Inverter-Based Resource Performance Requirements (IEEE 2800) (PAC-2024-2)

Interconnection Process Working Group (IPWG)

March 12, 2024

Updated 3/13/24

- Slides 5 and 21: Corrected text in table to read “require a damping ratio of **0.3** or higher”

Purpose & Key Takeaways

Purpose: Propose Inverter-Based Resource (IBR) performance requirements for implementation in 2024

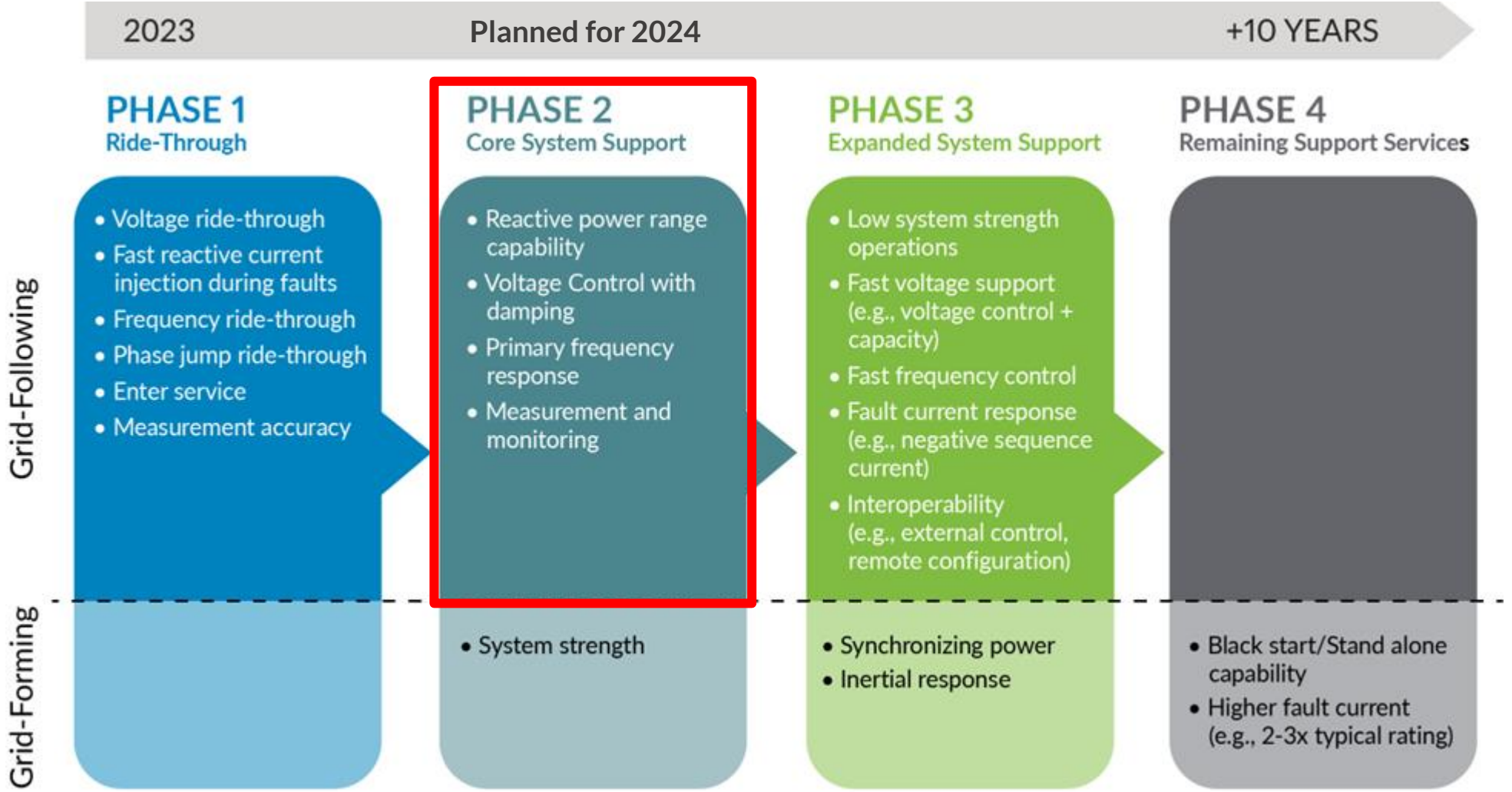
Key Takeaways:

- MISO shares proposed performance requirements for adoption covering voltage and frequency support, consecutive voltage deviation ride-through, and measurement
- Stakeholder feedback is requested on proposed requirements along with specific questions on adoption decisions
- MISO will propose Tariff redlines and an implementation plan at the next IPWG

2024 IPWG and PAC schedule for the implementation of IEEE 2800 performance requirements

	Date	IEEE 2800 Objective
IPWG	Jan 30	Present planned IBR performance requirements to be addressed in 2024
	Mar 12	Propose IEEE 2800 clauses for adoption **[Feedback]**
	May 2	Review feedback and propose implementation plan and tariff redlines **[Feedback]**
	June 4	Review feedback and share edits to tariff redlines **[Feedback]**
	July 23	Review feedback and share edits to tariff redlines
PAC	August 28	Present draft tariff redlines and implementation plan **[Feedback]**
	October 16	Share feedback responses and modifications

IBR performance requirements were identified as a key solution to ensuring system stability, and four main phases were proposed in the Attributes roadmap



Attributes Roadmap Publication: https://cdn.misoenergy.org/2023%20Attributes%20Roadmap631174.pdf

MISO recommends moving forward with the following performance requirements from IEEE 2800-2022 to refine existing requirements in MISO's GIA

Category	*Performance Capability*[1]	*IEEE 2800 Clause*[2]	*Summary of Performance Improvement Opportunity*
Voltage Support	**Minimum Reactive Power Capabilities**	**5.1**	**Define more specific reactive power requirements for IBRs, with additional details for Battery Energy Storage Systems (BESS) and Type III wind turbines**
	Reactive Power Capability at Zero Active Power	5.1	Require the capability to provide reactive power support when the primary energy source is not available
	Voltage and Reactive Power Control Modes - General	**5.2.1**	**List three required operating modes and specify voltage control as the default**
	Voltage Control	**5.2.2**	**Clearly define the voltage control mode, require a damping ratio of 0.3 or higher and other dynamic performance requirements**
	Constant Power Factor	**5.2.3**	**Clearly define the constant power factor control mode, require a damping ratio of 0.3 or higher**
	Constant Reactive Power	5.2.4	Clearly define the constant reactive power control mode, require a damping ratio of 0.3 or higher
Frequency Response	**Primary Frequency Response (PFR)**	**6.1**	**Add ranges of available settings for PFR droop and deadband values. Define dynamic performance parameters for PFR.**
Dynamic Responses/Reliability Services	Consecutive Voltage Deviation Ride-Through	7.2.2.4	Define consecutive voltage deviation ride-through to increase general ridethrough robustness
Measurement	**Measurement Data for Monitoring and Validation**	**11**	**Clear requirements for data types, format, sampling/recording, and retention**

