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Loss of Solar Resources during Transmission Disturbances due to Inverter Settings – II

Informational Webinar on Level 2 NERC Alert

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May 11, 2018

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Logistics

- This webinar will be recorded, and the slides and recording will be posted on the NERC website next week
- Please submit questions via the Q&A feature in Webex.
  - Questions regarding use of the NERC Alert System should be submitted to nerc.alert@nerc.net or by contacting 404-446-9797
  - Technical questions regarding the Alert recommendations and completing the Data Submission Spreadsheet should be addressed via the Q&A
- Notice of NERC Antitrust Compliance Guidelines
- Notice of Public Meeting

Webinar Outline

- Background – Blue Cut Fire
- Background – Canyon 2 Fire Disturbance Report
- Level 2 NERC Alert Release
- Alert Recommendations
- Alert Questions
- Alert Data Submission Spreadsheet
- Non-BES BPS-Connected Resources
- Q&A

Background: Blue Cut Fire Disturbance Report & Alert

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1,200 MW Fault Induced Solar Photovoltaic Resource Interruption Disturbance Report

Southern California 8/16/2016 Event

June 2017

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Industry Recommendation

Loss of Solar Resources during Transmission Disturbances due to Inverter Settings

Initial Distribution: June 20, 2017

NERC identified a potential characteristic exhibited by some inverter-based resources, particularly utility-scale solar photovoltaic (PV) generation, which reduces power output during fault conditions on the transmission system. An example of this behavior has been observed during recent BPS disturbances, highlighting potential risks to BPS reliability. With the recent and expected increases of utility-scale solar resources, the causes of this reduction in power output from utility-scale power inverters needs to be widely communicated and addressed by the industry. The industry should identify reliability preserving actions in the areas of power system planning and operations to reduce the system reliability impact in the event of widespread loss of solar-resources during faults on the power system.

For more information, see the 1,200 MW Fault Induced Solar Photovoltaic Resource Interruption Disturbance Report

About NERC Alerts >>

Status:	**Acknowledgement Required by Midnight Eastern on June 27, 2017** **Reporting Required by Midnight Eastern on August 31, 2017**
	PUBLIC: No Restrictions More on handling >>
Instructions:	This recommendation provides specific actions NERC registered entities should consider taking to respond to a particular issue. Pursuant to Rule 810 of NERC's Rules of Procedure, NERC registered entities shall 1) acknowledge receipt of this advisory within the NERC Alert System, and 2) report to NERC on the status of their activities in relation to this recommendation as provided below. For U.S. entities, NERC will compile the responses and report the results to the Federal Energy Regulatory Commission.

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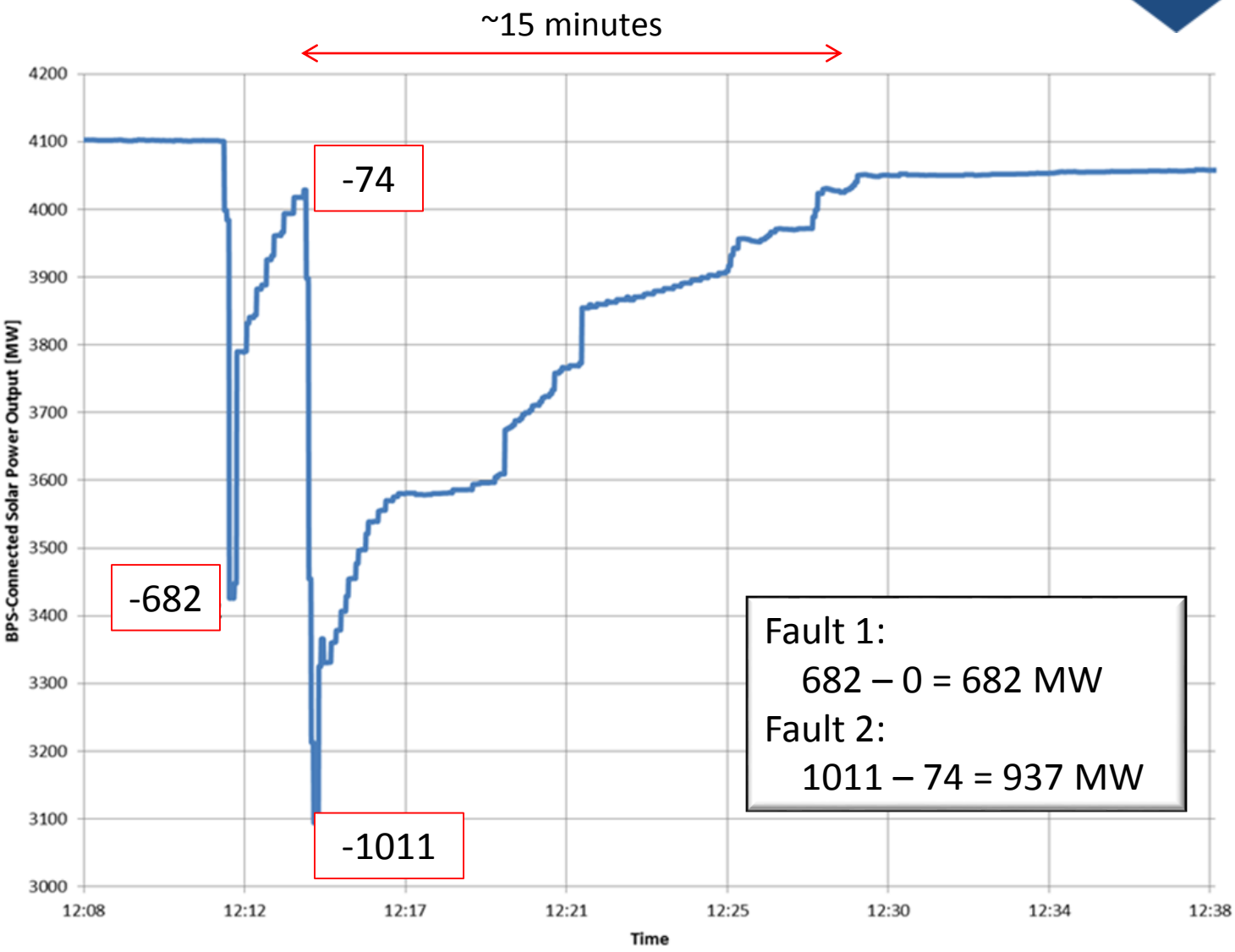
Canyon 2 Fire Disturbance Aggregate Solar PV Response



