Experience with the AEMC Pylon Tester Model 6472

Presented to IEEE Lightning Performance Working Group
On January 13, 2009 in Atlanta

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Lightning Performance Mitigation Using the AEMC 6472/74

- **NB Power first learned about the AEMC 6472/74 Ground Tester at IEEE conference in Chicago in 2008**
- **NB Power has used this test set on two projects**
  - **First was a 138 kV line where it was demonstrated in May 2008 by AEMC**
  - **Second was on a 345 kV transmission line in Fall 2008**
- **NB Power purchased the test set in August 2008**

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Note

Some of the following information has been supplied by AEMC for this presentation with their permission

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AEMC® Instruments
Tower Ground Resistance Testing System

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GroundFlex Coil Sensors (Rogowski Coils)

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Specifications

- Measures Ground resistance from 0.01 to 99,000 Ohms
- Selectable test voltages of 16 or 32 VDC
- Manual, automatic or sweep selection of test frequency from 41 to 5078 Hz
- Test currents up to 250mA
- Soil resistivity measurement from 0.01 to 99,000 Ohms
- Bond resistance measurement from 0.01 to 99,000 ohms
- Stores up to 512 test results
- Operates off of AC, battery or vehicular power
- Includes DataView software (free) to program, run tests and print reports
- Color coded inputs and test leads

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6472/74
GroundFlex™ Adaptor

- Heavy duty case to house both instruments such that they can operate from within the case.
- Case has wheels and pull handle similar to travel luggage.
- Lower compartment holds cables and GroundFlex sensors

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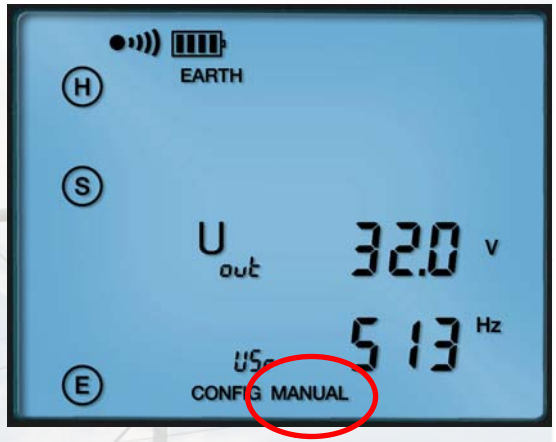
6472 Modes of Operation



3 operating modes:

Automatic mode in each function the instrument performs a measurement at 128 Hz and then chooses the most appropriate frequency in the event of interference voltages.

Sweep mode (automatic measurements at different frequencies) allowing a graph of impedance as a function of frequency to be plotted. Frequencies used can be selected in Set-Up or using DataView

Manual mode (User chooses the measurement frequency, display of all the voltages measured, etc.) for expert customers

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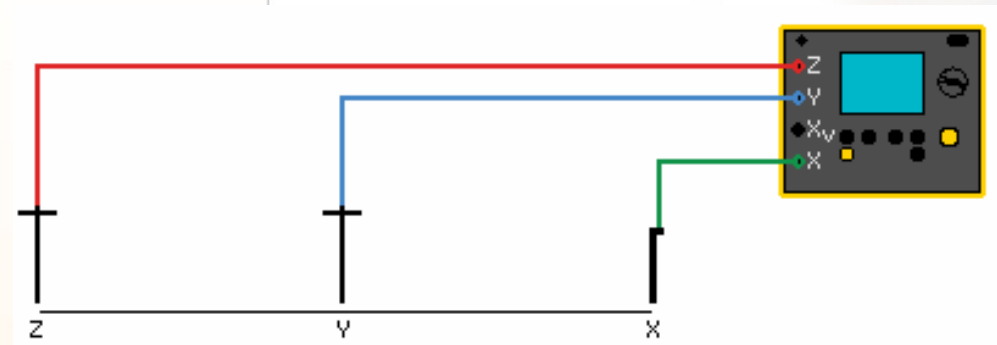
6472 Modes of Operation
3 Pole Fall of Potential Test

Characteristics:

- **Resistance range 0.01 Ω to 100 kΩ**
- **Selectable measurement voltage: 16 or 32 Vrms**
- **Adjustable measurement frequency:**

