

# Table of Contents

Generic Requirements Notice of Disclaimer . . . . .	iii
Preface . . . . .	xi
The Telcordia Technologies GR Process . . . . .	xi
About GR-3159-CORE . . . . .	xi
Submit Comments on This GR . . . . .	xii
Telcordia Consulting and Testing Services . . . . .	xii

## 1 Introduction

1.1 Purpose and Scope . . . . .	1-1
1.2 Background . . . . .	1-1
1.2.1 Related Industry Standards . . . . .	1-2
1.2.2 Requirement Overview . . . . .	1-4
1.3 Reasons for GR-3159-CORE, Issue 2 . . . . .	1-5
1.4 Target Audience . . . . .	1-6
1.5 Organization of This Document . . . . .	1-7
1.6 Historical Performance of Wood Poles . . . . .	1-8
1.7 Non-Wood Poles . . . . .	1-10
1.7.1 Operational Issues . . . . .	1-12
1.8 Field Experience and History of Non-Wood Poles . . . . .	1-12
1.9 Requirements Terminology . . . . .	1-15
1.10 Requirement Labeling Conventions . . . . .	1-16
1.10.1 Numbering of Requirement and Related Objects . . . . .	1-16
1.10.2 Requirement, Conditional Requirement, and Objective Identification . . . . .	1-16
1.11 Testing Information . . . . .	1-17
1.11.1 Laboratory Conditions . . . . .	1-17
1.11.2 Measurements . . . . .	1-17
1.11.3 Sample Selection and Size . . . . .	1-18
1.11.4 Product Re-Testing . . . . .	1-19
1.11.5 Reporting . . . . .	1-19
1.12 Navigating the GR-60 Portable Document Format (PDF) File . . . . .	1-19

## 2 Pole Design and Functional Engineering Requirements

2.1 Application and Physical Design Criteria . . . . .	2-1
2.1.1 Electrical Protection Commentary . . . . .	2-4
2.2 Pole Design . . . . .	2-5
2.2.1 Background – Pole Strength and Loading Considerations . . . . .	2-5
2.2.2 Pole Geometry and Cross-Section Criteria . . . . .	2-9
2.3 Pole Length and Shape . . . . .	2-9
2.4 Pole Strength . . . . .	2-12
2.5 Strength Under Point Loadings at Attachments . . . . .	2-15
2.5.1 Horizontal Strand and Guy Loadings . . . . .	2-15
2.5.2 Vertical Loadings for Mounted Hardware . . . . .	2-17
2.5.3 Compression and Hoop Stress for Tubular Poles . . . . .	2-18
2.5.4 Equipment Loading on Poles . . . . .	2-20
2.5.5 Resistance to Point Impact Damage . . . . .	2-21
2.5.6 Resistance to Automobile Impact . . . . .	2-22

