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PROJECT NO. 54233

TECHNICAL REQUIREMENTS AND	§	PUBLIC UTILITY COMMISSION
INTERCONNECTION PROCESSES FOR	§	
DISTRIBUTED ENERGY RESOURCES (DERS)	§	OF TEXAS

COMMENTS OF CENTERPOINT ENERGY HOUSTON ELECTRIC, LLC

CenterPoint Energy Houston Electric, LLC (“**CenterPoint Energy**” or the “**Company**”) submits these comments in response to the Commission Staff’s draft of a proposed new rule to be codified at 16 Tex. Admin. Code (TAC) § 25.212, related to the technical and operational requirements for the parallel operation of interconnected distributed energy resources (“**DERS**”).¹ The draft rule (the “**Technical Requirements Rule**”) was the subject of a workshop held on July 14, 2023, in which interested parties from various industry segments and consumer representatives participated along with Commission Staff. As understood by the Company, the Technical Requirements Rule would apply to all DERs interconnecting and operating in parallel with a DSP’s distribution system, except that the specific operational standards and performance requirements set out in subsection (d)(7)-(14) of the draft Technical Requirements Rule (collectively, the “**Voltage and Frequency Standards and Requirements**”) would not apply to DERs that have a nameplate capacity of 1MW or greater, nor to DERs (regardless of nameplate capacity) that register with ERCOT as resources (collectively, the “**1MW DERS**”), unless otherwise permitted by the interconnecting DSP; instead, pursuant to subsection (k) of the Technical Requirements Rule, ERCOT will be responsible for developing separate Voltage and Frequency Standards and Requirements to be applicable to those DERs.

Attachment 1 to these comments is CenterPoint Energy’s recommended changes to the draft Technical Requirements Rule. Below is a summary explanation of some of those recommended changes.

¹ This draft rule 25.212 uses the term “*distributed* energy resource” to mean a DER, but the draft rule 25.210 uses the term “*distribution* energy resource” to mean a DER. The same term should be consistently used in both rules.

A. ERCOT's Additional Voltage and Frequency Standards and Requirements under Subsection (k).

Based on the workshop discussion, it is envisioned that ERCOT will be delegated responsibility for developing the Voltage and Frequency Standards and Requirements for the 1MW DERs. Since those standards and requirements are not available for review at this time, and in an effort to clarify and limit the scope of the Voltage and Frequency Standards and Requirements that ERCOT may develop, the Company included in its Attachment 1 the most likely location within ERCOT Nodal Operating Guide sections that should specifically cover those standards and requirements; namely, sections 2.6.2 (Generators and Energy Storage Resources), which defines the necessary frequency trip and ride through settings for a DESR/DGR, and 2.9.2 (Voltage Ride-Through Requirements for DGR and DESR), which defines the necessary over/under voltage trip settings and over/under voltage ride through settings for a DESR/DGR. The Company believes that the Voltage and Frequency Standards and Requirements for 1MW DERs, when they are developed, should be placed within those Nodal Operating Guide sections, because DER providers should be already familiar with those sections, making them more readily identifiable for DER providers in the future.

B. DSP Discretion to Consider a Range of Allowable Operational Standards and Performance Requirements.

The Company believes there will be a need for a DSP to consider protection coordination with DER in the future that are outside of the settings adopted under subsection (d) of the draft Technical Requirements Rule. This was discussed in IEEE technical working group meetings and captured in the IEEE-1547-2018 standard. CenterPoint Energy is looking to add this flexibility into the subsection (d), as reflected in Attachment 1, for the DSP to adjust accordingly and to allow for upstream coordination. This was not something originally specified in Staff's version of 25.212, so the Company's Attachment 1 redlining in subsection (d) adds this flexibility, stipulating that the DSP may specify other settings to allow for coordination. This redlined language (including associated tables) was taken directly from IEEE-1547-2018 section 6.4.1 and is placed in two locations, subsection (d)(8), concerning voltage and clearing times for synchronous DERs, and subsection (d)(10), concerning voltage and clearing times for inverter-based DERs.

C. Synchronization Tolerances for DERs Providing Fundamental Voltage Prior to Interconnecting.

As discussed at the Workshop, the Company agrees with the removal of the “Phase Angle Difference” row in the subsection (d)(6) table of the draft Technical Requirements Rule. However, CenterPoint Energy believes that synchronization language needs to be included in the Technical Requirements Rule but placed more properly in its own table. To accomplish this, the Company’s Attachment 1 includes additional language and an additional table in subsection (d)(6) that borrows from the IEEE-1547-2018 section 4.10.4 language. The Company feels that this is a good addition to mitigate reliability concerns for DERs that synchronize outside of these parameters. The Company’s additional subsection (d)(6) table also clearly defines the tolerances necessary to safely synchronize without causing disturbances to nearby load customers.

