

Enhanced Inverters

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Planning Committee
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Key Work Activities

- Review inverter-related standards
- Review potential solutions
- Determine rule changes to implement potential solutions
- Require coordination with state agencies in development of proposed solutions

- 2/27 – Enhanced Inverter problem statement presented to MRC
- 3/31 and 4/28 - Education
- 5/30 and 6/27 – Interest and Design Components Identification
- 7/22- PJM package was posted for review
- 8/13- PJM presented the package at the (PC) Enhanced Inverter meeting
- No additional packages were proposed

- 69 responses
- Question: Do you support Package A?
- Poll results: **98.55%** voted in favor of Package A

YES	NO	ABSTAIN
68	1	0

- Applicable to PJM connected FERC jurisdictional inverter based generators which are defined as asynchronous generation in the PJM footprint that either have an ISA(Interconnection Service Agreement) or a WMPA(Wholesale Market Participation Agreement)
- Not applicable to merchant transmission facilities or HVDC inverter-converter facilities
- Not applicable to existing generation or generation in new service queue
- Not applicable to Attachment BB projects

- **Component : Active power control – automatic**
 - Enhanced inverters must have capability to have an automated reduction in active power in response to high system frequency with droop characteristics
 - Enhanced inverters must have the capability to have an automated increase in active power in response to low system frequency with droop characteristics when the resource has been curtailed by PJM either for economic or reliability reasons and has additional power available for generation at the time of the request

- **Component : Reactive power support/ Power factor control**
 - Enhanced inverters must have the capability to autonomously provide dynamic reactive support within a range of 0.95 leading to 0.95 lagging at inverter terminals independent of system impact study
 - More conservative limits can be required if system impact study or TO establishes a need for more conservative limits

- **Component : Voltage ride through**
 - Enhanced inverters must adhere to NERC PRC-024 standard irrespective of generator size
- **Component : Frequency ride through**
 - Enhanced inverters must adhere to NERC PRC-024 standard irrespective of generator size
- **Component : Ramp rate limitations**
 - Enhanced inverters must have the capability to limit ramp rates
- **Component : Implementation time frame**
 - Effective date will apply only to new queue requests; no retroactive requirements

- 11/30 MRC – First read
- 12/18 MRC – Vote
- 1/29 MC
- Target FERC Filing in Feb 2015
- Monitor IEEE 1547A standard development
- Continue coordination with states



APPENDIX

Design Components	Package A
Active Power Control - automatic (e.g. for frequency control)	<p>PJM connected FERC jurisdictional inverter based generators* must have the capability to :</p> <ol style="list-style-type: none"> 1) Have an automated reduction in active power in response to high system frequency with droop characteristics 2) Have an automated increase in active power in response to low system frequency with droop characteristics when the resource has been curtailed by PJM either for economic or reliability reasons has additional power available for generation at the time of the request.
Reactive Power Support / Power Factor Control	<p>PJM connected FERC jurisdictional inverter based generators* must have the capability to autonomously provide dynamic reactive support within a range of 0.95 leading to 0.95 lagging at inverter terminals unless system impact study or TO establishes a need for more conservative limits</p>
Voltage Ride-Through	<p>PJM connected FERC jurisdictional inverter based generators* must adhere to NERC PRC-024 standard irrespective of generator size</p>
Frequency Ride-Through	<p>PJM connected FERC jurisdictional inverter based generators* must adhere to NERC PRC-024 standard irrespective of generator size</p>
Ramp rate control	<p>PJM connected FERC jurisdictional inverter based generators* must have the capability to limit ramp rates</p>
Implementation Timeframe	<p>Effective date will apply to new queue requests</p>

Scenario	Applicability
10kW rooftop residential solar project	No
1MW solar project connecting at distribution level but participating in PJM Markets	Yes
Projects entering the queue prior to implementation of these rules	No
HVDC Inverters	No