SUBJECT: INSULATION COORDINATION

TD-192

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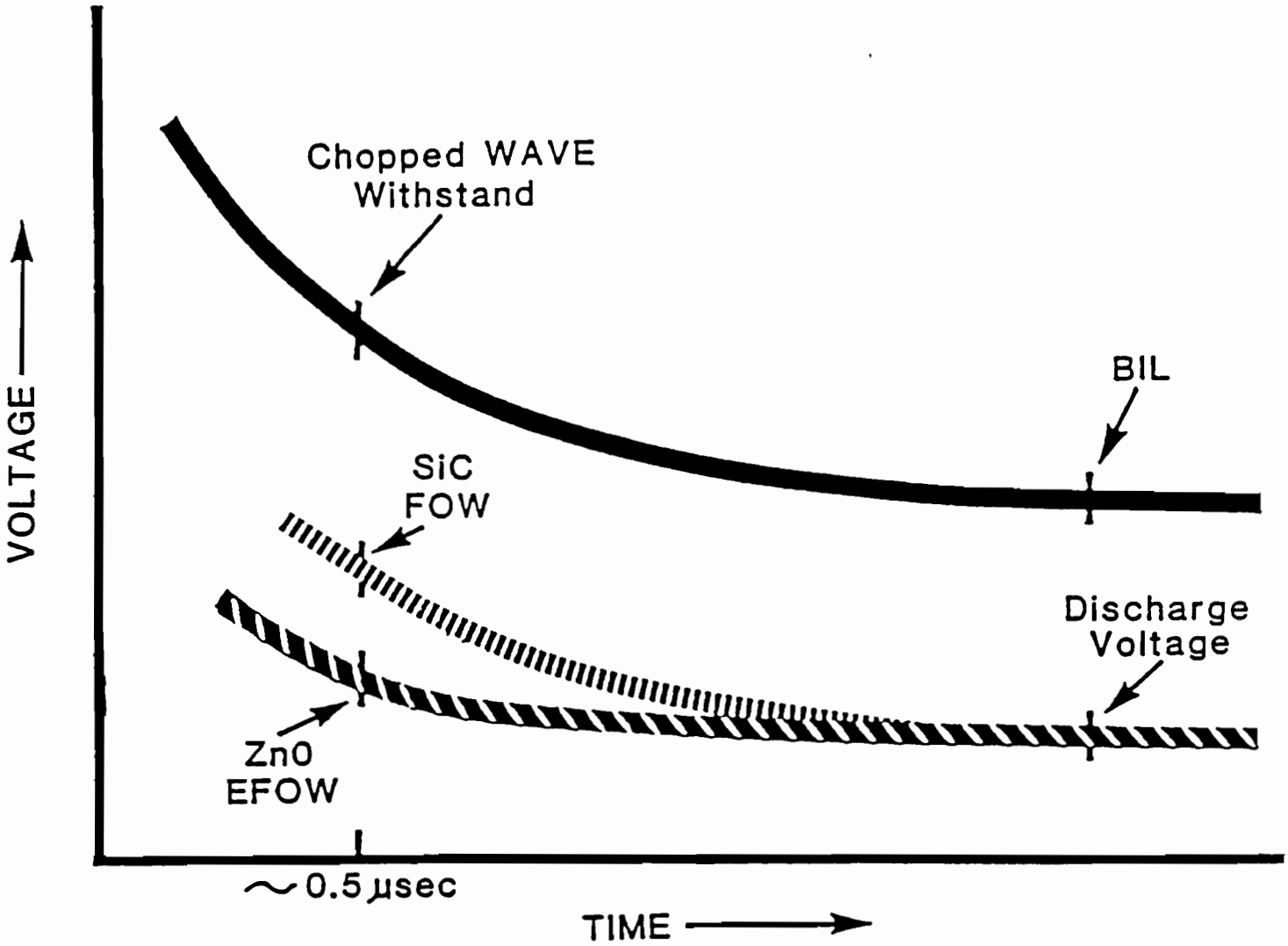
II. EQUIPMENT PROTECTION

Table 1



Equipment Insulation Withstand Capability

Silicon Carbide Arrester Protective Characteristics

Metal Oxide Arrester Protective Characteristics

Basic Concept of Equipment Protection is Insulation Coordination: limit voltage surges to a level below the equipment insulation withstand capability.

