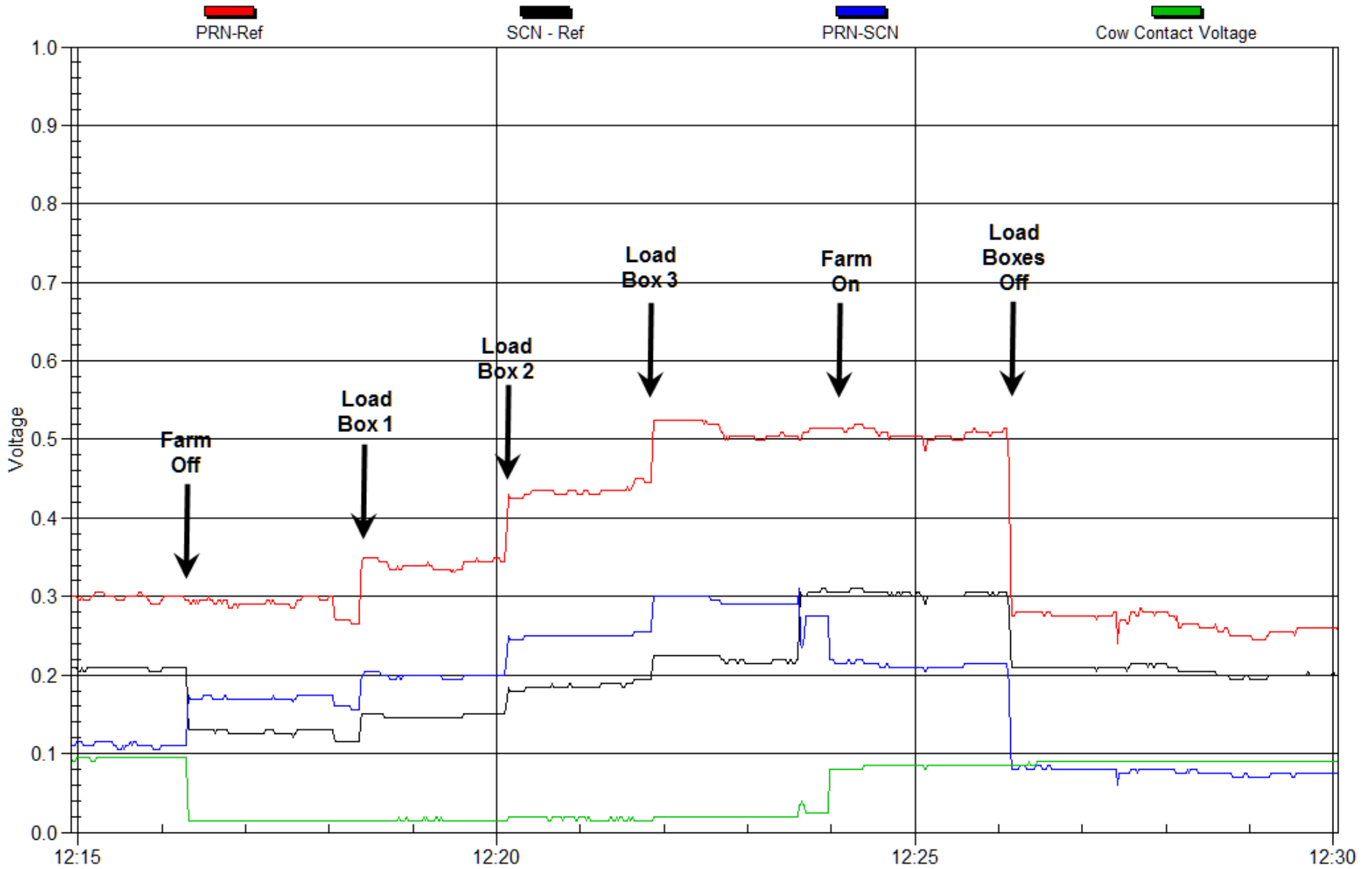




# Important Considerations are:

- A balanced three phase load on any system using three transformers will NOT cause any neutral current in the primary
- If the transformer bank has no primary winding connection to the primary neutral, the load (at the farm) CAN NOT cause a primary neutral current.
- The only way to move the primary neutral is to apply a load on the neutral from a transformer connected line to neutral (which may have to be at another location.)