Background: Canyon 2 Fire Disturbance

- Event occurred on October 9, 2017
  - Not a qualified event
  - Entities volunteered to work with ERO
- NERC/WECC event analysis
- NERC Inverter-based Resource Performance Task Force (IRPTF) technical support
- Published disturbance report in February 2018
- Primary Key Findings:
  - No frequency-related tripping
  - Continued use of momentary cessation
  - Voltage-related tripping

Second Level 2 NERC Alert: Industry Recommendation

- Published May 1, 2018
- Drivers:
  - Mitigating actions to ensure reliability
  - Data collection to understand extent of condition
- Distribution:
  - Balancing Authorities
  - Generator Owners
  - Generator Operators
  - Planning Coordinators
  - Reliability Coordinators
  - Transmission Planners
  - Transmission Operators

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Industry Recommendation

Loss of Solar Resources during Transmission Disturbances due to Inverter Settings - II

Initial Distribution: May 1, 2018

NERC has identified adverse characteristics of inverter-based resource performance during grid faults that could present potential risks to reliability of the BPS. As the penetration of inverter-based resources (particularly solar PV resources) continues to increase in North America, these adverse characteristics need to be widely communicated. This Level 2 Industry Recommendation alerts industry to these adverse characteristics observed with BPS-connected solar PV resources, and provides recommended actions to address fault ride-through and timely restoration of current injection by all inverter-based resources connected to the BPS. (See Background section for more information.)

Although this NERC Alert pertains specifically to BES solar PV resources, the same characteristics may exist for non-BES[1] solar PV resources connected to the BPS regardless of installed generating capacity or interconnection voltage. Owners and operators of those facilities are encouraged to consult their inverter manufacturers, review inverter settings, and implement the recommendations described herein.

For more information, see the October 9, 2017 Canyon 2 Fire Disturbance Report.

About NERC Alerts >>

Status: **Acknowledgement Required[2] by Midnight Eastern on XXXX XX, 2018**
Reporting Required by Midnight Eastern on XXXX XX, 2018

PUBLIC: No Restrictions
More on handling >>

[1] These resources do not meet the Bulk Electric System definition, and are generally less than 75 MVA yet connected to transmission-level voltage.
[2] To the extent that Canadian jurisdictions have implemented laws or requirements that vary from Section 810 of the ROP, NERC requests entities in such jurisdictions voluntarily participate in response to this Alert.

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Recommendations

- Review the October 9, 2017, Canyon 2 Fire Disturbance Report for more detailed, technical information
- Key findings and recommendations:
  - No erroneous frequency tripping
  - Continued use of momentary cessation
  - Ramp rate interactions with return from momentary cessation
  - Interpretation of PRC-024-2 voltage ride-through curve
  - Instantaneous voltage tripping and measurement filtering
  - Phase lock loop synchronization issues
  - DC reverse current tripping
  - Transient interactions and ride-through considerations

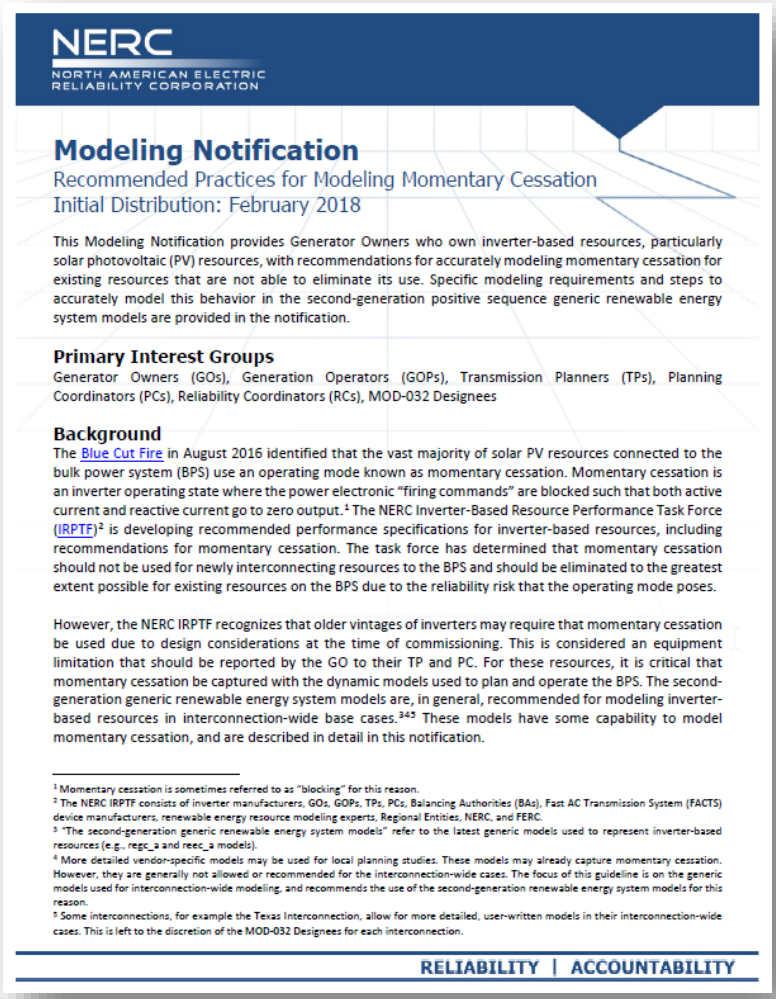
Generator Owner Recommendations

Generator Owners of solar PV resources who are receiving this Industry Recommendation should:

- Recommendation 1a:
  - Ensure that the dynamic model(s) being used accurately represent the dynamic performance of the solar facilities.
  - Refer to the Modeling Notification published on this topic.
  - If the inverters at the solar facility use momentary cessation, update the dynamic model(s) to accurately represent momentary cessation and provide the model(s) to the Transmission Planner and Planning Coordinator (to support NERC Reliability Standard TPL-001-4 studies) and to the Reliability Coordinator, Transmission Operator, and Balancing Authority (in accordance with NERC Reliability Standards TOP-003-3 and IRO-010-2).

