UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Large Loads Co-Located at Generating Facilities	)	Docket No. AD24-11-000

POST-TECHNICAL CONFERENCE COMMENTS OF THE NEW YORK STATE RELIABILITY COUNCIL

On November 1, 2024, the Federal Energy Regulatory Commission ("Commission") held a Commissioner-led technical conference in the above captioned proceeding to discuss generic issues related to the co-location of large loads at generating facilities. Thereafter, a Notice of Request for Comments was issued inviting post-conference comments by December 9, 2024.[1] The New York State Reliability Council, L.L.C. ("NYSRC") hereby submits these post-technical conference comments regarding additional matters that should be considered as part of the Commission's comprehensive review of the effects resulting from large new loads entering the system.

I. Introduction

The NYSRC is a not-for-profit entity, organized in 1999 and authorized by the Commission, whose mission is to promote and preserve the reliability of electric service on the New York State Power System by developing, maintaining, and, from time-to-time, updating the Reliability Rules which shall be complied with by the New York Independent System Operator, Inc. ("NYISO") and all entities engaging in electric transmission, ancillary services, energy and power transactions on the New York State Power System. The NYSRC conducts its mission with no intent to advantage or disadvantage any Market Participant's commercial interests. Its sole

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1 Docket No. AD24-11-000, *Notice of Request for Comments* (issued Nov. 8, 2024).

focus is maintaining the reliability of the bulk electric system in New York (the New York Control Area or "NYCA").

The subject large loads –whether co-located with generating facilities or standalone – will most likely be interconnected at voltage levels exceeding the 100kV NERC Definition of Bulk Electric System. As a result, this will bring the interconnection of such large load facilities within the scope of the Commission-approved Electric Reliability Organization ("ERO") mandatory requirements that are designed to preserve the reliable operation of the power system.[2]

In general, under the ERO standards, all proposed system modifications, including transmission and generation additions or significant load reductions or additions, must be analyzed and designed to ensure system-wide coordination and continued system reliability and resilience to provide society with an "adequate level of reliability."[3] Reliability Coordinators, Transmission Planners and Transmission Planning Coordinators and Regional Entities comply with ERO reliability standards requirements and, in some cases, regional criteria requirements that provide the minimum power system performance expectations. These requirements serve as the foundation for good utility practices in transmission planning and operation. The Commission has a substantial role through its policies, its oversight and approval of ERO activities.

As the power system becomes demonstrably more operationally stressed due to the increased penetration of intermittent resources, concerns over their performance during disturbances, and the upward pressure that is placed on the system due to public policy driven electrification programs coupled with the new large loads coming online, the likelihood of

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2 See the definition of Bulk Electric System (BES) and Bulk-Power System in the NERC Glossary *available at*:

https://www.nerc.com/pa/Stand/Glossary%20of%20Terms/Glossary_of_Terms.pdf.

3 *See*, NERC Filing to the Commission regarding Adequate Level of Reliability, May 10, 2013, attached hereto as Appendix 1.

triggering automatic underfrequency load shedding ("automatic UFLS") programs may increase.[4] While there are many areas of reliability related concern[5], one that has not been raised is Automatic UFLS programs in their role as the last line of defense used during periods of stressed system conditions after operators have exhausted all of their manual load shedding (*i.e.*, rotating blackout) options. Although the automatic UFLS standard calls for having a certain amount of load to be under automatic control to be shed, the addition of large loads at a swift pace makes it all the more important to ensure that the automatic UFLS programs are up to date and can address the presence of the new large loads on the system. The NYSRC has direct interest in ensuring that the addition of load does not disrupt reliability and resilience after a disturbance to the power system.

II. NERC Standards and Guiding Principles

There are a number of NERC standards and principles that the NYSRC submits should be relied upon more heavily in the analysis surrounding the reliability and resilience impacts of large new loads coming online and their interaction with existing automatic UFLS programs.

A. FAC-001-4 – Facility Interconnection Requirements

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4 *See*, NYISO 2024 Reliability Needs Assessment ("RNA") *available at*: https://www.nyiso.com/documents/20142/2248793/2024-RNA-Report.pdf/0fe6fd1e-0f28-0332-3e80-28bea71a2344 (issued Nov. 21, 2024). The RNA states:

> "[t]he forecasted transition from a summer-peaking system to a winter-peaking system also poses challenges to grid reliability . . . . This shift, driven by the electrification of the building and transportation sectors, is expected to accelerate over the next ten years. Increased winter demand introduces new reliability concerns, particularly around fuel availability for gas-fired generators. On the coldest days, natural gas distribution companies prioritize residential heating and limit the fuel available to generators without firm contracts. These coldest days also correspond to peak winter demand periods when the gas fleet is needed most.
>
> Given the rapid pace of change on the bulk electric system, the NYISO will continue to monitor these and other developments to determine whether changing system resources and conditions could impact the reliability of the New York electric grid."

5 A number of concerns raised during the Technical Conference are already in the record. These include reliability related ancillary services, black start capability, and resource adequacy for customers.

Under mandatory NERC Standard FAC-001-4 all Transmission Owners through requirement R1 are required to have documented Facility interconnection requirements to address interconnection for end-user loads. The purpose is to address the impact of these loads on the reliable operation of the power system in accordance with the purpose of the FAC-001-4 standard which is: "[t]o avoid adverse impacts on the reliability of the Bulk Electric System, Transmission Owners and applicable Generator Owners must document and make Facility interconnection requirements available so that entities seeking to interconnect will have the necessary information."[6]

B. FAC-002-3 – Facility Interconnection Studies

Mandatory NERC Standard FAC-002-2-4 is intended to assure that the impact of interconnecting new or changed Facilities on the Bulk Electric System are comprehensively studied. Through R6, the Planning Coordinator is required to have identified and make publicly available a threshold definition of what it considers a "qualified change" to the power system. Typically, this is in the form of a voltage threshold and a MW or MVA load size. In New York for example, this requirement is met through the NYISO's publication of Technical Bulletin #259 which specifies a 10 MW and 115 kV threshold.[7]

C. PRC-006-5 - Automatic Underfrequency Load Shedding (UFLS)

Not specifically discussed in the Technical Conference, but extremely important to the preservation of an adequate level of reliability are the mandatory requirements, is PRC-006-5 related to automatic UFLS. The purpose of the standard is stated as follows: "[t]o establish design

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6 *See*, NERC Standard FAC-001-4, available at: https://www.nerc.com/pa/Stand/Reliability%20Standards/FAC-001-4.pdf.

7 *See*, NERC Standard FAC-002-4 available at: https://www.nerc.com/pa/Stand/Reliability%20Standards/FAC-002-4.pdf.

and documentation requirements for [automatic UFLS] programs to arrest declining frequency, assist recovery of frequency following underfrequency events and provide last resort system preservation measures." (emphasis added.)

The functionality of this "last resort system preservation" program is assessed through studies, which identify the electrical islands that may be formed under simulated conditions. The studies are used to establish the parameters of the UFLS Entity automatic UFLS programs as required by the standard. Automatic load shedding programs will activate and shed pre-selected load automatically if all manual load shedding (rotating blackouts) by operators has been exhausted and system frequency continues to decline. The expectation is that the system can be reconstructed from the remaining energized islands to reduce the likelihood that the black start of the entire system is avoided as much as possible. This is a resilience performance requirement more than a reliability performance requirement in the first instance.