### Load Box Test: Load Box Operated From Single Phase Service on Farm



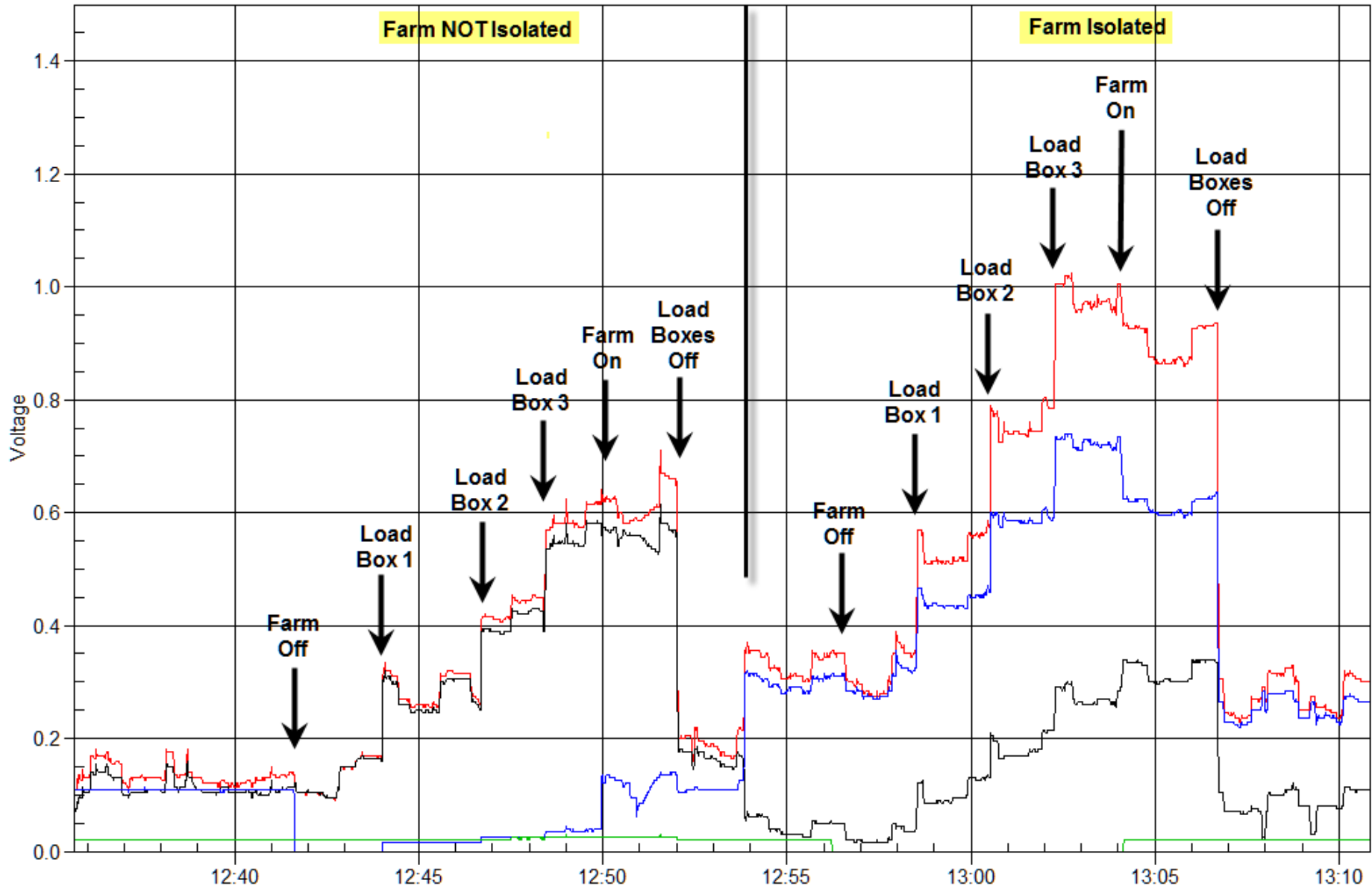
12 Thu Jun 2008

Farm service is a 240 Volt 3 phase ungrounded service. Farm House served from a single phase 120/240 Volt Transformer. Load box operated from house service. Measurements (graphs) from 3 phase service in barn.

SV investigation Load box test.