Modeling Notification: Momentary Cessation

- Existing models largely **DO NOT** accurately represent installed resource performance
  - Identified issue that must be addressed for models in planning and operations studies
  - Developed notification to help industry in modeling efforts
  - Guidance provided as part of second NERC Alert



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Modeling Notification
Recommended Practices for Modeling Momentary Cessation
Initial Distribution: February 2018

This Modeling Notification provides Generator Owners who own inverter-based resources, particularly solar photovoltaic (PV) resources, with recommendations for accurately modeling momentary cessation for existing resources that are not able to eliminate its use. Specific modeling requirements and steps to accurately model this behavior in the second-generation positive sequence generic renewable energy system models are provided in the notification.

Primary Interest Groups
Generator Owners (GOs), Generation Operators (GOPs), Transmission Planners (TPs), Planning Coordinators (PCs), Reliability Coordinators (RCs), MOD-032 Designees

Background
The Blue Cut Fire in August 2016 identified that the vast majority of solar PV resources connected to the bulk power system (BPS) use an operating mode known as momentary cessation. Momentary cessation is an inverter operating state where the power electronic "firing commands" are blocked such that both active current and reactive current go to zero output.[1] The NERC Inverter-Based Resource Performance Task Force (IRPTF)[2] is developing recommended performance specifications for inverter-based resources, including recommendations for momentary cessation. The task force has determined that momentary cessation should not be used for newly interconnecting resources to the BPS and should be eliminated to the greatest extent possible for existing resources on the BPS due to the reliability risk that the operating mode poses.

However, the NERC IRPTF recognizes that older vintages of inverters may require that momentary cessation be used due to design considerations at the time of commissioning. This is considered an equipment limitation that should be reported by the GO to their TP and PC. For these resources, it is critical that momentary cessation be captured with the dynamic models used to plan and operate the BPS. The second-generation generic renewable energy system models are, in general, recommended for modeling inverter-based resources in interconnection-wide base cases.[3][4][5] These models have some capability to model momentary cessation, and are described in detail in this notification.

[1] Momentary cessation is sometimes referred to as "blocking" for this reason.
[2] The NERC IRPTF consists of inverter manufacturers, GOs, GOPs, TPs, PCs, Balancing Authorities (BAs), Fast AC Transmission System (FACTS) device manufacturers, renewable energy resource modeling experts, Regional Entities, NERC, and FERC.
[3] "The second-generation generic renewable energy system models" refer to the latest generic models used to represent inverter-based resources (e.g., regc_a and reec_a models).
[4] More detailed vendor-specific models may be used for local planning studies. These models may already capture momentary cessation. However, they are generally not allowed or recommended for the interconnection-wide cases. The focus of this guideline is on the generic models used for interconnection-wide modeling, and recommends the use of the second-generation renewable energy system models for this reason.
[5] Some interconnections, for example the Texas Interconnection, allow for more detailed, user-written models in their interconnection-wide cases. This is left to the discretion of the MOD-032 Designees for each interconnection.

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Generator Owner Recommendations

Generator Owners of solar PV resources who are receiving this Industry Recommendation should:

- Recommendation 1a (cont.):
  - If no change is required in the model(s), a written notification that the previously provided model(s) accurately captures the dynamic behavior of the solar PV facility should be provided.
  - Provide the updated model(s) or written notification of no change to the Transmission Planner, Planning Coordinator, Reliability Coordinator, Transmission Operator, and Balancing Authority **as soon as possible but no later than July 31, 2018**.

Generator Owner Recommendations

Generator Owners of solar PV resources who are receiving this Industry Recommendation should:

