**ERCOT Nodal Operating Guide**

**Table of Contents**

**June 1, 2025**

[1 Overview 2](#_Toc194071800)

[1.1 Document Purpose 2](#_Toc194071801)

[1.2 Document Relationship 2](#_Toc194071802)

[1.3 Process for Nodal Operating Guide Revision 2](#_Toc194071803)

[1.3.1 Introduction 2](#_Toc194071804)

[1.3.2 Submission of a Nodal Operating Guide Revision Request 4](#_Toc194071805)

[1.3.3 Nodal Operating Guide Revision Procedure 4](#_Toc194071806)

[1.3.3.1 Review and Posting of Nodal Operating Guide Revision Requests 4](#_Toc194071807)

[1.3.3.2 Withdrawal of a Nodal Operating Guide Revision Request 5](#_Toc194071808)

[1.3.3.3 ROS Review and Action 6](#_Toc194071809)

[1.3.3.4 Comments to the ROS Report 7](#_Toc194071810)

[1.3.3.5 Nodal Operating Guide Revision Request Impact Analysis 7](#_Toc194071811)

[1.3.3.6 ROS Review of Impact Analysis 8](#_Toc194071812)

[1.3.3.7 ERCOT Impact Analysis Based on ROS Report 8](#_Toc194071813)

[1.3.3.8 PRS Review of Project Prioritization 8](#_Toc194071814)

[1.3.3.9 Technical Advisory Committee Vote 8](#_Toc194071815)

[1.3.3.10 ERCOT Board Vote 10](#_Toc194071816)

[1.3.3.11 PUCT Approval of Revision Requests 10](#_Toc194071817)

[1.3.3.12 Appeal of Action 11](#_Toc194071818)

[1.3.4 Urgent Requests 11](#_Toc194071819)

[1.3.5 Nodal Operating Guide Revision Implementation 12](#_Toc194071820)

[1.4 Definitions 12](#_Toc194071821)

[1.5 Operational Training 19](#_Toc194071824)

[1.5.1 System Operator Training Objectives 19](#_Toc194071825)

[1.5.2 System Operator Training Requirements 19](#_Toc194071826)

[1.5.3 ERCOT Operations Training Seminar 20](#_Toc194071827)

[1.5.4 ERCOT Severe Weather Drill 21](#_Toc194071828)

[1.5.5 Training Practices 21](#_Toc194071829)

[1.5.6 ERCOT Operator Certification Program 22](#_Toc194071830)

[2 System Operations and Control Requirements 1](#_Toc194072919)

[2.1 Operational Duties 1](#_Toc194072920)

[2.2 System Monitoring and Control 3](#_Toc194072921)

[2.2.1 Overview 3](#_Toc194072922)

[2.2.2 Security Criteria 5](#_Toc194072923)

[2.2.3 Response to Transient Voltage Disturbance 5](#_Toc194072924)

[2.2.4 Load Frequency Control 6](#_Toc194072925)

[2.2.4.1 Maintenance and Verification 7](#_Toc194072927)

[2.2.4.2 Regulation Provider Loss of AGC 7](#_Toc194072928)

[2.2.4.3 ERCOT Loss of AGC 7](#_Toc194072929)

[2.2.5 Automatic Voltage Regulators 8](#_Toc194072930)

[2.2.6 Power System Stabilizers 10](#_Toc194072931)

[2.2.7 Turbine Speed Governors 14](#_Toc194072932)

[2.2.8 Performance/Disturbance/Compliance Analysis 15](#_Toc194072933)

[2.2.9 Time Error and Time Synchronization 17](#_Toc194072934)

[2.2.9.1 Time Error 17](#_Toc194072935)

[2.2.9.2 Time Synchronization 18](#_Toc194072936)

[2.2.10 Generation Resource and Energy Storage Resource Response Time Requirements 18](#_Toc194072937)

[2.3 Ancillary Services 20](#_Toc194072938)

[2.3.1 Responsive Reserve 27](#_Toc194072939)

[2.3.1.1 Obligation 27](#_Toc194072940)