2.6	Fatigue Characteristics . . . . .	2-23
2.7	Pre-Drilled Holes and Inserts . . . . .	2-23
2.8	Top Caps and Butt Ends . . . . .	2-24
2.9	Pole Weight . . . . .	2-24
2.10	Fire Resistance of FRC Poles . . . . .	2-26
<b>3 Material and Environmental Resistance Requirements</b>		
3.1	FRC Pole Materials . . . . .	3-1
3.1.1	Finished FRC Pole – Material Requirements . . . . .	3-2
3.2	Concrete Pole Materials . . . . .	3-3
3.2.1	Finished Concrete Pole – Material Requirements . . . . .	3-5
3.3	Steel Pole Materials . . . . .	3-6
3.3.1	Protective Coatings for Steel Poles . . . . .	3-7
3.3.1.1	Above Groundline Pole Segments . . . . .	3-7
3.3.1.2	Below Groundline Pole Segments . . . . .	3-8
3.3.2	Finished Steel Pole – Material Requirements . . . . .	3-9
3.4	Pole Color, Finish, and Appearance . . . . .	3-9
3.4.1	General Requirements . . . . .	3-10
3.5	Environmental Resistance and Durability – Materials . . . . .	3-11
3.5.1	Test Specimens and Evaluation Criteria . . . . .	3-11
3.5.2	Chemical Resistance . . . . .	3-12
3.5.3	Flood and Ground Water Resistance . . . . .	3-13
3.5.4	Fungus Resistance . . . . .	3-14
3.5.5	Ultraviolet Radiation (Sunlight) Resistance . . . . .	3-15
3.5.5.1	FRC Poles . . . . .	3-15
3.5.5.2	Concrete Poles . . . . .	3-16
3.5.5.3	Steel Poles . . . . .	3-16
3.6	Environmental Aging . . . . .	3-17
3.6.1	Temperature and Humidity Cycling . . . . .	3-17
3.6.2	Aging of the Pole and Attachment Assembly . . . . .	3-18
3.6.3	Salt Fog Resistance . . . . .	3-19
3.7	Safety and Environmental Considerations . . . . .	3-20
3.8	Electrical Characteristics . . . . .	3-21
3.8.1	Dielectric Withstand for FRC and Concrete Poles . . . . .	3-21
3.8.2	Electrical Continuity for Steel and Reinforced Concrete Poles . . . . .	3-21
<b>4 Design Factors</b>		
4.1	Foundations . . . . .	4-1
4.2	Burial Depth . . . . .	4-2
4.3	Wiring Conduits and Raceways (for Tubular Poles) . . . . .	4-3
4.4	Grounding and Bonding . . . . .	4-3
4.5	Sectional Poles . . . . .	4-4
4.6	Drainage . . . . .	4-4
4.7	FRC Poles . . . . .	4-5
4.8	Steel Poles . . . . .	4-5
4.9	Concrete Poles . . . . .	4-5
4.9.1	Reinforcements . . . . .	4-6
4.10	Hybrid Structures . . . . .	4-6

## 5 Attachment Hardware and Accessories

5.1 General Attachment Hardware Concerns . . . . .	5-1
5.1.1 Guys . . . . .	5-1
5.1.2 Holes and Drilling . . . . .	5-4
5.1.3 Lag Screws and Support Straps . . . . .	5-4
5.1.4 Banded Hardware Attachments . . . . .	5-6
5.2 Hardware Reliability . . . . .	5-6
5.2.1 General Hardware Design Criteria . . . . .	5-7
5.3 Accessories and Replacement Parts . . . . .	5-9
5.4 Anchoring Hardware and Accessories . . . . .	5-9
5.4.1 General . . . . .	5-10
5.4.2 Steel Poles . . . . .	5-10
5.5 Steps, Climbing Apparatus, and Work Platforms . . . . .	5-10

## 6 Worker and Equipment Safety

6.1 General Safety Criteria . . . . .	6-1
6.2 Drilling . . . . .	6-1
6.2.1 Background . . . . .	6-1
6.3 Lifting and Setting of Poles . . . . .	6-2
6.4 Pole Condition and Monitoring Management System . . . . .	6-2

## 7 Documentation, Packaging, and Instructions

7.1 Ordering Information . . . . .	7-1
7.2 Labels and Marking . . . . .	7-1
7.3 Packaging and Shipping . . . . .	7-4
7.4 Documentation and Instructions . . . . .	7-5
7.5 Quality Assurance (QA) and Pole Test Documentation . . . . .	7-6

## 8 Quality and Reliability

8.1 Quality Management System (QMS) . . . . .	8-1
8.2 Product Change Notification . . . . .	8-2
8.3 Gauges, Meters, and Other Recording Instruments . . . . .	8-2
8.4 Pole Stock and Loading/Handling Practices . . . . .	8-3
8.5 Inspection Criteria and Guidance . . . . .	8-3