Auto, Manual or Sweep from 41Hz to 5.078 kHz



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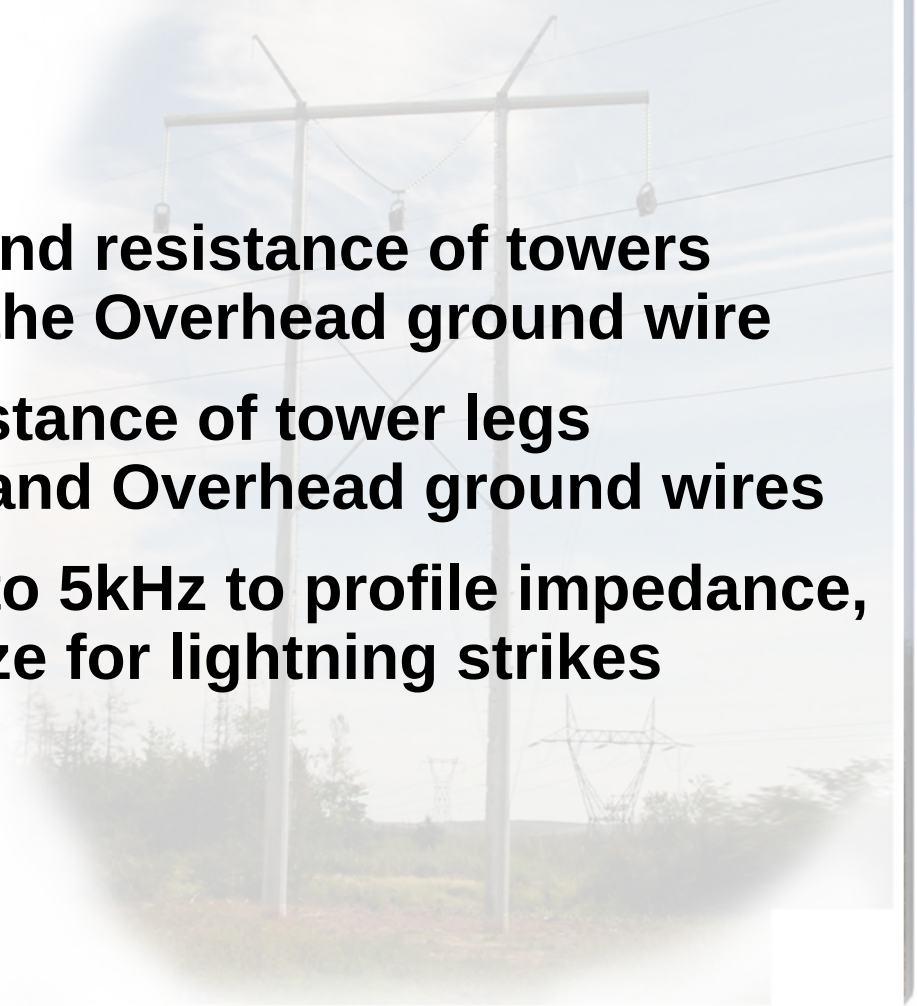
GroundFlex™ Adaptor

GroundFlex® Method

- Capable of testing ground resistance of towers without disconnecting the Overhead ground wire
- Tests both ground resistance of tower legs (individually and total) and Overhead ground wires
- Test at frequencies up to 5kHz to profile impedance, important to characterize for lightning strikes