[2.3.1.2 Additional Operational Details for Responsive Reserve Providers 27](#_Toc194072941)

[2.3.1.2.1 Limit on Resources Providing RRS Using Primary Frequency Response 33](#_Toc194072942)

[2.3.2 Non-Spinning Reserve Service 34](#_Toc194072943)

[2.3.2.1 Additional Operational Details for Non-Spinning Reserve Service Providers 34](#_Toc194072944)

[2.3.3 ERCOT Contingency Reserve Service 36](#_Toc194072945)

[2.3.3.1 Additional Operational Details for ERCOT Contingency Reserve Service (ECRS) Providers 36](#_Toc194072946)

[2.4 Outage Coordination 38](#_Toc194072948)

[2.5 Reliability Unit Commitment 39](#_Toc194072949)

[2.5.1 Criteria for Removing Contingencies from the Reliability Unit Commitment Analyses 39](#_Toc194072950)

[2.6 Requirements for Under-Frequency and Over-Frequency Relaying 39](#_Toc194072951)

[2.6.1 Automatic Firm Load Shedding 39](#_Toc194072952)

[2.6.2 Frequency Ride-Through Requirements for Generation Resources and Energy Storage Resources 43](#_Toc194072953)

[2.6.2.1 Frequency Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs 44](#_Toc194072954)

[2.6.2.1.1 Temporary Frequency Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs 45](#_Toc194072955)

[2.6.2.2 Frequency Ride-Through Requirements for Distribution Generation Resources (DGRs) and Distribution Energy Storage Resources (DESRs) 46](#_Toc194072956)

[2.6.3 Frequency Ride-Through Requirements for Direct Current Ties (DC Ties) 47](#_Toc194072957)

[2.7 System Voltage Profile and Operational Voltage Control 48](#_Toc194072958)

[2.7.1 Introduction 48](#_Toc194072959)

[2.7.2 Maintaining Voltage Profile 48](#_Toc194072960)

[2.7.3 Real-Time Operational Voltage Control 50](#_Toc194072961)

[2.7.3.1 Operational Guidelines 50](#_Toc194072962)

[2.7.3.2 ERCOT Responsibilities 51](#_Toc194072963)

[2.7.3.3 TO/TSP Responsibilities 53](#_Toc194072964)

[2.7.3.3 TO/TSP Responsibilities 54](#_Toc194072965)

[2.7.3.4 QSE Responsibilities 55](#_Toc194072966)

[2.7.3.5 Resource Entity Responsibilities and Generation Resource and Energy Storage Resource Requirements 56](#_Toc194072967)

[2.7.3.6 DCTO Responsibilities and DC Tie Requirements 57](#_Toc194072968)

[2.7.4 Special Consideration for Nuclear Power Plants 58](#_Toc194072969)

[2.7.5 Parameters for Standard Reactor and Capacitor Switching Plan 58](#_Toc194072970)

[2.7.6 Unit Dispatch Beyond the Corrected Unit Reactive Limit or Unit Reactive Limit 59](#_Toc194072971)

[2.8 Operation of Direct Current Ties 59](#_Toc194072972)

[2.9 Voltage Ride-Through Requirements for Generation Resources and Energy Storage Resources 60](#_Toc194072976)

[2.9.1 Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs), Type 2 WGRs and Type 3 WGRs 62](#_Toc194072977)

[2.9.1.1 Preferred Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs) 64](#_Toc194072978)

[2.9.1.2 Legacy Voltage Ride-Through Requirements for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs 67](#_Toc194072979)

[2.9.2 Voltage Ride-Through Requirements for Distribution Generation Resources (DGRs) and Distribution Energy Storage Resources (DESRs) 69](#_Toc194072980)

[2.10 Voltage Ride-Through Requirements for DC Ties 70](#_Toc194072981)

[2.11.1 Initial Frequency Ride-Through Capability Documentation and Reporting Requirements 71](#_Toc194072982)

[2.11.2 Initial Voltage Ride-Through Capability Documentation and Reporting Requirements 73](#_Toc194072983)