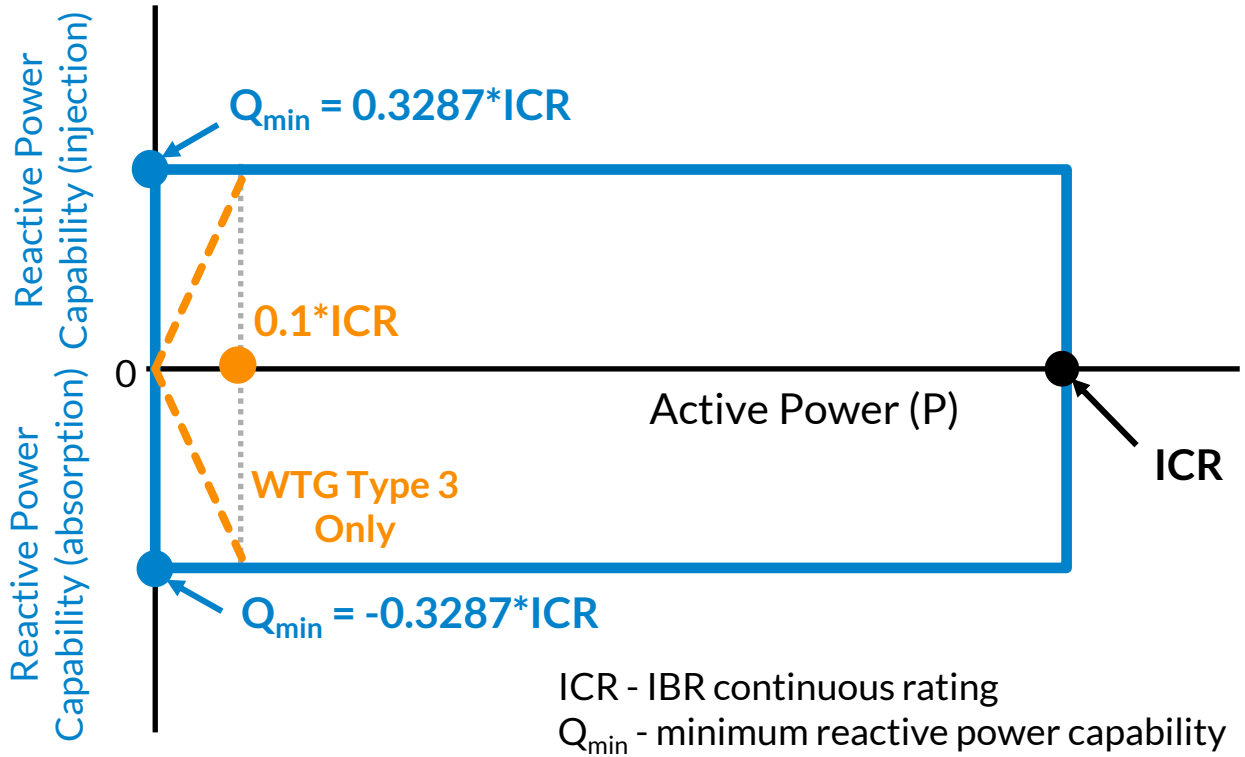
[1] **Bolded** items are performance areas that are currently included in MISO's tariff (Generator Interconnection Agreement). See Appendix (Slide 21) for details on existing MISO requirements in each area

[2] IEEE 2800-2022, IEEE Standard for Interconnection and Interoperability of Inverter-Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems

Requiring reactive power capability at zero active power could support system voltage across the range of IBR operating conditions

- The attributes project identified voltage support as a near term need
  - Planning and Generator Interconnection studies have also identified the need for additional reactive power support based on the changing resource mix
- MISO proposes to adopt the IEEE 2800 requirement for reactive power **capability** at zero active power
  - Type 3 wind plants are excluded, and have reduced reactive power requirements when active power is less than 10% of ICR
- MISO proposes requiring **utilization** of this capability when the plant is online

Minimum Range for Reactive Power (Q) Capability at RPA



ICR - IBR continuous rating
Q_{min} - minimum reactive power capability
WTG – wind turbine generator

Reference Point of Applicability (RPA) shall be the Point of Measurement (POM)

Note: Minimum reactive power coefficient of 0.3287 as shown in the figure corresponds to a power factor of 0.95

Three different voltage and reactive power control modes are defined in the standard

Voltage Control (Default)

Closed-loop automatic voltage control mode to regulate steady-state voltage at RPA to the reference value within 1% of the set point

Power Factor Control

Reactive power output that is in linear proportion to the active power

Reactive Power Control

Maintain specified constant reactive power output

- Operating modes are mutually exclusive (i.e., enabled one-at-a-time)
- For all modes, dynamic responses should be damped with a ratio of 0.3 or higher