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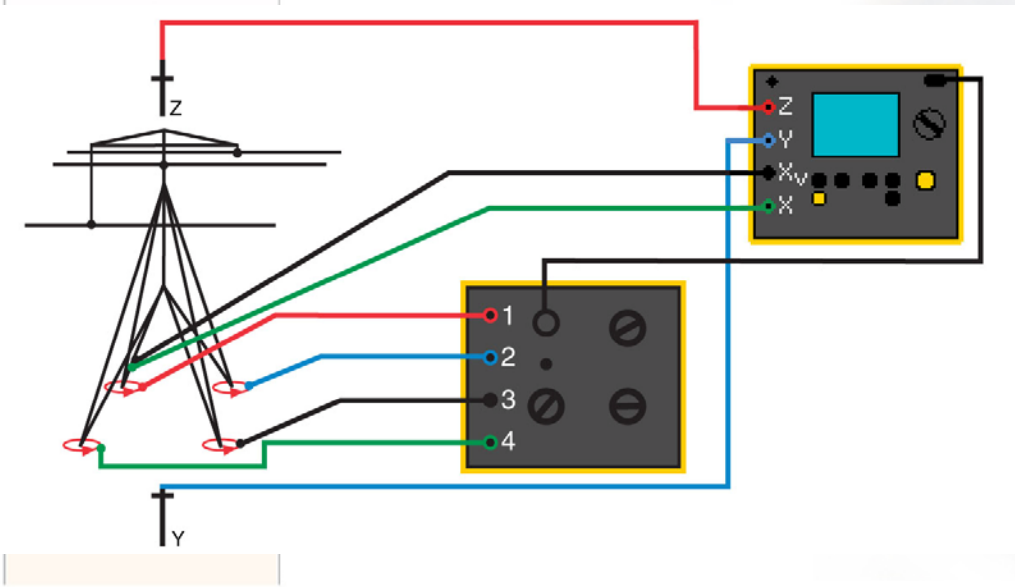
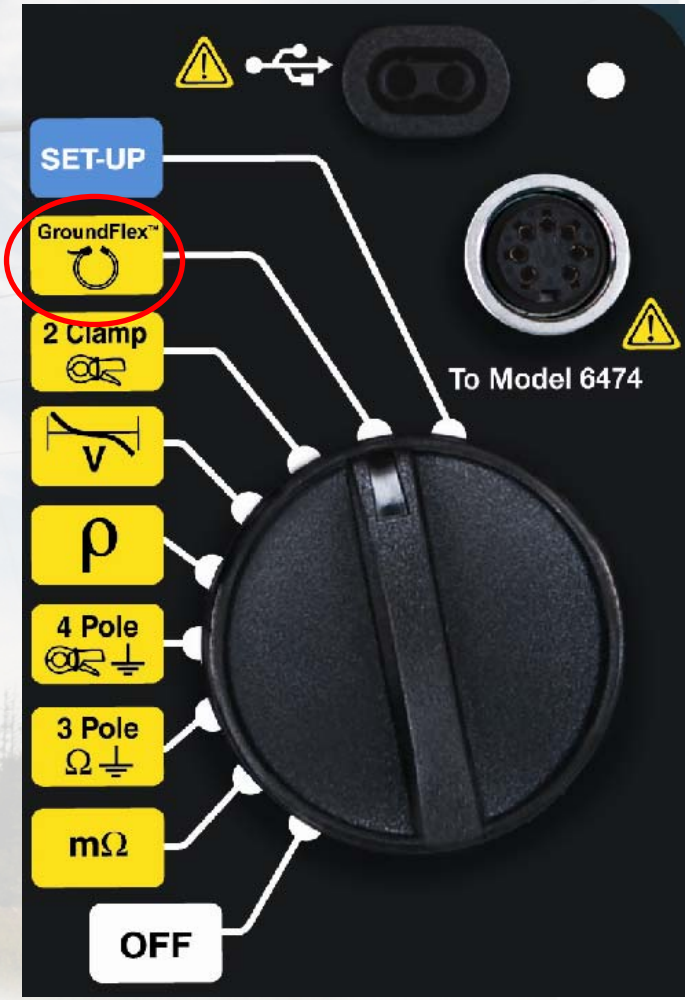
6472/74
GroundFlex™ Adaptor

GroundFlex® Method

- Connect flexible sensors and reference rods
- Test individual legs and total resistance





NB Power 138 kV Line 1183
Lighting Performance Improvement

- 38 wood pole shielded H-frame structures
- Overhead shield wires present

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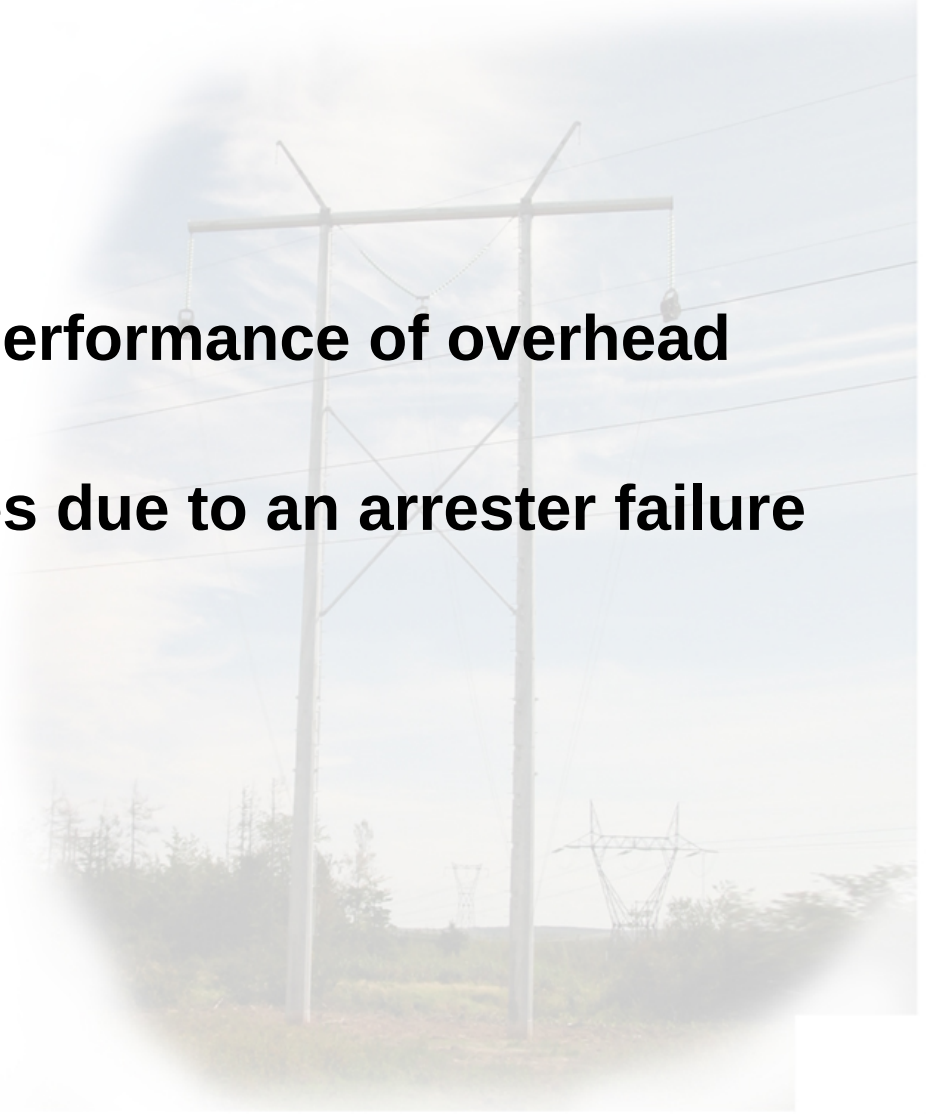
Lightning Mitigation Criteria