III. Impact of System Frequency on Reliability and Resilience

During the Technical Conference, a number of system reliability issues were raised, one of which was maintenance of system frequency within the prescribed limits. The system frequency is closely monitored by system operators, and deviations from normal ranges are reported through the requirements of BAL-003-2.[8]

Mr. Gugel, NERC's Vice President of Regulatory Oversight, during the Technical Conference described an example of over frequency (upon loss of a large load) reliability risk. Gugel expressed a reliability concern regarding situation where the sudden loss of a nearby large load might result in overspeed of the nearby generator and then dynamically propagate into other

8 *See* BAL-003-2 *available at*: https://www.nerc.com/pa/Stand/Reliability%20Standards/BAL-003-2.pdf. This standard requires that under normal operation, Balancing Authorities provide sufficient Frequency Response capability to maintain Interconnection Frequency within predefined bounds by arresting frequency deviations and supporting frequency until the frequency is restored to its scheduled value.

system elements, potentially leading to costly damage to generation equipment or uncontrolled system separation. This propagation may lead to loss of service to other loads outside the immediate large load facility and nearby generator(s). Expanding on this concern is the fact that if the impact of large loads on Automatic UFLS programs is not studied, and a propagating disturbance event is severe enough, it could also lead to the loss of generation in a wide area resulting in a frequency decline that triggers at the set points designed into automatic UFLS programs.

Potential adverse impacts to reliability and resilience must be examined in advance (not reactively) and be addressed through the design of the interconnection facility as specified in NERC standards FAC-001-4 and FAC-002-4. Good utility practice mandates that the reliability effects of the added large load be thoroughly examined in advance, the risks thoroughly identified, and then mitigated through the application of good utility practice in planning, design, construction, and testing. A substantial portion of what is required in the ERO standards is directed in such a way as to avoid ever experiencing load loss, cascading, and uncontrolled separation as outlined in the definition of the adequate reliability mentioned earlier. But the automatic UFLS programs are rarely thought of because they are not triggered frequently. Although, in recent years, automatic UFLS has come close to being activated during Winter Storm Uri.[9]

IV. Policy Considerations and Potential Solutions

Given the impact to public health and safety if the UFLS program is not properly triggered, coupled with the large size of the prospective new loads entering the system as discussed in the Technical Conference, it is strongly advised that the Commission offer some guidance on the applicability of the requirements of PRC-006-5 and the importance of the analysis prior to connecting the large load.

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9 *See*, *FERC - NERC - Regional Entity Staff Report: The February 2021 Cold Weather Outage in Texas and the South Central United States*, (Nov. 2021), p. 156.

It may be feasible to rely on the notion that the NERC standard speaks for itself and that good utility practice mandates that underfrequency load shedding programs be reviewed as part of each interconnection study under FAC-001 and FAC-002. There is currently no such requirement, however and the NYSRC submits that this concept should be considered as part of the dialogue and as a potential solution to preventing a potential future reliability issue.

It is likely that when the standards were drafted, NERC did not envision the magnitude of the single load additions that are being contemplated and studied at this time (*i.e.*, 500, 1,000, 1,500 MW/MVA loads). At the time of the standard's development, load growth was either relatively slow or non-existent in some areas and there was consensus around the current requirement in R4 to perform a functional review of the effectiveness of the UFLS program only once every five-years. It is entirely possible that without offering some portion of the newly connected large load to become part of the automatic UFLS program, the utility may not be able to find enough additional load to place under automatic UFLS control to meet the NERC or regional standard requirements. More importantly, if a portion of the large new load is not incorporated in a study, the studied system's automatic UFLS program may not work to achieve the purpose of providing guidance and limiting the extent of system separation. This is a retroactive, not preemptive approach. The Commission should consider modifying this approach to account for the current state of the system and the rapid changes underway.

The NYSRC respectfully requests that the Commission take note of this aspect of integration of large loads into the system and offer some guidance to the ERO and to industry. At the Technical Conference there was recognition that the large new loads will be coming quickly. The need to identify the processes necessary to serve these loads and understand the relationship between their service and automatic UFLS programs is urgent. It is likely that retroactive automatic UFLS studies conducted only once every five years will not pick up the reliability and resilience implications of these large loads on the existing automatic UFLS programs unless they are conducted more frequently or before energization of the new large load.

One model to consider is to require the automatic UFLS studies annually, as is currently required under the TPL-001 standard. Although other intervals between one and five years could be considered, these will suffer the same defect unless a forward-looking test year (near -term, long term as in TPL-001) is implemented. Alternatively, a review of each specific new large load, using each Planning Coordinator's existing definition of "qualified change" to trigger a review of the automatic UFLS program in the area to which it is interconnecting is appropriate. If the load is large (threshold to be determined), perhaps an even wider area examination beyond the local interconnecting utility's automatic UFLS programs might be necessary and considered, perhaps on a Balancing Authority wide area basis.

Accordingly, the NYSRC submits that automatic UFLS programs must be designed to be preemptive (as many things in electric utility design and operation already are) and not be reactive and modified only after an adverse public health and safety event our outcome occurs. The power system has its own unique way of very quickly signaling to society through adverse outcomes when mistakes in power system planning, design and operation are made. The topic of large load addition's reliability and resilience impacts on the effectiveness of automatic UFLS programs should be brought forward for review and discussion by the Commission. Understanding the new natural "islands" that may be formed after the large load is connected to the system is critical to development of resilient system restoration plans. These restoration operating plans rely on thorough, forward-looking understanding of the expected outcomes of large new loads on existing automatic UFLS programs.

V. **Conclusion**

The NYSRC thanks the Commission and Commission staff for conducting this technical conference and appreciates the thoughtful consideration of the comments advanced herein.

Dated: December 9, 2024
Albany, New York

Respectfully Submitted,

/s/ Amanda De Vito Trinsey

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APPENDIX 1

NERC
NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

May 10, 2013

VIA ELECTRONIC FILING

Ms. Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, D.C. 20426

Re: Informational Filing on the Definition of "Adequate Level of Reliability"

Dear Ms. Bose:

The North American Electric Reliability Corporation ("NERC") hereby submits solely as an informational filing the definition of "Adequate Level of Reliability" that the NERC Board of Trustees approved on May 9, 2013 (Attachment A), and a supporting technical report (Attachment B). NERC is not requesting the Commission to take any action on this definition.[1]

The Commission directed NERC to consider and propose methods for ensuring Reliability Standards provide for an adequate level of reliability and for defining an "adequate level of reliability" in the Commission order certifying NERC as the Electric Reliability Organization.[2] "Adequate level of reliability" is a term used in Section 215 (c)(1) of the Federal Power Act, specifying what standards the ERO can develop and enforce.

The definition of "Adequate Level of Reliability" will be used primarily to guide NERC Reliability Standards development, but also by the NERC Performance Analysis Subcommittee and NERC reliability assessment staff to assess Bulk Electric System reliability and identify gaps in data. Other NERC groups, such as the Reliability Issues Steering Committee, will be able to use the definition and supporting technical report for guidance when addressing major reliability issues and prioritizing work. Neither document should be interpreted as requiring the development of specific standards or additional compliance elements.

Respectfully submitted,

<u>/s/ Stacey Tyrewala</u>
Stacey Tyrewala
Senior Counsel for North American Electric Reliability Corporation

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[1] This definition supersedes the prior definition submitted for informational purposes on May 5, 2008 in Docket No. RR06-1-000.

[2] The Commission certified NERC as the electric reliability organization ("ERO") in accordance with Section 215 of the FPA on July 20, 2006. *N. Amer. Elec. Reliability Corp.*, 116 FERC ¶ 61,062 (2006).

Exhibit A

Definition of Adequate Level of Reliability

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Definition: Adequate Level of Reliability for the Bulk Electric System

Purpose Statement: *The definition of Adequate Level of Reliability (ALR) will be used primarily to guide NERC Reliability Standards development, but also by the NERC Performance Analysis Subcommittee and NERC reliability assessment staff to assess BES reliability and identify gaps in data. Other NERC groups, such as the Reliability Issues Steering Committee, will be able to use the document for guidance when addressing major reliability issues and prioritizing work. The definition and its supporting technical report should not be interpreted as requiring the development of specific standards or additional compliance elements. Both the definition and the technical report will be filed for information with FERC.*

Definition

ALR is the state that the design, planning, and operation of the Bulk Electric System (BES) will achieve when the listed Reliability Performance Objectives are met. Further, Reliability Assessment Objectives included in the definition must be evaluated to assess reliability risk in support of an adequate level of reliability.