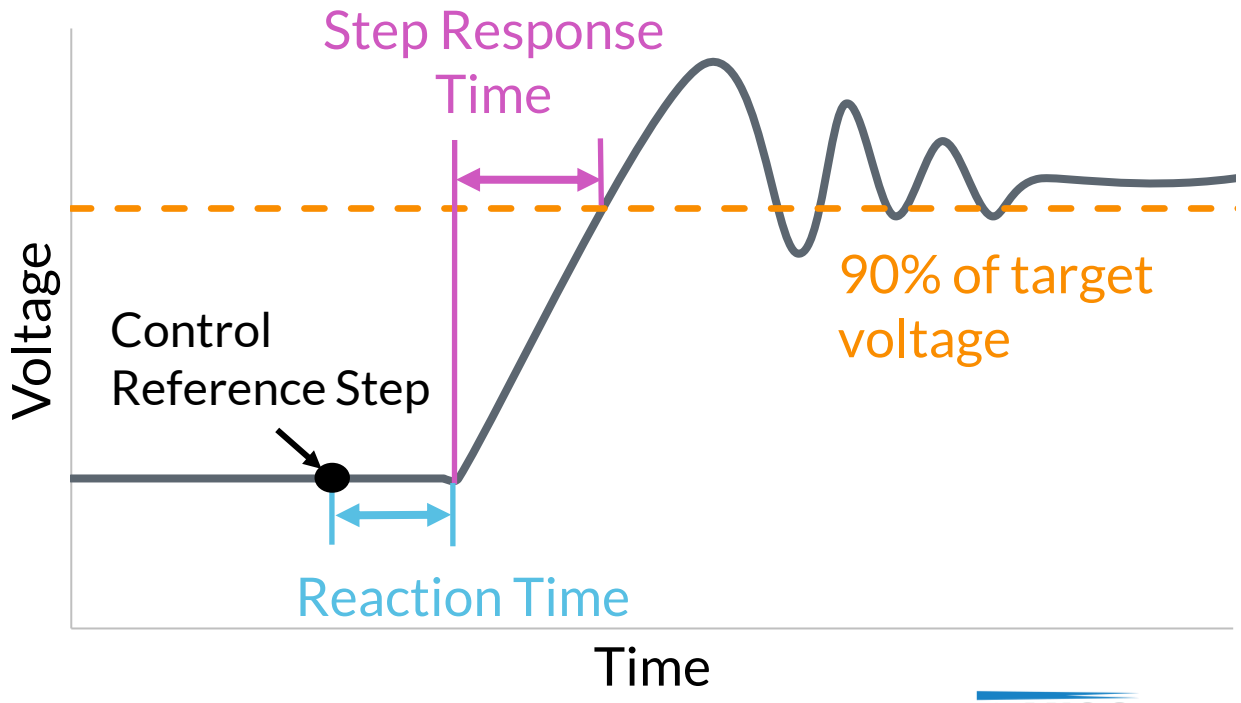
RPA: Reference Point of Applicability

MISO requests stakeholder feedback specific to voltage control dynamic performance requirements

- IEEE 2800 provides dynamic performance requirements that apply to the **voltage control mode**
- Seeking stakeholder input on two items:
  - **Maximum *step response time***, which should be within the suggested range of 1 – 30 seconds per guidance in the standard
  - Defining the **range of system conditions** for which dynamic performance requirements are applicable
    - Example: NYISO applied these requirements when the short circuit strength at the RPA was above the minimum value for a feasible generation scenario

Parameter	Performance Target
Reaction time	< 200 ms
Maximum *step response time*[1]	As required by the *Transmission System (TS) operator*
Damping ratio	0.3 or higher

Requirements in this table shall only be applicable to a defined range of TS equivalent impedance at the POM, specified by the *TS operator.*



[1] The standard states that the slowest response shall be tuned based on the *TS operator* requirements for response time and stability given grid strength, local voltage control devices, and overshoot requirements

MISO also requests stakeholder feedback specific to constant power factor control mode requirements

Power Factor Control

Reactive power output that is in linear proportion to the active power

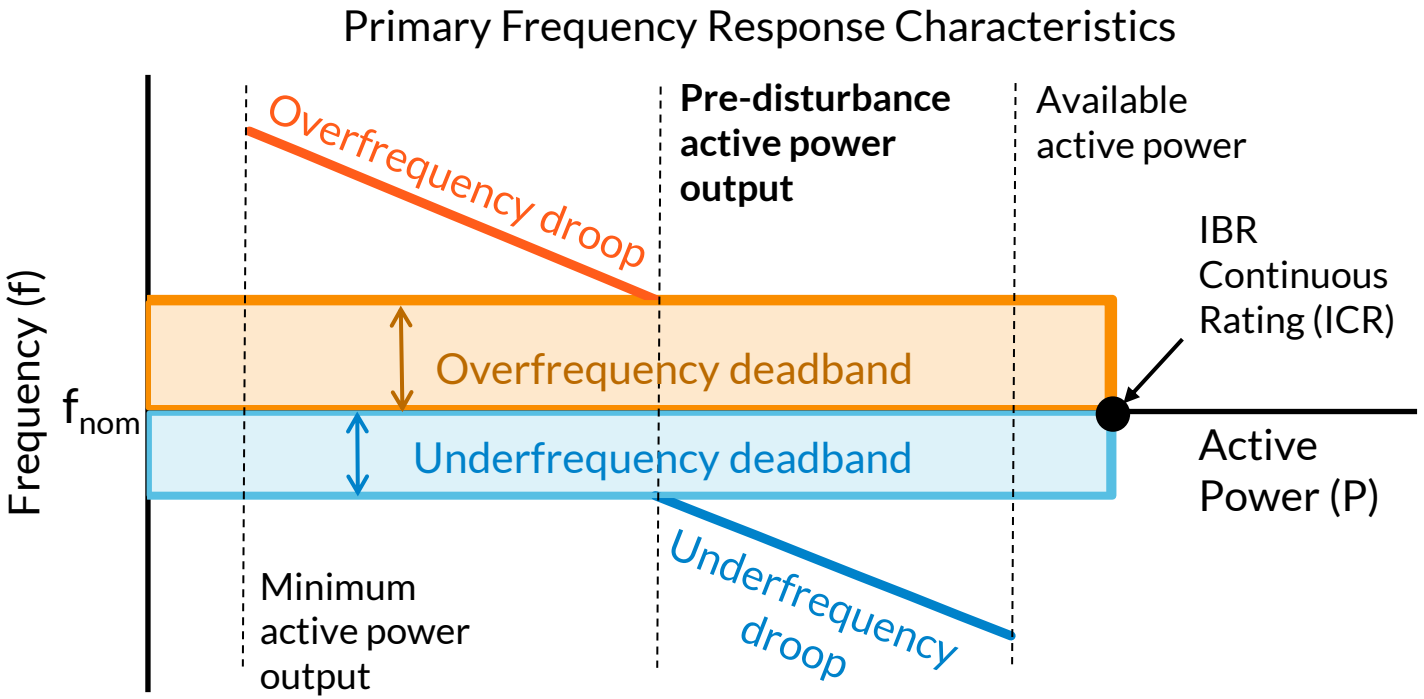
- IEEE 2800 states that the power factor control mode "shall appropriately operate at all active power levels down to **certain minimum IBR power level as specified by *TS operator***"
- Seeking specific input on this minimum active power level, especially related to:
  - Capabilities of inverter technology
  - Need for power factor control mode at low active power levels for reliable system operation

Questions

IEEE 2800 primary frequency response (PFR) requirements will enhance existing PFR requirements for IBRs

- Adoption of the PFR section of the standard would add dynamic performance requirements, along with range of available setting guidance for droop and deadband parameters
- IBR plants will **NOT** be required to operate with headroom to address under-frequency disturbances, as is the case today.
- MISO will evaluate language in the standard to ensure there are no conflicts with the requirements from FERC Order 842[1] in MISO's tariff, especially for battery energy storage systems (BESS)

Parameter	Units	Default Value	Ranges of available settings	
			Minimum	Maximum
Reaction time	Seconds	0.50	0.20 (0.5 for WTG)	1
Rise time	Seconds	4.0	2.0 (4.0 for WTG)	20
Settling time	Seconds	10.0	10	30
Damping ratio	Unitless	0.3	0.2	1.0
Settling band	% of change	Max of: 2.5% of change or 0.5% of ICR	1	5



[1] Federal Energy Regulatory Commission, Docket No. RM16-6-000; Order No. 842. Essential Reliability Services and the Evolving Bulk-Power System—Primary Frequency Response. Issued February 15, 2018.