D. Additional Certification Requirements for Battery Energy Storage Systems (BESS).

CenterPoint Energy believes that additional certification requirements should be included within the “General Interconnection and Protection Requirements for All DER” in subsection (f) of the Technical Requirements Rule, in recognition of the fact that there have been numerous reported fires associated with BESS systems in recent years. As shown in Attachment 1, the Company recommends revising subsection (f)(4)(A) of the Technical Requirements Rule to require certification of applicable DER equipment under the most recent versions of the UL-9540 and UL-9540A standards. Such certification will provide assurances that the BESS have a fire suppression system that has been tested and certified as capable of extinguishing in the event of a catastrophic failure and reduces safety and reliability concerns related to paralleling BESS with the distribution system.

E. Enchanted Rock Request to Exclude Certain Equipment Changes from the Subsection (c)(3) Trigger to Transition from Legacy DER Standards to New DER Standards.

Subsection (c)(3)(B) of the Technical Requirements Rule, as amended and shown in Attachment 1, provides as follows:

Unless otherwise reviewed and waived by the DSP, a legacy DER must transition to the standards required for a new DER under subsection (d) or subsection (k) of this section, as applicable to the size of the legacy DER, within 90 calendar days from the occurrence of any of the following; provided that

such timeframe may be extended by the DSP if additional studies are required before any of the following can occur:

- (i) The aggregate replacement of 50% or more of the nameplate capacity of the conversion devices (such as, for example, inverters) or changes to the intended operations or other terms in the legacy DER interconnection agreement; or
- (ii) A change in the fuel type of any one or more of the generators at the DER;
- (iii) The replacement of any generator, inverter or protective relay, or a change in the DER's mode of operation; and/or
- (iv) An increase in capacity at the DER.

CenterPoint Energy's recommended language in subsection (c)(3)(B)—“Unless otherwise reviewed and waived by the DSP”—is intended to give DER providers an option to request for waiver before having to initiate the transition from the legacy DER standards to the new DER standards.

In CenterPoint Energy's experience, a DER equipment change that affects capacity, fuel type, or intended operation, requires a full restudy to confirm the operating limits established in the legacy design. However, the Company also recognizes that changes in DER ownership and/or some equipment changes may not require a full restudy but would require an amendment to the interconnection agreement (IA) or revision to supplemental terms and conditions in the IA, or verification testing. If changing a generator or inverter to a newer model with the same capacity, certifications, and functionality, then merely updating the IA and verifying that the change has no impact to the protective relay functionality may be acceptable. If changing a protective relay with same make, model, and firmware, then a verification of protective relay settings, the factory defaults of the protective relay settings, verification testing, and/or telemetry settings may be required to ensure the proper operations of the relay and avoid unintended operations of the relay. Each situation is unique and, based on the requested modification, must be reviewed on a case-by-case basis. A blanket “like-for-like replacement with identical model number” exception to the legacy-to-new transition requirement without review by the DSP could lead to unintended operation of the relay causing reduced reliability, equipment damage, and safety hazards.

F. Subsection (d)(14)'s Dynamic Voltage Support Requirement.

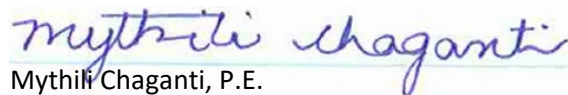
Subsection (d)(14) of the Voltage and Frequency Standards and Requirements, as amended and shown in Attachment 1, provides as follows: "Unless otherwise specified by the DSP, each DER must meet the reactive power requirements below and must have dynamic voltage support *disabled*." Emphasis added.

CenterPoint Energy believes it best to reserve the right to control the dynamic power produced by a DER provider if it could affect the DSP's distribution system customers on the interconnected line. The Company changed the default setting for a DER's dynamic voltage support from "enabled" to "disabled." The Company's concern is the DER provider would not have enough telemetry to make the best judgment and could, in fact, counter the efforts of the DSP's own line devices to provide dynamic voltage support for the distribution system if the DER's dynamic voltage support was enabled. If the systems are not coordinated correctly this could lead to damaging the DSP's and DER providers equipment, which may cause unnecessary outages and power quality issues for the DSP's distribution system load customers. The Company's recommended language would have the default setting be "disabled" and allow the DSP to determine if using the DER as means to provide dynamic voltage support is needed.

CONCLUSION

CenterPoint Energy thanks Commission Staff for hosting and conducting the workshops and for doing a great job in facilitating consensus on the rule changes that are needed. We respectfully reserve the right to provide additional comments in the future upon further review of stakeholder comments.

Respectfully submitted,



Mythili Chaganti, P.E.
Manager, Distributed Generation
CenterPoint Energy Houston Electric
TX P.E. License# 119897
1111 Louisiana Street
Houston, Texas 77002
mythili.chaganti@centerpointenergy.com
(713) 207-7417 (office)
(713) 207-9120 (efax)

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§25.212. Technical and Operational Requirements for Parallel Operation of Interconnected Distributed Energy Resources (DERs).

