Attachment #8.1
Return to Agenda

De-Carbonization / DER Report for NYSRC Executive Committee Meeting 2/9/2024

Contact: Matt Koenig (koenigm@coned.com)

The February 2024 edition of the De-Carbonization / Distributed Energy Resources (DER) Report includes the following items:

- NERC Submits Comprehensive Work Plan Addressing FERC Order 901 Directives
- Gamesa White Paper: What Advanced Grid Functionalities Should State-of-the-Art Inverters Offer?
- CleanTechnica Article : The Role of Fossil Gas Utilities in The Era of Clean Energy Gets Tested in New York
- NASA: Methane Super-Emitters Mapped by NASA's New Earth Space Mission
- Snapshot of the NYISO Interconnection Queue: Storage / Solar / Wind / Co-located

NERC Submits Comprehensive Work Plan Addressing FERC Order 901 Directives

On October 19, 2023, FERC issued FERC Order 901 directing NERC to develop new or modified Reliability Standard projects to address a wide spectrum of reliability risks to the bulk power system (BPS) from the application of inverter based technology; including requirements for inverter-based resources (IBR) that are owned or operated by NERC registered entities, as well as by those that are anticipated to be registered by NERC under pending new registration criteria. Additional requirements are directed for registered entities on effective data sharing and model validation for non-Bulk Electric System (BES) resource data (i.e., unregistered IBR) and distributed energy resources (DER) as these resources continue to contribute to increasing impacts on the reliable planning and operation of the BPS.

On January 18th, 2024, NERC submitted a comprehensive Standards Development Work Plan in support of NERC's 2024 work plan priorities around inverter-based resource reliability risks and to address directives from Order No. 901. It explains how NERC will prioritize the development of projects consistent with the timelines specified in the order, with full implementation of the resulting standards by 2030. The work plan also explains how NERC will develop new or modified Reliability Standards to address the following four broad topic areas related to IBRs identified in Order No. 901:

- Data sharing
- Data and model validation
- Planning and operational studies
- Performance

As a foundational matter, NERC plans to complete work in the first half of 2024 to establish a clear and consistent understanding of defined terms. This will include defining what is an "inverter-based resource" and "distributed energy resource" from a technological standpoint. Each drafting team will then be charged with determining the appropriate requirements, including identifying the appropriate applicable entities and applicable facilities which shall be consistent with any of the Commission's directives for such applicability in Order No. 901.

The Order No. 901 Work Plan consists of four key milestones with associated dates for completion:

- Milestone 1: **Submission of Order No. 901 Work Plan** (completion: January 2024)
  - Consistent terminology for IBR and DER
  - Use of the Term Unregistered IBRs
- Milestone 2: Development and Filing of Reliability Standards to **Address Performance Requirements and Post-Event Performance Validation for Registered IBRs** (completion: November 4, 2024)
  - Disturbance Monitoring Data Sharing
  - IBR Performance Requirements
  - Post-Event Performance Validation
- Milestone 3: Development and Filing of Reliability Standards to **Address Data Sharing and Model Validation for all IBRs** (completion: November 4, 2025)
  - Data Sharing
  - Model Validation
- Milestone 4: Development and Filing of Reliability Standards to **Address Planning and Operational Studies Requirements for all IBRs** (completion: November 4, 2026)

Projects under Milestone 2 are assigned the highest priority in the Order No. 901 Work Plan, as they are addressing matters for which the Commission directed Reliability Standards be submitted for approval by November 4, 2024. They are described in greater detail below.

Milestone 2 Part 1: Disturbance Monitoring Data Sharing

1. NERC must submit new or modified Reliability Standards that require disturbance monitoring data sharing and post-event performance validation for registered IBRs.
2. Reliability Standards must require generator owners to communicate to the relevant transmission planners, reliability coordinators, transmission operators, and balancing authorities the actual post-disturbance ramp rates and the ramp rates to meet expected dispatch levels (generation-load balance).
3. NERC to require:
   - Registered IBR generator owners to install disturbance monitoring equipment at their buses and elements
   - Registered IBR generator owners to provide disturbance monitoring data to Bulk-Power System planners and operators for analyzing disturbances on the Bulk-Power System
   - Bulk-Power System planners and operators to validate registered IBR models using disturbance monitoring data from installed registered IBR generator owners' disturbance monitoring equipment.
4. We agree with the findings in NERC reports (e.g., a lack of high-speed data captured at the IBR or plant-level controller and low-resolution time stamping of inverter sequence of event recorder information has hindered event analysis) and direct NERC through its standard development process to address these findings.
5. NERC to consider the burdens of generators collecting and providing data, while assuring that Bulk-Power System operators and planners have the data they need for accurate disturbance monitoring and analysis.