ALR Performance Objectives

1. The BES does not experience instability, uncontrolled separation, Cascading,[1] or voltage collapse under normal operating conditions and when subject to predefined Disturbances.[2]

   The performance outcomes are:

   - *Stable frequency and voltage within predefined ranges*
   - *No instability, uncontrolled separation, Cascading, or voltage collapse*

The "predefined Disturbances" in Performance Objectives 1-3 and Assessment Objectives 1 and 2 are the more probable Disturbances to which the power system is planned, designed, and operated. These Disturbances have a higher probability of occurring than other severe, low probability events; BES Facilities are designed and operated to withstand these Disturbances. An example of a predefined Disturbance is the loss of a Transmission circuit due to a lightning strike.

[1] NERC's Glossary of Terms defines Cascading as: "The uncontrolled successive loss of system elements triggered by an incident at any location. Cascading results in widespread electric service interruption that cannot be restrained from sequentially spreading beyond an area predetermined by studies."

[2] NERC's Glossary of Terms defines Disturbance as: "1. An unplanned event that produces an abnormal system condition. 2. Any perturbation to the electric system. 3. The unexpected change in ACE that is caused by the sudden failure of generation or interruption of load.

2. BES frequency is maintained within defined parameters under normal operating conditions and when subject to predefined Disturbances.

   The performance outcomes are:

   - *Stable frequency within predefined range*
   - *Facility Ratings respected*
   - *Frequency oscillations experience positive damping*

3. BES voltage is maintained within defined parameters under normal operating conditions and when subject to predefined Disturbances.

   The performance outcomes are:

   - *Stable voltage within predefined range*
   - *Facility Ratings respected*
   - *Voltage oscillations experience positive damping*

4. Adverse Reliability Impacts[3] on the BES following low probability Disturbances (e.g., multiple contingences, unplanned and uncontrolled equipment outages, cyber security events, and malicious acts) are managed.

   The performance outcome is to manage the propagation of frequency, voltage, or angular instability, uncontrolled separation, or Cascading.

5. Restoration of the BES after major system Disturbances that result in blackouts and widespread outages of BES elements is performed in a coordinated and controlled manner.

   The performance outcome is to recover the BES and restore available resources and load to a stable interconnected operating state

The Disturbances in Performance Objectives 4 and 5 cannot be predefined. For these less probable severe events, BES owners and operators may not be able to apply any economically justifiable or practical measures to prevent or mitigate their Adverse Reliability Impact on the BES despite the fact that these events can result in Cascading, uncontrolled separation or voltage collapse. For this reason, these events generally fall outside of the design and operating criteria for BES owners and operators. Less probable severe events would include, for example, losing an entire right of way due to a tornado or simultaneous or near simultaneous multiple Transmission Facilities outages due to a hurricane or other severe natural phenomena.

[3] NERC's Glossary of Terms defines Adverse Reliability Impact as "The impact of an event that results in Bulk Electric System instability or Cascading."

expeditiously after a major system Disturbance.

ALR Assessment Objectives

"Adequate level of reliability" is a term used in Section 215 (c)(1) of the Federal Power Act, specifying what standards the electric reliability organization (ERO) can develop and enforce. Section 215 specifically does not authorize the ERO to develop standards related to adequacy and safety. However, this definition of ALR is meant to encompass all the duties of the ERO, including obligations to perform assessments of resource and Transmission[4] adequacy.

A target to achieve adequate Transmission transfer capability and resource capability to meet forecast demand is an inherent, fundamental objective for planning, designing, and operating the BES. The Assessment Objectives do not suggest that NERC Reliability Standards mandate that such additions be developed; they are not directly related to NERC's standards development and enforcement activities.

1. BES Transmission capability is assessed to determine availability to meet anticipated BES demands during normal operating conditions and when subject to predefined Disturbances.

   The outcome is that assessment results are available to provide situational awareness for appropriate actions.

2. Resource capability is assessed to determine availability to the BES to meet anticipated BES demands during normal operating conditions and when subject to predefined Disturbances.

   The outcome is that assessment results are available to provide situational awareness for appropriate actions.

Time Periods and Performance Outcomes

In the associated technical report supporting this definition, performance outcomes associated with each Reliability Objective are addressed in further detail based on four time frames:

Steady State – Time period before a Disturbance occurs and after system restoration has achieved normal operating conditions. It is a stable pre-event condition for the existing system configuration, which includes all existing BES elements, including elements on planned outage for maintenance, construction or safety purposes or unplanned outage.

[4] NERC's Glossary of Terms defines Transmission as: "An interconnected group of lines and associated equipment for the movement or transfer of electric energy between points of supply and points at which it is transformed for delivery to customers or is delivered to other electric systems."

Transient – Transitional time period beginning after a Disturbance in which high-speed automatic actions occur in response to the Disturbance. This time period starts at the time of the Disturbance and can continue for seconds or until a new steady state is achieved.

Operations Response – Time period after a Disturbance during which some automatic actions occur and operators act to minimize the impact of Disturbances and return the BES to a new steady state, if possible. This state may begin seconds after the Disturbance and continue for hours.

Recovery and System Restoration – Time period after a widespread outage or blackout occurs, through the initial restoration to a sustainable operating state, and recovery to a new steady state that meets reliability objectives established by the circumstances of the Disturbance.

Technical Report Supporting Definition of Adequate Level of Reliability

The associated technical report describes the relationship among Reliability and Assessment Objectives, performance outcomes, and Disturbances in greater detail. The report also provides some examples of means to meet Reliability Objectives. Reviewed together, these items provide the tools for both understanding and achieving an adequate level of reliability.

Exhibit B

Technical Report Supporting Definition of Adequate Level of Reliability

Technical Report Supporting Definition of Adequate Level of Reliability

1.0 Introduction

The Adequate Level of Reliability Task Force (ALRTF or Task Force) was formed in May 2011 under the auspices of the NERC Standing Committees Coordinating Group (SCCG), which is comprised of the chairs and vice chairs of NERC's standing committees (the Operating Committee, the Planning Committee, the Critical Infrastructure Protection Committee, the Standards Committee, and the Compliance and Certification Committee) to address concerns expressed by the NERC Board of Trustees (BOT), the Member Representatives Committee (MRC), and stakeholders that NERC's current definition of Adequate Level of Reliability (ALR) needed reassessment in order to make certain that the definition supports and helps to define NERC's mission to ensure reliable operation of the Bulk Electric System (BES).

The ALRTF's Draft Scope Document[1] describes the Task Force's purpose as follows:

> Deliver, for use by the ERO enterprise, a document which includes a definition of ALR and associated characteristics with demonstrated ability to measure the relative state of ALR on an ongoing basis. The definition and associated characteristics may be identical to those previously approved or may be enhanced if necessary. Further, these measurable objectives and characteristics should focus on support for the ERO's key activities, including Reliability Standards and Compliance and Certification functions.

Simply stated, the ALRTF's goal is to develop a definition of ALR that encompasses NERC's responsibility to ensure reliable planning and operation of the BES, along with the obligation to assess the capability of the BES. The definition identifies and defines Reliability Performance Objectives that drive what system planners and operators do on a day-to-day basis to ensure that the BES is reliable and defines Reliability Assessment Objectives that identify risks to system reliability that alert system planners and operators so appropriate actions can be taken.

The Task Force sought to be as concise as possible in the development of these core characteristics of BES reliability, recognizing that too little detail may leave core characteristics unexplained, while extraneous text often obscures a lack of clarity or agreement on the core characteristics. ALR is clearly not a single value or outcome or state; rather, ALR is an outcome of a multi-dimensional effort to identify Reliability Performance and Assessment Objectives and then achieve outcomes that will support reliable operations. This multi-dimensional effort is reflected in NERC's current and evolving

[1] The ALRTF Draft Scope Document is posted here: http://www.nerc.com/docs/standards/Att%202a%20-%20ALR%20TF_DRAFT_Scope%20-V5_Clean.pdf.

body of reliability standards, which work together to establish a portfolio of performance outcomes, risk reduction, and capability-based reliability standards that are designed to achieve a defense in depth against an inadequate level of reliability. Other NERC programs, such as industry alerts, reliability assessments, event analysis, education, and the compliance with and enforcement of reliability standards, are designed to work in concert with reliability standards to support reliable operation. Each of these activities should be driven by the goal of consistently achieving an adequate level of reliability.