- (a) **Application.** This section prescribes the minimum technical and operational requirements that must be maintained on an ongoing basis for all distributed energy resources (DERs) in Texas interconnected ~~on and running in parallel with~~ a DSP's distribution system, except that, pursuant to subsection (k) of this section, or unless specifically stated otherwise in an executed interconnection agreement, paragraphs (7) through (14) of subsection (d) of this section do not apply. ~~The only part of this section that applies to~~ DERs located in the Electric Reliability Council of Texas (ERCOT) region and have a nameplate capacity of at least one megawatt (~~MW~~MVA), or DERs that are registered with ERCOT ~~as resources, is subsection (k) of this section.~~ If a DSP located outside of the ERCOT region establishes and maintains technical and operational requirements for DERs with a nameplate capacity of one ~~MW~~MVA or more that are different from those provided in subsection (c)-(j) of this section, then the only part of this section that applies to the DERs with a nameplate capacity of one ~~MW~~MVA or more that interconnected to that DSP's distribution system is subsection (k).
- (b) **Definitions.** The following words and terms when used in this section have the following meanings, unless the context indicates otherwise:
- (1) **Interconnection application** - means the form provided in 25.211(q) or 25.210(~~#~~?) as applicable to the size of the DER.
 - (2) **Interconnection agreement** - means the form provided in 25.211(p) or 25.210(~~m~~?) as applicable to the size of the DER.
 - (3) **Interconnection** - means the physical connection of a DER to a DSP's distribution system at a POI in accordance with the requirements of 25.210 or 25.211 as applicable to the size of the DER.
 - (4) **Protective Function** - will be the same as in 25.210
 - (5) **DER** - will be the same as in 25.210 and 25.211
 - (6) **DER provider** - will be the same as in 25.210
 - (7) **Parallel operation (includes parallel and paralleling)** - will be the same as 25.210 and 25.211
 - (8) **Point of interconnection (POI)** - will be the same as 25.210 and 25.211
 - (9) **Certified equipment** - will be the same as 25.210 and 25.211
 - (10) **Stabilized** - A distribution system is considered stabilized when, following a disturbance, the distribution system returns to normal range of voltage and frequency for a duration of no less than two minutes, unless otherwise specified by the DSP. ~~A shorter time may be mutually agreed to by the DSP and DER provider.~~
 - (11) **Distribution system** - will be the same as 25.210 and 25.211
- (c) **New and legacy DERs.**
- (1) **New DERs.** A DER is ~~subject to the requirements for new DERs under subsection (c) of this section, considered a new DER~~ unless a DER is it qualifies as a legacy DER under paragraph (2) of this subsection. A new DER must comply with this section, as applicable, ~~other than including the standards required under~~ subsection (d) of this section, or such other standards developed by ERCOT under subsection (k) of this section, as applicable to the size of the new DER.
 - (2) **Legacy DERs.** A legacy DER is a DER that is covered by an executed interconnection agreement with an effective date on or before the effective date ~~must comply with this section, as applicable, except for subsection (c) of this section.~~ A legacy DER must comply with this section, as applicable, including the standards required under subsection (e) of

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this section, or such other standards developed by ERCOT under subsection (k) of this section, as applicable to the size of the legacy DER.

~~(A) — a DER that was interconnected to a DSP on or before January 1, 2024; or~~

~~(B) — a DER for which an interconnection application was received by the DSP and was under review prior to January 1, 2024.~~

(3) Transition from legacy DER standards to new DER standards.

(A) Beginning 90 calendar days after the effective date of this section, any new or replacement equipment or facilities ~~being~~ installed on a legacy DER must comply with the standards required ~~for a new DER~~ under subsection ~~(ed)~~ or subsection (k) of this section, as applicable to the size of the legacy DER, except that the DER provider may submit information on the planned new or replacement equipment installation to the DSP for review, and the DSP may review such information and waive this compliance requirement for that particular new or replacement equipment installation.

(B) ~~A~~ Unless otherwise reviewed and waived by the DSP, a legacy DER must transition to the standards required for a new DER under subsection ~~(ed)~~ or subsection (k) of this section, as applicable to the size of the legacy DER, within 90 calendar days from the occurrence of any of the following; provided that such timeframe may be extended by the DSP if additional studies are required before any of the following can occur:

(i) ~~For a DER with a nameplate capacity rating of one MWMVA or greater, the aggregate replacement of 50% or more of the any equipment or facilities of associated with that DER; The aggregate replacement of 50% or more of the nameplate capacity of the conversion devices (such as, for example, inverters) or changes to the intended operations or other terms in the legacy DER interconnection agreement; or~~

(ii) A change in the fuel type of any one or more of the generators at the DER;

(iii) The replacement of any generator, inverter or protective relay, or a change in the DER's mode of operation; and/or

(iv) An increase in capacity ~~of more than 10% of the previous capacity~~ at the DER.