Milestone 2 Part 2: Performance Requirements

1. Establish IBR performance requirements, including requirements addressing frequency and voltage ride through, post-disturbance ramp rates, phase lock loop synchronization, and other known causes of IBR tripping or momentary cessation."
2. Develop new or modified Reliability Standards that require registered IBR generator owners and operators to use appropriate settings (i.e., inverter, plant controller, and protection) to ride through frequency and voltage system disturbances and that permit IBR tripping only to protect the IBR equipment in scenarios similar to when synchronous generation resources use tripping as protection from internal faults."
3. The new or modified Reliability Standards must require registered IBRs to continue to inject current and perform frequency support during a Bulk-Power System disturbance."
4. Any new or modified Reliability Standard must also require registered IBR generator owners and operators to prohibit momentary cessation in the no-trip zone during disturbances.
5. Submit new or modified Reliability Standards that establish IBR performance requirements, including requirements addressing frequency and voltage ride through, post-disturbance ramp rates, phase lock loop synchronization, and other known causes of IBR tripping or momentary cessation."
6. NERC through its standard development process to determine whether the new or modified Reliability Standards should provide for a limited and documented exemption for certain registered IBRs from voltage ride through performance requirements.
7. To require the limited and documented exemption list (i.e., IBR generator owner and operator exemptions) to be communicated with their respective Bulk-Power System planners and operators (e.g., the IBR generator owner's or operator's planning coordinator, transmission planner, reliability coordinator, transmission operator, and balancing authority).
8. Develop and submit to the Commission for approval new or modified Reliability Standards that require post-disturbance ramp rates for registered IBRs to be unrestricted and not programmed to artificially interfere with the resource returning to a pre-disturbance output level in a quick and stable manner after a Bulk-Power System.
9. The proposed new or modified Reliability Standards must require registered IBRs to ride through momentary loss of synchronism during Bulk-Power System disturbances and require registered IBRs to continue to inject current into the Bulk-Power System at pre-disturbance levels during a disturbance, consistent with the IBR Interconnection Requirements Guideline and Canyon 2 Fire Event Report recommendations.
10. Related to ACP/SEIA's comment recommending the revision of the directives to require generators to maintain synchronism where possible and continue to inject current to support system stability, NERC is directed to consider whether there are conditions that may limit generators to maintain synchronism."

Milestone 2 - Part 3: Post Event Performance Validation

1. To the extent NERC determines that a limited and documented exemption for those registered IBRs currently in operation and unable to meet voltage ride-through requirements is appropriate due to their inability to modify their coordinated protection and control settings, NERC to develop new or modified Reliability Standards to mitigate the reliability impacts to the Bulk-Power System of such an exemption."
2. New or modified Reliability Standards that would require registered IBRs to ride through any conditions not addressed by the proposed new or modified Reliability Standards that address frequency or voltage ride through, including phase lock loop loss of synchronism."

Gamesa White Paper: What Advanced Grid Functionalities Should State-of-the-Art Inverters Offer?
This Whitepaper published in March, 2023 by Siemens Gamesa, the renewable energy subsidiary of Siemens, provides a useful summary of the industry's perspective of Inverter-based Resource functions and abilities.

The stability of any power grid is achieved by controlling the following parameters:

- Voltage control. The adjustment is performed by controlling the reactive power through devices such as synchronous generators (which allow dynamic control), capacitor banks or inductive loads.
- Frequency control. The balance between the power generated and the power consumed ensures a steady grid frequency, variations of any value will cause a frequency change that has to be corrected by modifying the active power (by modifying the mechanical speed in the case of synchronous generators).
- Rotor angle control, or rotor angle stability, is the capacity of a synchronous generator to keep synchronism after a disturbance. The disturbance may accelerate or decelerate the rotor speed, so the different speed respect to generators of the same grid affect to its angular position and may lead to instability.