For these reasons, the Task Force also agreed that the characteristics of ALR must be objective and measurable in recognition of NERC's commitment that the electric reliability organization (ERO) enterprise must be a learning organization that assesses industry performance, analyzes trends, and learns from its performance successes and failures, allowing the ERO enterprise – which encompasses NERC, its Regional Entities, and the industry – to focus on and align its activities with specific characteristics of ALR.

The Task Force's report revisits the current NERC BOT-approved definition of ALR, which was adopted by the BOT in February 2008 and filed for informational purposes with the Federal Energy Regulatory Commission in May 2008, as well as NERC's Reliability Principles,[2] which are intended to guide reliability standard development. The Reliability Principles are included in the Standard Processes Manual and listed in Section 6.0 below.

2.0 Overview of ALR Definition Structure

To define ALR, it is necessary to first determine what constitutes "adequate" reliability.

What is deemed "adequate" varies by perspective. Traditionally, asset owners and operators plan and operate BES Facilities according to their specific local area criteria and requirements. Over time, these specific design and operation criteria and requirements have defined the de-facto adequate level of reliability for the concerned owners and operators. But Reliability Performance and Assessment Objectives must be established based on the impact on interconnected operations; one entity may only impact the network on a small scale, but without consistent objectives across North America, an adequate level of reliability cannot be achieved. The goal of the ALRTF was to determine the specific Reliability Performance Objectives that should be adopted for the design and operation of interconnected BES Facilities and Reliability Assessment Objectives that identify system conditions beyond BES design and/or regulatory authority that jeopardize reliability. Situational awareness of these conditions allow for appropriate plans and actions to be developed.

[2] NERC's Reliability Principles are posted at http://www.nerc.com/files/Reliability_Principles.pdf.

Rationale for Developing Reliability Performance and Assessment Objectives

Reliability Performance Objectives

The ALR definition document presents Reliability Objectives in general terms. ALR is the performance state that the design, planning, and operation of the BES will achieve when the following Reliability Performance Objectives are met:

1. The BES does not experience instability, uncontrolled separation, Cascading,[3] or voltage collapse under normal operating conditions and when subject to predefined Disturbances.[4]
2. BES frequency is maintained within defined parameters under normal operating conditions and when subject to predefined Disturbances.
3. BES voltage is maintained within defined parameters under normal operating conditions and when subject to predefined Disturbances.
4. Adverse Reliability Impacts[5] on the BES following low-probability Disturbances (e.g., multiple contingences, unplanned and uncontrolled equipment outages, cyber security events, and malicious acts) are managed.
5. Restoration of the BES after major system Disturbances that result in blackouts and widespread outages of BES elements is performed in a coordinated and controlled manner.

Reliability Assessment Objectives

The ALR definition document also presents Reliability Assessment Objectives to identify reliability risks resulting from possible adequacy and safety insufficiencies not enforceable by the ERO. The following Reliability Objectives must be assessed to support an adequate level of reliability.

1. BES Transmission capability is assessed to determine availability to meet anticipated BES demands during normal operating conditions and when subject to predefined Disturbances.
2. Resource capability is assessed to determine availability to the BES to meet anticipated BES demands during normal operating conditions and when subject to predefined Disturbances.

Outcomes

To drive proper operational behavior, it is necessary to set specific expected outcomes for the Reliability Objectives. The outcome assigned to each of the Reliability Objectives in the definition serves to provide measurable goals. There must be a finite scope for the conditions within which the proposed Reliability Objectives and their outcomes can be accomplished, or there will be no limit to the potential BES

[3] NERC's Glossary of Terms defines Cascading as: "The uncontrolled successive loss of system elements triggered by an incident at any location. Cascading results in widespread electric service interruption that cannot be restrained from sequentially spreading beyond an area predetermined by studies."

[4] NERC's Glossary of Terms defines Disturbance as: "1. An unplanned event that produces an abnormal system condition; 2. Any perturbation to the electric system; 3. The unexpected change in ACE that is caused by the sudden failure of generation or interruption of load." Further, the stated BES performance when "subject to predefined Disturbances" extends to the post-Disturbance period such that the BES is returned to stable frequency and voltage within predefined ranges after the transient period.

[5] NERC's Glossary of Terms defines Adverse Reliability Impact as "The impact of an event that results in Bulk Electric System instability or Cascading."

investments or assessment study scenarios needed to guard against any and all possible events that could occur on the BES. Collectively, the outcome and associated predefined Disturbances fully describe the characteristics of each Reliability Objective – what it is and under what conditions it must be achieved.

The specified performance outcomes are the expected results that a Reliability Performance Objective aims to achieve. For example, keeping system frequency at 60 Hz (+/- a tolerance) is the performance outcome that provides an indication that sufficient resource and control measures are in place to maintain a demand/resource/interchange balance.

With respect to the Reliability Assessment Objectives, an assessment of reliability has no value if the results are not provided to planning and operations personnel. Therefore, the expected outcome of a reliability assessment is to make the results available for use by planners and operators. The planners are then able to use information from the assessment to propose plans to meet forecast demand and projected system conditions. Likewise, operations personnel can gain situational awareness so that they can prepare for and take appropriate actions as changes occur in BES conditions.

Each of the Reliability Objectives defined in the ALR definition document has at least one outcome assigned to it. A detailed discussion of how outcomes are related to Reliability Objectives is presented in Section 3.0. Expected outcomes that are applicable to individual Reliability Objectives will be determined in the standard development process or assessment study scoping process.

Disturbances

BES Facilities are designed and operated to withstand certain predefined Disturbances that have a higher probability of occurring than other severe, low-probability events. For each predefined Disturbance, BES owners and operators would normally be required to apply planning and operating measures to guard against Adverse Reliability Impacts in order to achieve specific performance outcomes. An example of a predefined Disturbance is the loss of a Transmission circuit due to lightning or the failure of a circuit breaker to open to clear a fault. Reliability Performance Objectives 1 through 3 and Assessment Objectives 1 and 2 address the expected performance or assessment within the scope of predefined Disturbances, where the goal is to prevent Adverse Reliability impacts.

For less probable severe events, BES owners and operators may not be able to apply any economically justifiable or practical measures to prevent or mitigate Adverse Reliability Impacts on the BES, despite the fact that these events can result in Cascading, uncontrolled separation or collapse. For this reason, these events generally fall outside of the design and operating criteria for BES owners and operators. Less probable severe events might include the loss of an entire right of way due to a tornado or simultaneous or near simultaneous multiple Transmission Facility outages due to a hurricane or other severe natural phenomena. Reliability Performance Objectives 4 and 5 address the expected performance when less probable Disturbances occur, where the goal is to minimize Adverse Reliability Impacts and recover rapidly.

Mitigation measures to address such severe events, including reliability standards, may be developed and applied under specific circumstances if industry stakeholders and regulatory authorities reach consensus that it would be prudent and cost effective to do so. In this case, the event would be reclassified as a predefined Disturbance for which reliability standards or other mitigation measures may be adopted to mitigate the identified risks, thereby changing the planning and operational design basis for the BES. The Reliability Performance Objectives that achieve ALR would not be modified, although the expected Performance Outcomes may need to be restated in probabilistic terms.[6]

Section 4.0 presents a detailed discussion on the Disturbances associated with each Reliability Objective. Specific Disturbances that are applicable to individual Reliability Performance Objectives will be determined in the standard development process. Specific disturbances that are applicable to individual Reliability Assessment Objectives will be determined in the assessment scoping process.