[2.12 Procedures for Frequency and Voltage Ride-Through Exemptions and Extensions for Transmission-Connected Inverter-Based Resources (IBRs), Type 1 Wind-powered Generation Resources (WGRs) and Type 2 WGRs 75](#_Toc194072984)

[2.12.1 Exemptions and Extensions Process 75](#_Toc194072985)

[2.12.1.1 Submission of Exemption Requests 77](#_Toc194072986)

[2.12.1.2 Submission of Extension Requests 77](#_Toc194072987)

[2.12.1.3 Timeline for Submission and Determination of Extension Requests 79](#_Toc194072988)

[2.13 Actions Following a Transmission-Connected Inverter-Based Resource (IBR), Type 1 Wind-powered Generation Resource (WGR) or Type 2 WGR Apparent Failure to Ride-Through 81](#_Toc194072989)

[3 ERCOT and market participant responsibilities 1](#_Toc178089048)

[3.1 System Control Interfaces with ERCOT 1](#_Toc178089049)

[3.1.1 Introduction 1](#_Toc178089050)

[3.1.2 Compliance with Dispatch Instructions 1](#_Toc178089051)

[3.1.3 Dispatch Instructions 1](#_Toc178089052)

[3.2 Qualified Scheduling Entities 3](#_Toc178089053)

[3.2.1 Operating Obligations 3](#_Toc178089054)

[3.2.2 Changes in Resource Status 4](#_Toc178089055)

[3.2.3 Regulatory Required Incident and Disturbance Reports 5](#_Toc178089056)

[3.2.4 Ancillary Service Qualification and Testing Program 6](#_Toc178089057)

[3.3 Resource Entities 6](#_Toc178089058)

[3.3.1 Unit Capability Requirements 8](#_Toc178089059)

[3.3.2 Unit Reactive Capability Requirements 9](#_Toc178089060)

[3.3.2.1 Corrected Unit Reactive Limits (CURL) 9](#_Toc178089061)

[3.3.2.2 Reactive Testing Requirements 10](#_Toc178089063)

[3.3.3 Resource Entity Responsibilities for Equipment Ratings 16](#_Toc178089065)

[3.4 Load Resource Testing Requirement 17](#_Toc178089066)

[3.5 ERCOT Implementation 17](#_Toc178089067)

[3.6 Transmission Service Providers 18](#_Toc178089068)

[3.7 Transmission Operators 18](#_Toc178089070)

[3.7.1 Transmission Owner Responsibility for a Vegetation Management Program 21](#_Toc178089071)

[3.7.2 Transmission Service Provider Responsibilities for Equipment Ratings 21](#_Toc178089072)

[3.8 Requirements for Reporting Sabotage Information 22](#_Toc178089074)

[4 EMERGENCY OPERATIONS 2](#_Toc194075233)

[4.1 Introduction 2](#_Toc194075234)

[4.2 Communication Prior to and During Emergency Conditions 2](#_Toc194075235)

[4.2.1 Operating Condition Notice 2](#_Toc194075236)

[4.2.2 Advisory 3](#_Toc194075237)

[4.2.3 Watch 4](#_Toc194075238)

[4.2.4 Emergency Notice 5](#_Toc194075239)

[4.3 Operation to Maintain Transmission System Security 5](#_Toc194075240)

[4.3.1 Real-Time and Short Term Planning 6](#_Toc194075241)

[4.4 Block Load Transfers between ERCOT and Non-ERCOT System 6](#_Toc194075242)

[4.5 Energy Emergency Alert (EEA) 6](#_Toc194075243)

[4.5.1 General 6](#_Toc194075244)

[4.5.2 Operating Procedures 7](#_Toc194075245)

[4.5.3 Implementation 9](#_Toc194075246)

[4.5.3.1 General Procedures Prior to EEA Operations 11](#_Toc194075247)

[4.5.3.2 General Procedures During EEA Operations 14](#_Toc194075248)

[4.5.3.3 EEA Levels 15](#_Toc194075249)

[4.5.3.4 Load Shed Obligation 21](#_Toc194075250)