Consecutive voltage deviation is the only remaining requirement needed to complete adoption of all ride-through capabilities in the standard

- Requires the IBR plant to ride through multiple voltage excursions outside of the continuous operation region
  - Exceptions provided in tables[1]
- This clause was not included in Phase I of 2800 requirement adoption due to concerns about original equipment manufacturer (OEM) readiness
- MISO is requesting feedback about technology readiness for this clause, now that there has been more time to evaluate the impacts of 2800 requirements on different inverter models

Time Period	May Trip for this number of Voltage Deviations
10s	5+
120s	7+
30min (1,800s)	11+

Time Period	May Trip for this number of Voltage Deviations Below 50% of Nominal Voltage
10s	3+
120s	4+

[1] Additional exceptions are listed in the Appendix (Slide 33)

MISO proposes to enhance existing monitoring and recording data requirements in four areas

Data Type[1]	Data Format	Summary
Sequence of Events Recording (SER) data	Tab log file	Storage of event records and logs
Digital Fault Recording (DFR) data	COMTRADE	Capture plant-level response to BPS events, typically transient point-on-wave data with high resolution
Dynamic Disturbance Recorder (DDR) data	COMTRADE	Plant-level data captured **continuously,** including voltage phasor, frequency, and current phasor
Inverter fault codes and dynamic recordings	Tab log file, COMTRADE	For events which trigger ride-through operation of an IBR unit, record fault codes and current/voltage values at the IBR unit-level

[1] Bolded data types have overlap with existing requirements in MISO's GIA

- The four categories of measurement data above are identified in both the IEEE 2800 standard and the draft PRC-028 standard (Disturbance Monitoring and Reporting Requirements for IBRs)
- Detailed information on data items, recording rates, and retention and duration requirements will be provided at the next IPWG

MISO is requesting feedback on this proposal to require phasor measurement unit (PMU) data for IBRs

- IEEE 2800 and the draft standard PRC-028 have plant-level dynamic disturbance recorder (DDR) data requirements
  - MISO is proposing to specifically require PMU data rather than DDR data more broadly
- It is MISO's understanding that PMUs are commonly installed with standard plant equipment, and are a known solution for meeting DDR requirements
- There are two applications of PMU technology to be considered:
  - Local storage of PMU data, for post-event analysis
  - Real-time streaming of PMU data, which could support future real-time analysis tools for operators
- MISO is exploring the need for data streaming versus data storage, and will propose the PMU data collection method at the next IPWG

Dynamic Disturbance Recording (DDR)

NERC - "The recording of time sequenced data for dynamic power system characteristics."[1]

Fast, continuous sampling (i.e. output of 30-60 times per second)

Phasor Measurement Unit (PMU)

High-speed devices that measure time synchronized voltage and current phasors of the power system, and can provide data in real-time

Capable of meeting DDR sampling requirements

[1] https://www.nerc.com/pa/Stand/Project%20200711%20Disturbance%20Monitoring%20RF%20DL/DM_Webinar_1st_Posting_Rev1.4.pdf

There are decision points associated with MISO's recommended performance requirements that will be detailed in the tariff language

Category	Performance Capability	*IEEE 2800 Clause*	*Decision Points*
Voltage Support	Minimum Reactive Power Capabilities	5.1	None (adopt by reference)
	Reactive Power Capability at Zero Active Power	5.1	None (adopt by reference)
	Voltage and Reactive Power Control Modes - General	5.2.1	None (adopt by reference)
	Voltage Control	5.2.2	Dynamic performance requirements decisions: max *step response time* and range of conditions for requirement applicability
	Constant Power Factor	5.2.3	Determine minimum active power level for power factor control mode
	Constant Reactive Power	5.2.4	None (adopt by reference)
Frequency Response	Primary Frequency Response (PFR)	6.1	Specify utilization of PFR capability
Dynamic Responses/Reliability Services	Consecutive Voltage Deviation Ride-Through	7.2.2.4	None (adopt by reference)
Measurement	Measurement Data for Monitoring and Validation	11	Specify exact data categories, data points, recording rates, retention and duration times

MISO is requesting input from stakeholders on many of these adoption decision points

Next Steps

- Request, review, and respond to stakeholder feedback on proposed performance requirements
- MISO will provide further detail on proposed measurement data requirements
- MISO will propose Tariff redline language for MISO's Tariff Attachment X-Appendix 6 at the next IPWG
- MISO will also propose an implementation plan

Stakeholder Feedback Request

- MISO is requesting feedback on the **Recommended IBR Performance Requirements (PAC-2024-2)** presented today by March 26th, 2024.
  - Concerns or reasons not to proceed with recommended performance requirements
  - Other performance requirements you see as priorities that should be considered in this round of implementation
  - Specific input on the following technical questions, with rationale for preferences:
    - What **voltage control maximum *step response time***, within the range of 1-30 seconds, is preferred? (Slide 8)
    - What is the preferred methodology for defining the **range of system conditions** that the voltage control dynamic performance requirements should be applicable for? (Slide 8)
    - What is the preferred **minimum active power level** for power factor control mode operation? (Slide 9)
    - Concerns about implementation of consecutive voltage deviation ride-through requirements (Slide 12)
    - Thoughts on measurement data categories and requirement of PMU data (Slides 13 and 14)
- Feedback requests and responses are managed through the Feedback Tool on the MISO website: https://www.misoenergy.org/engage/stakeholder-feedback/

Questions?