In grid-feeding mode (also known as grid-following), the power converter behaves as a current source and the grid sets the voltage, being the inverter control system synchronized with said voltage. Functionalities like frequency or voltage regulation are achieved by controlling the exported active and reactive power.

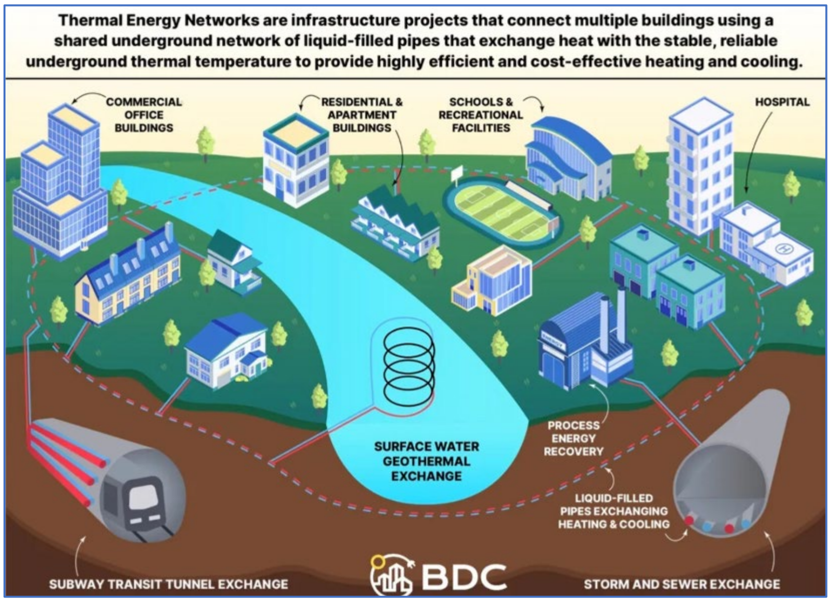
In grid-forming mode, the converter is a voltage source with the ability to modify its operation according to external setpoints. Therefore, all functions available in grid-feeding mode are also available here. The control strategy used is known as Virtual Synchronous Machine (VSM) where the inverter control is capable of emulating the synchronous generator behavior. The power response of the system by a BESS with grid-forming is greater and faster, as this mode provides greater inertia as well and damping. The virtual inertia contribution means that the ROCOF will be less abrupt in the case of a BESS operating in grid-forming mode than in a BESS operating in grid-feeding mode.

The table below summarizes the functionalities that are available in each operation mode. Note that Off-grid mode is synonymous with islanded operation, while On-grid mode implies full transmission grid connectivity.

Functionality	Grid-feeding inverter	Grid-forming Offgrid	Grid-forming Ongrid[2]
Voltage regulation	✓	✓	✓
Power factor control	✓	X	✓
Active and reactive power ramp rate	✓	X	✓
External setpoints (secondary frequency control, energy shifting, trading…)	✓	X	✓
SI (Synthetic Inertia)[3]	✓	✓	✓
PFR (Primary Frequency Response)[4]	✓	✓	✓
FRT (Fault Ride-Through)	✓	✓	✓
POD (Power Oscillation Damping)	✓	X	✓
Islanding operation	X	✓	✓
Black-start	X	✓	X
VSM (Virtual Synchronous Machine)	X	✓	✓

CleanTechnica: The Role of Fossil Gas Utilities in The Era of Clean Energy Gets Tested in New York

This Article was published on January 17th on the Cleantechnica website, which focuses on Clean Energy initiatives, including energy storage, electric vehicles, Smart Grid and efficiency. The article explored the concepts of combining a variety of geothermal energy resources with a network of heat pumps utilizing existing gas mains to carry water or other liquids as the heat exchange agent. Heat pumps can be more efficient when they can exchange heat and cold with fluid at a stable temperature rather than from cold outside air. The Department of Energy estimates such ground source heat pumps reduce energy consumption and emissions by up to 44 percent compared to air source heat pumps and 72 percent compared to standard air conditioning equipment.