Reliability Objective Example
A Reliability Performance Objective is: "BES frequency is maintained within defined parameters under normal operating conditions and when subject to predefined Disturbances."
Its performance outcome for the transient time period is that the frequency deviation is arrested rapidly after predefined Disturbances. During the transient period, frequency stays in a predefined range and frequency oscillations exhibit positive damping.
The scope of Disturbances for this Reliability Objective in this time period could include an event resulting in loss of single BES element, like an unplanned loss and/or failure of a single element on the BES that is cleared normally. A single element may include multiple equipment failures within the single element zone of protection. For example, a single contingency could remove a Transmission line and a Transmission voltage high and low side bulk power transformer that share a common power circuit breaker. The cause may be equipment failure, lightning strike, foreign intrusion, human error, environmental, contamination, sabotage, vandalism, or fire.

3.0 Performance and Assessment Outcomes

The outcomes expected for an adequately reliable BES can vary within defined parameters depending on the time period relative to the Disturbance event. The Task Force has described four time periods in this document. In some cases, the outcomes are the same across different time periods. Where they differ, the Task Force has addressed the expected actions or outcomes in a given time period separately for each category of Disturbance.

1. **Steady State** – The time period before a Disturbance occurs and after system restoration has achieved normal operating conditions. It is a stable pre-event condition for the existing system configuration, which

[6] Some HILF events may be amenable to deterministic analysis. However, beyond some range of severity and complexity, HILF events may require probabilistic approaches and scenario analysis,

includes all existing BES elements, including elements on planned outage for maintenance, construction, or safety purposes or unplanned outage.

2. **Transient** – The transitional time period beginning after a Disturbance in which high-speed automatic actions occur in response to the Disturbance. This time period starts at the time of the Disturbance and can continue for seconds or until a new steady state is achieved.
3. **Operations Response** – The time period after a Disturbance during which some automatic actions occur and operators act to minimize the impact of Disturbances and return the BES to a new steady state, if possible. This state may begin seconds after the Disturbance and continue for hours.
4. **Recovery and System Restoration** – The time period after a widespread outage or blackout occurs, through the initial restoration to a sustainable operating state, and recovery to a new steady state that meets Reliability Objectives established by the circumstances of the Disturbance.

Performance Outcomes for an Adequate Level of Reliability

In this section, we restate the five Reliability Performance Objectives and then describe the associated outcomes for each time period.

1. *The BES does not experience instability, uncontrolled separation, Cascading, or voltage collapse under normal operating conditions and when subject to predefined Disturbances.*

Instability is the loss of the ability of an electric system to maintain a state of equilibrium during normal and abnormal conditions or Disturbances. Uncontrolled separation is the unplanned loss of BES elements resulting in islanding and possible unplanned BES load loss. The expected performance outcomes for preventing instability and uncontrolled separation for each time period are described below:

Steady State – Stability is maintained. Frequency and voltage remain in a normal or defined range; generation and load are balanced.

Transient – Frequency and voltage remain in a defined range and the frequency oscillations exhibit positive damping. Controlled loss of BES elements may be planned during the transient period, thus minimizing the impact on the electrical system by preventing Cascading or uncontrolled separation.

System Instability

System instability is the inability of the Transmission system to remain in synchronism. This is characterized by the inability to maintain a balance of mechanical input power and electrical output power following a Disturbance on the BES. If generators that supply the BES accelerate or decelerate too much during a Disturbance, large power swings may be seen on the Transmission system, and these generators may go out of step and trip off-line, causing additional acceleration and deceleration of other generators on the system. The inability of the generators to return to a balanced operating condition is system instability. System instability is dependent on loading and configuration of the BES.

Operations Response – Operators and some automatic devices take actions that arrest further frequency and voltage oscillations, loss of BES elements, resources or loads to bring the BES to a new steady state. Actions may include load shedding or generation re-dispatch, switching and other actions that create a new steady state for the BES.

Recovery and System Restoration – This time period is not applicable to this Reliability Objective.

Cascading is defined in the NERC Glossary of Terms as: "The uncontrolled successive loss of system elements triggered by an incident at any location. Cascading results in widespread electric service interruption that cannot be restrained from sequentially spreading beyond an area predetermined by studies."[7] The expected performance outcomes for preventing Cascading for each time period are described below:

Steady State – The BES operates with frequency and voltage in predefined ranges; generation and load are balanced within predefined ranges.

Transient – The BES operates automatically to prevent Cascading for predefined Disturbances.

Operations Response – Operators and some automatic devices take actions that maintain the BES without Cascading. Actions may include load shedding or generation changes, switching, and other actions that create a new steady state for the BES.

Cascading
Cascading occurs when a BES element is interrupted due to any Disturbance and the original power flow across the element is shifted to other BES elements causing those BES elements to exceed their capacity and interrupt, shifting power flow to other BES elements causing those BES elements to exceed their capacity and interrupt. A Cascading event will continue until sufficient load is consequentially shed due to the BES element interruptions such that remaining in-service BES elements are supplying power within their rated capacity.

Recovery and System Restoration – This time period is not applicable to this Reliability Objective.

[7] The ALRTF interprets "system elements" to mean BES system elements. The ALRTF interprets "widespread electric service interruption" to mean a widespread electric service interruption on the BES. This explicitly excludes widespread distribution outages that could be caused by natural disasters, etc.

Voltage collapse is the process by which voltage instability leads to a loss of voltage control in a significant area of the electrical system. Voltage collapse occurs when there is not enough local reactive support available to serve the power system's requirements. The expected performance outcomes for preventing voltage collapse for each time period are described below:

Voltage Collapse
Voltage collapse conditions threaten when Transmission lines are delivering large quantities of power over long distances with limited local reactive power supply. A voltage collapse is characterized by a progressive decline of Transmission system voltage over a period of time, usually accompanied by a progressive escalation of electric system load. Very fast reactive supply devices, designed to address a voltage collapse risk are required to arrest the voltage decay before their capacitive benefits are lost due to extremely depressed system voltages.

Steady State – Voltage and reactive reserves are maintained within a normal or defined range.

Transient – Voltage is automatically maintained within a predefined range and without BES equipment damage.[8] BES voltage stability is maintained during and after the Disturbances. During the return to steady state, voltage stays in a defined range and voltage oscillations exhibit positive damping.

Operations Response – Voltage is maintained within a predefined range and without BES equipment damage. BES voltage stability is maintained during and after the events. Operators and some automatic devices take actions that maintain voltage on the BES. Actions may include increasing reactive support, load shedding, generation re-dispatch, switching, and other actions that return the BES to a steady state voltage.

Recovery and System Restoration – This time period is not applicable to this Reliability Objective.

2. *BES frequency is maintained within defined parameters under normal operating conditions and when subject to predefined Disturbances.*

Frequency is the rate of change of electrical quantities demonstrated in synchronous electrical systems. Nominal frequency is 60 Hertz in North America. The expected performance outcomes for maintaining frequency for each time period are described below:

Steady State – Frequency is kept in a predefined range without BES frequency excursions that result in instability or BES equipment damage.

[8] "…without BES equipment damage" refers to operating within Facility Ratings. Facility Ratings may vary based on time frame considered.

Transient[9] – Frequency deviation is arrested rapidly after predefined Disturbances. During the transient period, frequency stays in a predefined range and frequency oscillations exhibit positive damping.

Operations Response – System frequency is maintained. Operators and some automatic devices take actions that support system frequency in a predefined range without serious BES frequency excursions, instability or BES equipment damage. Actions may include: Generation re-dispatch, switching, demand management, load shedding, and other actions that arrest frequency deviation and maintain BES frequency.

Recovery and System Restoration – This time period is not applicable to this Reliability Objective.

3. *BES voltage is maintained within defined parameters under normal operating conditions and when subject to predefined Disturbances.*

Voltage is the electrical potential of the BES which has nominal values between 100 kV and 800 kV. The expected performance outcomes for maintaining voltage for each time period are described below:

Steady State – BES voltage is kept in a predefined range without BES voltage excursions that result in voltage collapse or BES equipment damage.