- Maximize the lightning performance of overhead shield wires
- Minimize the risk outages due to an arrester failure



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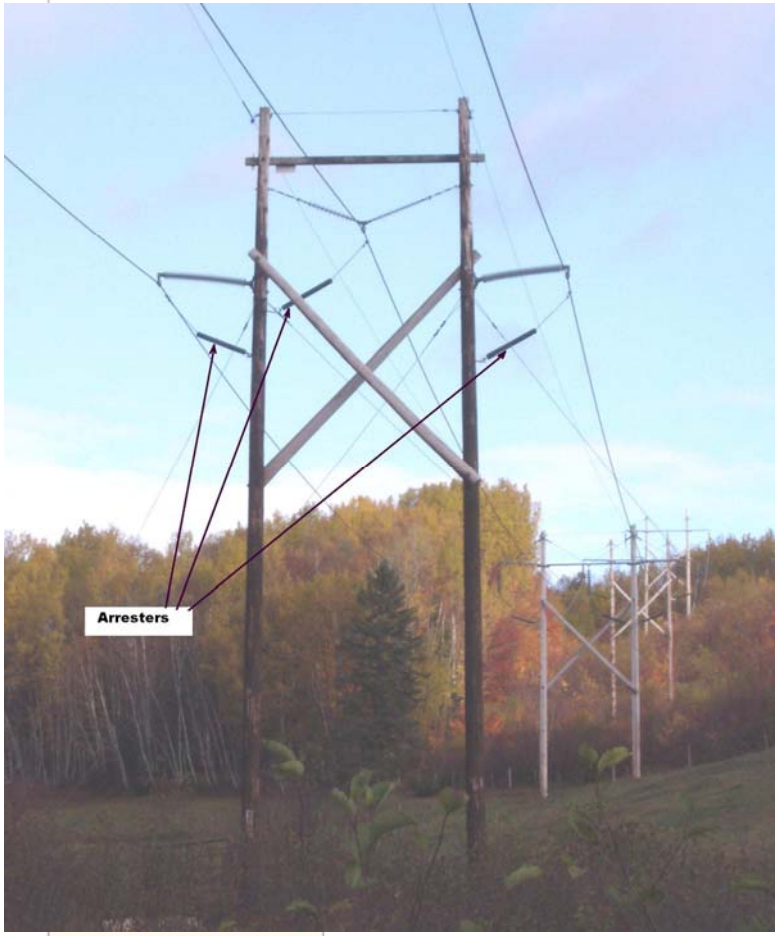
138 kV Line 1183



- Field testing and computer modeling determined that good grounding could not be achieved at many of the structures
- Reasonable improvements were made to existing structure grounding systems
- Arresters were added where good grounding could not be achieved