[4.5.3.5 EEA Termination 23](#_Toc194075251)

[4.6 Black Start Service 23](#_Toc194075252)

[4.6.1 Principles 24](#_Toc194075253)

[4.6.2 Strategies 24](#_Toc194075254)

[4.6.3 Priorities 25](#_Toc194075255)

[4.6.4 Responsibilities 26](#_Toc194075256)

[4.6.5 Black Start Emergency Back Up Communication Facilities Criteria 29](#_Toc194075257)

[4.7 Geomagnetic Disturbance Operating Plan 30](#_Toc194075258)

[4.7.1 Monitoring and Dissemination of Space Weather Information 30](#_Toc194075259)

[4.7.2 Development and Submission of TO GMD Operating Procedures or Processes 30](#_Toc194075260)

[4.7.3 ERCOT’s GMD Operating Plan and ERCOT Review of TO GMD Operating Procedures or Processes 4-31](#_Toc194075261)

[4.8 Responsive Reserve Service During Scarcity Conditions 31](#_Toc194075262)

[4.8.1 Responsive Reserve Service Manual Deployment 32](#_Toc194075263)

[4.8.2 Responsive Reserve Service Manual Recall 32](#_Toc194075264)

[5 NETWORK OPERATIONS MODELING REQUIREMENTS 1](#_Toc311210840)

[5.1 System Modeling Information 1](#_Toc311210841)

[6 DISTURBANCE MONITORING AND SYSTEM PROTECTION 1](#_Toc173244102)

[6.1 Disturbance Monitoring Requirements 1](#_Toc173244103)

[6.1.1 Introduction 1](#_Toc173244104)

[6.1.1.1 Applicability 2](#_Toc173244105)

[6.1.2 Fault Recording and Sequence of Events Recording Equipment 2](#_Toc173244106)

[6.1.2.1 Fault Recording Requirements 2](#_Toc173244107)

[6.1.2.2 Fault Recording and Sequence of Events Recording Equipment Location Requirements 3](#_Toc173244108)

[6.1.2.3 Fault Recording and Sequence of Events Recording Data Requirements 5](#_Toc173244109)

[6.1.2.4 Fault Recording and Sequence of Events Recording Data Retention and Reporting Requirements 7](#_Toc173244110)

[6.1.3 Dynamic Disturbance Recording Equipment Including Phasor Measurement Unit Equipment 9](#_Toc173244111)

[6.1.3.1 Dynamic Disturbance Recording Equipment Requirements 9](#_Toc173244112)

[6.1.3.1.1 Recording and Triggering Requirements 9](#_Toc173244113)

[6.1.3.1.2 Dynamic Disturbance Recording Equipment Location Requirements 10](#_Toc173244114)

[6.1.3.1.3 Dynamic Disturbance Recording Data Recording and Redundancy Requirements 11](#_Toc173244115)

[6.1.3.1.4 Dynamic Disturbance Recording Data Retention and Data Reporting Requirements 12](#_Toc173244116)

[6.1.3.2 Phasor Measurement Unit Requirements 12](#_Toc173244117)

[6.1.3.2.1 Phasor Measurement Unit Recording Requirements 12](#_Toc173244118)

[6.1.3.2.2 Phasor Measurement Unit Location Requirements 13](#_Toc173244119)

[6.1.3.2.3 Phasor Measurement Unit Data Recording and Redundancy Requirements 15](#_Toc173244120)

[6.1.3.2.4 Phasor Measurement Unit Data Retention and Data Reporting Requirements 16](#_Toc173244121)

[6.1.4 Fault Recording, Sequence of Events Recording, and Phasor Measurement Unit Requirements for Inverter-Based Resources (IBRs) 17](#_Toc173244122)

[6.1.4.1 Fault Recording and Sequence of Events Recording Equipment Requirements 17](#_Toc173244123)

[6.1.4.1.1 Sequence of Events Recording Data Requirements 18](#_Toc173244124)

[6.1.4.1.2 Fault Recording Data and Triggering Requirements 18](#_Toc173244125)

