Contents

List of Illustrations xi
Preface xv
Acknowledgments xix

Part 1 Preparation 1
Chapter 1: Site Preparation 3
  1.1 Foreign Material Exclusion 3
  1.2 Safety Procedures—Electrical Clearances 9
  1.3 Inspection Frequency 12
    1.3.1 Condition Based Maintenance (CBM) 13
    References 13

Chapter 2: Inspection Tools 15

Chapter 3: Inspection Forms 19
  Form 1: Basic Information 25
  Form 2: Nameplate Information 26
  Form 3: Inspection Accessibility 26
  Form 4: Stator Inspection 27
  Form 5: Rotor Inspection 30
  Form 6: Excitation Inspection 32
  Form 7: Salient Poles Condition Report 33
  Form 8: Comments 34
  Form 9: Wedge Survey 35
  Form 10: Electric Test Data 37
Part 2 Inspection

Chapter 4: Description of Stator Items (Form 4)

S01: Cleanliness of Bore
S02: Air/Gas Ducts Clogged/Unclogged
S03: Iron Oxide Deposits
S04: Hardware Condition
S05: High-Voltage Bushings
S06: Stand-Off Insulators
S07: Bushing Vents
S08: Greasing/Red Oxide Deposits on Core Bolts and Spring Washers
S09: Space Heaters
S10: Fan-Baffle Support Studs
S11
and S12: Heat Exchanger Cleanliness and Leaks
S13: Hydrogen Desiccant/Dryer
S14: Core-Compression ("Belly") Belts
S15: Bearing Insulation (at Pedestal or Babbitt)
S16: Coil Cleanliness (including water cooled windings)
S17: Blocking Condition
S18
and S19: Ties Between Coils
S20
and S21: Ties to Surge-Rings
S22: Surge-Ring Insulation Condition
S23: Surge-Rings Support Assembly
S24: Additional End-Winding Support Hardware
S25: RTDs and TCs Wiring Hardware
S26: Asphalt Bleeding/Soft Spots
S27: Tape Separation/Girth Cracking
S28: Insulation Gallling/Necking Beyond Slot
S29: Insulation Bulging into Air Ducts
S30: Insulation Condition
S31: Circumferential Bus Insulation
S32: Corona Activity
S33: Wedges Condition
S34: Wedges Slipping Out
S35: Fillers Slipping Out
S36: Bars Bottomed in Slot
S37: Laminations Bent/Broken in Bore
S38: Laminations Bulging into Air Ducts
S39: Terminal Box Current Transformer (CT) Condition
S40: Bushing Well Insulators and H₂ Sealant Condition
S41: End-Winding Expansion–Bearing Bolts Condition

References
Chapter 5: Description of Rotor Items (Form 5) 97
R01: Rotor Cleanliness 97
R02: Retaining Rings’ Visual Appearance 98
R03: Centering Rings’ Visual Appearance 103
R04: Fan Rings’ Visual Appearance 103
R05: Fretting/Movement at Rings’ Interference-Fit Surfaces 105
R06: Fan Blades Condition 105
R07: Bearing Journals Condition 106
R08: Balance Weights/Bolts Condition 108
R09: End-Wedges Condition 108
R10: Other wedges 110
R11: End-Windings Condition 111
R12: Top Series Connections 114
R13: Bottom Series Connections 114
R14
and R15: Field-Pole Keys in Dovetail and Inter-Pole Blocking 114
R16
and R17: Insulation Between Turns 115
R18: Starting-Bars (Damper Winding) Condition 117
R19
and R20: Bull-Ring Segments and Bracing to Starting-Bars Condition 119
R21: Collector Rings Condition 119
R22: Collector Insulation Condition 122
R23: Brush-Spring Pressure and General Condition 123
R24: Brush-Rig Condition 123
R25: Shaft-Voltage Discharge-Brush Condition 123
R26: Inner/Outer Hydrogen Seals 123
R27: Circumferential Pole Slots Condition 124
References 125

Chapter 6: Description of Excitation Items (Form 7) 127
E01: Cleanliness 127
E02: Shaft-Mounted Diodes Condition 128
E03: Diodes Connections and Support Hardware 128
E04
to E07: Commutator, Brushes, Springs and Brush-Rig Condition 128
E08: DC Generator Stator Condition 129
E09: DC Generator Armature Condition 130
E10
and E11: Exciter-Drive Motor Cleanliness and Stator Condition 130
E12: Exciter-Motor Rotor 131
E13: Field Discharge Resistor Condition 131
# Chapter 7: Description of Generator Auxiliaries

7.1 Lubrication System

7.2 Hydrogen Seal Oil System

7.3 Stator Water Cooling System

7.4 Hydrogen System

# Chapter 8: Standard Electrical and Mechanical Tests

8.1 Electric Tests

8.1.1 Winding Resistance (DC)

8.1.2 Insulation Resistance (DC)

8.1.3 Polarization Index (PI)

8.1.4 Dielectric (Over-Potential or Hi-Pot) test

8.1.5 Turn-to-Turn Insulation (Surge Comparison) Test

8.1.6 Shorted Turns in Excitation Field Windings

8.1.7 Open Circuit Test (for Detection of Rotor Shorted Turns)

8.1.8 Power Factor Test

8.1.9 Tip-Up Test (for Stator Winding)

8.1.10 Dielectric Absorption

8.1.11 Partial Discharge (PD) Test (for Stator Windings)

8.1.12 Slot-Discharge (SD) Test

8.1.13 Stator Interlaminar Insulation Tests

8.1.14 Core-Compression Bolts Insulation Test

8.1.15 Bearing Insulation Test

8.2 Mechanical Tests

References

# Appendix: Principles of Operation of Synchronous Machines

A.1 General Discussion

A.2 Construction

A.3 Operation

A.3.1 No-Load Operation

A.3.2 Motor Operation

A.3.3 Generator Operation

A.3.4 Equivalent Circuit

A.3.5 Performance Characteristics: V curves and Rating Curves

A.4 Operating Constraints

A.4.1 Volts per Hertz (V/Hz)

A.4.2 Negative Sequence Currents and \((I_2)^2t\)

A.4.3 Maximum Speed

References

Index