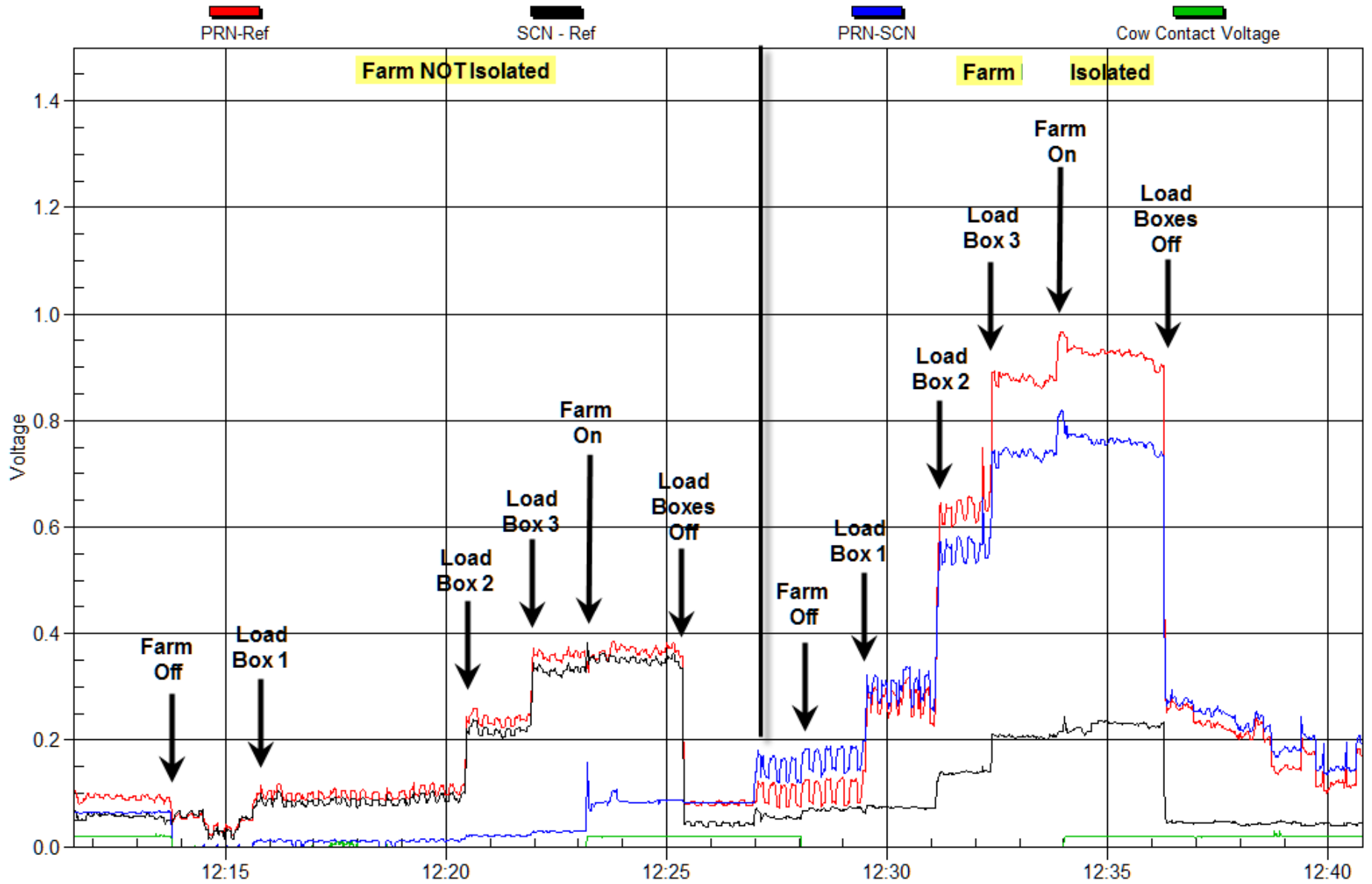
### Load Box Test



10 Wed Dec 2008

Farm service is a 240 Volt 3 phase ungrounded service. Farm House served from a single phase 120/240 Volt Transformer. Load box operated from house service. Measurements (graphs) from 3 phase service in barn.

# Load Box Test



11 Tue Oct 2005

Farm served from three phase service. Load Box operated from single phase service 6 spans to the north.

What about the system  
calculations?