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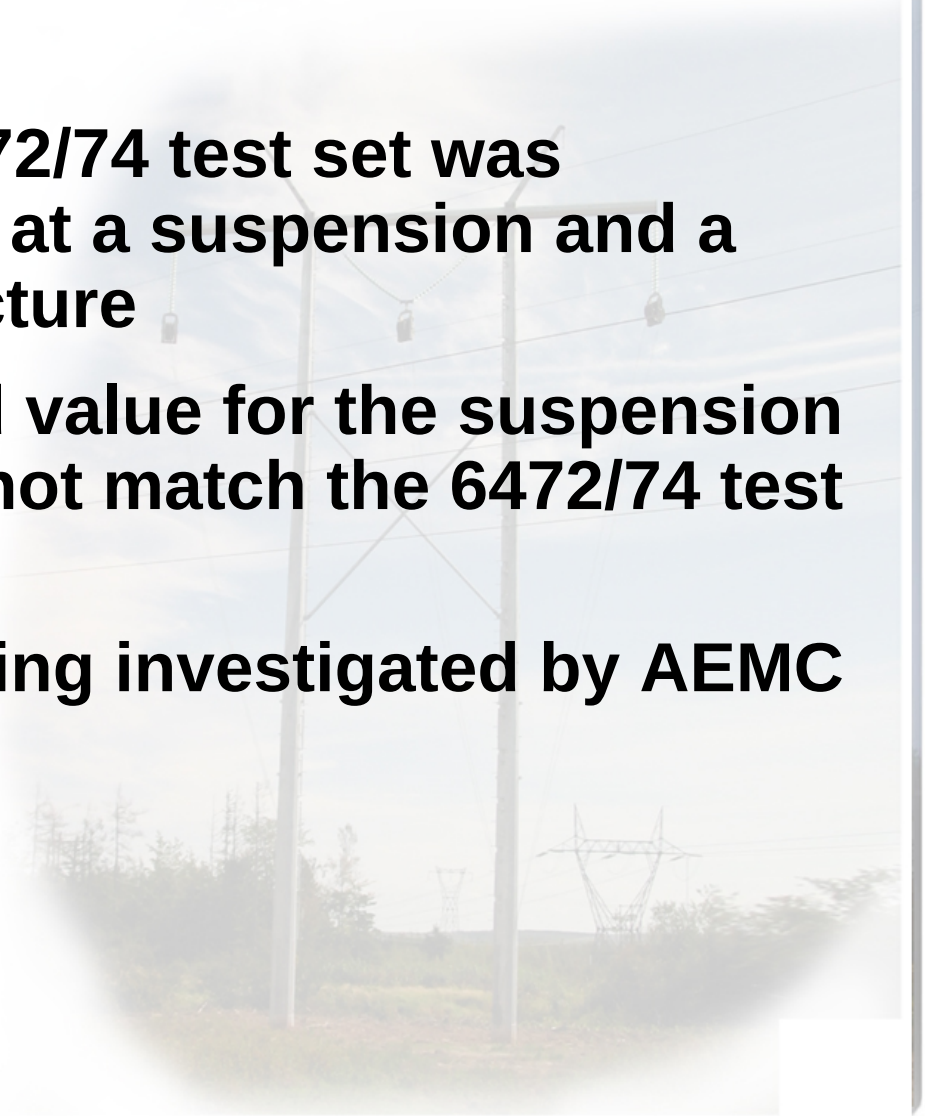
Results of Demonstration Tests

- The AEMC 6472/74 test set was demonstrated at a suspension and a deadend structure
- The computed value for the suspension structure did not match the 6472/74 test result
- This is still being investigated by AEMC



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345 kV Line 3016

Typical Tower

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Steel Foundations

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Foundation Design

- Steel culverts 1st installed
- Corrocoate coating on steel foundation

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Test Equipment Used

- Soil Resistivity Testing using 4-point Wenner
  - Megger Earth Tester Model - DET4TD