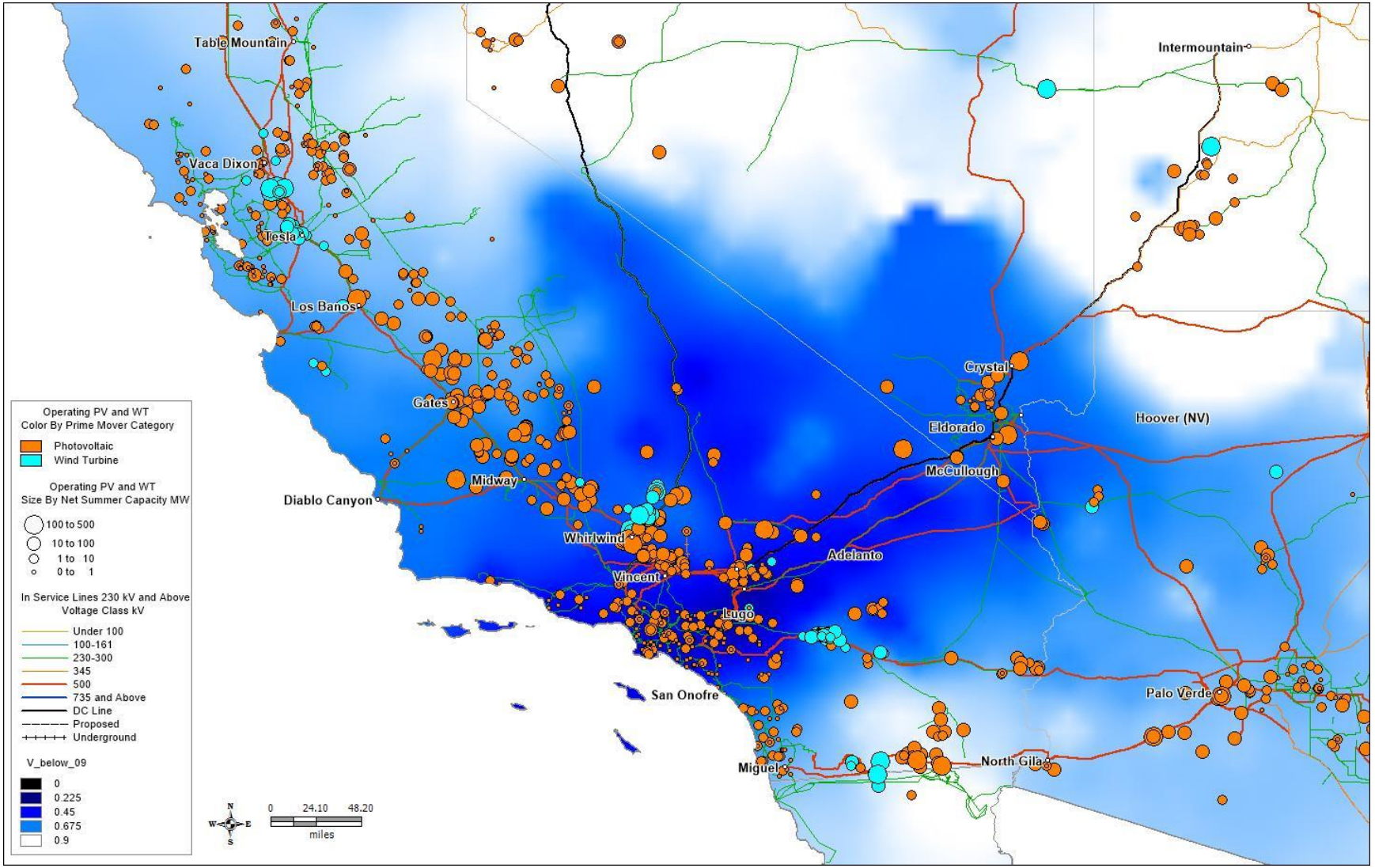
- Recommendation 1b:
  - Work with their inverter manufacturer(s) to identify the changes that can be made to eliminate momentary cessation of current injection to the greatest extent possible, consistent with equipment capability.
  - For inverters where momentary cessation cannot be eliminated entirely (i.e., by using another form of ride-through mode), identify the changes that can be made to momentary cessation settings that result in:
    a. Reducing the momentary cessation low voltage threshold to the lowest value possible.
    b. Increasing the momentary cessation high voltage threshold to the highest value possible, at least higher than the NERC Reliability Standard PRC-024-2 voltage ride-through curve levels.

Generator Owner Recommendations

Generator Owners of solar PV resources who are receiving this Industry Recommendation should:

- Recommendation 1b:
  - c. Reducing the recovery delay (time between voltage recovery and start of current injection) to the smallest value possible (i.e., on the order of 1-3 electrical cycles).
  - d. Increasing the active power ramp rate upon return from momentary cessation to at least 100% per second, unless specific reliability studies have demonstrated otherwise.
  - Provide these proposed changes, and an accompanying proposed dynamic model, to their Transmission Planner and Planning Coordinator.
  - GOs should provide these proposed models, according to their Transmission Planners'/Planning Coordinators' procedures for modifying existing facilities, **as soon as possible but no later than July 31, 2018**.
  - Make the proposed changes to equipment settings once the Transmission Planner/Planning Coordinator approves or disapproves the changes (based on Recommendation 6b).

IRPTF Momentary Cessation Studies



Generator Owner Recommendations

Generator Owners of solar PV resources who are receiving this Industry Recommendation should:

- Recommendation 2:
  - Ensure that inverter restoration from momentary cessation is not impeded by plant-level control ramp rates. This could involve adding a short delay before the plant-level controller resumes sending power commands to the individual inverters after voltage recovers and the inverters re-enter continuous operation range.

Generator Owner Recommendations

Generator Owners of solar PV resources who are receiving this Industry Recommendation should:

- Recommendation 3:
  - Coordinate with their inverter manufacturer(s) to set inverter voltage trip settings using the following principles:
    a. The region outside the "No Trip Zone" of the voltage (and frequency) ride-through curves of NERC Reliability Standard PRC-024-2 does not state that it is a "Must Trip Zone".
    b. Inverter voltage trip settings should be based on physical equipment limitations to protect the inverter, as necessary. The PRC-024-2 voltage ride-through curve defines the baseline level of voltage trip settings rather than specifying required trip settings.
    c. Refer to Figure 2.4, Pg. 15 of the Canyon 2 Fire Disturbance Report for additional guidance on recommended transient overvoltage ride-through. It is preferable to avoid instantaneous tripping coupled with an unfiltered voltage measurement that could cause inverters to trip for transient (sub-cycle) overvoltages the inverter could withstand without tripping.

Generator Owner Recommendations

Generator Owners of solar PV resources who are receiving this Industry Recommendation should:

- Recommendation 4:
  - Consult with their inverter manufacturer(s) and their PV panel manufacturer(s) to implement inverter DC reverse current protection settings based on equipment limitations, such that the resource will not trip unnecessarily during high voltage transients on the BPS.
- Recommendation 5:
  - Provide responses to the questions in this NERC Alert to their Reliability Coordinator, Balancing Authority, Transmission Operator, Planning Coordinator, and Transmission Planner **as soon as possible but no later than July 31, 2018**.

TP, PC, TOP, and RC Recommendations

Transmission Planners, Planning Coordinators, Transmission Operators, and Reliability Coordinators who are receiving this Industry Recommendation should:

- Recommendation 6a:
  - Track, retain, and use the updated dynamic model(s) (and any other pertinent information gathered from this NERC Alert) of existing resource performance that are supplied by the Generator Owners to perform assessments and system analyses to identify any potential reliability risks related to instability, cascading, or uncontrolled separation **as soon as possible but no later than December 7, 2018**, with notification to their Regional Entity that these studies are complete.
  - For updated models received after July 31, 2018, assessments and system analyses should be performed **within 120 calendar days**.

