nationalgrid

East Pulaski
Energy Storage System
Wholesale Market Participation
Annual Report

Cases 18-E-0130
and 16-M-0411

September 29, 2025

Table of Contents

Executive Summary

The East Pulaski Energy Storage System Project (the "East Pulaski ESS" or "ESS Project") is owned by Niagara Mohawk Power Corporation d/b/a National Grid ("National Grid" or the "Company") and installed at the Company's East Pulaski Substation in the Village of Pulaski. This 2 megawatt ("MW") and 3 megawatt-hour ("MWh") ESS Project participates in the wholesale energy market.

National Grid filed a petition with the New York Public Service Commission ("Commission") and was subsequently granted Commission approval to dispatch and market the output from the East Pulaski ESS into the New York Independent System Operator ("NYISO") wholesale market. The East Pulaski ESS was originally developed to provide local reliability support. Building on experiences to date, the Company continues to aim to further enhance customer value by increasing market participation during periods when the ESS is not required for local reliability support. Additionally, the Company continues to gain an understanding of the mechanisms of market participation that may be instructive in connection with the development of other energy storage projects.

The East Pulaski ESS and its supporting systems had to be modified for market participation since it had been commissioned and interconnected to National Grid's distribution system in 2018 to relieve local thermal loading constraints. This annual report focuses on the Company's experience with market participation.

This report covers the following focus areas:

- *Power Marketer*
- *Treatment of Wholesale Revenues and Costs*
- *Information and Operational Technology*
- *Technical Challenges*
- *Operations Plan*
- *Communication Pathways*
- *Lessons Learned*

The ESS Project began bidding into the NYISO Energy Storage Resource ("ESR") market in March 2024. National Grid hosted a stakeholder information session on March 20, 2024 where it provided an overview of the East Pulaski ESS, preparation for and operation of the ESS in the NYISO wholesale market, and key lessons learned from the project team and the third-party power marketer ('Power Marketer") engaged to support the ESS Project.

This report is the Company's third annual report. The next annual report will be filed in September 2026 where National Grid will continue to share lessons learned and best practices with bidding the East Pulaski ESS into the wholesale market.

Introduction

The ESS Project was originally developed to provide local reliability support, but National Grid has since added wholesale market participation as a use case for this ESS. This allows the Company to use the ESS to provide increased value for the benefit of its customers, while also gaining an understanding of the mechanisms of market participation ahead of developing other energy storage projects.

Background

The Commission's March 9, 2017 *Order on Distributed System Implementation Plan Filings* directed that "no later than December 31, 2018, each individual utility must have energy storage projects deployed and operating at no fewer than two separate distribution substations or feeders" that "should strive to perform at least two types of grid functions with the deployed energy storage resources (e.g., increasing hosting capacity and peak load reduction)."[1] Accordingly, National Grid developed and placed in service an ESS in 2018 within the existing footprint of the Company's East Pulaski Substation to provide peak load reduction to mitigate thermal overload of the substation's 115-13.2 kV transformer during normal peak system conditions. The ESS is located in the Village of Pulaski in Oswego County. The East Pulaski ESS Project is shown Figure 1 and its technical specifications are provided in Table 1.

Figure 1: East Pulaski ESS

Table 1: ESS Technical Specifications

Specification	Value
Maximum Rated Discharge / Charge Output	2 MW / 2MW
Guaranteed End of Life Capacity	3 MWh
Commercial Operation Date	December 2018
Energy Storage Technology	Lithium-Ion Nickel Manganese Cobalt
Energy Storage Manufacturer	Samsung

[1] Cases 16-M-0411 et al., *In the Matter of Distributed System Implementation Plans* ("DSIP Proceeding"), Order on Distributed System Implementation Plan Filings (issued March 9, 2017) ("2017 DSIP Order"), p. 30.

National Grid also installed a second 2 MW and 3 MWh ESS at the Company's North Troy Substation, also for peak load reduction to mitigate thermal overload conditions.

Since 2018, the East Pulaski ESS has successfully provided local reliability support during several normal peak system conditions. This reliability support to date has only been required during the summer peak months (i.e., June through September) leaving the ESS in standby mode for the rest of the year. To maximize the value of the ESS Project and to utilize the ESS when it would otherwise be sitting idle, National Grid filed a petition with the Commission to allow the Company to dispatch and market the output from the East Pulaski ESS into the NYISO wholesale markets.[2] The Commission subsequently approved National Grid's request in its September 9, 2021 *Order Approving Utility-Owned Asset Participation in Wholesale Markets.*[3] In addition, the Commission required that the Company hold a stakeholder information session to share valuable experience gained as well as file annual reports regarding the dispatching of the ESS Project.[4] The Company successfully hosted a stakeholder information session to address the full gamut of lessons learned on its way to successfully bid the ESS into the NYISO markets on March 20, 2024.