# At the single phase transformer

- $\Delta I_{pri} = \Delta I \text{ load box} / \text{transformer ratio}$
- $R_t = \Delta V_p / \Delta I_{pri}$
- $R_p = \Delta V_p / \Delta I_{pneutral}$

**OR**

**$R_p =$**

**Parallel Combination of**

**$\Delta V_p / \Delta I_{p\text{neutral}}$**

**In Each Direction**

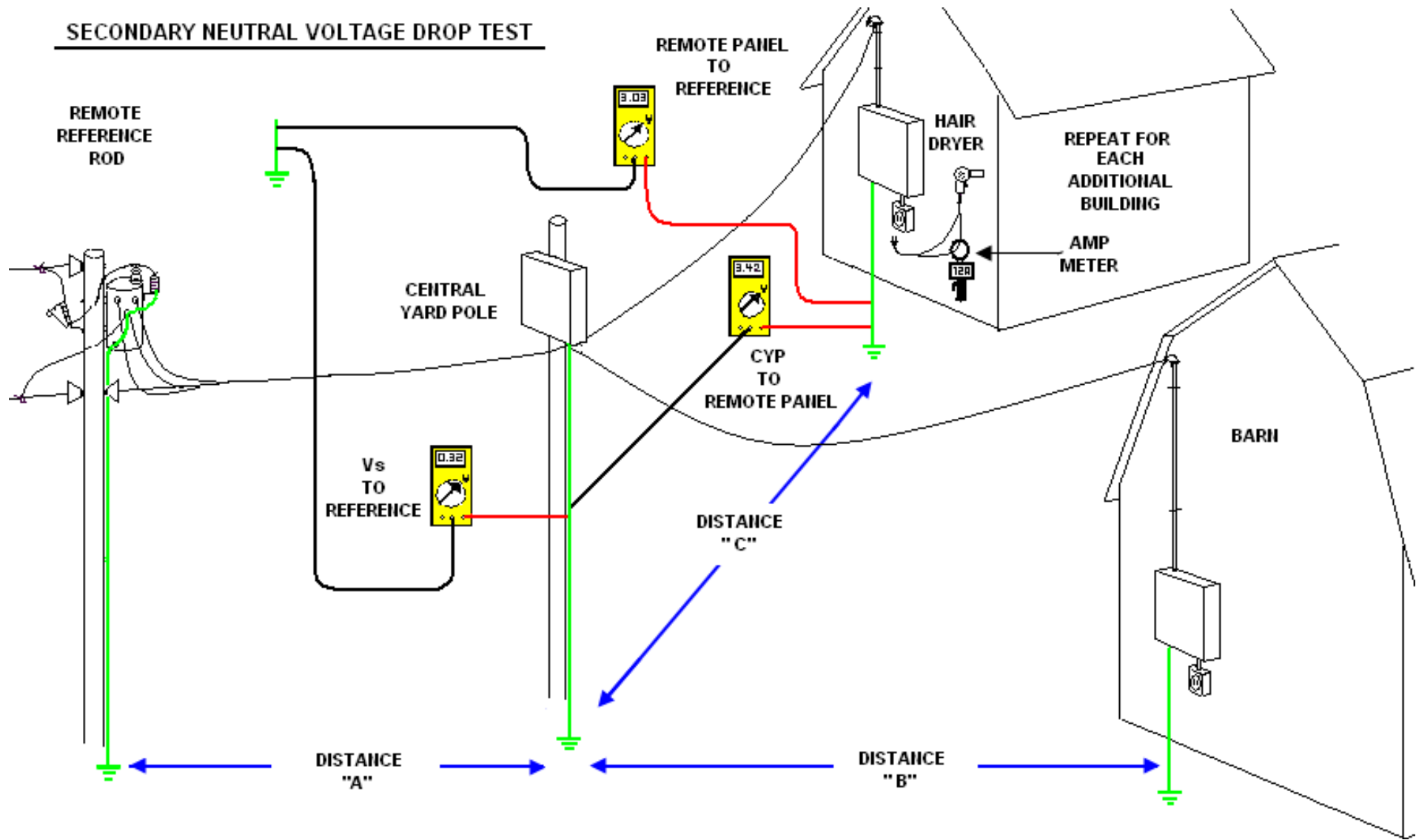
# At the three phase transformer

- $\Delta I_{\text{net}} = \Delta I_{\text{sec(farm)}}$
- $R_f = \Delta V_s / \Delta I_{\text{sec(farm)}}$
- $K = V_{\text{cc (hi)}} / V_s(\text{hi}) \times 100$
- $\Delta \text{CR} = (I_{\text{Primary Neutral}} / I_{\text{Phase}}) \times 100$

