

Stray Voltage Issues

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Purpose of Paper

The purpose of this paper is to address some of the stray voltage issues, we have seen, in the past two years.

Topics

- **Terminology**
- **Problems in Identifying Stray Voltage**
- **Mitigation Difficulties**

Terminology

Stray Voltage (Historically)

- **Steady State**
- **Neutral-to-Earth Voltage**
- **Associated with Return Current**

Terminology

Stray Voltage is NOT

- TOV (Swells)
- Contact Voltage
- Step & Touch Voltage
(Associated with Fault Current)

Detection of Stray Voltage

Stray voltage is very difficult and time consuming to identify and mitigate.

Common Points of Stray Voltage Detection

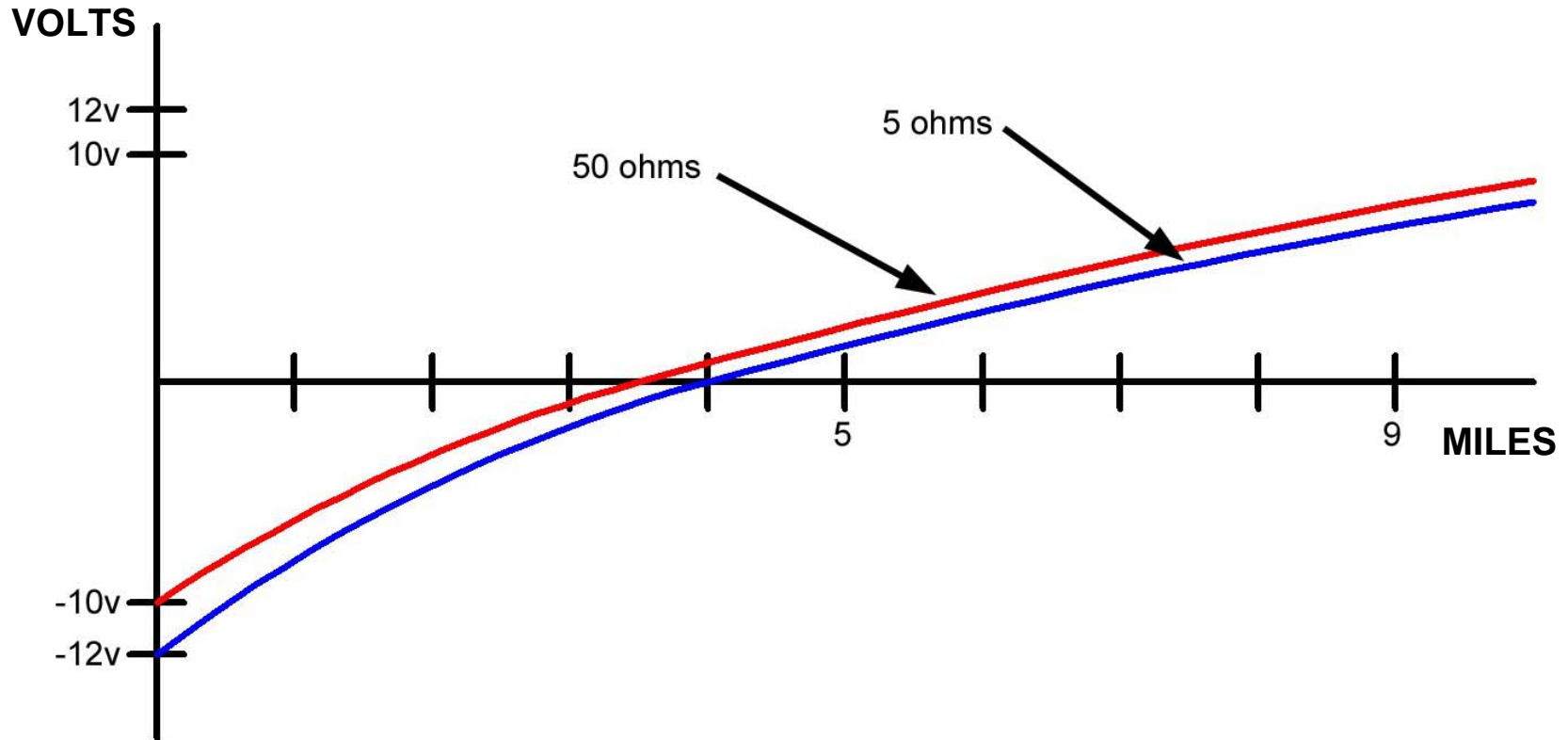
- **Water Faucets**
- **Swimming Pools**
- **Appliances & Equipment Housings**
- **Dairy Farm Equipment**