(d) **Operational standards and performance requirements for new DERs.** ~~A~~ Except as otherwise provided in subsection (k) of this section for DERs with a nameplate capacity over one (1) MVA, a new DER, except as provided under paragraph (b)(2) of this section, must comply with the requirements of this subsection on an ongoing basis.

(1) A DER must not cause the primary and secondary circuit voltage to exceed the nominal operating ranges established in ~~American National Standards Institute (ANSI) C84.1-2011~~ section 25.51.

(2) A DER must comply with the following power quality requirements.

(A) A DER interconnected at a voltage of one kilovolt (kV) to ~~35kV-60kV~~ must not cause step or ramp changes in the root mean squared (RMS) voltage at the point of interconnection exceeding 3% of nominal and exceeding 3% per second averaged over a period of one second.

(B) A DER interconnected at a voltage less than one kV must not cause step or ramp changes in the RMS voltage at the POI exceeding 5% of nominal and exceeding 5% per second averaged over a period of one second.

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(#) A DER provider shall have an automatic method of disconnecting the DER from the distribution system if sustained voltage deviations occur. The DER provider may reconnect when the distribution system voltage and frequency return to a normal range and the system is stabilized. The DSP may require additional operational and protective devices and coordination.

(C) Flicker must be measured and assessed by methods defined in the most recent version of IEEE 1453~~2015~~ and must be no more than:

E_{Pst}	E_{Plt}
0.35	0.25

(i) E_{Pst} is the emission limit for the short-term flicker severity (P_{st}). If not specified differently, the P_{st} evaluation time is 600 seconds.

(ii) E_{Plt} is the emission limit for long-term flicker severity (P_{lt}). If not specified differently, the P_{lt} evaluation time is two hours.

(D) The following current distortion limits are exclusive of any harmonics present in the DSP's distribution system without the DER connected. Current distortion must be no more than:

Individual odd harmonic order (h)	$h < 11$	$11 \leq h < 17$	$17 \leq h < 23$	$23 \leq h < 35$	$35 \leq h < 50$	Total Rated current distortion (TRD)
Percent (%)	4.0	2.0	1.5	0.6	0.3	5.0

Individual even harmonic order	$h = 2$	$h = 4$	$h = 6$	$8 \leq h < 50$
Percent (%)	1.0	2.0	3.0	Range and limits as defined for odd harmonics

- (3) For short-circuit faults on the distribution system to which a DER is connected, the DER must cease to energize and trip within two seconds ten cycles if the voltage on one or more phases falls below -30% of nominal voltage on the utility system serving the DER unless specified otherwise by the DSP. ~~This requirement is not applicable to faults that cannot be detected by the DSP's protection systems.~~
- (4) A DER must detect and cease to energize and trip all phases to which the DER is connected for any open-phase condition at the POI. The DER must cease to energize and trip within two seconds of the open-phase condition unless specified otherwise by the DSP.
- (5) A DER must detect any unintentional island condition and, within two seconds of the formation of the island, must cease to energize and trip unless specified otherwise by the DSP. The DER must not remain connected to or energize a de-energized circuit owned by the DSP unless specified otherwise by the DSP. When

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restoring output after momentary cessation, the restore output settings of the DER must be coordinated with the DSP's reclosing timing.

- (6) A DER must not connect and operate in parallel with the distribution system unless it is capable of detecting the system voltage and frequency, and synchronizing with the DSP's distribution system, and the applicable system voltage and frequency are within the ranges specified below:

Enter Service Criteria		System
Applicable voltage within range	Minimum	0.917 per unit (p.u.)
	Maximum	1.05 p.u.
Frequency within range	Minimum	59.5 Hz
	Maximum	60.1 Hz
Phase Angle Difference (in kilovolt-amperes (kVA))	0-500 kVA	Within 20°
	>500-1500 kVA	Within 15°
	>1500 kVA	Within 10°

The DER must parallel with the DSP without causing step changes in the RMS voltage at the POI exceeding 3% of nominal when the POI is at medium voltage or exceeding 5% of nominal when the POI is at low voltage. A DER that produces fundamental voltage before connecting to the DSP shall not be synchronized outside of the tolerances stated in the table below (but could be waived by the DSP if paralleling does not exceed the limitation of voltage fluctuations specified in subsection (d)(2).

