

**Dissipation Loss Factor Measurements
on LADWP's Underground Transmission Cables**

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Presented

by

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LADWP's Underground Transmission System

- **230-kV**

**High-Pressure Pipe-Type
Cross-Linked Polyethylene(XLPE)**

- **138-kV**

**Low-pressure Oil-Filled (LPOF)
Cross-linked Polyethylene(XLPE)**

230-kV High-Pressure Pipe-Type

- **Number of Circuits:** 18
- **AGE:** 17 – 45 Years
- **Individual Lengths:** 0.1 – 9 Circuit Miles
- **Total Circuit Miles:** 42

230-kV XLPE

- **Number of Circuits: 2**
- **AGE: 3 - 5 Years**
- **Individual Lengths: 4.5 – 5.5 Circuit Miles**
- **Total Circuit Miles: 10**

138-kV LPOF

- **Number of Circuits:** 24
- **AGE:** 36 - 64 Years
- **Individual Lengths:** 0.1 – 6 Circuit Miles
- **Total Circuit Miles:** 69

138-kV XLPE

- **Number of Circuits:** 2
- **AGE:** 2 - 7 Years
- **Individual Lengths:** 2.5 – 3.5 Circuit Miles
- **Total Circuit Miles:** 6

Types of Tests Regularly Performed

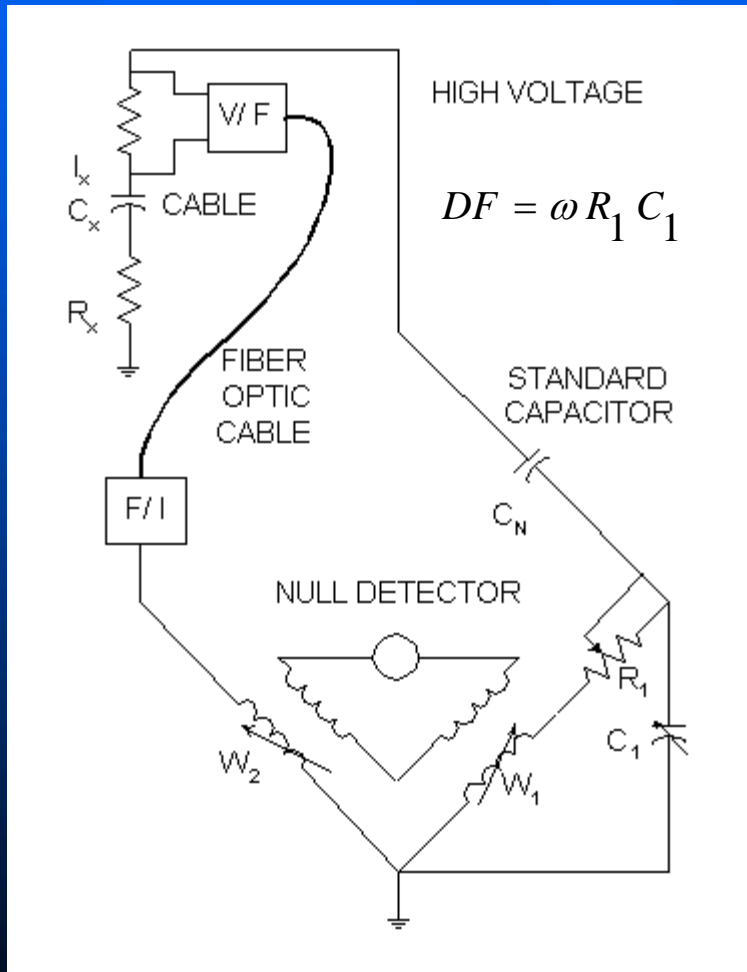
- Dissipation Loss Factor (Power Factor/Tan Delta)
- AC Commissioning (Using VF Source)
- DC High-Pot and Leakage Current
- Distributed Temperature Measurements (DTS)
- Conductor Resistance
- Cable Capacitance
- Pothead Capacitance
- Pothead Power Factor
- Radiography (Checking For Cable Movement)
- Oil Testing (DGA)

Dissipation Loss Factor Test (Pipe-Type Cables Tested)

- **Scattergood – Olympic Line #2, 230-kV (8.7 Miles)
Installed In 1974 (2500 MCM, 760-mils)**
- **Tarzana – Olympic Line #3, 230-kV (3.2 Miles)
Installed In 1968 (2500 MCM, 835-Mils)**
- **Toluca – Van Nuys Cable C, 230-kV (5.6 Miles)
Installed In 1964 (1000 MCM, 920-Mils)**
- **Toluca – Van Nuys Cable A, 230-kV (5.6 Miles)
Installed In 1964 (1000 MCM, 920 Mils)**