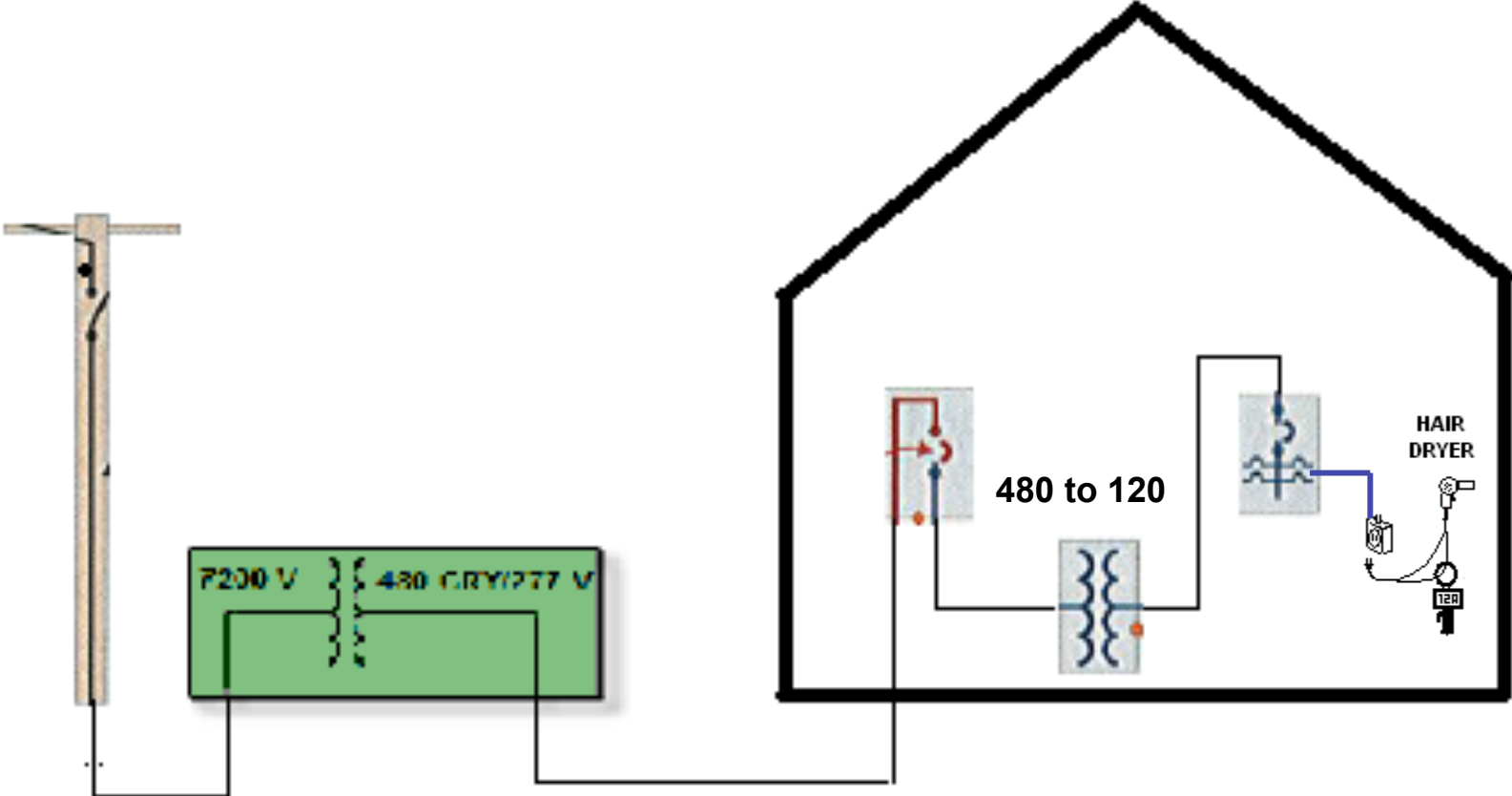
# Voltage Drop Test

Designed to assess the condition of the secondary distribution neutral system by measuring the resistances of the service drop neutral.