TP, PC, TOP, and RC Recommendations

Transmission Planners, Planning Coordinators, Transmission Operators, and Reliability Coordinators who are receiving this Industry Recommendation should:

- Recommendation 6b:
  - Track, retain, and analyze the proposed dynamic model(s) supplied by the Generator Owners that indicate their proposed changes (based on Recommendation 1b) to eliminate momentary cessation to the extent possible.
  - Based on the analysis, approve or disapprove the potential changes based on reliability risks related to instability, cascading, or uncontrolled separation **as soon as possible but no later than December 7, 2018**, with notification to their Regional Entity that these studies are complete.
  - For updated models received after July 31, 2018, assessments and system analyses should be performed **within 120 calendar days**.

Reporting Instructions

- Initial Acknowledgement required by May 8, 2018
- Responses to questions required by July 31, 2018
- Questions enable understanding of extent of condition
- Confidential Information handled by NERC according to Section 1500 of NERC Rules of Procedure

- All GOs, GOPs, RCs, BAs, TOPs, PCs, and TPs are required to acknowledge receipt of this Alert and respond as applicable.

Reporting Instructions for TPs, PCs, TOPs, and RCs

Contact information for each Region, necessary for the status updates detailed in Recommendations 6a and 6b, is listed below:

- WECC: alerts@wecc.biz
- TRE: rapa@texasre.org
- SPP: spprecompliance@spp.org
- SERC: Solar_Inverter_Alert@serc1.org
- RF: NERCInverterAlert@rfirst.org
- NPCC: SolarAlertII@npcc.org
- MRO: alerts@midwestreliability.org
- FRCC: ea@frcc.com

If your entity is currently transitioning, or has transitioned, from SPP to a different NERC Region, respond to the Alert in the system using the SPP as your Region.

Reporting Instructions for GOs

All Generator Owners (GOs) are required to respond to the following questions:

For GOs: Do you own or operate any solar photovoltaic (PV) generating facilities that are registered in the Bulk Electric System (BES)? (Yes, No)

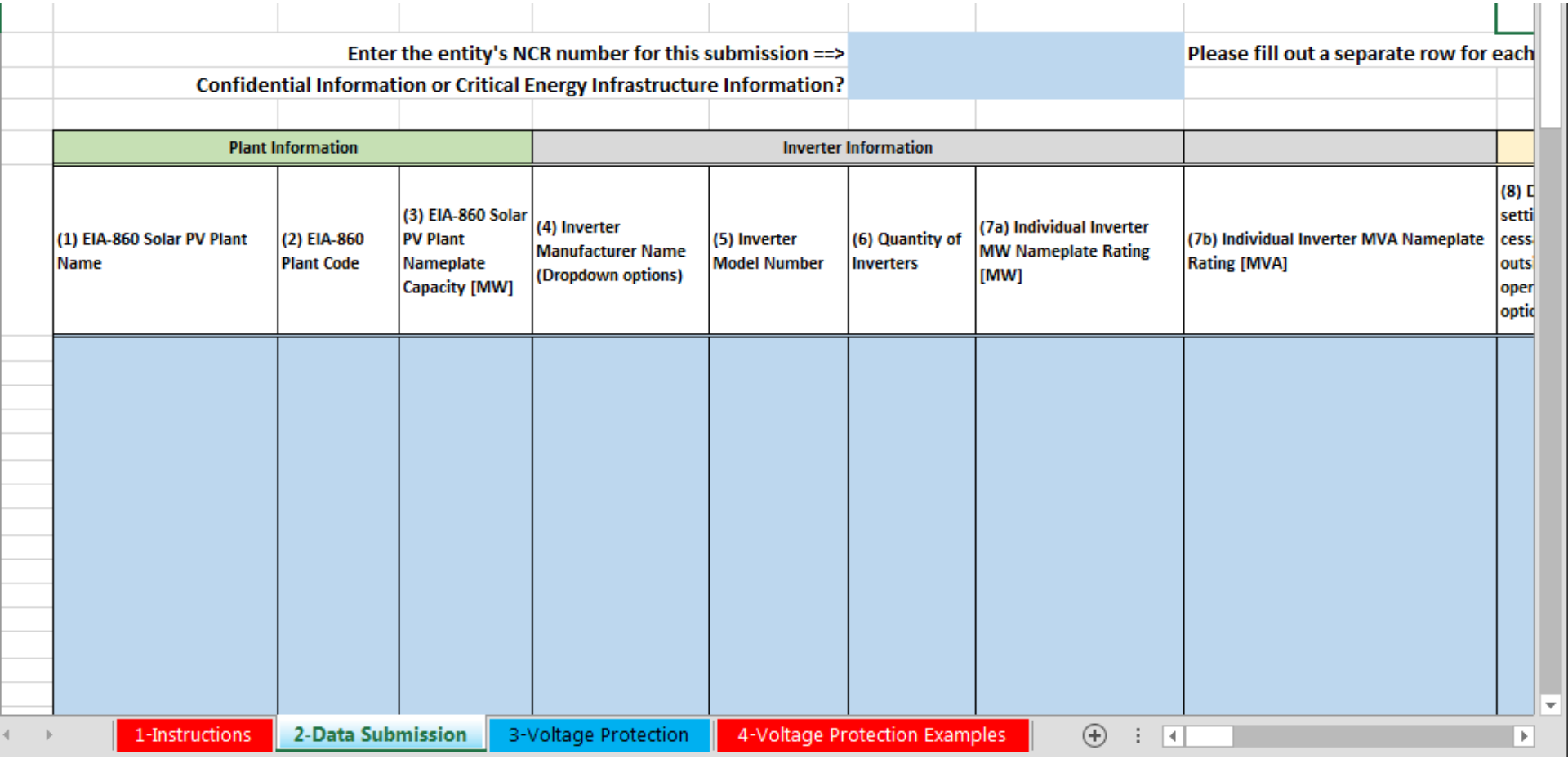
For GOs that answered "Yes" to the question above, answer the following questions in the attached Data Submission Worksheet. Use the "Add Additional Document" link on the NERC Alert System response web page to submit the completed worksheet. Each row in the worksheet should represent a make and model of inverter at each solar PV facility identified.