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Appendix

Links to previous 2024 MISO presentations:

- 20240130 IPWG Item 04 IBR Performance Requirements

Category	Performance Capability	*IEEE 2800 Clause*	*Current MISO Tariff Requirement*	*Summary of Performance Improvement Opportunity*
Voltage Support	Minimum Reactive Power Capabilities	5.1	Attachment X Appendix 6 Section 9.6.1.2: Plant shall be "capable of maintaining a composite power delivery at continuous rated power output at the high-side of the generator substation at all power factors over 0.95 leading to 0.95 lagging". Attachment X Appendix 6, Appendix G, Section A.ii. : Plant "shall maintain a factor within the range of 0.95 leading to 0.95 lagging … measured at the high side of the generator substation."	Define more specific reactive power requirements for IBRs, with additional details for BESS and Type III WTGs
	Reactive Power Capability at Zero Active Power	5.1	Not required	Require the capability to provide reactive power support when the primary energy source is not available
	Voltage and Reactive Power Control Modes - General	5.2.1	Attachment X Appendix 6 Section 9.6.2: "Interconnection Customer shall operate the Generating Facility to maintain the specified output voltage or power factor"	List three required operating modes and specify voltage control as the default
	Voltage Control	5.2.2	Attachment X Appendix 6 Section 9.6.2.1: "Interconnection Customer shall operate the Generating Facility with its speed governors and voltage regulators in automatic operation."	Clearly define the voltage control mode, require a damping ratio of 0.3 or higher and other dynamic performance requirements
	Constant Power Factor	5.2.3	Attachment X Appendix 6 Section 9.6.2: "Interconnection Customer shall operate the Generating Facility to maintain the specified output voltage or power factor"	Clearly define the constant power factor control mode, require a damping ratio of 0.3 or higher
	Constant Reactive Power	5.2.4	Not required	Clearly define the constant reactive power control mode, require a damping ratio of 0.3 or higher
Frequency Response	Primary Frequency Response (PFR)	6.1	Attachment X Appendix 6 Section 9.6.4: IC "is required to install a governor or equivalent controls with the capability of operating with a maximum 5 percent droop and +-0.036 Hz deadband...". Attachment X Appendix 6 Section 9.6.4.2: IC shall ensure that the plant's real power response is automatic, immediate, and sustained until the frequency returns to a value within the deadband. See additional language in sections 9.6.4, 9.6.4.1, 9.6.4.2. 9.6.4.3, and 9.6.4.4	Add ranges of available settings for PFR droop and deadband values. Define dynamic performance parameters for PFR.
Dynamic Responses/Reliability Services	Consecutive Voltage Deviation Ride-Through	7.2.2.4	Not required	Define consecutive voltage deviation ride-through to increase general ridethrough robustness
Measurement	Measurement Data for Monitoring and Validation	11	Attachment X Appendix 6, Appendix G, Section A.iv. : "Non-synchronous generating facilities with generating capacities of more than 20 MW must monitor and record data for all frequency ride-through events, transient low-voltage disturbances that initiated reactive current injection, reactive current injection or momentary cessation for transient high-voltage disturbances, and inverter trips. See full tariff section for more details.	Clear requirements for data types, format, sampling/recording, and retention

Additional information on IEEE 2800-2022 performance requirements

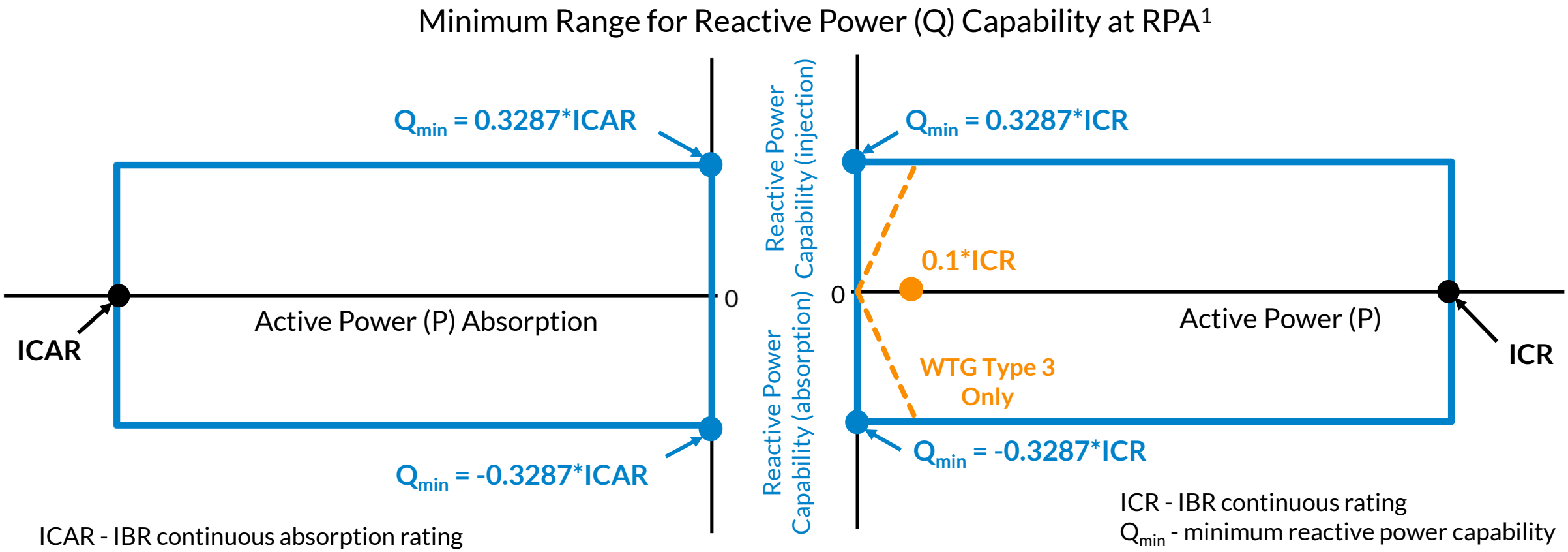
Slides contain MISO's summary of the standard, see the IEEE 2800-2022 publication for complete details

IEEE 2800 defines minimum reactive power capabilities

- IBR minimum reactive power capability to inject or absorb at least 32.87% of IBR continuous rating (ICR) at the point of measurement (POM).
  - Applies only when applicable voltage and frequency are within the *continuous operation region*
  - Applies both when IBR is injecting and absorbing active power[1].
  - Applies at all levels of active power, with several exceptions[2]
    - Type III wind turbine generators have reduced reactive requirement at low active power levels.
  - Equates to +/-0.95 power factor, consistent with FERC Orders 2003[3] and 827[4]
  - Capability requirement applies regardless of primary energy source availability status.[5]
    - Under mutual agreement, the capability may be used to participate in reactive power exchange at zero active power.
    - If IBR is designed to cease operation below a specified minimum active power capability that's greater than zero, the IBR plant will not produce reactive power after operation ceases.