# Single Phase Service

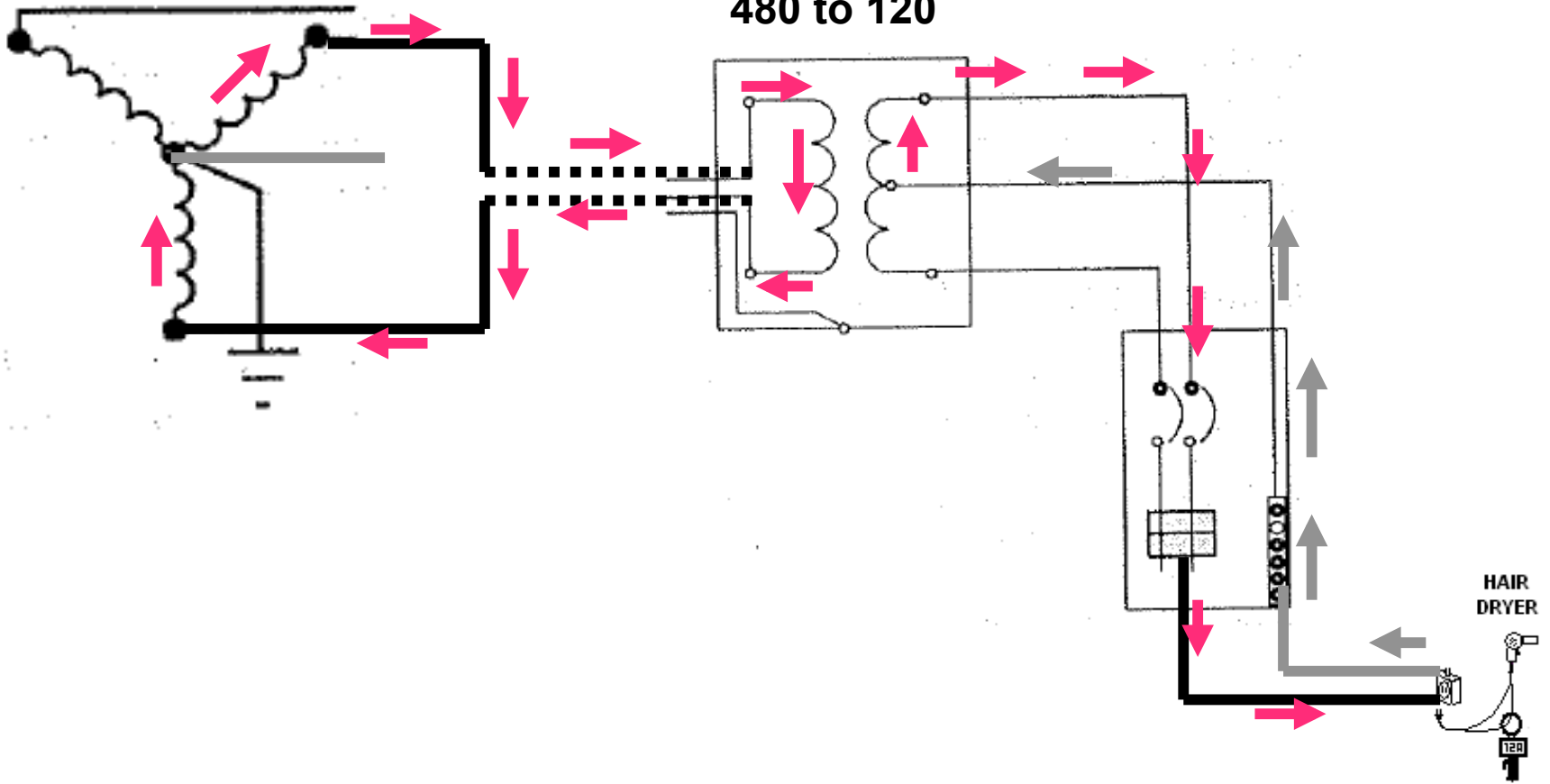


# 480 Gr Y/277 Volt Service



480 GrY/277 Volts

480 to 120



- **There is no convenient test load for operation at 277 Volts.**
- **There is no convenient outlet to energize a test load at 277 Volts.**
- **Available fault currents and arc flash hazards make connecting a load directly in a panelboard hazardous.**
- **Little Farm load is operated at 277 Volts, making substitution of farm load uncertain.**

# **Solution?**

**Operate a 120 Volt test load at subpanel outlets as part of your signature test.**

# Signature Test

Designed to look for on-farm equipment faults and problems with the farm wiring system.

- The test will still identify detectable faults.
- The system response to various loads are interpreted differently, depending upon the connection of the load.

# Further Complications

- The farm may be milking on a virtually continuous basis, making it necessary to conduct tests on top of farm load.
- Be careful not to overload equipment, including transformer fuses when conducting testing simultaneously with farm load.

# Primary Profile Test

Designed to assess  
the condition of the  
primary neutral  
system.

# “24 Hour Test”

Done to monitor the normal operation of the farm over two milkings.

# A Couple of Last Tests

- Spot checks at stock tanks. (There may be a lot of them.)
- Check for crowd gate caused transients in the cow contact areas, and for possible high frequency signals caused by the farm's cow ID system.