Con Edison has proposed three projects taking on some of the most challenging urban settings, including the landmark Rockefeller Center. The company plans to convert three large commercial buildings from the utility's district steam heating network to heat pumps. These heat pumps would draw on water that is warmed up by waste heat from sources including the sewers, data centers and cooling systems of adjoining buildings. Another Con Ed project in Manhattan's Chelsea neighborhood plans to get 100 percent of heating, cooling and hot-water needs for a low-income multifamily residential building from a nearby data center.

These projects would lower the cost of complying with New York City's Local Law 97, which requires all large buildings to reduce their carbon emissions by 40 percent from 2019 levels by 2030. Hitting those targets will require an estimated $18.2 billion in investment in alternatives to fossil gas fired boilers and furnaces.

The efficiency benefits of these networks can also provide significant relief to power grids that will experience massive growth in demand from building heating and electric vehicles. Department of Energy research has found that installing geothermal heat pumps in nearly 80 percent of U.S. homes could reduce the costs of decarbonizing the grid by 30 percent and avoid the need for 24,500 miles of new transmission lines by 2050.

Additional Info: Building Decarbonization Coalition (BDC)
New York State Senate: Utility Thermal Energy Network and Jobs Act
DOE Report: Grid Cost and Total Emissions Reductions Through Mass Deployment of Geothermal Heat Pumps for Building Heating and Cooling Electrification in the United States

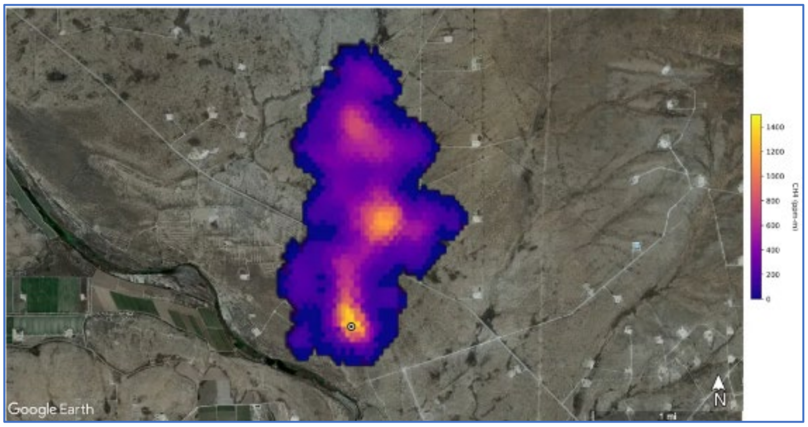
NASA: Methane Super-Emitters Mapped by NASA's New Earth Space Mission

This [Article] was originally published on the [NASA JPL Website] on October 25th, 2022. It recounts NASA's Earth Surface Mineral Dust Source Investigation (EMIT) mission, which has been mapping the prevalence of key minerals in the planet's dust-producing deserts since July of 2022 – information that will advance our understanding of airborne dust's effects on climate. But EMIT has demonstrated another crucial capability: detecting the presence of methane, a potent greenhouse gas.

In the data EMIT has collected since being installed on the International Space Station in July, the science team has identified more than 50 "super-emitters" in Central Asia, the Middle East, and the Southwestern United States. Super-emitters are facilities, equipment, and other infrastructure, typically in the fossil-fuel, waste, or agriculture sectors, which emit methane at high rates.

The EMIT instrument is an imaging spectrometer which are widely used in the agency's space missions — that will measure light in visible and infrared wavelengths. When the various wavelengths of light – the spectrum – are distributed across the instrument's detector, they display unique spectral signatures indicating the mineral composition of the surface.

The image below shows a methane plume 2 miles detected southeast of Carlsbad, New Mexico. Methane is a potent greenhouse gas that is much more effective at trapping heat in the atmosphere than carbon dioxide.



Relative to carbon dioxide, methane makes up a fraction of human-caused greenhouse-gas emissions, but it is estimated to be 80 times more effective, ton for ton, at trapping heat in the atmosphere in the 20 years after release. Moreover, where carbon dioxide lingers for centuries, methane persists for about a decade, meaning that if emissions are reduced, the atmosphere will respond faster, leading to slower near-term warming.

Identifying methane point sources can be a key step in the process. With knowledge of the locations of big emitters, operators of facilities, equipment, and infrastructure can quickly act to limit emissions.