[1] Absorbing active power applies to energy storage. The continuous active power absorption rating is used for determining reactive power during absorption.
[2] An exception related to off-shore wind exists in IEEE 2800-2022 clause 5.1.
[3] Federal Energy Regulatory Commission, Docket No. RM02-1-000; Order No. 2003. Standardization of Generator Interconnection Agreements and Procedures. Issued July 24, 2003.
[4] Federal Energy Regulatory Commission, Docket No. RM16-1-000; Order No. 827. Reactive Power Requirements for Non-Synchronous Generation. Issued June 16, 2016.
[5] Type III WTG may have reduced reactive power capabilities when primary energy source is not available.

Minimum reactive power capability requirements apply during both active power injection and active power absorption (if applicable)



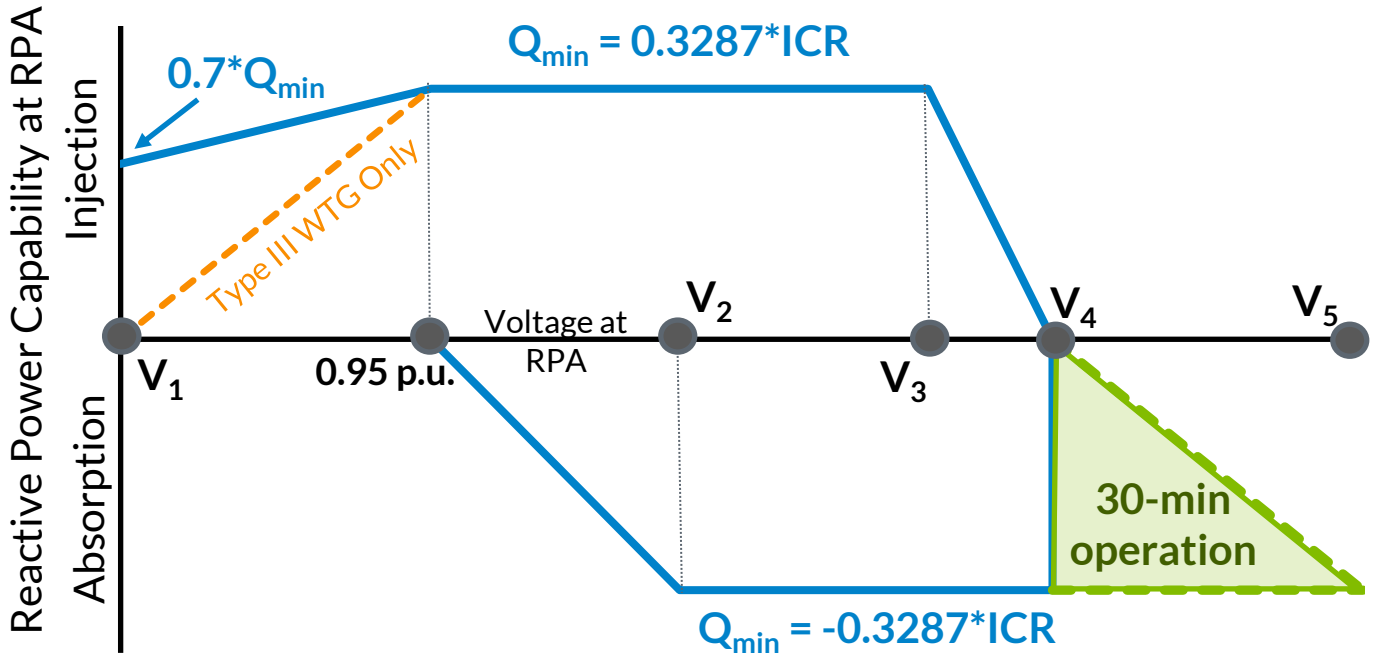
Reference Point of Applicability (RPA) shall be the Point of Measurement (POM)

[1] Figures shows minimum reactive power capability, actual reactive power capability can go beyond this

Additional reactive power capability requirements apply for non-nominal voltage conditions

- Minimum reactive power capability requirements differ by nominal RPA voltage, as shown in the table below.[1]
- Different requirements exist for continuous versus 30-minute operation.
- IBR shall maintain voltage schedule provided by transmission operator, within required capability[2]

TS nominal voltage at the RPA[3]	V1 (p.u.)	V2 (p.u.)	V3 (p.u.)	V4 (p.u.)	V5 (p.u.)
< 200 kV	0.90	0.99	1.03	1.05	1.10
>= 200 kV (except 500 kV and 735 kV)	0.90	1.00	1.04	1.05	1.10
500 kV	0.90	1.02	1.06	1.10	1.10
735 kV	0.90	1.02	1.06	1.088	1.10



Reference Point of Applicability (RPA) shall be the Point of Measurement (POM)

[1] An exception exists for Type III WTG for voltages less than 0.95 p.u.
[2] Requirement applies to storage across charging or discharging statuses, including the transition between.
[3] *TS operator* can require different values for V1-V5

The standard also contains dynamic requirements for reactive capability and control

- Reactive power capability and control shall be dynamic as defined by the voltage control requirements (IEEE 2800, Table 5) shown in Slide 27.
  - IBR time response for steady-state condition includes transformer tap changing that's needed to retain IBR unit voltages within range of Q requirements.
  - Switched shunts or LTC transformer tap change operation needed to restore dynamic reactive power capability shall respond within 60 seconds.
- Non-dynamic reactive power devices can be used to compensate for losses between *IBR units* and the RPA if they are automatically controlled to maintain *IBR plant* dynamic capability

Dynamic Reactive Power Devices

- Power electronics based systems (*IBR units*, SVC, STATCOM, etc.)
- Rotating machines (synchronous machines, type III WTGs, etc.)
- Electronically-switched compensation devices

Non-Dynamic Reactive Power Devices

- Mechanically-switched reactive power compensation devices (shunt capacitors, shunt reactors, etc.)