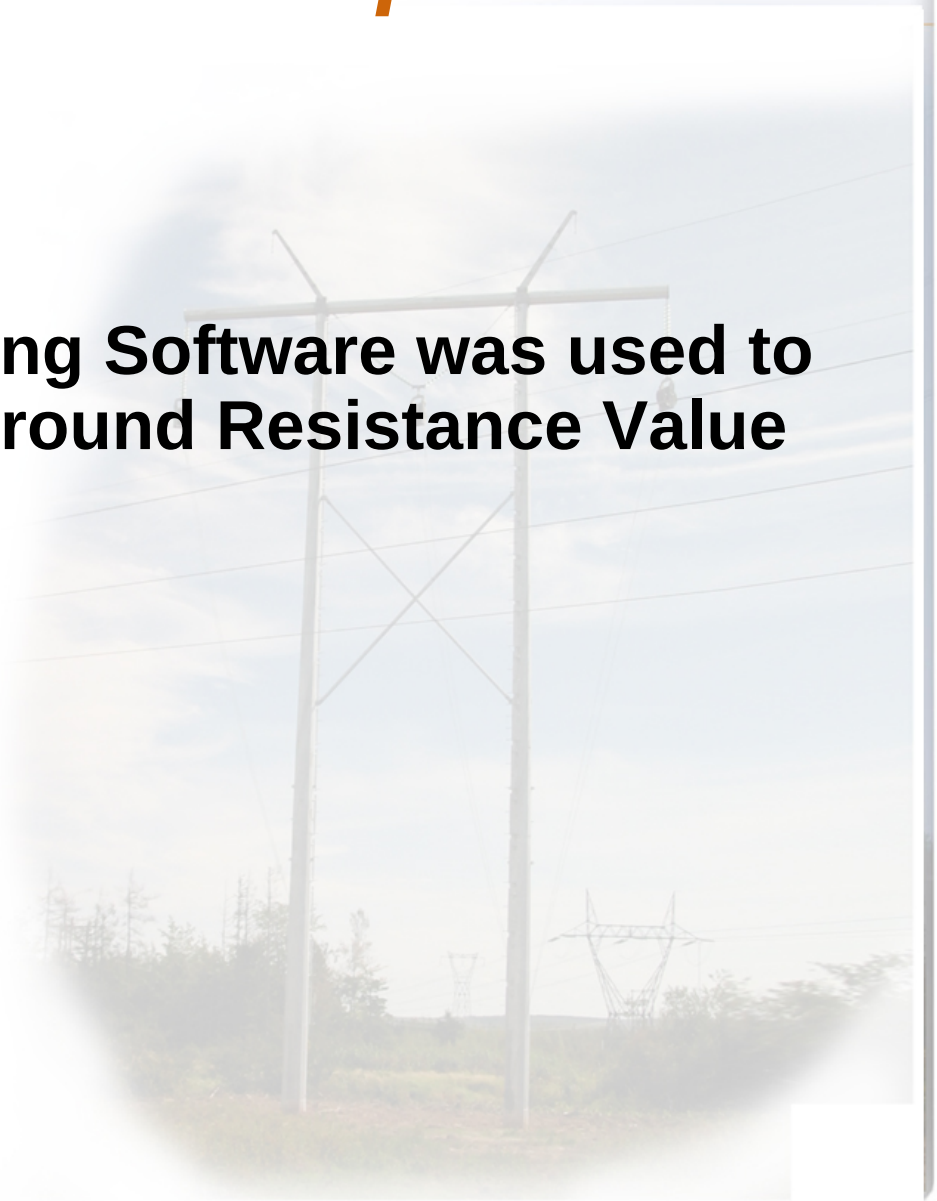
- Ground Impedance by Fall of Potential
  - AEMC Ground Tester Model 6472 and Model 6474

Important Note

Resistivity and Resistance tests were done on the same day

Calculated Values of Impedance

- CDEGS Grounding Software was used to calculated the Ground Resistance Value



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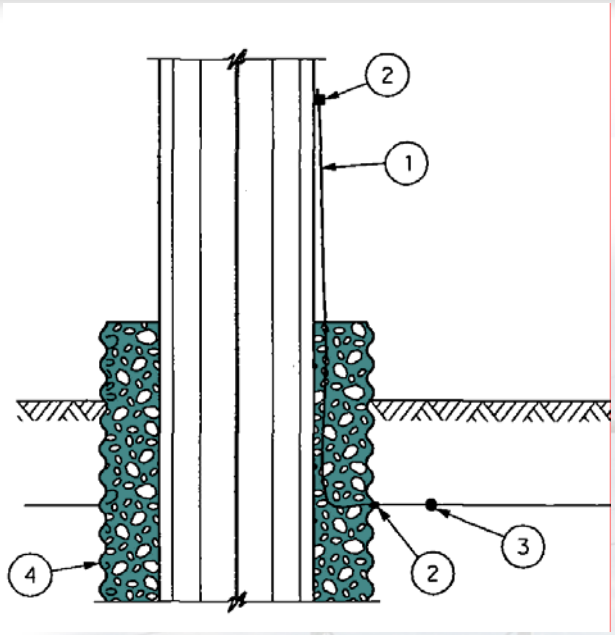
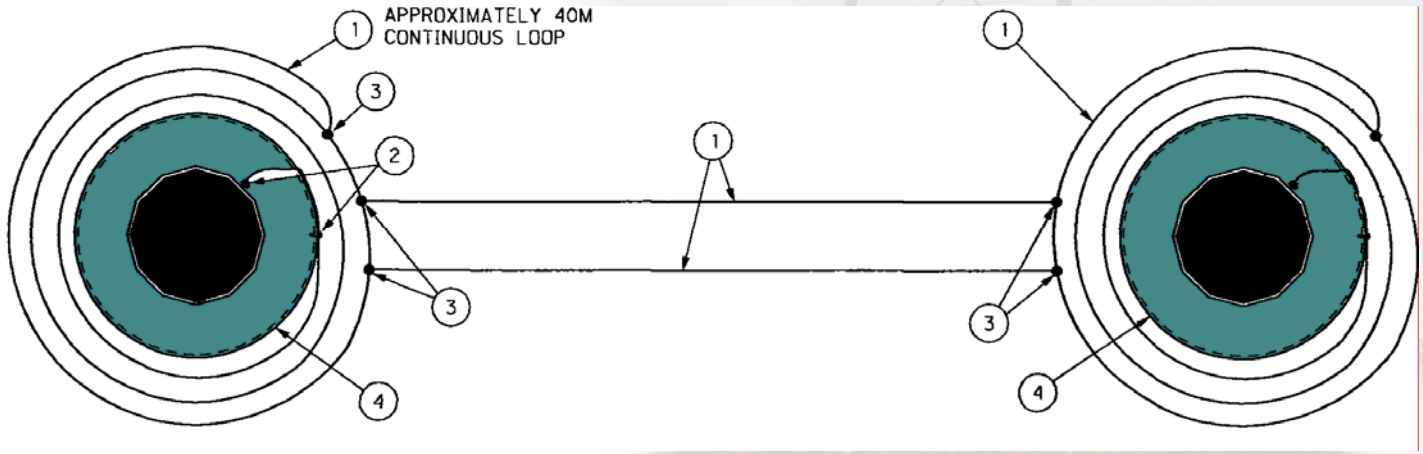
Structure Grounding