Transient – Voltage remains within a defined range and recovers to pre-Disturbance values. During the transient period, voltage stays in a defined range and the voltage oscillations exhibit positive damping.

Operations Response – System voltage is maintained in a predefined range without serious BES voltage excursion, voltage collapse, or BES equipment damage. During this time period, operators and some automatic devices take actions that may include: Adjusting reactive support, load shedding, switching, and other actions that return the BES to steady state voltage.

Recovery and System Restoration – This time period is not applicable to this Reliability Objective.

4. *Adverse Reliability Impacts on the BES following low-probability Disturbances (e.g., multiple contingences, unplanned and uncontrolled equipment outages, cyber security events, and malicious acts) are managed.*

This objective is designed to consider preplanning and actions taken for recovery or emergency action scenarios. These scenarios could result from Disturbances that exceed design criteria, failure of the BES

[9] In this context, the transient time period (usually measured in seconds) includes the dynamic time period (usually measured in minutes).

to respond as designed, or human error. The expected performance outcomes for minimizing Adverse Reliability Impacts for each time period are described below:

Steady State – This time period is not applicable to this Reliability Objective.

Transient – The scope of the Adverse Reliability Impact is managed through high-speed automatic actions such as underfrequency load shedding, undervoltage load shedding, and governor response.

Operations Response –The scope of the Adverse Reliability Impact is managed using automatic devices and operator action to limit propagation of Cascading, minimize or control collapse, and minimize BES equipment damage.

Recovery and System Restoration – The BES is efficiently returned to a stable state and resources and load are restored.

5. *Restoration of the BES after major system Disturbances that result in blackouts and widespread outages of BES elements is performed in a coordinated and controlled manner.*

This objective is designed to consider preplanning and actions taken for recovery and system restoration scenarios. These scenarios could result from Disturbances that exceed design criteria, failure of the BES to respond as designed, or human error. The expected performance outcomes for recovering from major system Disturbances is described below:

Steady State – This time period is not applicable to this Reliability Objective.

Transient – This time period is not applicable to this Reliability Objective.

Operations Response – This time period is not applicable to this Reliability Objective.

Recovery and System Restoration – The BES is recovered and available resources and load are restored to a stable interconnected operating state expeditiously after a major system Disturbance. This includes actions such as black starting generation, restoring load, and restoring the BES in an orderly, efficient, and controlled manner.

Assessment Outcomes for an Adequate Level of Reliability

In this section, we restate the two Reliability Assessment Objectives outlined above and then describe the associated outcomes for each time period.

1. *BES Transmission capability is assessed to determine availability to meet required BES demands during normal operating conditions and when subject to predefined Disturbances.*

BES Transmission network capability is the BES's ability to transfer energy from available resources to meet load obligations. While Transmission network capability typically refers to the aggregate capability of the network to accomplish a variety of reliability, commercial, regulatory, and policy objectives, here the Task Force focused solely on the Reliability Objective.[10] The expected outcomes for making sufficient Transmission capability available for each time period are described below:

Steady State – Deliver sufficient energy from resources to meet the load obligation placed on the BES while operating within established boundaries.

Transient – Remain within a predefined set of limits during predefined Disturbances. This may include Special Protection System or Remedial Action Scheme operation.

Operations Response – BES Transmission network capability is maintained within predefined limits. During this time period, operators and some automatic devices take actions that may include: Generation re-dispatch, load shedding, switching, and other actions that restore the BES to within its predefined limits.

Recovery and System Restoration – This time period is not applicable to this Reliability Objective.

2. *Resource capability is assessed to determine availability to the BES to meet required BES demands during normal operating conditions and when subject to predefined Disturbances.*

The objective is to provide and maintain sufficient resources to meet BES load obligations. The industry is responsible for ensuring that sufficient resources are procured and delivered to meet the needs of consumers. While resource adequacy typically refers to the aggregate capability of generation capacity and other resources to accomplish a variety of reliability, commercial, regulatory, and policy objectives, here the Task Force focused solely on the Reliability Objective. The expected outcomes for making sufficient resource capability available for each time period are described below:

Steady State – Sufficient supply is established, utilized and reserved to meet system needs.

[10] The ALR Task Force emphasizes that under Section 215 (i)(2,3) of the Federal Power Act (the FPA), NERC and FERC are not authorized "to set and enforce compliance with standards for adequacy…of electric facilities or services." In the U.S., many state and local regulatory agencies have authority to establish resource adequacy requirements for jurisdictional utilities. These resource and Transmission adequacy requirements may encompass a variety of commercial and policy objectives that are not required to ensure BES reliability, although such policy objectives do impose constraints upon how BES reliability is achieved. Similarly, the FERC has certain limited authority under other sections of the FPA to approve the siting of interstate electric Transmission Facilities, to approve Transmission rate incentives, to direct the planning of Transmission Facilities to meet the service obligations of load serving entities, and take other actions required to ensure non-discriminatory Transmission access is provided by jurisdictional utilities. FPA Section 215 does require NERC to assess the future adequacy and reliability of the bulk-power system, and NERC continues to believe that the term reliability must include the concept of adequacy. Therefore, ALR addresses adequacy.

Transient – Supply and demand mismatch is automatically controlled during predefined Disturbances.

Operations Response – Supply and demand mismatch is managed within a predefined range after predefined Disturbances. During this time period, operators, and some automatic devices take actions that may include: Automatic reserve sharing commitment, utilization of demand response program resources, reestablishment of operating reserves, and other actions that keep the load and generation in balance.

Recovery and System Restoration – This time period is not applicable to this Reliability Objective.

4.0 Disturbances

This section defines Disturbances that are referred to in the previous performance and assessment outcomes section.

4.1 Disturbance Scenarios

Disturbances are a set of operational scenarios in two major categories: Predefined and beyond the scope of predefined.

Predefined Disturbances are deterministic in nature and include specific events or grid Disturbances that fall into the following three categories:

1. *Steady state, no contingencies:* Disturbances in this category occur in a known, analyzed state of the BES where it is operating within established operating limits. Under steady state conditions it is common to have devices and elements out of service as a result of contingencies and/or normal or forced maintenance. Steady state conditions imply operation at projected customer demand and with proper and/or anticipated equipment functionality. Disturbances that are not severe may allow the BES to remain in normal conditions. The Disturbance may be a minor weather event (e.g., a lightning strike on a Transmission circuit) that affects BES outage planning but allows the normal operation of the BES.
2. *Event resulting in loss of single BES element:* An unplanned loss and/or failure of a single element on the BES that is cleared normally. A single element may include multiple equipment failures within the single element zone of protection. For example, a single contingency could remove a Transmission line or a transformer from service. The cause may be equipment failure, lightning strike, foreign intrusion, human error, the environment, contamination, sabotage, vandalism, or fire.
3. *Events resulting in loss of two or more BES elements:* A single event involving more than one element in a single protection zone, or two or more dependent or separate events leading to an unplanned loss and/or failure of elements on the BES, that results in the loss of multiple Facilities

not common to a single zone of protection. The events occur simultaneously or in close time proximity. An example is the loss of two circuits due to a lightning strike causing the outage of one element followed by a protection misoperation that causes an outage of another element. Multiple contingencies may be the result of some Cascading of elements initiated by equipment failure, lightning strike, foreign intrusion, human error, the environment, contamination, sabotage, vandalism, or fire, or multiple element outages initiated by regional disaster events (e.g., hurricane or volcano) on Transmission infrastructure.

The kinds of Disturbances that fall into categories 1-3 above are addressed in Reliability Performance Objectives 1-3 and Reliability Assessment Objectives 1 and 2. Specific, applicable Disturbances for the Objectives will be determined through the standard development process or assessment study scoping process.

