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Contingency & System Operating Limits Response

CONTINGENCY & SYSTEM OPERATING LIMITS RESPONSE

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2.0 Executive Summary

This Contingency and System Operating Limits Response procedure provides a systematic approach for maintaining Transmission System continuity of service when adverse events such as the following occur:

- Switching operations.
- Customer load increases and decreases.
- Generation Planned/Forced Outages.
- Transmission line or element outages.
- Equipment damage.
- Other emergencies that change transmission load flows.

Quickly and effectively responding to adverse events by evaluating plausible contingency scenarios can help prevent equipment failure, emergency load shedding, or system blackout.

2.0 Objectives/Scope/Roles

2.1 Objectives

This procedure describes how system ratings for normal, long- and short-term emergency operations are established and documented. The requirements for developing / implementing / maintaining a contingency program that recognizes potential unplanned outages and / or equipment and line failures and puts appropriate actions in place to reduce or avoid downtime. The requirements for continuous monitoring of normal operations so that sudden changes in load flows on the transmission and sub-transmission system are managed and equipment damage or load loss avoided. How to respond appropriately to system alarms.

2.2 Scope

This procedure affects all areas of the Bulk Power System. Under normal conditions, the system is designed to maintain loads on equipment at or under design limits; however, sudden changes in electrical flow within the system can raise load levels to exceed equipment ratings. The generating stations, transmission/sub-transmission lines, and transmission substations have equipment electrical ratings that, if exceeded, can result in unplanned line and breaker trips, shortened equipment life, or equipment failures that can lead to Forced Outages and / or system instability.

2.3 Roles and Responsibilities

This procedure applies to all System Operations personnel in the Transmission Operations Center and the Generation Facility Operator.

2.3.1 Manager, Control Center Operations (MCCO)

- Provides general management oversight of all electrical system operations.
- Ensures that all aspects of system operations function in unison.
- Provides general management oversight of system operators.
- Oversees the daily operations of the TOC and ensures that trained personnel are available for routine and emergency operations.
- Manages the Senior Shift Engineers at the TOCs.

2.3.2 Manager Control System Support (MCSS)

- Supervises the development and maintenance of electrical ratings criteria for all transmission lines and transmission substation equipment.
- Maintains up-to-date equipment ratings as equipment ages or is modified.
- Manages the communication of all ratings information with the Transmission Operations Center personnel involved in operating the BPS.

2.3.3 Supervisor Transmission and Generation (STG)

- Supervises the Daily activities of the Senior Transmission Operators, Transmission Operators, Senior Shift Engineers and Shift Engineers
- Manages all the activities in the TOC and communications to the MCCO.

2.3.4 Lead Engineer Energy Balancing (LEEB)

- Manages changes to the Energy Management System.

2.3.5 Senior Shift Engineer (SSE)

- Is responsible for overall system operations and management of personnel in the TOC.
- Manages the output of the Interconnected Facilities.
- Manages the transmission system design and operating equipment.
- Determines acceptable normal and emergency operating limits for transmission lines, transmission substations, and other elements.

2.3.6 Shift Engineer (SE)

- Dispatches real and reactive power as well as ancillary services for all Interconnected facilities.
- Maintains direct communication with the Interconnected facilities GFO and TOs at all power plants.

2.3.7 Senior Transmission Operator (STO) /Transmission Operator (TO)

- STO is responsible for the routing and balance of real and reactive power through the 230/115 KV transmission lines and working with the SE to jointly manage energy needs.
- TO is responsible for the routing and balance of real and reactive power through the 38kv transmission lines and working with the SE to jointly manage energy needs.
- Is responsible for coordinating with the SE regarding frequency regulation, transmission flows, outage status, and recall times and reacts with the Senior Shift Engineer.
- Acknowledges all alarms and notifies the SSE when a #3 alarm activates.
- Operates the BPS by doing the following:
    - Monitors and analyzes real-time data in the Supervisory Control and Data Acquisition (SCADA) computer system.
    - Operates remote switches.
    - Directs field personnel to operate field switches.
    - Operates breakers, capacitor banks, and tap changers.
    - Notifies Interconnected facilities of required changes in output or operating conditions.
    - Monitors the weather and overall transmission system conditions and alerts STG of emerging threats to the transmission system.

2.3.8 Generator Facility Operator (GFO)

- Is the main point of contact for communication between the SE and the Interconnected facility.
- Is responsible for ensuring the Interconnected facility complies with the system operations principles.

3.0 Procedure

This procedure consists of four primary sets of steps:

- Establish and Document System Ratings.
- Develop and Implement a Contingency Program.
- Perform Normal Operations.
- Respond to System Alarms.