<u>Aggregate rating of DER units (kVA)</u>	<u>Frequency difference (Hz)</u>	<u>Voltage difference (p.u.)</u>	<u>Phase Angle difference (degrees)</u>
<u>0-500</u>	<u>0.3</u>	<u>0.10</u>	<u>20</u>
<u>>500-1,500</u>	<u>0.2</u>	<u>0.05</u>	<u>15</u>
<u>>1,500</u>	<u>0.1</u>	<u>0.03</u>	<u>10</u>

- (7) Each DER must have frequency droop parameters set to a maximum of 5% at 0.017 Hz and shall cease to energize the trip if exceeded. The DSP may permit other frequency-droop tripping and clearing time trip settings and may require additional operational and/or protective devices and coordination.
- (8) Each DER utilizing synchronous generation must have over-voltage and under voltage relays set to trip during the following abnormal operating conditions:

Synchronous Must-Trip Settings	Voltage (V) (p.u. of nominal)	Clearing Time (seconds)
OV2	≥ 1.20	0.16
OV1	≥ 1.10	2
UV1	≤ 0.70	2
UV2	≤ 0.45	0.16

The DSP may specify other voltage and clearing times within a range of allowable settings to consider DSP protection coordination as defined in the table below.

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<u>Range of Allowable Settings</u>	<u>Voltage Range (p.u. of nominal)</u>	<u>Clearing Time (seconds)</u>
<u>OV2</u>	<u>Fixed at 1.20</u>	<u>Fixed at 0.16</u>
<u>OV1</u>	<u>1.10 – 1.20</u>	<u>1.0 – 13.0</u>
<u>UV1</u>	<u>0.00 – 0.88</u>	<u>2.0 – 21.0</u>
<u>UV2</u>	<u>0.00 – 0.50</u>	<u>0.16 – 2.0</u>

- (9) Each DER utilizing synchronous generation must ride through in only the following abnormal operating conditions:

Voltage (p.u. of nominal)	Minimum Ride-Through Time (seconds)
$0.88 \leq V \leq 1.10$	continuous
$0.70 \leq V < 0.88$	Linear slope of 4 seconds/1 p.u. voltage starting at 0.7 seconds at 0.7 p.u.

- (10) Each DER utilizing inverter-based generation must have over-voltage and under voltage relays set to trip during the following abnormal operating conditions:

Inverter Must-Trip Settings	Voltage (p.u. of nominal)	Clearing Time (seconds)
OV2	≥ 1.20	0.16
OV1	≥ 1.10	13.0
UV1	≤ 0.88	21.0
UV2	≤ 0.50	2.0

The DSP may specify other voltage and clearing times within a range of allowable settings to consider DSP protection coordination as defined within the table below.

<u>Range of Allowable Settings</u>	<u>Voltage Range (p.u. of nominal)</u>	<u>Clearing Time (seconds)</u>
<u>OV2</u>	<u>Fixed at 1.20</u>	<u>Fixed at 0.16</u>
<u>OV1</u>	<u>1.10 – 1.20</u>	<u>1.0 – 13.0</u>
<u>UV1</u>	<u>0.00 – 0.88</u>	<u>2.0 – 50.0</u>
<u>UV2</u>	<u>0.00 – 0.50</u>	<u>2.0 – 21.0</u>

- (11) Each DER utilizing inverter-based generation must ride-through the following abnormal operating conditions:

Voltage (p.u. of nominal)	Ride-Through Mode	Minimum Ride-Through Time (seconds)
$1.10 < V \leq 1.20$	Momentary Cessation	12
$0.88 \leq V \leq 1.10$	Continuous Operation	continuous
$0.70 \leq V < 0.88$	Mandatory Operation	20
$0.50 \leq V < 0.70$	Mandatory Operation	10

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V < 0.50	Momentary Cessation	1
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- (12) Each DER must have under-frequency and over-frequency relays set to trip during the following abnormal operating conditions:

Must-Trip Function	Frequency (Hz)	Clearing Time (seconds)
OF2	62.0 61.8	0.16
OF1	61.2	300.0
UF1	58.5	300.0
UF2	56.5	0.2

- (13) Each DER must ride-through the following abnormal operating conditions:

Frequency (f) (Hz)	Ride-Through Mode	Minimum Ride-through Time (seconds)
f > 61.8	No ride-through requirements	
61.2 < f ≤ 61.8	Mandatory Operation	299
58.8 ≤ f ≤ 61.2	Continuous Operation	continuous
57.0 ≤ f ≤ 58.8	Mandatory Operation	299
f < 57.0	No ride-through requirements	

- (14) ~~Each~~ Unless otherwise specified by the DSP, each DER must meet the reactive power requirements below and must have dynamic voltage support ~~enabled~~disabled.

Category of DER	Injection capability as percent of nameplate apparent power rating (kVA)	Absorption capability as percent of nameplate apparent power rating (kVA)
A (non-inverter based)	44	25
B (inverter based)	44	44

- (15) A DER which parallels with the distribution system for 100 milliseconds or less (high speed closed transition switching), must also have at minimum the following protective devices: an interconnect disconnect device, a generator disconnect device, a breaker failure scheme, and an automatic synchronizing check for a DER with stand-alone capability. The DER provider may be required to provide the DSP test reports that demonstrate that the system operated in less than 100 milliseconds and that breaker failure, hung breaker, and shunt trip protective safety measures were installed and tested. Written comments are to be placed in the test report by the testing agent stating the system operated as designed.