## 9 Commentaries

9.1 Wood and Non-Wood Poles . . . . .	9-1
9.1.1 Pole Material Choices . . . . .	9-1
9.1.2 Decay of Wood Poles . . . . .	9-2
9.1.3 Non-Wood Pole Susceptibilities . . . . .	9-3
9.1.4 Fiber-Reinforced Composite (FRC) Poles . . . . .	9-4
9.1.5 Concrete Poles . . . . .	9-6
9.1.6 Steel Poles . . . . .	9-7
9.2 Pole Strength Considerations . . . . .	9-7
9.2.1 Equivalent Pole Strength . . . . .	9-8
9.3 Gloss and Haze . . . . .	9-10
9.3.1 Gloss Measurements . . . . .	9-10
9.3.2 Haze . . . . .	9-11

9.4 Hardware Issues . . . . .	9-11
9.4.1 Down Guys and Guy Hooks . . . . .	9-11
9.4.2 Through Holes and Drilling . . . . .	9-12
9.4.3 Lag Screws and Support Straps . . . . .	9-13
9.4.4 Banded Hardware Attachments . . . . .	9-15

## **Appendix A: References**

A.1 Telcordia Documents . . . . .	A-1
A.2 Other Referenced Material (in alphabetical order) . . . . .	A-1
1.2.1 To Obtain Additional Reference Material . . . . .	A-5
A.3 Telcordia Reference Notes . . . . .	A-6
A.3.1 Contact Telcordia Customer Service . . . . .	A-6
A.3.2 Order Documents Online From the Telcordia Information SuperStore . . . . .	A-6
A.3.3 Web Sites for Generic Requirements Information . . . . .	A-7
A.3.4 Licensing Agreements for Telcordia Documents . . . . .	A-7

## **Appendix B: Acronyms and Definitions**

### **Requirement-Object Index**

## List of Figures

Figure 1-1	Decision Tree for Root Cause Analysis of Pole Failure . . . . .	1-13
Figure 1-2	FRC Pole Failure . . . . .	1-14
Figure 2-1	Cross-Section Schematics of Polygonal Shaped Pole . . . . .	2-8
Figure 2-2	Sweep Measurement of Pole . . . . .	2-10
Figure 2-3	Example of a Prohibited Crook . . . . .	2-11
Figure 2-4	Through-Bolt Test for Point Loading Tests . . . . .	2-16
Figure 2-5	Vertical Point Load Test Schematic . . . . .	2-17
Figure 2-6	V-Edge for Penetration/Compression Test . . . . .	2-22
Figure 3-1	Schematic of Temperature Cycling Profile (Partial) . . . . .	3-18
Figure 7-1	Label Schematic . . . . .	7-2
Figure 9-1	Wood Decay Zone Map of the USA . . . . .	9-3
Figure 9-2	Susceptibility Zone Map . . . . .	9-4
Figure 9-3	Possible Pole Configurations . . . . .	9-5
Figure 9-4	Typical Strength Distribution for Typical Class 4 Wood Poles . . . . .	9-9
Figure 9-5	Schematic of Pole Strength Distributions . . . . .	9-9
Figure 9-6	Carbide Tip Bits . . . . .	9-12
Figure 9-7	Support-Strap Configuration . . . . .	9-13

## List of Tables

Table 1-1	Wood Pole Characteristics . . . . .	1-9
Table 1-2	FRC Pole Characteristics . . . . .	1-10
Table 1-3	Concrete Pole Characteristics . . . . .	1-11
Table 1-4	Steel Pole Characteristics . . . . .	1-11
Table 2-1	Strength Factors for Structures from NESC . . . . .	2-6
Table 2-2	Pole Class and Strength . . . . .	2-7
Table 2-3	Sample Pole Data Table . . . . .	2-13
Table 2-4	Maximum Deflection at 500-Pound Lateral Load . . . . .	2-14
Table 2-5	Minimum Breaking Strength Based on Strand . . . . .	2-15
Table 2-6	Nominal Maximum Weights . . . . .	2-25
Table 4-1	Minimum Depth of Setting Pole . . . . .	4-2
Table 5-1	Hardware Types and Applications . . . . .	5-2