3.1 Establish and Document System Ratings

The Manager Control System Support, with input from staff, **shall** establish and document system ratings and procedures for responding to alarms. The following details **shall** be included in the reference documentation:

- The logic used to establish the ratings.
- The consequences to the equipment when ratings are exceeded.
- The logic regarding time or ambient temperature constraints when operating within and beyond normal operating ratings.
- The inclusion of the following system elements:
  - Transmission/sub-transmission lines.
  - Transformers.
  - Transformer tap changers.
  - Substation busses and breakers.
  - Generating stations.
  - Capacitor Banks.

3.2 Develop and Implement a Contingency Program

The LEEB, with input from the staff, shall develop and implement a sub-system, or contingency program, in SCADA that can:

- Anticipate possible equipment and line element failures that could potentially occur on the real-time actual system configuration.
- Determine the resulting line and equipment loadings and then determine if the system integrity would be compromised under the potential scenario.
- Consider thermal limits based on amperage and ambient temperature, voltage limits, stability limits (voltage phase angle differences), and cycles-per-second (cps).
- Be used as an integral part of daily system operations, noting any system instability, and alerting appropriate persons as necessary.
- Ensure that proposed system changes do not adversely affect system stability prior to performing any switching, equipment blocking or other modifications to the system configuration.
- Evaluate and update the program when the system configuration is changed so that the new configuration does not jeopardize system stability if a system element failure occurs.

3.3 Perform Normal Operations

The Transmission Operator **shall** continuously monitor the following:

- SCADA real-time data.
- Additional data including line and transformer loadings, power factor, cps (cycles per second) data, and voltages.
- Weather conditions, including present and forecasted.
- Outputs of all operating Interconnected facilities.
- Status of all generation not currently running on the system.
- Status of all system elements (including, but not limited to, generating stations not currently on-system, transmission/sub-transmission lines, transmission substation breakers, capacitor banks) that are out of service and ongoing estimated time(s) to restore back onto the system.
- Comparative economics for each generation source.

Based on the data reviewed, the TO **shall**:

- Inform the on-shift SSE and the STG immediately of unanticipated status changes.
- Operate under the supervision of the SSE during normal shift operations.

The SSE **shall**:

- Evaluate the potential impact of unanticipated changes in system elements using the SCADA.
- Notify the MCCO when the element is critical to system stability.

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The MCCO **shall**:

- Evaluate unanticipated changes communicated by the STG.
- Determine if additional action is required.
- Initiate necessary action(s) to resolve the issue.

3.4 Respond to System Alarms

Unexpected system element failures may cause the automatic system monitoring equipment to alarm. When this occurs all normal operations cease. The TOC personnel shall focus their attention on restoring the system to stable operation within the time limits described in Alarm Levels 3.4.1. Responding to system alarms may necessitate the following action(s):

- Energize or de-energize capacitor banks.
- Operate power transformer tap changers.
- Parallel transmission lines.
- Operate substation bus and transmission line breakers.
- Add available spinning generation reserves, as necessary.
- Create generation islands.

3.4.1 Alarm Levels

This section describes the three alarm levels and required actions for each.

ALARM 1

- One or more system elements has exceeded normal operating ratings by 10%.
- The Transmission Operators shall eliminate the condition by taking the appropriate response(s) described in Respond to System Alarms 3.4 above within 30 minutes.
- If unable to eliminate the Alarm 1 within this timeframe, the condition will escalate to Alarm 2.
- Economic Dispatch/Merit Order Dispatch will be a primary consideration when resolving an Alarm 1 event.

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ALARM 2

- One or more system elements have exceeded normal operating ratings by 20%.
- The TO's **shall** eliminate the condition by taking the appropriate response(s) described in Respond to System Alarms 3.4 within 15 minutes.
- Failure to correct an Alarm 2 within this time **shall** escalate the condition to Alarm 3.
- Economic Dispatch/Merit Order Dispatch **shall** be a secondary consideration when resolving an Alarm 2 event.

ALARM 3

- One or more system elements have exceeded normal operating ratings by 30%.
- The TO's **shall** eliminate the condition by taking the appropriate response(s) described in Respond to System Alarms 3.4 above within 15 minutes.
- Failure to correct an Alarm 3 within this time **shall** result in an immediate Load Shedding event.
- Load Shedding **shall** continue until Alarm 2 is reached.
- This is a critical alarm and safe restoration is paramount. Load Shedding may be necessary to resolve an Alarm 3 (See Load Shedding procedure.).
- During an Alarm 3, the Energy Dispatch Scheduling and Merit Order **shall** Procedure **shall** not be enforced.