- (e) **Operational standards and performance requirements for legacy DERs.** A DER that meets the requirements of paragraph (~~bc~~) (2) of this section must comply with the requirements of this subsection on an ongoing basis until transition to the standards for new DERs listed in subsection (~~ed~~) of this section, or such other standards developed by

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ERCOT under subsection (k) of this section, as applicable to the size of the new DER, is completed in the manner prescribed by paragraph (bc)(3) of this section.

- (1) **Voltage.** A DER provider must operate its generating equipment in such a manner that the voltage levels on a DSP's distribution system are in the same range as if the generating equipment were not connected to a DSP's distribution system. A DER provider must provide an automatic method of disconnecting the DER from a DSP's distribution system if a sustained voltage deviation in excess of +5.0 % or -10% from nominal voltage persists for more than 30 seconds, or a deviation in excess of +10% or -30% from nominal voltage persists for more than ten cycles. A DER may be reconnected when a DSP's distribution system voltage and frequency return to normal range and the distribution system is stabilized.
 - (2) **Flicker.** A DER must not cause excessive voltage flicker on a DSP's distribution system. This flicker must not exceed 3.0% voltage dip, in accordance with IEEE 519 as measured at the point of interconnection.
 - (3) **Frequency.** The operating frequency of a DER must not deviate more than +0.5 Hz or -0.7 Hz from a 60 Hz base. A DER must automatically disconnect from a DSP's distribution system within 15 cycles if this frequency tolerance cannot be maintained. A DER may be reconnected when a DSP's distribution system voltage and frequency return to normal range and the distribution system is stabilized.
 - (4) **Harmonics.** In accordance with IEEE 519 the total harmonic distortion voltage must not exceed 5.0% of the fundamental 60 Hz frequency nor 3.0% of the fundamental frequency for any individual harmonic when measured at the point of interconnection with a DSP's distribution system.
 - (5) **Fault and line clearing.** A DER must automatically disconnect from a DSP's distribution system within ten cycles if the voltage on one or more phases falls below -30% of nominal voltage on a DSP's distribution system. This disconnect timing also ensures that a DER is disconnected from a DSP's distribution system prior to automatic re-close of breakers. A DER may be reconnected when a DSP's distribution system voltage and frequency return to normal range and the distribution system is stabilized. To enhance reliability and safety and with a DSP's approval, a DER provider may have installed a modified relay scheme with delayed tripping or blocking using communications equipment between the DER and the DSP.
 - (6) **Requirements specific to a DER paralleling for sixty cycles or less (closed transition switching).** The protective devices required for a DER with nameplate capacity of ten ~~MW~~MVA or less which operates in parallel with the distribution system for 60 cycles or less is an interconnect disconnect device, a generator disconnect device, an automatic synchronizing check for generators with stand-alone capability, an over-voltage trip, an under-voltage trip, an over-frequency and underfrequency trip, and either a ground over-voltage trip or a ground over-current trip depending on the grounding system, if required by the DSP.
- (f) **General interconnection and protection requirements for all DER.**
- (1) A DER must meet all applicable national, state, and local construction and safety codes.
 - (2) A DER must be equipped with protective-the necessary hardware and software equipment designed to prevent the DER from being connected to a de-energized circuit owned by the DSP.

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- (3) A DER must be equipped with the necessary ~~protective~~ hardware and software equipment designed to prevent connection or parallel operation of the DER with the DSP's distribution system unless the DSP's distribution system service voltage and frequency is ~~of normal magnitude~~ stabilized.
- (4) DER equipment must be certified in the following manner.
 - (A) Certification of DER equipment occurs when specific generating and protective equipment systems have been tested and certified by the NRTL as complying with applicable portion of the most recent versions of UL-1741, UL-9540, UL-9540A, and IEEE-1547 standards relating to safety and reliability. However, the DSP may impose different or additional certification criteria for DER equipment depending on the DSP's protection requirements for the DSP's distribution system.
 - (B) Certified equipment ~~may that will~~ be ~~installed on~~ interconnected to a DSP's distribution system must be interconnected in accordance with an approved interconnection control and protection scheme. The design of certified equipment ~~may will~~ be reviewed and approved by the DSP before it is interconnected with the DSP's distribution system.
 - (C) When the DER is exporting energy to the DSP's distribution system using certified equipment, the protective settings and operations must be those specified by the DSP.
- (5) A DER provider is responsible for protecting its DER in such a manner that DSP's distribution system outages, short circuits, or other disturbances including zero sequence currents and ferroresonant over-voltages do not damage the DER. The DER provider's protective equipment must also prevent unnecessary tripping of the DSP's distribution system breakers that would affect the DSP capability of providing reliable service to other customers.
- (6) For a DER that has a nameplate capacity greater than two ~~MW~~ MVA, if an impact study requires and/or if transmission ground fault overvoltage protection is needed, the DSP may require that a communication channel and transfer trip be provided by the DER provider to provide communication between the DSP and the DER.
- (7) Circuit breakers or other interrupting devices at the point of interconnection must be capable of interrupting maximum available fault current. A DER that has a nameplate capacity greater than two ~~MW~~ MVA and exporting energy to the DSP's distribution system must have a redundant circuit breaker unless a listed recloser device suitable for the rated application is used ~~or the DSP has a circuit breaker or other interrupting device on the DSP's side of the POI capable of interrupting current to the distribution resource~~.
- (8) A DER provider will ~~have~~ installed a manual disconnect device as part of the DER that has a visual break that is appropriate to the voltage level (a disconnect switch, a draw-out breaker, or fuse block), that is readily accessible to the DSP's personnel, and capable of being locked in the open position. The DER must follow the DSP's switching, clearance, tagging, and locking procedures, which the DSP must provide to the DER provider.
- (g) **Control, protection, and safety equipment requirements for all DERs.** A DSP may require a DER provider to install additional operational or protection devices on a DER exporting energy to the distribution system and may require the DER provider to coordinate operations for such operations with the DSP.