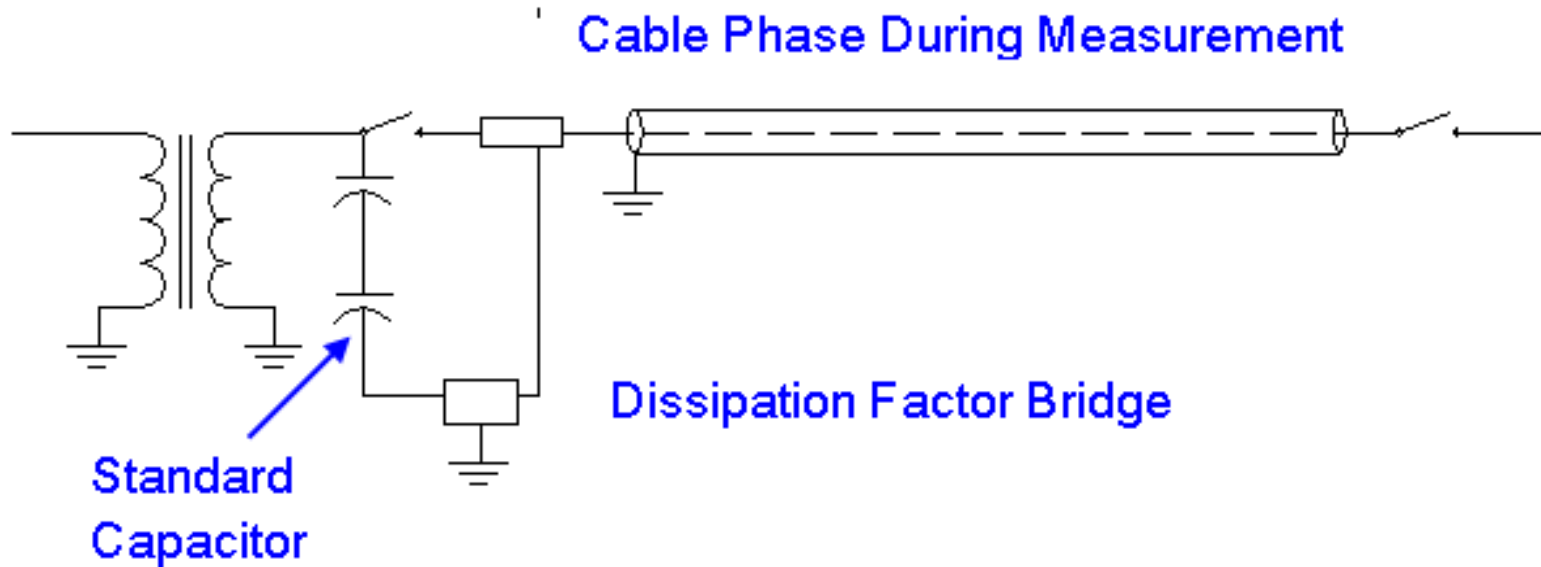
Dissipation Loss Factor Test (Equipment Used)

Modified Transformer Ratio-Arm Bridge



Dissipation Loss Factor Test (Equipment Used)

Power System During Measurements



Dissipation Loss Factor Test

(Test Procedures)

- **Obtain Clearances For Measurements.**
- **De-energize And Apply Safety Grounds.**
- **Connect Equipment To Cable Pothead.**
- **Connect Standard Capacitor To Station Bus.**
- **Remove Safety Grounds.**
- **Energize All Three Cable Phases From One End.**
- **Perform Dissipation Factor Measurement On 1st Phase.**
- **De-energize And Apply Safety Ground.**
- **Repeat Above For Phases 2 and 3.**

Dissipation Loss Factor Test (Data)

Cable	Phase	Date Installed	Date Tested	Service Age	Factory DF%	Current DF%	% Change
Tarzana Olympic Line 3	A	1968	2004	36	0.267	0.271	1.50%
	B	1968	2004	36	0.267	0.279	4.49%
	C	1968	2004	36	0.267	0.297	11.24%
	AVE				0.267	0.282	5.62%
Scattergood-Olympic Line 2	A	1974	2007	33	0.208	0.334	60.58%
	B	1974	2007	33	0.208	0.345	65.87%
	C	1974	2007	33	0.208	0.297	42.79%
	AVE				0.208	0.325	56.25%
Toluca-Van Nuys Cable C	A	1964	2004	40	NA	0.224	--
	B	1964	2004	40	NA	0.230	--
	C	1964	2004	40	NA	0.232	--
						0.228	
Toluca-Van Nuys Cable C	A	1964	2005	41	NA	0.221	--
	B	1964	2005	41	NA	0.252	--
	C	1964	2005	41	NA	0.228	--
	AVE					0.234	
Toluca-Van Nuys Cable A	A	1964	2007	43	0.273	0.295	8.06%
	B	1964	2007	43	0.273	0.285	4.40%
	C	1964	2007	43	0.273	0.288	5.49%
	AVE				0.273	0.289	5.86%

Dissipation Loss Factor Test (Data Analyses)

- **Compare Measurement Results To Factory Production Test, If Available.**
- **Compare Measurement Results To Maximum Allowable AEIC CS-2 (At Time Of Cable Manufacture).**
- **Compare Measurement Results For Three Cable Phases.**
- **IEEE Std. 1425 – Guide For The Evaluation Of The remaining Life Of Impregnated Paper-Insulated Transmission Cable Systems.**

Conclusions

- **Scattergood Cable, Showing The Largest DF% Increase Has Failed Twice In The Past (1989, 2005).**
- **Testing One Phase At The Time, Given The Clearance Procedures, Is Inefficient.**
- **Periodic DF% Test Is An Effective Tool To Assess The Condition Of Pipe-Type Cables.**
- **LADWP Has Determined That It Is Beneficial To Conduct Periodic DF% Tests On Transmission Cables.**