The events beyond the scope of predefined Disturbances include specific events or grid Disturbances that fall into the following two categories:

4. *Severe events resulting in the removal of two or more BES elements with high potential to Cascade:* Two or more dependent or separate events leading to an unplanned loss and/or failure of elements on the BES that results in the loss of multiple Facilities not common to a single zone of protection. The events occur simultaneously or in close time proximity. An example is the loss of three circuits due to a lightning strike causing the outage of one element followed by a protection misoperation that causes an outage of another element followed by an overload that causes an outage of another element. Severe events can be the result of widespread cascading elements initiated by equipment failure, lightning strike, foreign intrusion, human error, the environment, contamination, sabotage, vandalism, or fire, or multiple element outages initiated by regional disaster events (e.g., hurricane or volcano) on Transmission infrastructure.
5. *High-Impact, Low-Frequency Events:* HILF is class of improbable events with the potential to significantly affect the reliability of the BES and cause long-term, catastrophic damage to BES Facilities. The probability and magnitude of these events' occurrence is uncertain but can result in Cascading, voltage collapse, or system instability, leading to uncontrolled separation. An example is a tornado or hurricane resulting in the failure of multiple BES elements (e.g. transformers) and voltage collapse. HILF events include coordinated cyber, physical, or blended attacks, pandemic illness, major earthquakes, Electromagnetic Pulse (EMP), and severe weather events.

Disturbances that belong to categories 4 and 5 cannot be predefined. Reliability Performance Objectives 4 and 5 address responses to minimize and recover from Adverse Reliability Impacts on the BES resulting from conditions beyond the scope of predefined Disturbances.

It is the ALRTF's general expectation that predefined Disturbances are determined through technical studies and the standards development process. Recognizing that reliability risks due to specific causes or events may be identified from time to time, the list of predefined Disturbances may need to be revised or expanded if industry stakeholders and regulatory authorities reach agreement that a particular risk should be mitigated with due regard to such causes or events.

4.2 Causes of Disturbances

This section provides examples of causes or triggers that may initiate the Disturbance in the categories listed above. The types of causes include weather/natural disasters, human performance, equipment, sabotage/vandalism, foreign intrusion, and fire.

Cause severity is often associated with the degree of BES reliability impact. Within each category, the causes could plausibly lead to anything from continued steady state operation (i.e., no reliability impact) to severe or HILF events. For example, within the weather category, a mild storm could result in continued steady state operation, whereas a hurricane could lead to severe events or Cascading or be categorized as HILF. Typically, low severity causes that result in continued steady state operation have no BES reliability impact. The examples are not necessarily a complete list, but rather represent common and recognized causes of events.

Weather/Natural Disaster – Weather events that potentially cause Disturbances to the BES include lightning, high winds (e.g., storms, hurricanes, tornadoes), earthquakes, snow/ice storms, severe cold, severe heat, and flooding impacting electrical substations in flood plain areas.

Human Performance – Personnel errors that potentially cause Disturbances to the BES include operating the incorrect piece of equipment, failing to appropriately isolate equipment for maintenance activities, incorrectly operating equipment (e.g., disconnecting load with a non-load break disconnect switch), and design errors (e.g., incorrect relay settings). Human performance errors may include design errors or incorrect assumptions that have been assumed valid by industry, perhaps even for a sustained period of time.

Equipment – Equipment failure that potentially causes Disturbances to the BES includes power transformers, circuit breakers, Transmission structures, disconnect switches, potential transformers, current transformers, secondary equipment (e.g., relays, meters and remote terminal units), bus work, and power line carrier equipment. Equipment failure includes manufacturer defects, wear and tear, inadequate maintenance, operation outside of equipment design tolerances, and aggressive treatment.

Foreign Intrusion – Foreign intrusion that causes a Disturbance to the BES includes animal intrusion into energized equipment, vegetation intrusion into Transmission lines as a result of high winds, or natural disaster events.

Sabotage/Vandalism – Sabotage is a deliberate action aimed at jeopardizing the integrity and reliability of the BES through obstruction, diversion, or destruction of BES elements. Sabotage may take the form of an action that results in immediate failure or one that has the potential to create a future failure. Sabotage may come in the form of physical damage to BES elements via explosive devices, firearms, electromagnetic pulses, or unauthorized manipulation of BES elements via manual operation of switching devices or unauthorized electronic access to BES critical cyber assets.

Vandalism is a willful and malicious action to defile BES elements without intent to jeopardize the reliability of the Transmission system. Vandalism may look like sabotage or have similar consequences, but is determined by competent investigation to have had no purposeful intent.

Fire – Fire may be caused and introduced to the BES by any source not necessarily associated with the electric grid (e.g., a forest fire started by arid conditions that encroaches on the BES as it travels from tree to tree). Fire may be caused by a separate Disturbance already described in this document (e.g., failure of electrical equipment, lightning, or vandalism) that Cascades to other BES elements not directly a target of the primary Disturbance. Fire may cause direct damage or destruction to BES elements in the path of the fire. Smoke from the fire may cause ionization, weakening equipment dielectric properties resulting in short circuits that interrupt Transmission elements.

Contamination – Contamination is the presence of an undesired constituent that has a detrimental effect on BES elements. For instance, salt contamination on substation bus support and Transmission insulators may cause tracking that weakens the dielectric properties of the insulator, resulting in short circuits that interrupt Transmission elements.

5.0 Means to Meet Reliability Objectives

The performance target or reliability outcome for each Reliability Objective can be maintained or achieved through various means, which may include some combination of: installing new Facilities, upgrading existing Facilities, providing capability, developing short-term operational plans or implementing operating/control measures in real time.

The extent to which any of these means need to be deployed is assessed against a set of performance criteria, minimum thresholds, or consistency in executing operating controls/measures. For example:

- Installing new Facilities can be assessed against the dynamic and steady-state behavior of the BES whose criteria could be the ability to remain stable and to damp out oscillations, subject to limits for minimum and maximum voltage levels, BES equipment loading, etc.;
- Provision of specific capability can be assessed against the ability to monitor the status of all critical Facilities, or the ability to respond to specific situations, such as evacuation of the

primary control center or rapid decay of system frequency, or the competency of system operators in handling certain situations; or

- Executing operating controls/measures can be assessed against the time required to return loading on the Transmission system to within established limits.

The various means to meet a Reliability Objective thus becomes the scope and purpose of standards development or recommendations of a reliability assessment. For the Reliability Objectives defined in the ALR Definition Document, an overview of some of the means to meet the objectives is depicted in Appendix A.

6.0 Reliability Principles

To ensure consistency among its proposed Reliability Objectives and NERC's Standards Development Reliability Principles, which provide the foundation for every standard and requirement NERC develops, the ALRTF compared its Objectives to the Reliability Principles, listed below, and found that they are mutually supportive.

1. Interconnected bulk power systems shall be planned and operated in a coordinated manner to perform reliably under normal and abnormal conditions as defined in the NERC Standards.
2. The frequency and voltage of interconnected bulk power systems shall be controlled within defined limits through the balancing of real and reactive power supply and demand.
3. Information necessary for the planning and operation of interconnected bulk power systems shall be made available to those entities responsible for planning and operating the systems reliably.
4. Plans for emergency operation and system restoration of interconnected bulk power systems shall be developed, coordinated, maintained, and implemented.
5. Facilities for communication, monitoring, and control shall be provided, used, and maintained for the reliability of interconnected bulk power systems.
6. Personnel responsible for planning and operating interconnected bulk power systems shall be trained, qualified, and have the responsibility and authority to implement actions.
7. The reliability of the interconnected bulk power systems shall be assessed, monitored, and maintained on a wide-area basis.
8. Bulk power systems shall be protected from malicious physical or cyber attacks.

Reliability Principles 1, 2, 4, 7, and 8 (focusing on reliability planning and operating performance, frequency and voltage performance, emergency preparation, wide-area view, and security, respectively) are directly associated with specific ALR Reliability Objectives. Reliability Principles 3, 5, and 6 (focusing on reliability information, communications and control, and personnel, respectively) underpin all of the Reliability Objectives; they serve as means to achieve all the Reliability Objectives.