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- (1) **Single-phase generators connected to a DSP's distribution system.** The necessary control, protection, and safety equipment specific to a single-phase generator that has a nameplate capacity of 50 kilowatts (kW) or less connected to a secondary or primary system includes an interconnect disconnect device, a generator disconnect device, an over-voltage trip, an under-voltage trip, an over-frequency and under-frequency trip, and a synchronizing check for synchronous and other types of generators with stand-alone capability.
- (2) **Three-phase synchronous generators, induction generators, and inverter systems.**
 - (A) **Three-phase synchronous generators.** DER circuit breakers must be three-phase devices with electronic or electromechanical control. A DER provider is solely responsible for properly synchronizing its DER with a DSP's distribution systems.
 - (i) The excitation system response ratio must not be less than 0.5. A DER's excitation systems must conform, as near as reasonably achievable, to the field voltage versus time criteria specified in the most recent version of ANSI C50.13-1989 in order to permit adequate field forcing during transient conditions.
 - (ii) For a DER that has a nameplate capacity greater than two ~~MW~~MVA the DER provider must maintain, at all times, the automatic voltage regulator (AVR) for each generating unit in service and operable. If the AVR is removed from service for maintenance or repair, the DSP's dispatching office must be notified, and the DER must be removed from service until the AVR is returned to service. The DSP must be notified regarding both the removal and return to service.
 - (B) **Three-phase induction generators and inverter systems.** A DER utilizing induction generation may be connected and brought up to synchronous speed (as an induction motor) if the DER provider can demonstrate that the initial voltage drop measured on the ~~distribution system~~DER side of the POI is within the visible flicker stated in subparagraph (d)(2)(C) of this section for DERs subject to requirements for new DERs and paragraph (d)(2) of this section for DERs subject to the requirements for legacy DERs. If the DER provider cannot demonstrate that the initial voltage drop measured on the distribution system is within the visible flicker requirement, then the DER provider may be required to install hardware or employ other techniques to bring voltage fluctuations to acceptable levels.
 - (i) Line-commutated inverters do not require synchronizing equipment.
 - (ii) Self-commutated inverters whether of a DSP interactive type or stand-alone type must be used in parallel with a DSP's distribution system only with synchronizing equipment.
 - (iii) Direct-current generation must not be operated in parallel with the DSP's distribution system.
 - (C) **Protective function requirements.** The protective function requirements for three-phase facilities of different sizes and technologies are listed below.