[6.1.4.3 Phasor Measurement Unit Equipment Requirements 19](#_Toc173244126)

[6.1.4.4 Data Retention and Data Reporting Requirements for Fault Recording, Sequence of Events Recording, and Phasor Measurement Unit Equipment 20](#_Toc173244127)

[6.1.5 Maintenance and Testing Requirements 21](#_Toc173244128)

[6.1.5.1 Geomagnetic Disturbance (GMD) Measurement Data Processes 21](#_Toc173244129)

[6.1.6 Equipment Reporting Requirements 22](#_Toc173244130)

[6.1.7 Review Process 22](#_Toc173244131)

[6.2 System Protective Relaying 22](#_Toc173244132)

[6.2.1 Introduction 22](#_Toc173244133)

[6.2.1.1 Applicability 23](#_Toc173244134)

[6.2.2 Design and Operating Requirements for ERCOT System Facilities 23](#_Toc173244135)

[6.2.3 Performance Analysis Requirements for ERCOT System Facilities 24](#_Toc173244136)

[6.2.4 Protective Relay System Failure Response 27](#_Toc173244137)

[6.2.5 Maintenance and Testing Requirements for ERCOT System Facilities 28](#_Toc173244138)

[6.2.6 Requirements and Recommendations for ERCOT System Facilities 28](#_Toc173244139)

[6.2.6.1 General Protection Criteria 28](#_Toc173244140)

[6.2.6.1.1 Dependability 28](#_Toc173244141)

[6.2.6.1.2 Security 29](#_Toc173244142)

[6.2.6.1.3 Dependability and Security 29](#_Toc173244143)

[6.2.6.1.4 Operating Time 30](#_Toc173244144)

[6.2.6.1.5 Testing and Maintenance 30](#_Toc173244145)

[6.2.6.1.6 Analysis of System Performance and Associated Protection Systems 31](#_Toc173244146)

[6.2.6.2 Equipment and Design Considerations 32](#_Toc173244147)

[6.2.6.2.1 Current Transformers 32](#_Toc173244148)

[6.2.6.2.2 Voltage Transformers and Potential Devices 33](#_Toc173244149)

[6.2.6.2.3 Batteries and Direct Current Supply 34](#_Toc173244150)

[6.2.6.2.4 AC Auxiliary Power 35](#_Toc173244151)

[6.2.6.2.5 Circuit Breakers 35](#_Toc173244152)

[6.2.6.2.6 Communications Channels 35](#_Toc173244153)

[6.2.6.2.7 Control Cables and Wiring 36](#_Toc173244154)

[6.2.6.2.8 Environment 36](#_Toc173244155)

[6.2.6.3 Specific Application Considerations 37](#_Toc173244156)

[6.2.6.3.1 Transmission Line Protection 37](#_Toc173244157)

[6.2.6.3.2 Transmission Station Protection 38](#_Toc173244158)

[6.2.6.3.3 Breaker Failure Protection 39](#_Toc173244159)

[6.2.6.3.4 Generator and Energy Storage Resource Protection and Relay Requirements 39](#_Toc173244160)

[6.2.6.3.5 Automatic Under-Frequency Load Shedding Protection Systems 40](#_Toc173244161)

[6.2.6.3.6 Automatic Under-Voltage Load Shedding Protection Systems 41](#_Toc173244162)

[7 Telemetry and Communication 1](#_Toc65163580)

[7.1 ERCOT Wide Area Network 1](#_Toc65163581)

[7.1.1 ERCOT Responsibilities 2](#_Toc65163582)

[7.1.2 WAN Participant Responsibilities 2](#_Toc65163583)

[7.1.3 Joint Responsibilities (Maintenance and Restoration) 11](#_Toc65163585)

[7.2 ERCOT ICCP Interface 11](#_Toc65163586)

[7.2.1 Quality Codes 11](#_Toc65163587)

[7.2.2 Metric of Availability 12](#_Toc65163588)

[7.3 Telemetry 12](#_Toc65163589)