To unlock this wholesale participation capability while maintaining thermal overload mitigation capability, several site modifications, processes, and contracting elements had to be developed, enabling the ability to leverage the ESS Project in different use cases, a first for the Company.

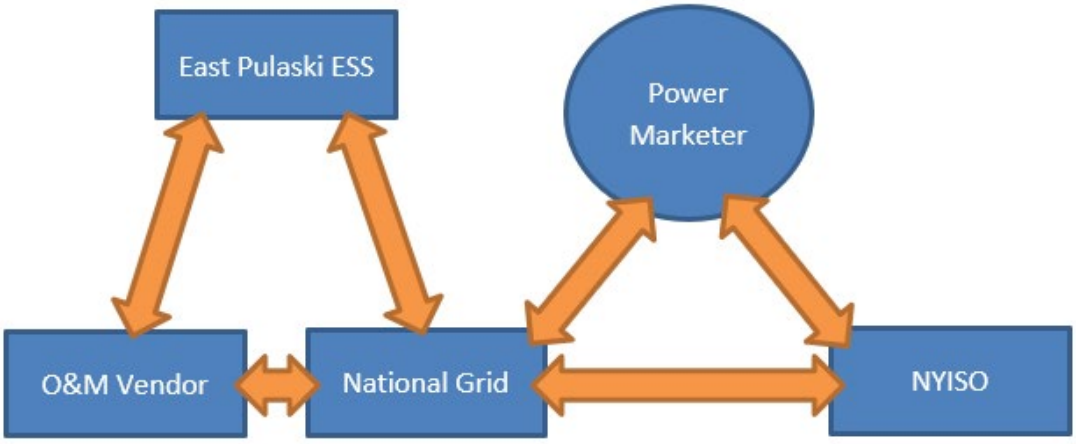
This report focuses on National Grid's experience, lessons learned, and next steps in developing this new capability. This report is intended to provide useful information to other entities in the energy storage industry to maximize the value of ESS in the state, in support of achieving New York State's clean energy goals.

[2] DSIP Proceeding, Petition of Niagara Mohawk Power Corporation d/b/a National Grid for Approval to Dispatch and Wholesale Market the Output from a Utility-Owned Energy Storage System Project (filed January 12, 2021).
[3] DSIP Proceeding, Order Approving Utility-Owned Asset Participation in Wholesale Markets (issued September 9, 2021) ("Order").
[4] *Id*., p. 14.

Market Participation Operation

This section provides an overview of the Company's experience to date since beginning NYISO wholesale market participation with the East Pulaski ESS. Figure 2 shows the parties involved and general information pathways used to date for the ESS wholesale market participation between the East Pulaski ESS, National Grid Control Center Operator ("CCO"), the Power Marketer engaged by National Grid, the ESS Operations and Maintenance ("O&M") Vendor, and the NYISO.

Figure 2: Project Information Pathways



Power Marketer

As National Grid continues to serve as a Load Serving Entity ("LSE") only, it has limited internal experience in bidding generation, especially energy storage projects, into the NYISO markets. As such, the Company contracted with Customized Energy Solutions Ltd., with experience in bidding other energy storage projects into wholesale market, to fulfill the role of Power Marketer. The Power Marketer has been responsible for conducting all the bidding of the East Pulaski ESS on behalf of the Company, ensuring the ESS warranty is maintained, recommending bidding strategies, and providing monthly updates to National Grid.

In participating in the NYISO markets, the Company and the Power Marketer have learned that cycle limitations and the availability of the ESS Project for dispatch into the market are the most impactful in optimizing our bidding strategy for market participation. The site is only available for dispatch into the market when it is not scheduled for a reliability need or not offline due to maintenance. The Company continues to modify its operating procedures and communications plans for the ESS Project to appropriately balance the availability for reliability, NYISO market participation, and maintenance operations.

Per the warranty, the recommended cycling limit for the ESS Project is 300 cycles per year. To date, the ESS Project has evenly distributed the cycles across the 12-month calendar year, approximately 25 cycles per month. However, going forward, the Power Marketer is looking into placing the ESS Project in a better position for leveraging higher energy arbitrage opportunities by distributing cycling across the

seasons. The distribution will approximately be 100 cycles per season in winter and summer and 50 cycles per season in fall and spring.