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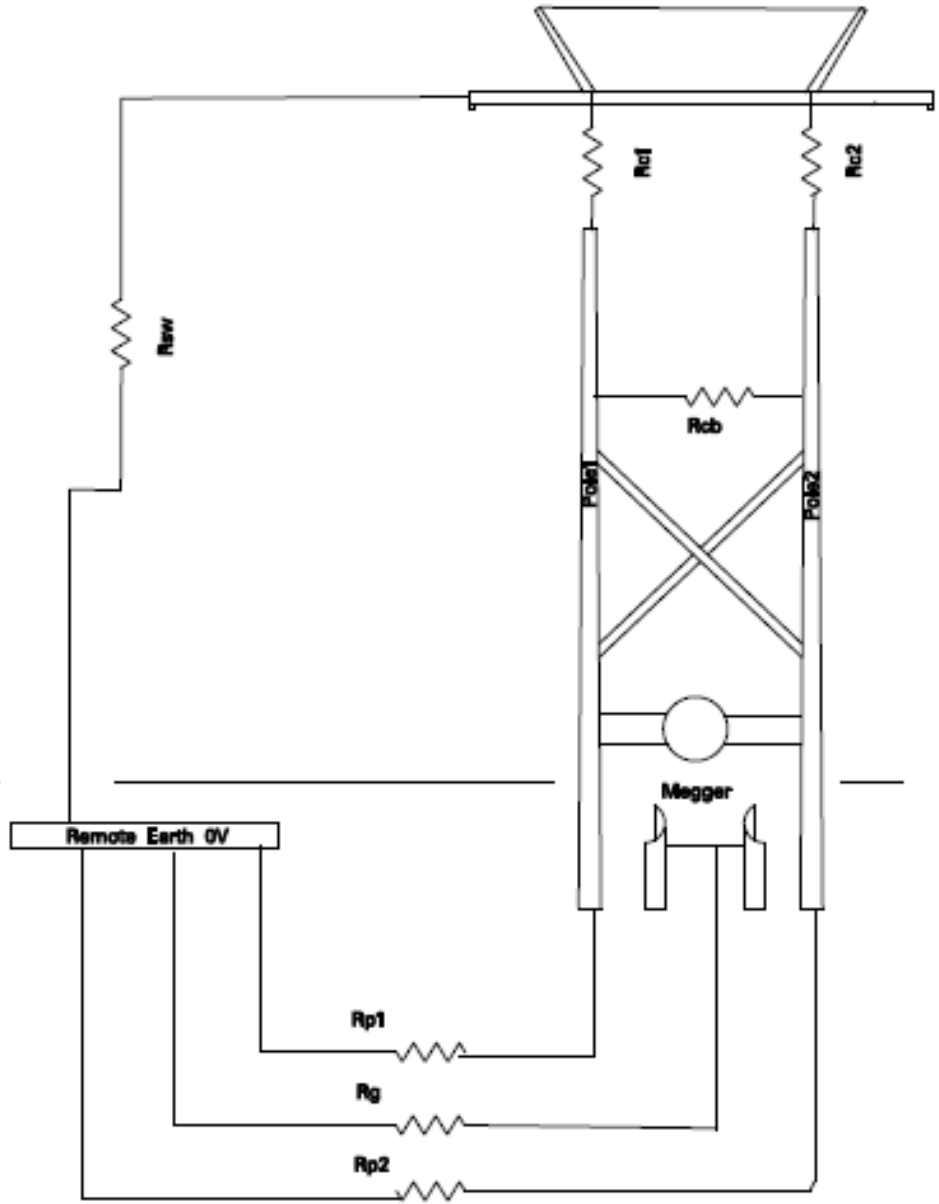
Structure Electrical Circuit



