

# VLF Testing at TVA Nuclear Fall 2006 Update

Kent W. Brown  
TVA Nuclear



# Tan Delta Protocol

- Sine wave
- 0.1 Hz
- 0.5, 1.0, 1.5 and 2.0 U<sub>o</sub>
- Baseline of new cable
- Assess aged cable
  - IEEE 400 acceptance values (XLPE)
  - Shape of curve (EPR)
  - Re-test interval fixed by test results

TD @ 2V <sub>o</sub>	Eval	Test Frequency (TVA criteria)
TD < 1.2E-03	Good	5 years
TD ≥ 1.2E-03	Aged	Annually
TD ≥ 2.2E-03	Highly Degraded	Cable shall be replaced

# Withstand Protocol

- Sine wave
- 0.1 Hz
- IEEE 400.2 levels
- Confirm workmanship of new cable (30 min)
- Identify weak spots in aged cable (15 min)

	Accept 30 min	Maint 15 min
5 kV	10 kV	7 kV
8 kV	13 kV	10 kV
15 kV	20 kV	16 kV

# Spring 2006 Status

- 320 tan delta assessments
  - 304,000 conductor feet (196,000 aged, 108,000 new)
  - Many re-tests early in the program
    - Due to poor prep, poor setup and marginal equipment
- 214 withstand tests
  - 2 failures during re-tests of highly aged cable
- 24 field and laboratory breakdown tests
  - To assess margin
  - 5 minute step rise test

# Fall 2006 Update

- 52 additional tan delta assessments
  - 25000 additional conductor feet
  - Primarily baseline testing of new cable
  - Only one retest
    - Better training, better equipment
- 51 additional withstand tests
  - No breakdowns
- No in-service failures of tested circuits since program inception