IEEE 2800 provides requirements and dynamic performance requirements for the default voltage control operating mode

- Automatic voltage control mode droop shall have a range of settings from 0 to 0.3 p.u. voltage change for 1.0 per unit reactive power on the ICR base
- Dynamic reactive power response to a step change in voltage must meet the performance requirements in the table
  - A stable and damped response takes precedence over response time

Voltage Control Mode

Closed-loop automatic voltage control mode to regulate steady-state voltage at RPA to the reference value within 1% of the set point

Parameter	Performance Target
Reaction time	< 200 ms
Maximum *step response time*[1]	As required by the *TS operator*[2]
Damping ratio[3]	0.3 or higher

Requirements in this table shall only be applicable to a defined range of TS equivalent impedance at the POM, specified by the *TS operator.*

[1] The standard states that the slowest response shall be tuned based on the *TS operator* requirements for response time and stability given grid strength, local voltage control devices, and overshoot requirements
[2] *Step response time* typically ranges between 1 – 30 seconds
[3] Damping ratio will depend on grid strength

IEEE 2800 requires primary frequency response within the limits of minimum and available active power

- The IBR plant shall have the capability to provide primary frequency response in both the continuous and mandatory operation regions
  - Response to under-frequency conditions is limited by available active power
  - Response to over-frequency conditions is limited by minimum active power capability
- The IBR plant PFR controller shall have the following default values and ranges of possible settings
  - Default values for deadband and droop match what is currently required in the MISO Generator Interconnection Agreement[1]

Parameter	Units	Default Value	Ranges of available settings	
			Minimum	Maximum
Underfrequency deadband (db_{UF})	Hz	0.06% x f_{nom}	0.025% x f_{nom}	1.6% x f_{nom}
Overfrequency deadband (db_{OF})	Hz	0.06% x f_{nom}	0.025% x f_{nom}	1.6% x f_{nom}
Underfrequency droop (k_{UF})		5%	2%	5%
Overfrequency droop (k_{OF})		5%	2%	5%

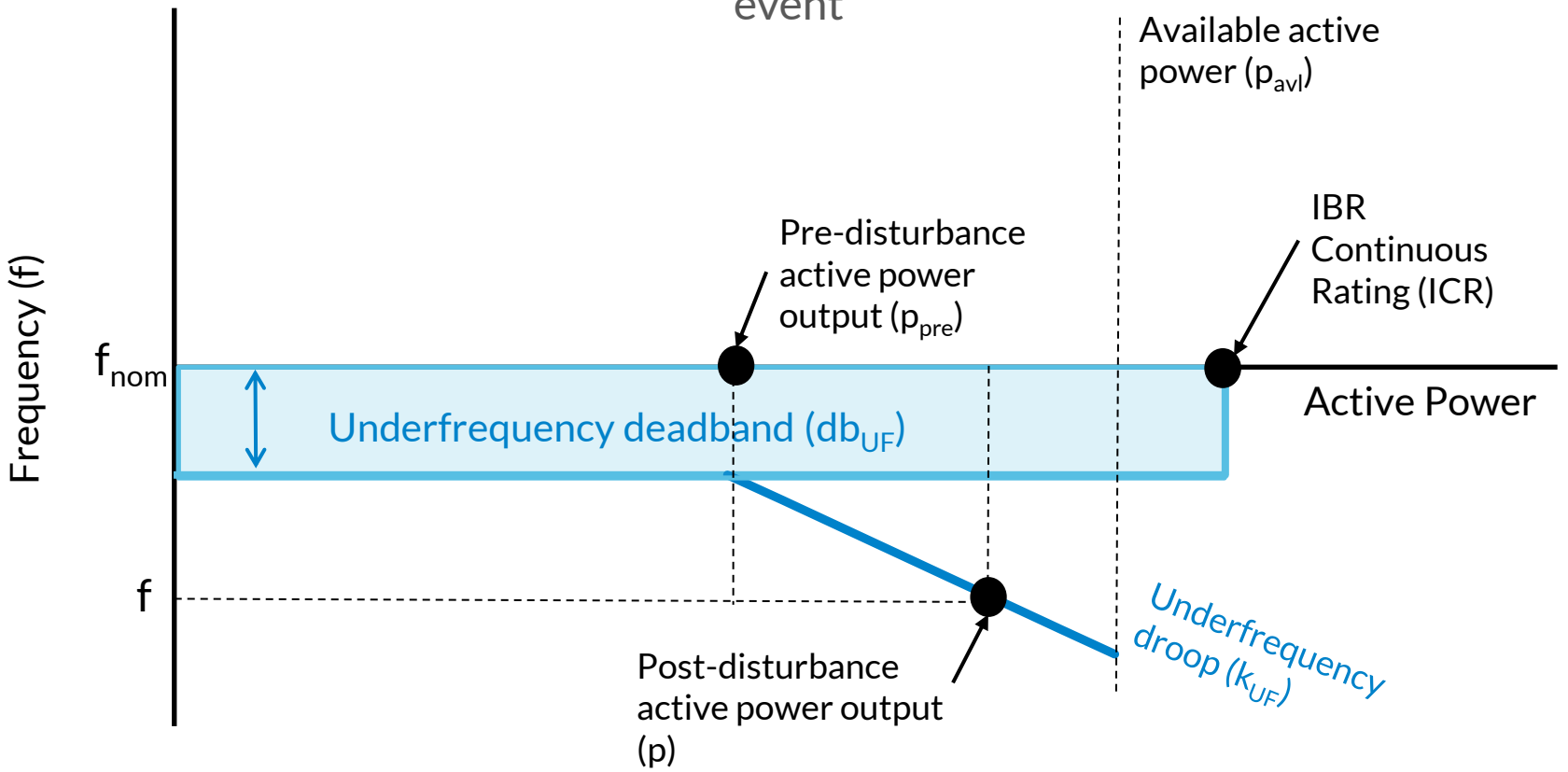
[1] With an f_{nom} value of 60 Hz, the default underfrequency and overfrequency deadbands show in the table are 0.036 Hz

PFR - Underfrequency Event Example

- Calculate the desired active power output with PFR response following the provided equation
- Active power output will be the desired active power output with PFR response, unless available active power is limiting

$$p = \min\left\{p_{avl}, p_{pre} + p_{PFR}\right\} = \min\left\{p_{avl}, p_{pre} + \max\left(0, \frac{f_{nom} - f - db_{UF}}{f_{nom} \times k_{UF}}\right)\right\}$$