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Sensor Installation

- Top sensor measures shield wire impedance
- Bottom sensor measures structure impedance

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Test Setup

- Two sensors on each pole
- Two turns in each sensor

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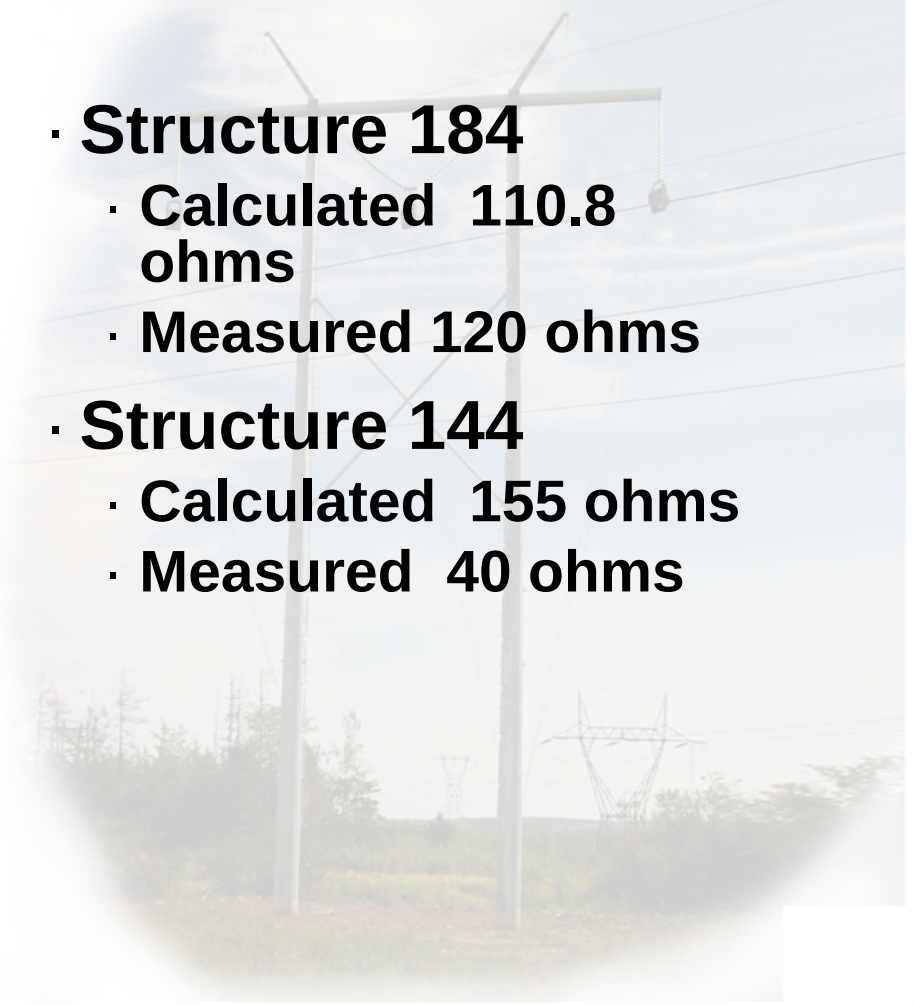
Results of Testing

- **Structure 243**
  - **Calculated 7.9 ohms**
  - **Measured 6.7 ohms**
- **Structure 248**
  - **Calculated 13.3 ohms**
  - **Measured 12.9 ohms**
- **Structure 184**
  - **Calculated 110.8 ohms**
  - **Measured 120 ohms**
- **Structure 144**
  - **Calculated 155 ohms**
  - **Measured 40 ohms**



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Observations

- An uncharged battery was a problem on one day of testing.
- Memory was full on another day and Sweep mode could not be used
- Shorter spools of wire would have been a help as shorter lengths were all that was required and each structure was the same
- Handles on the big case were uncomfortable to carry a long distance
- The complete setup for testing these towers was quite heavy to carry a long distance
- The cables to the sensors have colored numbered markers which would be better if they were larger
- The Megger test set was used for soil resistivity tests because it was lighter and more easily transported

The End

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J’aime mon travail!