# Fall 2006 Update



Old setup



New setup

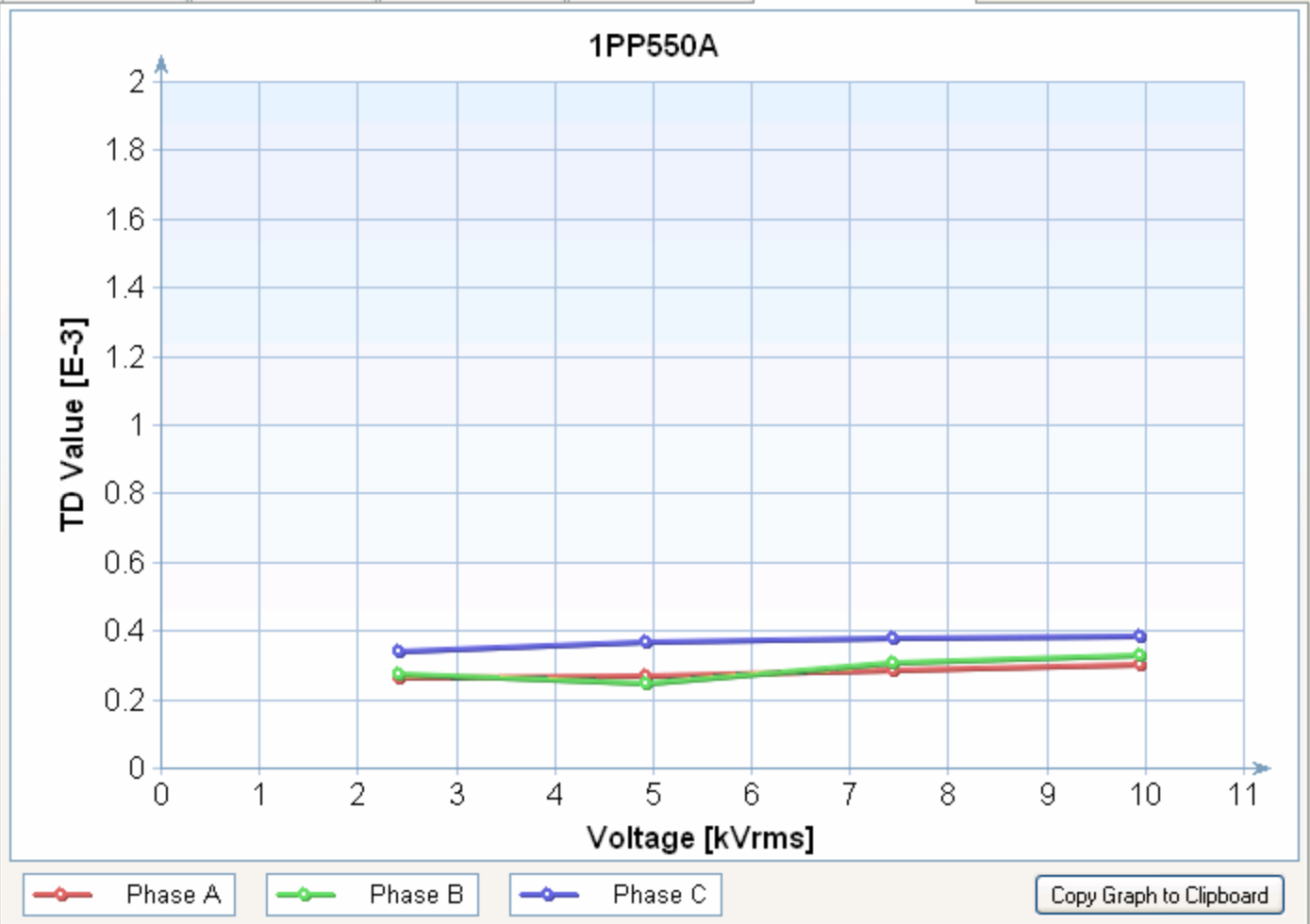
not connected

**TD30 Control Center V1.51**  
Monday, 10/23/2006 10:02:50 PM



Phase A    Phase B    Phase C    Wave View    **Graph TD vs. Voltage**

Tan Delta value [E-3]  
**0**



- Currently Measuring ...
- Phase A
  - Phase B
  - Phase C

- Test Data
- Clear Report
- Edit Report Information
- Load Report
- Save Report
- Print Report

not connected

**TD30 Control Center V1.51**  
Monday, 10/23/2006 10:04:18 PM



Phase A | Phase B | Phase C | Wave View | Graph TD vs. Voltage

**TD Report for Phase A, 1PP550A**  
System used SN: GH0300.05B002

Start 4/12/2001 3:49:11 AM

Phase A **Change Phase**

Mean (5): TD 0.3 +/- 0.0 E-3, 2.4 kVrms, 0.066 mArms, 0.1 Hz, 44 nF

#	TD [E-3]	Voltage [rms]	Current [rms]	Load Cap.	Duration
1	0.3	2.4 kV	0.066 mA	44 nF	0 min
2	0.3	2.4 kV	0.066 mA	44 nF	0 min
3	0.3	2.4 kV	0.066 mA	44 nF	0 min
4	0.3	2.4 kV	0.066 mA	44 nF	0 min
5	0.3	2.4 kV	0.066 mA	44 nF	0 min

Start 4/12/2001 3:50:57 AM

Phase A **Change Phase**

Mean (7): TD 0.3 +/- 0.0 E-3, 4.9 kVrms, 0.136 mArms, 0.1 Hz, 44 nF

#	TD [E-3]	Voltage [rms]	Current [rms]	Load Cap.	Duration
1	0.3	4.9 kV	0.136 mA	44 nF	0 min
2	0.3	4.9 kV	0.136 mA	44 nF	0 min
3	0.3	4.9 kV	0.136 mA	44 nF	0 min
4	0.3	4.9 kV	0.136 mA	44 nF	0 min
5	0.3	4.9 kV	0.136 mA	44 nF	0 min
6	0.3	4.9 kV	0.136 mA	44 nF	0 min
7	0.3	4.9 kV	0.135 mA	44 nF	1 min

Start 4/12/2001 3:52:43 AM

Phase A **Change Phase**

Mean (9): TD 0.3 +/- 0.0 E-3, 7.4 kVrms, 0.205 mArms, 0.1 Hz, 44 nF

#	TD [E-3]	Voltage [rms]	Current [rms]	Load Cap.	Duration
1	0.3	7.4 kV	0.205 mA	44 nF	0 min

Tan Delta value [E-3]  
**0**

Currently Measuring ...

- Phase A
- Phase B
- Phase C

Test Data

Clear Report

Edit Report Information

Load Report

Save Report

Print Report

COM5

Connect to TD System

TD System Sleep

Set Limits

Exit

# Questions?

Thank You