Data Submission Worksheet Instructions Tab

					Enter the entity's NCR number for this submission ==>	NCR10098	Please fill out a separat	
					Confidential Information or Critical Energy Infrastructure Information?	Confidential Information		
Plant Information			Inverter Information					
(1) EIA-860 Solar PV Plant Name	(2) EIA-860 Plant Code	(3) EIA-860 Solar PV Plant Nameplate Capacity [MW]	(4) Inverter Manufacturer Name (Dropdown options)	(5) Inverter Model Number	(6) Quantity of Inverters	(7a) Individual Inverter MW Nameplate Rating [MW]	(7b) Individual Inverter MVA Nameplate Rating [MVA]	(8) Do the momentar outside th range? (Dr
Plant ABC	11111	120	ABB	TWC-123	60	2	2.2	
Solar PV Plant A	22222	48.4	Power Electronics	T5LDXW	22	2.2	2.4	
SolarWorld	33333	63	Satcon	103495K	35	1.8	2	
Desert Solar Plant	44444	42	General Electric	B534KWn	28	1.5	1.8	
Enter the Plant Name used for submitting EIA-860 data. If no EIA-860 Plant Name exists, use a unique plant name identifier. Each solar PV plant should have at least one	Enter the Plant Code used for submitting EIA-860 data. If no EIA-860 Plant	Enter the total solar PV plant capacity,	Enter the name of the inverter manufacturer. Use a separate row for each make of inverter	Enter the inverter model number for each make of manufacturer (from (4)). Use a	Enter the number of inverters of this make and model (from (4) and	Enter the nameplate rating (in MW) of each model of	Enter the nameplate rating (in MVA) of each model of	Select the a answer for can be elim

1-Instructions | 2-Data Submission | 3-Voltage Protection | 4-Voltage Protection Examples

Data Submission Worksheet
Data Submission Tab



Enter the entity's NCR number for this submission ==>

Please fill out a separate row for each

Confidential Information or Critical Energy Infrastructure Information?

Plant Information			Inverter Information					
(1) EIA-860 Solar PV Plant Name	(2) EIA-860 Plant Code	(3) EIA-860 Solar PV Plant Nameplate Capacity [MW]	(4) Inverter Manufacturer Name (Dropdown options)	(5) Inverter Model Number	(6) Quantity of Inverters	(7a) Individual Inverter MW Nameplate Rating [MW]	(7b) Individual Inverter MVA Nameplate Rating [MVA]	(8) D setti cess outs oper optic

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Data Submission Worksheet Voltage Protection Tab

For each inverter model described in the "Data Submission" tab, please complete the following tables...

These tables should be completed based on the voltage protection settings in the inverters. This is NOT the settings for momentary cessation.

Each table should represent the settings of one make and model of solar PV inverter. One table should be completed for each make and model within each solar PV plant.

Solar PV Plant Name:	[Enter Solar PV Plant Name]							
Inverter Manufacturer:	[Enter Inverter Manufacturer Here]							
Inverter Model Number:	[Enter Inverter Model Number Here]							
	High-Voltage Ride-Through (HVRT)				Low-Voltage Ride-Through (LVRT)			
	Existing Settings (Before Changes)		Revised Settings (After Changes)		Existing Settings (Before Changes)		Revised Settings (After Changes)	
	Voltage (pu)	Time Delay (sec)	Voltage (pu)	Time Delay (sec)	Voltage (pu)	Time Delay (sec)	Voltage (pu)	Time Delay (sec)
	[Enter HVRT Value]	[Enter Time]	[Enter HVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]
	[Enter HVRT Value]	[Enter Time]	[Enter HVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]
	[Enter HVRT Value]	[Enter Time]	[Enter HVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]
	[Enter HVRT Value]	[Enter Time]	[Enter HVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]
	[Enter HVRT Value]	[Enter Time]	[Enter HVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]
	[Enter HVRT Value]	[Enter Time]	[Enter HVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]

Solar PV Plant Name:	[Enter Solar PV Plant Name]							
Inverter Manufacturer:	[Enter Inverter Manufacturer Here]							
Inverter Model Number:	[Enter Inverter Model Number Here]							
	High-Voltage Ride-Through (HVRT)				Low-Voltage Ride-Through (LVRT)			
	Existing Settings (Before Changes)		Revised Settings (After Changes)		Existing Settings (Before Changes)		Revised Settings (After Changes)	
	Voltage (pu)	Time Delay (sec)	Voltage (pu)	Time Delay (sec)	Voltage (pu)	Time Delay (sec)	Voltage (pu)	Time Delay (sec)
	[Enter HVRT Value]	[Enter Time]	[Enter HVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]
	[Enter HVRT Value]	[Enter Time]	[Enter HVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]
	[Enter HVRT Value]	[Enter Time]	[Enter HVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]
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	[Enter HVRT Value]	[Enter Time]	[Enter HVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]

1-Instructions | 2-Data Submission | 3-Voltage Protection | 4-Voltage Protection Examples

Data Submission Worksheet
Voltage Protection Example Tab

For each inverter model described in the "Data Submission" tab, please complete the following tables...

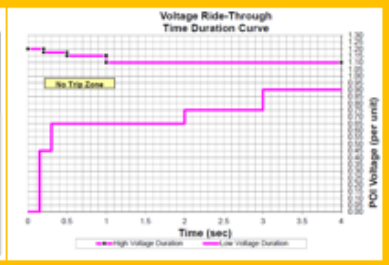
This tab shows two examples of how to complete the Voltage Protection table(s) based on the existing and future high- and low-voltage ride-through characteristics.