Appendix A: Glossary

Term	Definition
Accepted Operating Procedure (AOP)	The practices, methods, standards and procedures that are consistent with Law and are generally accepted, engaged in and followed during the relevant time period by reasonably skilled, competent, experienced, and prudent owners and operators of generating and transmission facilities.
Blackout	A loss of electrical energy due to weather, equipment failure, or damage to equipment such that all electric customers, usually in a defined area, lose electrical power. In the worst case, the loss of electrical energy results in a total loss of all electrical power on the entire system. This is known as a total blackout.
Bulk Power System (BPS)	Refers to all transmission and distribution system and related facilities, equipment and other assets related to the transmission and distribution system.
Economic Dispatch/Merit Order Dispatch	The merit order is a way of ranking available resources of energy in ascending order of price. Dispatching generation in this way, known as economic dispatch and is designed to minimize the cost of electricity. SOP: The short-term determination of the optimal output of generation facilities, to meet system load, at the lowest possible cost, subject to transmission and operational constraints.
Forced Outage	The shutdown condition of a power station, transmission line or distribution line due to an unexpected breakdown.
Generation Island	Electric utilities with multiple generation sources will connect their generation in parallel to increase service reliability. Under some special circumstances a utility may separate their system into distinct sections that are not connected to each other and effectively operate as separate and non-connected systems.
Generation Planned Outage	An outage that has been requested by the GFO with advance notice with a specified scope and duration.

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Term	Definition
Interconnected Facility	Interconnected Facility means any generation produces or energy storage facility that releases stored power to the bulk power system.
Load Shedding	The deliberate shutdown of electric power in part of a power-distribution system to prevent the failure of the entire system when the demand strains the capacity of the system.
SCADA	An acronym for the Supervisory Control and Data Acquisition computer system. It is a system of computer-aided tools used by operators of electric utility grids to monitor, control, and optimize the performance of the generation or transmission system.
Stable Operation	Electric utilities normally operate their system in a configuration that provides the most reliable and economic service to their customers. If unforeseen conditions develop, the utility may be forced to alter their “normal” configuration. The system can operate in this mode but is no longer in an ideal configuration.
System Alarms	Unexpected system element failures may cause the automatic system monitoring equipment to alarm. TOC personnel will focus their attention on restoring the system to stable operation within the time limits described in Alarm Levels in the Contingency and System Operating Limits Response procedure, which describes the three alarm levels and required actions for each.

Appendix B: Procedure Cross-Reference Matrix

Procedure Reference Matrix, Part 1 of 2	Short Term Load Forecasting	New Facility Interconnection	Resource Adequacy Planning	Interconnected Facility Retirements	Legacy T&G Demarcation	Interconnected Facilities Capabilities	Black Start	Telemetry	Cybersecurity	Root Cause Analysis & Corrective Actions	Public Reporting	Performance Reporting	Stakeholder Management	Policy on Reserves
Short Term Load Forecasting														
New Facility Interconnection														
Resource Adequacy Planning														
Interconnected Facility Retirements														
Legacy T&G Demarcation														
Interconnected Facilities Capabilities														
Black Start														
Telemetry														
Cybersecurity														
Root Cause Analysis & Corrective Actions														
Public Reporting														
Performance Reporting														
Stakeholder Management														
Policy On Reserves														
Reducing Risk Exposure to Contingencies														
Critical Loads														
Load Shedding														
Contingency and System Operating														
Energy Dispatch, Scheduling and Merit Order														
Transmission Operations														
Plant Level Communications														
Balancing Frequency and Voltage														
Demand-Side Resources (Non-Wire Alternatives)														
System Operator Training														
Scheduling Planned T&G Outages														
Forced Outage														
Outage Execution and Closeout														
Emergency Response Execution														
Emergency Response Drills														

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Procedure Reference Matrix, Part 2 of 2	Reducing Risk Exposure to Contingencies	Critical Loads	Load Shedding	Contingency & System Operating Limits Response	Energy Dispatch, Shedding & Merit Order	Transmission Operations	Plant Level Communications	Balancing Frequency & Voltage	Demand Side Resources (NWA)	System Operator Training	Scheduling Planned T&G Outages	Forced Outage	Outage Execution & Closeout	Emergency Response Execution	Emergency Response Drills
Short Term Load Forecasting															
New Facility Interconnection															
Resource Adequacy Planning															
Interconnected Facility Retirements															
Legacy T&G Demarcation															
Interconnected Facilities Capabilities															
Black Start															
Telemetry															
Cybersecurity															
Root Cause Analysis & Corrective Actions															
Public Reporting															
Performance Reporting															
Stakeholder Management															
Policy On Reserves															
Reducing Risk Exposure to Contingencies															
Critical Loads															
Load Shedding															
Contingency and System Operating			X		X										
Energy Dispatch, Scheduling and Merit Order															
Transmission Operations															
Plant Level Communications															
Balancing Frequency and Voltage															
Demand-Side Resources (Non-Wire Alternatives)															
System Operator Training															
Scheduling Planned T&G Outages															
Forced Outage															
Outage Execution and Closeout															
Emergency Response Execution															
Emergency Response Drills															

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