EMIT is the first of a new class of spaceborne imaging spectrometers to study Earth. Another example is Carbon Plume Mapper (CPM), an instrument in development at JPL that is designed to detect methane and carbon dioxide. JPL is expecting to launch CPM in early 2024.

Additional information can be found at these JPL links:

EMIT: https://earth.jpl.nasa.gov/emit/

CPM https://www.jpl.nasa.gov/news/nasa-built-greenhouse-gas-detector-moves-closer-to-launch

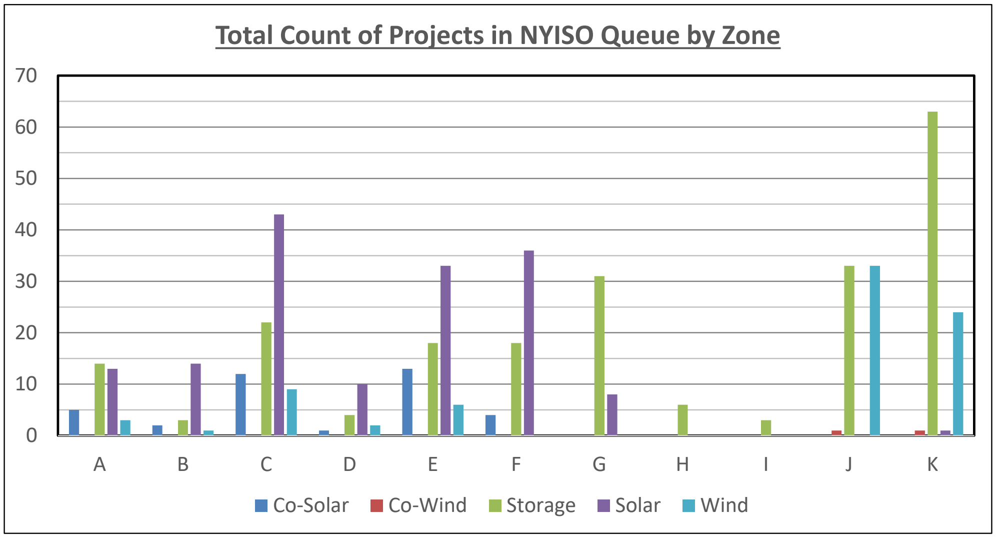
Interconnection Queue: Monthly Snapshot – Storage / Solar / Wind / CSRs (Co-located Storage)

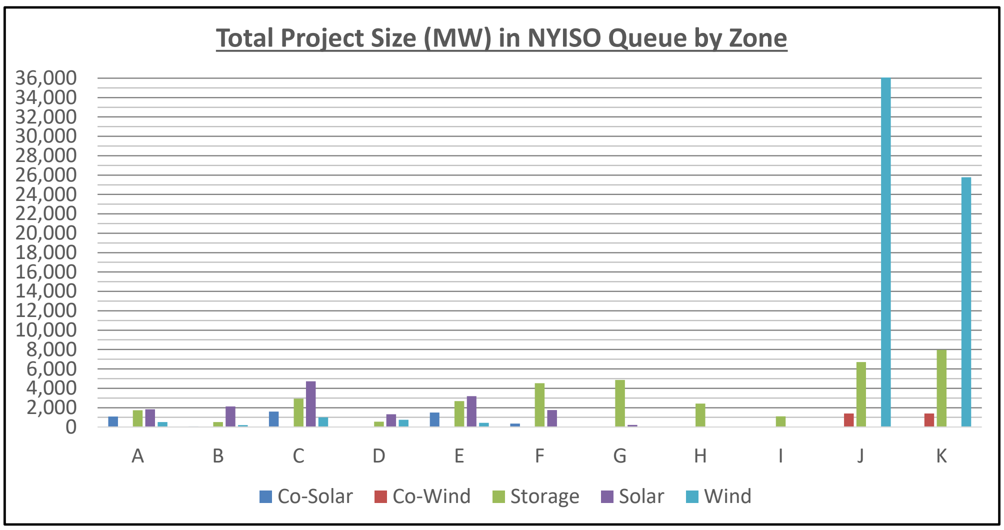
The intent is to track the growth of Energy Storage, Wind, Solar and Co-Located Storage (Solar and Wind) projects in the NYISO Interconnection Queue, looking to identify trends and patterns by zone and in total for the state. The information was obtained from the NYISO Interconnection Website, based on information published on January 22nd, and representing the Interconnection Queue as of December 31st. Note that 15 projects were added, and 8 were withdrawn during the month of December.