EXAMPLE 1

This example shows the inverter set with existing settings to the PRC-024-2 ride-through curve. Based on this NERC Alert, the Generator Owner is able to change the trip setting for 1.2 pu from "Instantaneous" to 0.035 seconds (35 milliseconds) to avoid spurrious tripping on short-duration transients. The revised settings input below reflect the changes made to the inverter protection.

Ride Through Duration:

High Voltage Ride Through Duration		Low Voltage Ride Through Duration	
Voltage (pu)	Time (sec)	Voltage (pu)	Time (sec)
≥1.200	Instantaneous trip	<0.45	0.15
≥1.175	0.20	<0.65	0.30
≥1.15	0.50	<0.75	2.00
≥1.10	1.00	<0.90	3.00



Solar PV Plant Name:	Plant ABC
Inverter Manufacturer:	Other. specify in neighboring column.
Inverter Model Number:	Example-123Xv123

High-Voltage Ride-Through				Low-Voltage Ride-Through			
Existing Settings (Before Changes)		Revised Settings (After Changes)		Existing Settings (Before Changes)		Revised Settings (After Changes)	
Voltage (pu)	Time Delay (sec)	Voltage (pu)	Time Delay (sec)	Voltage (pu)	Time Delay (sec)	Voltage (pu)	Time Delay (sec)
≥ 1.200	Instantaneous	≥ 1.200	0.035	< 0.45	0.15	No Change Made	No Change Made
≥ 1.175	0.2	≥ 1.175	0.2	< 0.65	0.3	No Change Made	No Change Made
≥ 1.150	0.5	≥ 1.150	0.5	< 0.75	2	No Change Made	No Change Made
≥ 1.100	1	≥ 1.100	1	< 0.90	3	No Change Made	No Change Made
[Enter HVRT Value]	[Enter Time]	[Enter HVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]
[Enter HVRT Value]	[Enter Time]	[Enter HVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]	[Enter LVRT Value]	[Enter Time]

1-Instructions | 2-Data Submission | 3-Voltage Protection | 4-Voltage Protection Examples

Data Submission Questions

- **Q1:** Enter the EIA-860 Solar PV Plant Name[1]
- **Q2:** Enter the EIA-860 Solar PV Plant Code[1]
- **Q3:** Enter the EIA-860 Solar PV Plant Nameplate Capacity (MW)[2]
- **Q4:** Enter the inverter manufacturer name (use a different row for each manufacturer in plant)
- **Q5:** Enter the inverter model number (use a different row for each model of inverter for each manufacturer in plant)
- **Q6:** Enter the quantity of inverters for each make and model of inverter

1. If no EIA-860 data exists, use a unique plant name and plant code for each distinct solar PV facility.

2. If no EIA-860 data exists, provide the equivalent plant nameplate capacity.

Data Submission Questions

- **Q7a:** Enter the individual inverter nameplate MW rating for each make and model of inverter (MW)
- **Q7b:** Enter the individual nameplate MVA rating of for each make and model of inverter (MVA)
- **Q8:** Do the existing inverter settings use momentary cessation when voltage falls outside the continuous operating range? (dropdown options)

Data Submission Questions

- **Q9a:** If you answered "Yes" to (8), what is the existing low voltage momentary cessation voltage threshold? (dropdown options – p.u. voltage)
- **Q9b:** If you answered "Yes" to (8), what is the existing high voltage momentary cessation voltage threshold? (dropdown options – p.u. voltage)
- **Q9c:** If you answered "Yes" to (8), what is the existing time delay before the inverter begins injecting current after momentary cessation, once voltage has returned to within the momentary cessation voltage threshold(s)? (milliseconds)
- **Q9d:** If you answered "Yes" to (8), what is the existing active current ramp rate when recovering from momentary cessation? (% of nameplate rating/sec)

Data Submission Questions

- **Q10:** Can the inverters be updated to COMPLETELY ELIMINATE the use of momentary cessation for these? (Dropdown options)
- **Q11:** If you answered "No" to (10), can you MAKE CHANGES TO the momentary cessation settings (see Recommendation #1b of this NERC Alert)? (Dropdown options)
- **Q11a:** If you answered "No" to (11), explain the rationale. (Open-ended response)

Data Submission Questions

- **Q12a:** If you answered "Yes" to (11), what is the proposed low voltage momentary cessation threshold? (Dropdown options - p.u. voltage)
- **Q12b:** If you answered "Yes" to (11), what is the proposed high voltage momentary cessation threshold? Dropdown options - p.u. voltage)
- **Q12c:** If you answered "Yes" to (11), what is the proposed time delay before the inverter begins injecting current after momentary cessation, once voltage has returned to within the momentary cessation voltage threshold(s)? (milliseconds)
- **Q12d:** If you answered "Yes" to (11), what is the proposed active current ramp rate when recovering from momentary cessation? (% of nameplate rating/sec)

Data Submission Questions

- **Q13:** Which models were provided to the Transmission Planner, Planning Coordinator, Reliability Coordinator, and Transmission Operator based on Recommendations 1a and 1b? (Dropdown options)
- **Q14:** Complete the tables in the "Voltage Protection" tab for each inverter model specified for each plant. If no changes were made to voltage protection settings, provide existing settings only. (Complete "Voltage Protection" tab)

Data Submission Questions

- **Q15:** Have you provided your response to the questions in this NERC Alert to your Reliability Coordinator, Balancing Authority, Transmission Operator, Planning Coordinator, and Transmission Planner? (Dropdown options)
- **Q15a:** If you answered "Planned" to (15), provide an expected date for submitting this information to the RC, BA, and TOP. (Enter date)
- **Q16:** Provide any additional comments or clarifications, as necessary. (Open-ended response)

Quick Review of Data Submission Worksheet

[See Data Submission Worksheet]

Alerts

To acknowledge, respond to, or approve of an alert, please click here.