[7.3.1 Data from ERCOT to QSEs 13](#_Toc65163590)

[7.3.2 Data from ERCOT to TSP 13](#_Toc65163591)

[7.3.3 Data from WAN Participants to ERCOT 14](#_Toc65163593)

[7.3.4 Resolving Real-Time Data Issues that affect ERCOT Network Security Analysis 15](#_Toc65163595)

[7.3.5 TSP and QSE Telemetry Restoration 16](#_Toc65163596)

[7.3.6 General Telemetry Performance Criterion 16](#_Toc65163598)

[7.4 Calibration and Testing of Telemetry Responsibilities 16](#_Toc65163599)

[7.5 Competitive Renewable Energy Zone Circuits and Stations 17](#_Toc65163600)

8 ATTACHMENTS

8A Black Start Info

8B Protection System Misoperation Report

8C Turbine Governor Speed Tests

8D Seasonal Unit Net Real Power Capability Verification

8E Black Start Plan Template

8F Seasonal Hydro Responsive Reserve Net Capability Verification

8G Load Resource Tests

8H Unit Alternative Fuel Capability

8I Black Start Resource Availabiity Test Form

8J Initial and Sustained Measurements for Primary Frequency Response

8K Remedial Action Scheme (RAS) Template

8L Emergency Operations Plan

8M Selecting Buses for Capturing Sequence of Events Recording and Fault Recording Data

8N Procedure for Calculating RRS MW Limits for Individual Resources to Provide RRS Using Primary Frequency Response

[9 Monitoring Programs 1](#_Toc160109982)

[9.1 QSE and Resource Monitoring Program 1](#_Toc160109983)

[9.1.1 Real-Time Data 1](#_Toc160109984)

[9.1.2 Compliance with Valid Dispatch Instructions 1](#_Toc160109985)

[9.1.3 Resource Outage Reporting 2](#_Toc160109986)

[9.1.4 Current Operating Plan Metrics for QSEs 2](#_Toc160109987)

[9.2 TSP Monitoring Program 3](#_Toc160109988)

[9.2.1 Intentionally Left Blank 3](#_Toc160109990)

[9.2.2 Real-Time Data Monitor 3](#_Toc160109991)

[9.2.3 Transmission Outage Reporting 3](#_Toc160109993)

[9.3 ERCOT Monitoring Program 4](#_Toc160109994)

[9.3.1 Transmission Control 4](#_Toc160109995)

[9.3.2 System and Resource Control 5](#_Toc160109996)

[9.3.3 Computer and Communication Systems Real-Time Availability and Systems Security 6](#_Toc160109997)

[9.4 Ancillary Services Monitoring Program 6](#_Toc160109998)

[9.4.1 Hydro Responsive Testing 7](#_Toc160109999)

[9.4.2 Resource-Specific Responsive Reserve Performance 7](#_Toc160110000)

[9.4.3 Resource-Specific Non-Spinning Reserve 7](#_Toc160110001)

[9.4.4 Resource-Specific ERCOT Contingency Reserve Service 7](#_Toc160110002)

[10 Market Data Transparency 1](#_Toc350414767)

[10.1 Direct Current Tie Outage Information 1](#_Toc350414768)

[11 CONSTRAINT MANAGEMENT PLANS AND REMEDIAL ACTION SCHEMES 1](#_Toc477858636)

[11.1 Introduction 1](#_Toc477858637)

[11.2 Remedial Action Schemes 2](#_Toc477858638)

[11.2.1 Reporting of RAS Operations 8](#_Toc477858639)

[11.3 Automatic Mitigation Plans 9](#_Toc477858640)

[11.4 Remedial Action Plan 10](#_Toc477858641)

[11.4.1 Remedial Action Plan Process 11](#_Toc477858642)

[11.5 Mitigation Plan 12](#_Toc477858643)

[11.6 Pre-Contingency Action Plans 13](#_Toc477858644)

[11.6.1 Pre-Contingency Action Plan Process 14](#_Toc477858645)

[11.7 Temporary Outage Action Plan 14](#_Toc477858646)