Mitigation Difficulties

Typical Methods

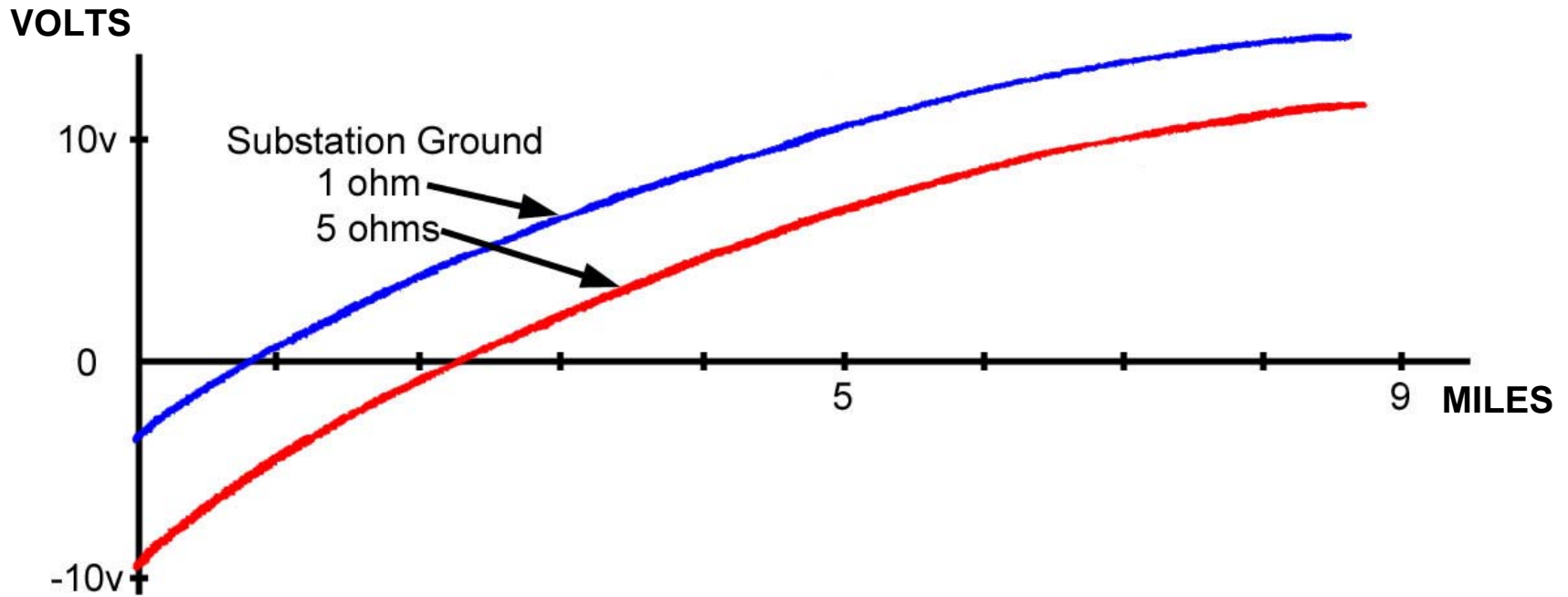
- Larger Neutral
- Better Grounds
- Neutral Isolators
- Etc ...