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- (i) A DER that has a nameplate capacity of ten ~~kW-kVA~~ or less must have an interconnect disconnect device, a generator disconnect device, an over-voltage trip, an under-voltage trip, an over-frequency and under-frequency trip, and a manual or automatic synchronizing check (for facilities with stand-alone capability).
 - (ii) A DER that has a nameplate capacity in excess of ten ~~kW-kVA~~ but not more than 500 ~~kW-kVA~~ must have an interconnect disconnect device, a generator disconnect device, an over-voltage trip, an under-voltage trip, an over-frequency and under-frequency trip, a manual or automatic synchronizing check (for facilities with stand-alone capability), either a ground over-voltage trip or a ground overcurrent trip depending on the grounding system if required by the DSP, and reverse power sensing if the DER is not exporting energy. Communication based telemetry and transfer trip may also be required by the DSP as part of a transfer tripping or blocking protective scheme.
 - (iii) A DER that has a nameplate capacity of more than 500 ~~kW-kVA~~ but not more than 2,000 ~~kW-kVA~~ must have an interconnect disconnect device, a generator disconnect device, an over-voltage trip, an under-voltage trip, an over-frequency and under-frequency trip, either a ground over-voltage trip or a ground over-current trip depending on the grounding system if required by the DSP, an automatic synchronizing check (for facilities with stand-alone capability) and reverse power sensing if the DER is not exporting energy. If the DER is exporting energy, the power direction protective function may be used to block or delay the under-frequency trip if the DSP agrees in writing to such use. Communication based telemetry and transfer trip may also be required by the ~~company-DSP~~ as part of a transfer tripping or blocking protective scheme.
 - (iv) A DER that has a nameplate capacity of more than two ~~MW-MVA~~ must have an interconnect disconnect device, a generator disconnect device, an over-voltage trip, an under-voltage trip, an over-frequency and under-frequency trip, either a ground over-voltage trip or a ground over-current trip depending on the grounding system if required by the DSP, an automatic synchronizing check and AVR for facilities with stand-alone capability, and reverse power sensing if the DER is not exporting energy. If the DER is exporting energy, the power direction protective function may be used to block or delay the under-frequency trip if the DSP agrees in writing to such use. Communication based telemetry and transfer trip may also be required by the DSP as part of a transfer tripping or blocking protective scheme.
- (h) **DER facilities not identified.** If standards for a specific DER are not prescribed under this section, the DSP and DER provider may interconnect a facility using ~~mutually agreed upon~~ DSP-approved technical standards.

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- (i) **Alternative requirements.** Certain specific interconnection sites and conditions may require the installation and use of more sophisticated protective devices and operating schemes than prescribed by this subsection, such as when the DER is exporting energy to the DSP's distribution system. If the minimum operational and technical requirements described under this section are inappropriate for a specific DER, the DER provider and the DSP may agree to different requirements. A DER provider or DSP may petition the commission for a good cause exception to one or more requirements specified under this section after every commercially reasonable effort to resolve a disagreement related to a such a requirement between the DER provider and the DSP has been made. Such a petition to the commission must indicate the specific operational and technical requirements of this section that are alleged to be inappropriate for the specific DER and include all commercially reasonable efforts made up to the date the petition was filed.
- (j) **Maintenance.** A DER provider is responsible for routine maintenance of the DER and for maintaining control, protection, and safety equipment. A DER provider must use good utility practice to maintain each DER and associated interconnection facilities under its ownership or control to reduce the likelihood of adverse impacts on other customers or the distribution system.
- (1) A DER provider must maintain records of such maintenance activities, which the DSP may review at reasonable times. For a DER greater than 500 kW, a log of DER operations must be kept. At a minimum, the log must include the date, facility time on, and facility time off, and ~~MW/MVA~~ and megavar output. The DSP ~~must~~ may review such logs at ~~least once every 30 calendar days~~ intervals it considers appropriate.
- (2) When a one ~~MW/MVA~~ or greater DER is rendered offline for maintenance or repair for greater than 24 hours, the DER provider must notify the DSP ~~must be notified by the DER provider~~ immediately. The DER provider must also notify the DSP and obtain approval for a return to service ~~must also be notified by the DER provider prior to return to service~~ through each the DSP's designated point of contact.
- (k) ~~Requirements-Additional requirements~~ **for DERs with a nameplate capacity over one MW/MVA or registered as resources with ERCOT.** ~~Unless otherwise specified by the DSP, DERs with a nameplate capacity over one MW/MVA or registered as resources with ERCOT must follow the technical and operational requirements established by ERCOT in ERCOT Nodal Operating Guide sections 2.6.2 and 2.9.1 related specifically to the areas of frequency and voltage ride through and trip settings, in lieu of the requirements in subsection (d)(7)-(14) of this section,~~ or, as applicable, a DSP outside of the ERCOT region.
- (l) ERCOT must establish and maintain rules for technical and operational requirements related specifically to the areas of frequency and voltage ride through and trip settings, in lieu of the requirements in subsection (d)(7)-(14) of this section, for DERs over one ~~MW/MVA~~ and for DERs registered as resources with ERCOT that are interconnected in the ERCOT region.
- (2) A DSP outside of the ERCOT region may establish and maintain technical and operational requirements that are different than established in this section but, as applicable, are consistent with the operational requirements established by the DSP's applicable ISO. A DER interconnected outside of the ERCOT power region with a nameplate capacity over one ~~MW/MVA~~ is required to comply with this section, unless the interconnecting DSP established different technical and operational requirements. A DSP outside of the ERCOT region that establishes

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and maintains technical and operational requirements with a nameplate capacity over one ~~MW~~MVA that are different than in this section, must:

- (i) Make the requirements publicly available on the DSP's website;
- (ii) Provide all interconnected DER providers and DER providers in the process of seeking interconnection a copy of the published DSP's technical and operational requirements; and
- (iii) Must provide all existing interconnected DER providers, at a minimum, six months to come into compliance with the new technical and operational requirements.