2018 Alerts	
Date	**Description**
05.01.18	**Industry Recommendation:** Loss of Solar Resources during Transmission Disturbances due to Inverter Settings - II Attachment 1: Loss of Solar Resources during Transmission Disturbances due to Inverter Settings - II Alert Attachment 2: Data Submission Worksheet

Clarification for Non-BES Resources connected to the BPS

- Although this NERC Alert pertains specifically to **BES solar PV resources**, the same characteristics may exist for **non-BES[1] solar PV resources connected to the BPS** regardless of installed generating capacity or interconnection voltage.
- Owners and operators of those facilities are encouraged to consult their inverter manufacturers, review inverter settings, and implement the recommendations described herein.
- While this NERC alert focuses on solar PV, we encourage similar activities for other inverter-based resources such as, but not limited to, battery energy storage and wind resources.

1 These resources do not meet the Bulk Electric System definition, and are generally less than 75 MVA yet connected to transmission-level voltage.

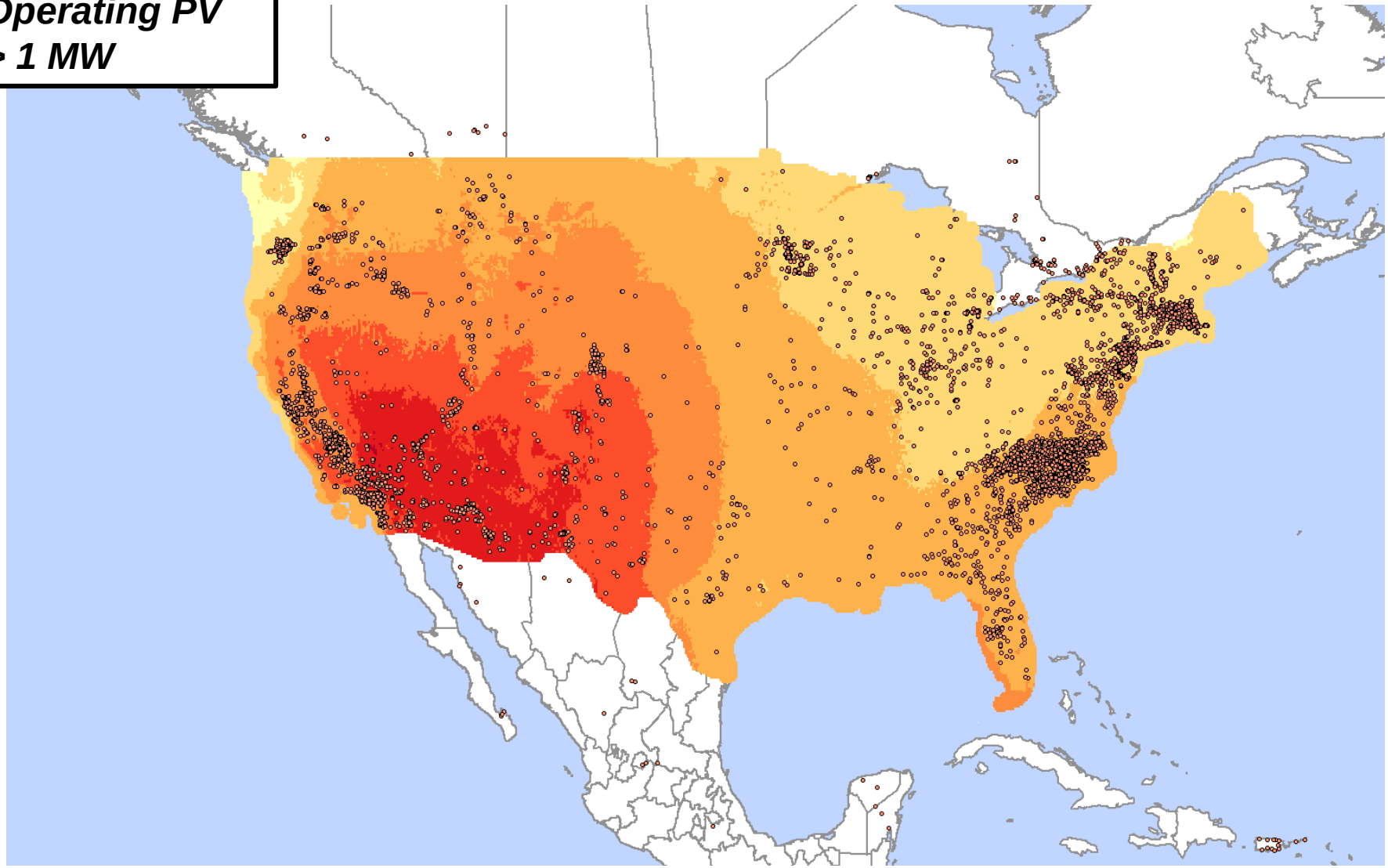
Large BES Solar Resources

Operating PV
> 75 MW

Unofficial - Illustration Purposes Only

BPS-Connected Solar Resources

Operating PV
> 1 MW



Unofficial - Illustration Purposes Only

Relevant Materials

- Disturbance Report: https://www.nerc.com/pa/rrm/ea/October%209%202017%20Canyon%202%20Fire%20Disturbance%20Report/900%20MW%20Solar%20Photovoltaic%20Resource%20Interruption%20Disturbance%20Report.pdf
- NERC Alerts Page: https://www.nerc.com/pa/rrm/bpsa/Pages/Alerts.aspx
- Level 2 NERC Alert – Loss of Solar Resources II: https://www.nerc.com/pa/rrm/bpsa/Alerts%20DL/NERC_Alert_Loss_of_Solar_Resources_during_Transmission_Disturbance-II_2018.pdf
- Data Submission Worksheet: https://www.nerc.com/pa/rrm/bpsa/Alerts%20DL/Data_Submission_Worksheet-IId.xlsx

Questions and Answers

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