Effect of Better Ground Rods



Good grounding has little affect

Effect of Substation Grounding



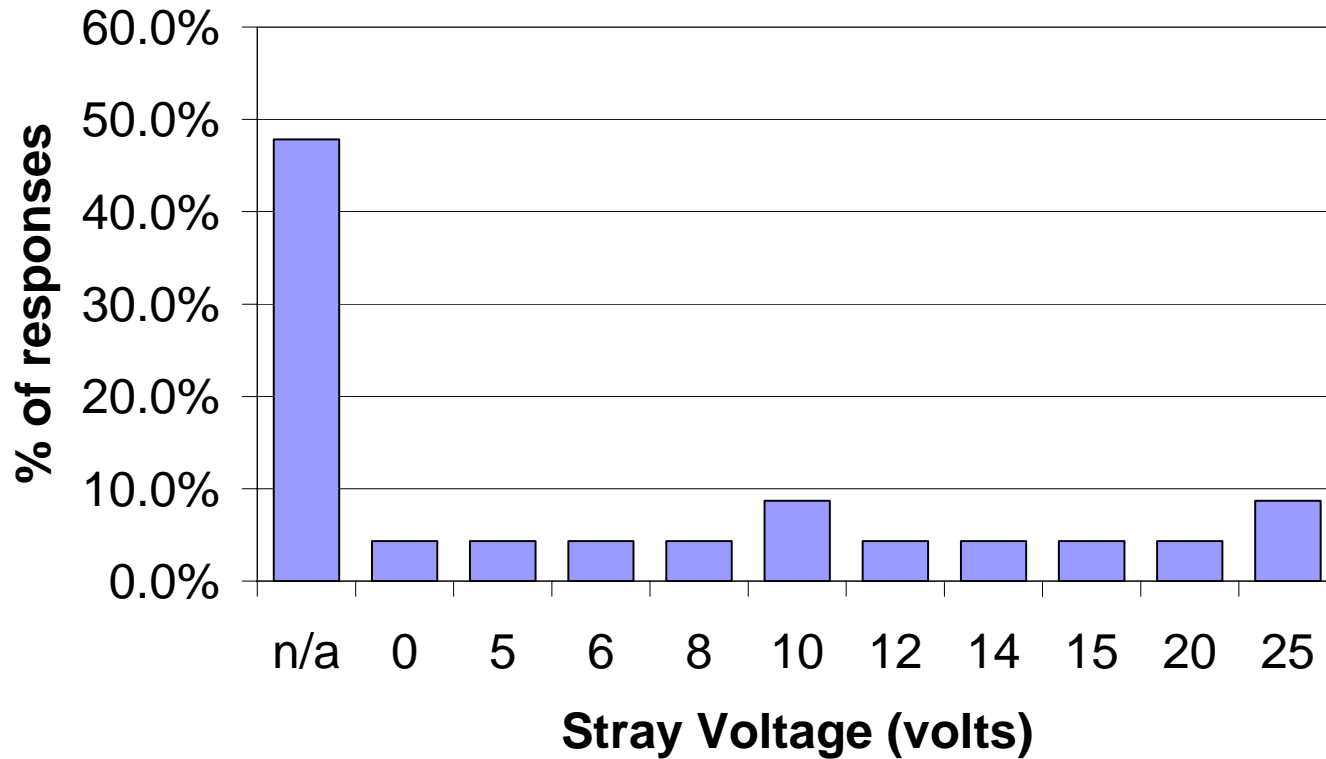
Good grounding helps....sometimes
Good grounding hurts....sometimes

Cable Neutral Deterioration

- **Deteriorated neutrals can cause “stray voltages”**
- **Problems with earlierunjacketed concentric neutral cables**
- **Most utilities have switched to jacketed cables**