7.0 Comparison with Old Definition

The NERC BOT approved the current definition of ALR, as shown in the text box below, on February 12, 2008, and submitted the definition to the FERC as an informational filing on May 12, 2008. As part of its filing, NERC also submitted a background paper prepared by the NERC Planning and Operating Committees that the BOT considered in the process of approving the definition.

Characteristics of a System With an Adequate Level of Reliability

1. The System is controlled to stay within acceptable limits during normal conditions.
2. The System performs acceptably after credible Contingencies.
3. The System limits the impact and scope of instability and cascading outages when they occur.
4. The System's Facilities are protected from unacceptable damage by operating them within Facility Ratings.
5. The System's integrity can be restored promptly if it is lost.
6. The System has the ability to supply the aggregate electric power and energy requirements of the electricity consumers at all times, taking into account scheduled and reasonably expected unscheduled outages of system components.

(Note: Capitalized terms are taken from the NERC Glossary of Terms Used in Reliability Standards.)

Approved by NERC Board of Trustees
February 12, 2008

The ALRTF compared the proposed definition of ALR and the discussion in this technical report to the current BOT-approved definition and supporting document and identified the following material similarities and differences:

- The ALRTF's proposed Reliability Performance and Assessment Objectives are generally quite similar to the ALR characteristics in the current BOT-approved definition. However, the two definitions are structured and organized differently.
- The current definition describes ALR as "characteristics of a System," while the proposed definition describes ALR as "the performance state that the design, planning, and operation of the Bulk Electric System (BES) will achieve" when specific Reliability Performance and Assessment Objectives and associated outcomes are met.

- The current definition uses the term "System," which the NERC Glossary defines as: "A combination of generation, Transmission, and distribution components." The ALRTF elected to use "Bulk Electric System" in describing ALR to more narrowly and precisely focus on specific Reliability Performance and Assessment Objectives and outcomes that are within NERC's mission.
- The current definition addresses System performance after credible Contingencies and severe events, while the proposed definition addresses expected outcomes when the BES is subject to predefined Disturbances that may result in Adverse Reliability Impacts.
- The current definition is structured to address ALR during a series of different System conditions or time horizons: e.g., during normal conditions (ALR-1), performance after credible Contingencies (ALR-2), or during major system events that result in instability or Cascading outages (ALR-3). The proposed definition addresses BES performance for each Reliability Performance and Assessment Objective across four time periods or system conditions: steady state, transient, operations response, and recovery and system restoration.
- The proposed definition explicitly identifies freedom from uncontrolled separation and voltage collapse as core Reliability Performance Objectives. These objectives are implicit in the current definition.
- The proposed definition identifies voltage and frequency as discrete Reliability Performance Objectives.
- The proposed definition does not explicitly identify protection of Facilities from unacceptable damage, as shown in current characteristic ALR-4. However, operation within Facility Ratings is identified as a performance outcome for proposed Reliability Performance Objectives 2, 3, and 4. The technical report proposes that Facility Ratings must be respected during all time periods and operating conditions.
- The current definition relies upon the NERC Glossary definition of Adequacy in characteristic ALR-6 to address the ability of the System (which includes generation, Transmission, and distribution Facilities) to supply the requirements of electricity consumers. The proposed ALR definition recognizes that adequate level of reliability is a term used in section 215 of the Federal Power Act specifying what standards the ERO can develop and enforce. Specifically, the ERO is not authorized to develop standards related to adequacy and safety. Because the ALR definition is meant to encompass all ERO duties, separate Reliability Assessment Objectives for sufficient BES Transmission capability and sufficient BES resource capability to meet "anticipated BES demands" are included in the proposed ALR definition. In other respects, the proposed ALR definition addresses these issues in a similar way to the current definition.

Appendix A - Means to Meet Reliability Objectives, with Examples

Reliability Objective	Means to Meet Objectives (with examples for illustration purposes only; examples are not meant to be exhaustive and are not standards)		
	Criteria *The conditions and initiating events and the yardstick that the BES need to observe and attain to achieve the performance outcome/target*	**Capability** *The facilities, functions and competency needed to achieve the performance outcome/target*	**Practice** *The planning and operating protocol and actions that need to be performed consistently to achieve the performance outcome/target*
Prevent the occurrence on the BES of:			
•Instability and uncontrolled separation	Contingency set Synchronism Damping factor for stability Restoration to normal operations	Awareness Training Stabilizers, exciters Communication facilities Reliability analysis model/tools	Reliability assessments Operating instructions and directives Prepared actions Execution authority and timing
•Cascading	Contingency set Voltage limits and BES equipment ratings Frequency limits Restoration to normal operations Protection design	Awareness Training Protection systems Communication facilities Reliability analysis model/tools	Reliability assessments Operating instructions and directives Prepared actions Execution authority and timing Protection coordination
•Collapse	Contingency set	Awareness	Reliability assessments

Reliability Objective	**Means to Meet Objectives (with examples for illustration purposes only; examples are not meant to be exhaustive and are not standards)**		
	Criteria *The conditions and initiating events and the yardstick that the BES need to observe and attain to achieve the performance outcome/target*	**Capability** *The facilities, functions and competency needed to achieve the performance outcome/target*	**Practice** *The planning and operating protocol and actions that need to be performed consistently to achieve the performance outcome/target*
	Synchronism Voltage limits Restoration to normal operations	Training AVR and reactive capabilities Special Protection Systems UFLS facilities Communication facilities Reliability analysis model/tools	Operating instructions and directives Prepared actions Execution authority and timing
Maintain system frequency	Contingency set Frequency levels Frequency response	Awareness Training Communication facilities Governors AGC	Reliability assessments Operating instructions and directives Prepared actions Execution authority and timing
Maintain system voltage	Contingency set Voltage levels Reactive requirements Restoration to normal	Awareness Training Communication facilities Reactive devices	Reliability assessments Operating instructions and directives Prepared actions Execution authority and timing

Reliability Objective	Means to Meet Objectives (with examples for illustration purposes only; examples are not meant to be exhaustive and are not standards)		
	Criteria *The conditions and initiating events and the yardstick that the BES need to observe and attain to achieve the performance outcome/target*	**Capability** *The facilities, functions and competency needed to achieve the performance outcome/target*	**Practice** *The planning and operating protocol and actions that need to be performed consistently to achieve the performance outcome/target*
	operations	AVR	
Manage Adverse Reliability Impacts	N/A	Awareness Training Communication facilities Special Protection Systems UFLS/UVLS facilities Manual load shedding	Reliability assessments Operating instructions and directives Prepared actions Execution authority and timing
Restore the integrity of the BES in a controlled manner after major Disturbances	N/A	Awareness Training Communication facilities Blackstart resources	Develop plans Execution authority
Sufficient Transmission capability is available to meet anticipated BES demands	Contingency set Performance targets Uncontrolled loss of load	Reliability analysis model/tools	Reliability assessments

Reliability Objective	**Means to Meet Objectives (with examples for illustration purposes only; examples are not meant to be exhaustive and are not standards)**		
	Criteria *The conditions and initiating events and the yardstick that the BES need to observe and attain to achieve the performance outcome/target*	**Capability** *The facilities, functions and competency needed to achieve the performance outcome/target*	**Practice** *The planning and operating protocol and actions that need to be performed consistently to achieve the performance outcome/target*
Sufficient resource capability is available to meet anticipated BES demands	Contingency set Uncontrolled loss of load Reserve margin Replenish time	Reliability analysis model/tools	Reliability assessment Reserve allocation authority

Document Content(s)

CERTIFICATE OF SERVICE

I hereby certify that the foregoing Comments of the New York State Reliability Council, L.L.C. has been served upon each person designated on the official service list compiled by the Secretary in this proceeding in accordance with the requirements of Rule 2010 of the Commission's Rules of Practice and Procedure.

Dated: December 9, 2024
Albany, New York

/s/ Amanda De Vito Trinsey
Amanda De Vito Trinsey