II. MARGIN OF PROTECTION CALCULATION

The margin of protection is generally determined at 3 points using the following method:

MP1 is the margin of protection in the fast front region and is defined as follows:

$$MP1 = \left[\frac{CWW}{FWPL} - 1 \right] \times 100$$

CWW = Chopped Wave Withstand
FWPL = Front of Wave Protective Level

MP2 is the margin of protection in the slower front range and is defined as follows:

$$MP2 = \left[\frac{BIL}{DV} - 1 \right] \times 100$$

BIL = Basic Insulation Level
DV = Discharge Voltage

The switching surge protective margin is defined as MP3 and is calculated as:

$$MP3 = \left[\frac{BSL}{SSPL} - 1 \right] \times 100$$

BSL = Basic Surge Withstand Level
SSPL = Switching Surge Protective Level

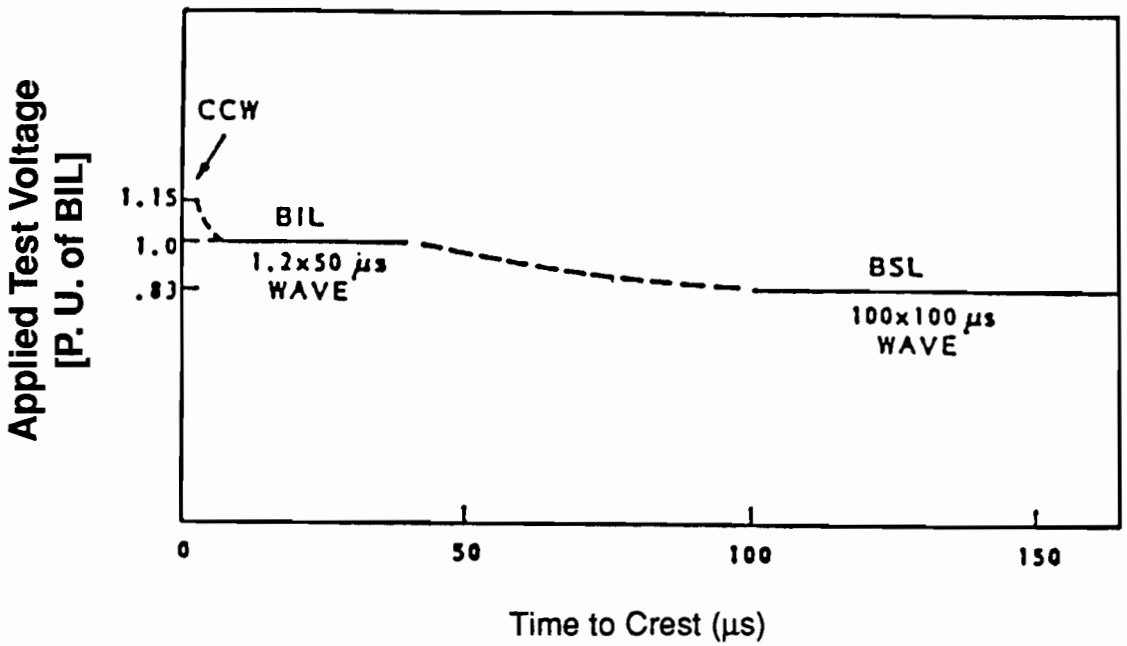
III. REFERENCE INSULATION INFORMATION

Table 2

Standard Insulation Levels Relative to BIL	
Test Impulse	BIL Multiplier
BIL - Standard 1.2 x 50μs	1.0
Tail Chopped Impulse	1.15
Switching Surge 100 x 1000 μs	0.83
Fast Chopped Impulse	1.5

These tests are referred to as withstand tests, as the objective of the test is to prove that the equipment insulation can withstand a given impulse voltage level without breaking down. The usual terminology assigned to the different types of withstand tests are:

BIL ..... *full wave test for distribution equipment*
BSL ..... *switching surge full wave test (transmission class equipment only)*
CWW ..... *tail chopped wave test*



Volt-Time Characteristic of Non-Restorable Insulation

III. REFERENCE INSULATION INFORMATION

Table 3

Insulation Classes for Single Phase Oil-Filled Distribution Transformers

Rated High Voltage (V)	High Voltage Insulation Class (kV)
2400/4160 Y	5.0
4800/8320 Y	8.7
7200/12470 Y	15.0
12470 Grd Y/7200	15.0
8000/13860 Y	15.0
13860 Grd Y/8000	15.0
12420	15.0
13860	15.0
14400/24940 Y	18.0
24940 Grd Y/14400	18.0
27600 Grd Y/16000	18.0
34500 Grd Y/19920	25.0
34500	34.5

Table 4

Insulation Test Standards for Oil-Filled Distribution Transformers

Insulation Class (kV)	BIL and Full Wave Crest	Tail Chopped Wave		0.5 μs Front Chopped Wave Crest (kV)
		BIL and Full Wave Crest	BIL and Full Wave Crest	
1.2	30	36	1.0	45
5.0	60	69	1.5	90
8.7	75	88	1.6	113
15.0	95	110	1.8	143
18.0	125	145	2.25	188
25.0	150	175	3.0	225
34.5	200	230	3.0	300

COOPER
Cooper Power Systems

P.O. Box 2850, Pittsburgh, PA 15230