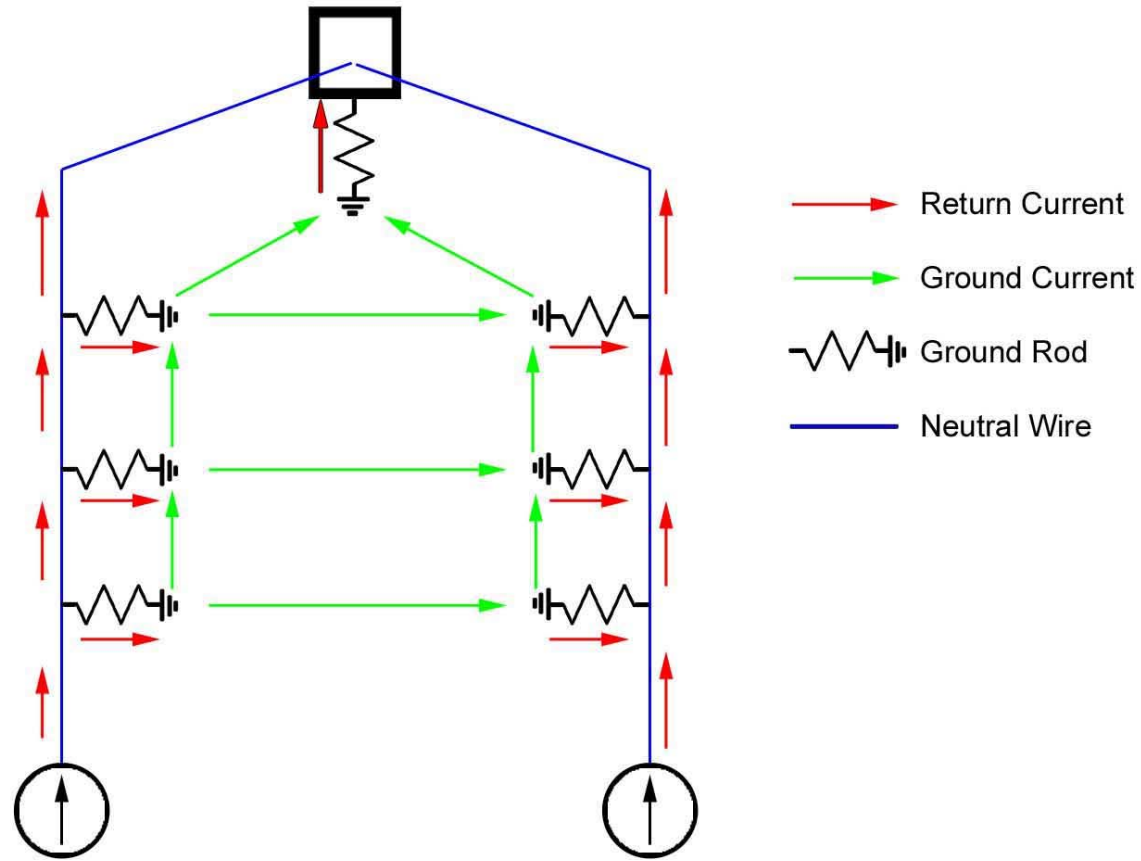
Cable Survey

Stray Voltage Levels Recorded



Complexity of Analysis

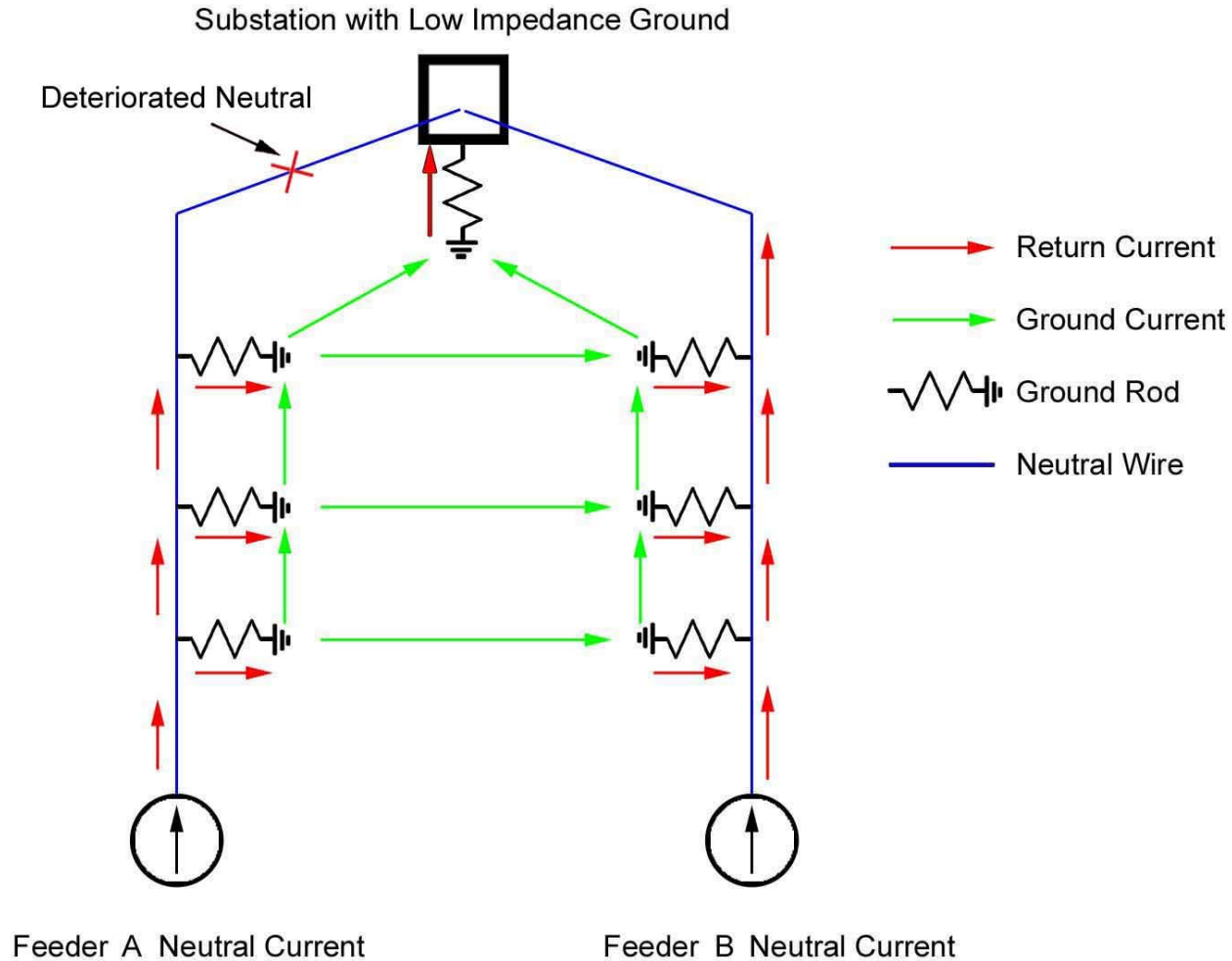
Substation with Low Impedance Ground



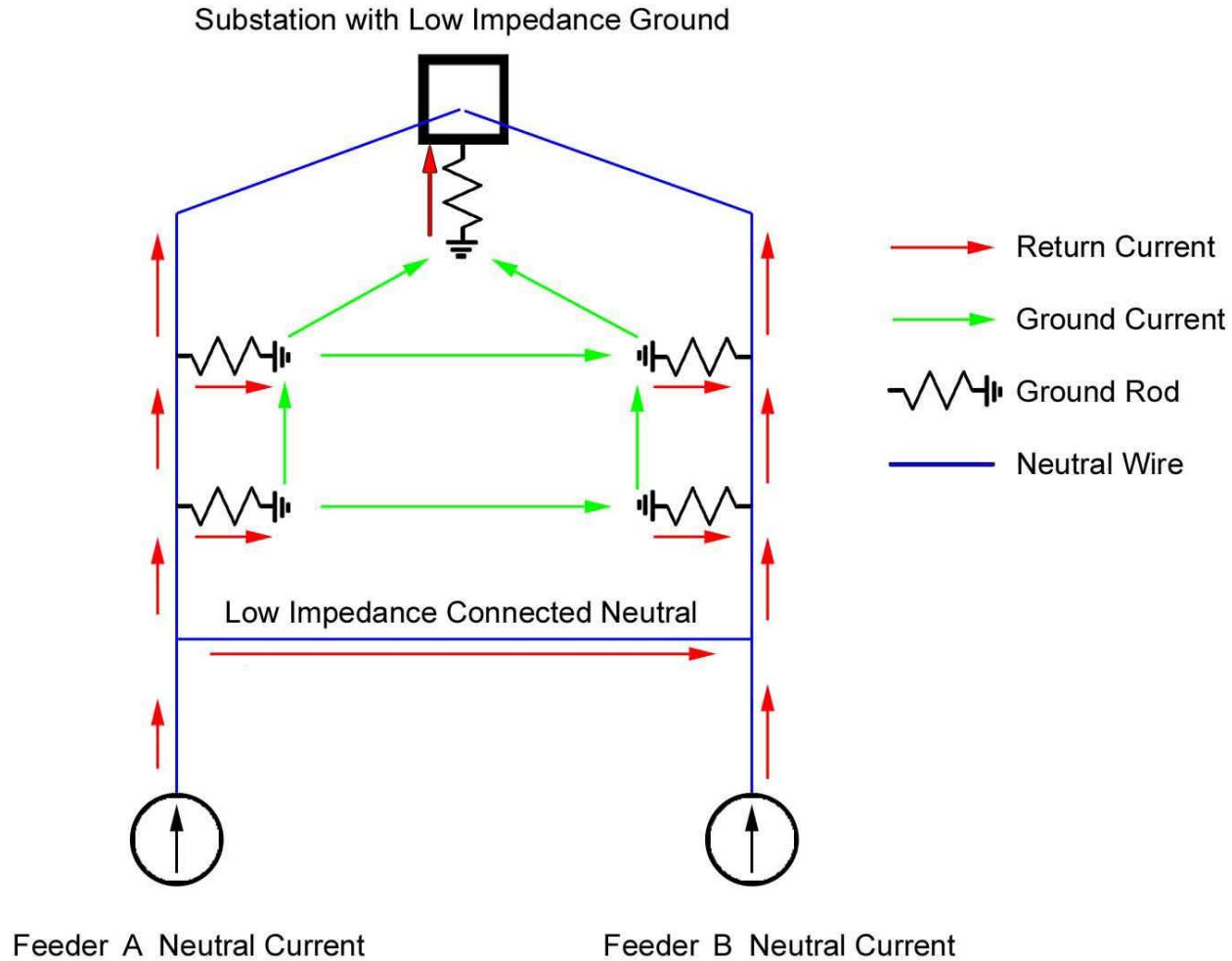
Feeder A Neutral Current

Feeder B Neutral Current

Complexity of Analysis



Complexity of Analysis



Conclusions:

- **Terminology is not well defined**
- **Detection of contributing source is difficult**
- **Analysis is complicated**
- **Mitigation is not simple**