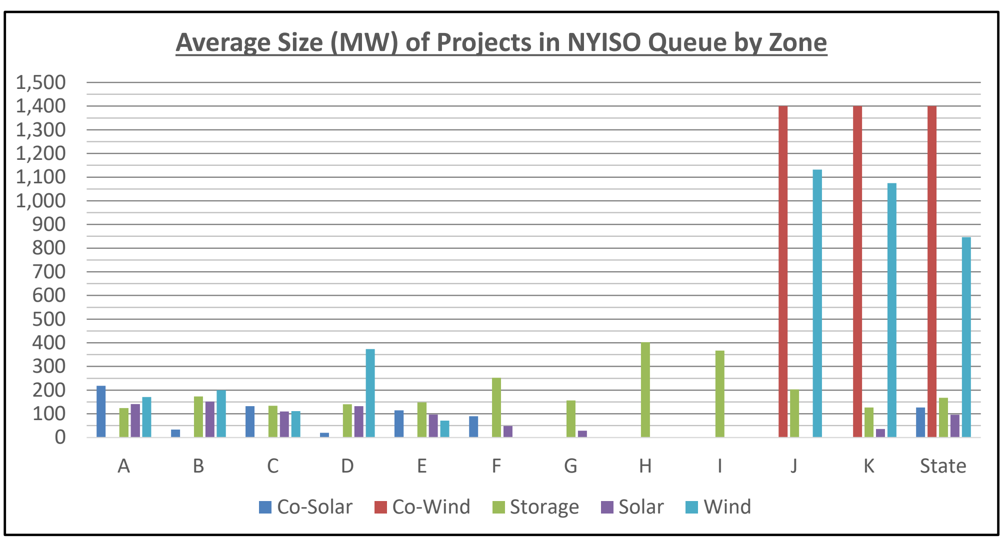
Total Count of Projects in NYISO Queue by Zone					
Zone	Co-Solar	Co-Wind	Storage	Solar	Wind
A	5		14	13	3
B	2		3	14	1
C	12		22	43	9
D	1		4	10	2
E	13		18	33	6
F	4		18	36	
G			31	8	
H			6		
I			3		
J		1	33		33
K		1	63	1	24
State	38	2	215	158	78

Total Project Size (MW) in NYISO Queue by Zone					
Zone	Co-Solar	Co-Wind	Storage	Solar	Wind
A	1,092		1,736	1,833	514
B	67		520	2,125	200
C	1,591		2,941	4,722	1,001
D	20		560	1,322	747
E	1,492		2,674	3,186	430
F	360		4,532	1,761	
G			4,858	230	
H			2,416		
I			1,100		
J		1,400	6,705		37,351
K		1,400	7,965	36	25,786
State	4,828	2,800	36,007	15,214	66,028

Average Size (MW) of Projects in NYISO Queue by Zone					
Zone	Co-Solar	Co-Wind	Storage	Solar	Wind
A	218		124	141	171
B	34		173	152	200
C	133		134	110	111
D	20		140	132	374
E	115		149	97	72
F	90		252	49	
G			157	29	
H			403		
I			367		
J		1,400	203		1,132
K		1,400	126	36	1,074
State	127	1,400	167	96	847


Total Count of Projects in NYISO Queue by Zone
70
60
50
40
30
20
10
0
A
B
C
D
E
F
G
H
I
J
K
Co-Solar
Co-Wind
Storage
Solar
Wind


Total Project Size (MW) in NYISO Queue by Zone
36,000
34,000
32,000
30,000
28,000
26,000
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
A
B
C
D
E
F
G
H
I
J
K
Co-Solar
Co-Wind
Storage
Solar
Wind


Average Size (MW) of Projects in NYISO Queue by Zone
1,500
1,400
1,300
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
0
A
B
C
D
E
F
G
H
I
J
K
State
Co-Solar
Co-Wind
Storage
Solar
Wind