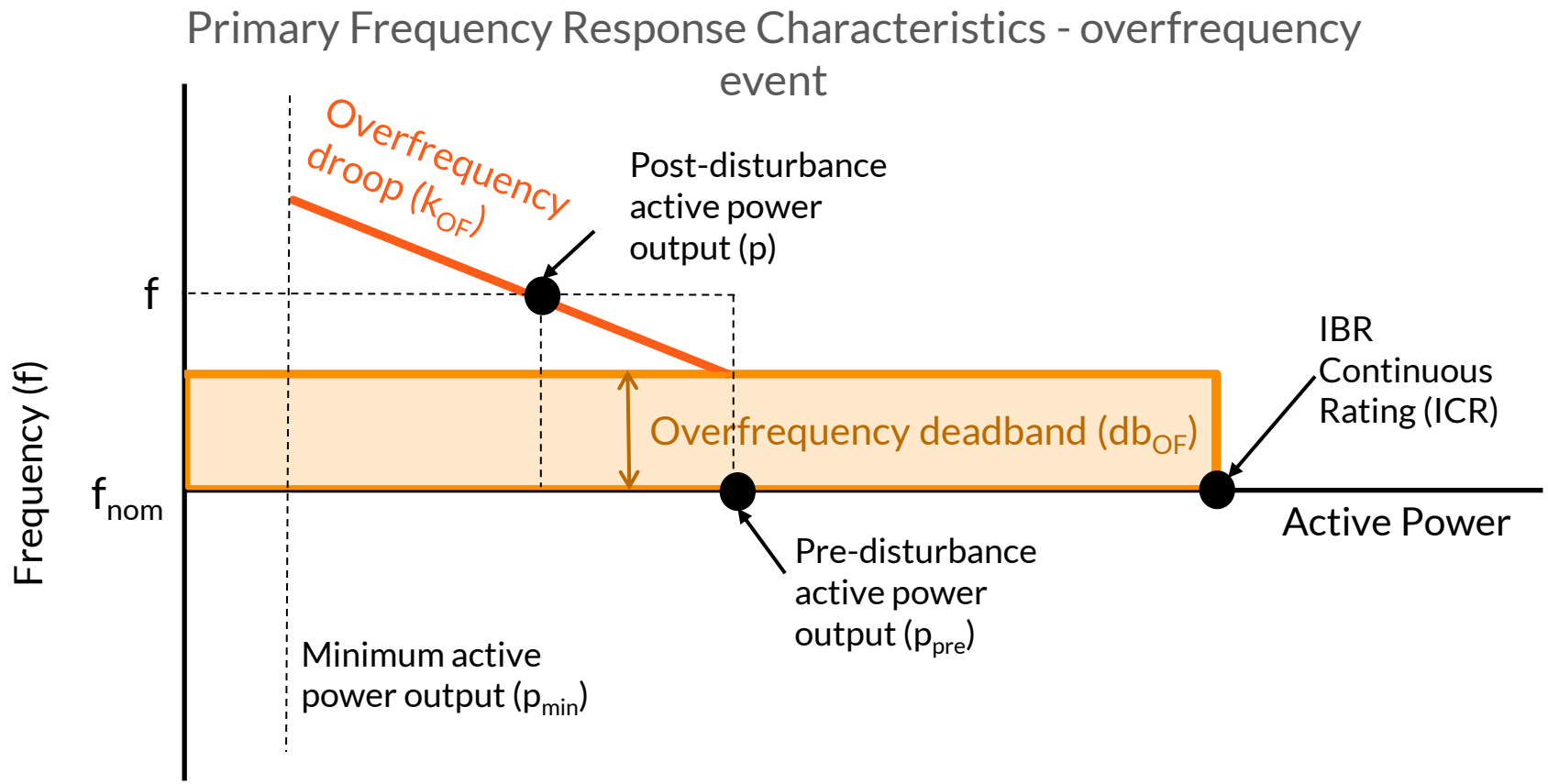
Primary Frequency Response Characteristics - underfrequency event



PFR Overfrequency Event Example

- Calculate the desired active power output with PFR response following the provided equation
- Active power output will be the desired active power output with PFR response, unless minimum active power is limiting

$$p = \max\left\{p_{\min}, p_{\text{pre}} + p_{\text{PFR}}\right\} = \max\left\{p_{\min}, p_{\text{pre}} + \min\left(0, \frac{f_{\text{nom}} - f + db_{\text{OF}}}{f_{\text{nom}} \times k_{\text{OF}}}\right)\right\}$$



Dynamic performance capabilities are defined for primary frequency response

- IBR plant shall sustain PFR for as long as the primary energy source is available
- Dynamic response for a step change in applicable frequency shall adhere to the parameters in the table below
- IBR plant will not be required to change its active power output at a rate greater than its ramping capability
- Response shall be stable and positively damped with a ratio of 0.3 or higher
  - A damped response takes priority over the rise and settling time parameters

Parameter	Units	Default Value	Ranges of available settings	
			Minimum	Maximum
Reaction time[1]	Seconds	0.50	0.20 (0.5 for WTG)	1
Rise time	Seconds	4.0	2.0 (4.0 for WTG)	20
Settling time	Seconds	10.0	10	30
Damping ratio	Unitless	0.3	0.2	1.0
Settling band	% of change	Max of: 2.5% of change or 0.5% of ICR	1	5

[1] Reaction time starts when the applicable frequency deviates outside of the PFR deadband

IEEE 2800 also contains clarifications for the utilization of PFR in operations

- If the IBR plant is in curtailed operation, response to under-frequency disturbances is required up to the IBR plant's available active power
- Total active power output may be allowed to temporarily exceed the ICR of the IBR plant up to its IBR short-term rating (ISR)
- IBR plant shall return to normal operation when the frequency returns within the PFR deadbands, at that point the PFR magnitude will inherently become zero
- For energy storage systems, the dynamic performance during PFR when changing from exporting to importing active power (and vice versa) shall not prevent the IBR plant from meeting the dynamic performance requirements

ICR: IBR continuous rating

Consecutive voltage deviation ride-through is required, but exceptions are provided for high numbers of voltage deviations

- IBR plant shall ride through multiple voltage excursions outside of the continuous operation regions except:
  - May trip for the cases shown in the tables below
  - May trip if the cumulative duration of voltage deviations exceeds the voltage ride-through durations
  - May trip for any voltage deviation outside of continuous operation regions that follows the end of a previous deviation by less than 20 cycles of system fundamental frequency
  - Individual WTG units may trip to self-protect for consecutive voltage deviations that result in mechanical resonances that exceed equipment limits

Voltage Deviation Definition

- Begins when the voltage leaves the continuous operation region
- End when the rms magnitude of the voltage is within the continuous operation region

Time Period	May Trip for this number of Voltage Deviations
10s	5+
120s	7+
30min (1,800s)	11+

Time Period	May Trip for this number of Voltage Deviations Below 50% of Nominal Voltage
10s	3+
120s	4+