The Company plans to expand the ESS Project into NYISO's Regulation market. Participation in this market is common for ESS given their ability to respond quickly to frequency regulation needs. National Grid plans to proceed with bidding the ESS Project into the Regulation market but will need to assess the impacts of doing so on the cycling limitations per warranty and be prepared to make adjustments as needed. National Grid successfully tested the appropriate communications with the NYISO in September 2025 to enter the ESS project into the Regulation market by Q1 2026.

Treatment of Wholesale Revenues and Costs

Since the ESS Project began bidding into the NYISO wholesale market, it has incurred both revenues and costs associated with market participation. The Company has used its Legacy Transition Charge ("LTC") mechanism to return to customers any revenues that exceed costs (i.e., net revenues) associated with wholesale dispatch and marketing of the facility. Since the ESS Project began bidding into the NYISO wholesale market, 100 percent of the net revenues from the dispatch and wholesale marketing of the East Pulaski ESS Project have been applied to the benefit of National Grid's customers through the LTC. The LTC continues to be included in the Company's monthly Electric Supply Statement filed with the Commission.

The Power Marketer provides a monthly file detailing the payment and revenues from the previous month. The Company's Accounting teams create an invoice and provide it to the Power Marketer for the remittance of payment.

Technical Challenges

The ESS Project has faced new technical challenges while participating in the NYISO wholesale market. During required ESS maintenance and troubleshooting, the ESS Project was not available to bid into the market. The Company and the ESS O&M Vendor have worked closely to remedy technical issues to minimize these interruptions. National Grid also encountered unavailability challenges caused by the transition of the Company's operating network and server storage capacity limitations. The Company's experiences have been incorporated into this report for others who plan to participate or are participating in the NYISO wholesale market to leverage.

At the time the Company filed its last annual report, two technical challenges were in progress. Table 2 displays a summary of the technical challenges described in this section and their updated status. Previously, the ESS Project was not communicating the NYISO basepoint for dispatch within NYISO's required 6 second window. National Grid's CCO modified their interval to 5 seconds within the Company's Energy Management System ("EMS") and resolved this issue.

Additionally, the Company resolved the issue of misalignment between point of interconnection and dispatch by modifying its basepoints from NYISO using scalar values dependent on the ESS Project mode. The ESS Project interprets the NYISO signal and determines whether it should operate in charge,

discharge, or steady state mode and modifies the basepoint accordingly. This solution was validated through an end-to-end communications test.

In early 2024, National Grid transitioned its operating network to a new circuit under the Company's Information Technology ("IT") management system. However, certain devices were unintentionally excluded from the management system, causing connectivity issues between the Virtual Desktop Interface ("VDI") and ESS Project. This raised concerns about troubleshooting network devices during incidents. As a result, the ESS Project was temporarily unavailable for bidding in the NYISO while the Company resolved the issue. The Company identified the exclusion of ESS Project's devices from the management system transition and worked to include the ESS Project to remedy the connectivity issue, restoring full operational capabilities. The system has since been able to resume normal activities.

Recently, the ESS Project experienced challenges related to maximum storage capacity on its local servers. These issues led to periodic outages, including a July 2025 incident when the Battery Power Plant Manager ("BPPM") powered down, and a near-capacity event in mid-August when the system reached 99.7% storage utilization. The situation culminated in July 2025 when the server system reached full capacity and went offline due to the inability to store ESS data. While offline, the batteries discharged below their lower limits, requiring on-site recovery by qualified third parties. The ESS O&M Vendor had previously implemented temporary maintenance solutions to keep the servers operational, but a long-term fix was needed. Options considered included adding more storage, upgrading server units, or implementing an automated solution to clear space above a certain threshold. Following a meeting with the ESS O&M Vendor, the Company proceeded with a server upgrade, and new units were ordered. The upgraded servers were installed, and the ESS was fully recovered and returned to wholesale market operations in July 2025.

Table 2: Technical Challenges Overview

Date Identified	Challenge	Status	Conclusion/Next Steps
August 2023	Delayed delivery of the basepoint and dispatch from National Grid's Control Center to the storage facility	Resolved	National Grid Control Center modified the interval to 5 seconds in EMS
August 2023	Misalignment between point of interconnection and dispatch	Resolved	Scalar modification to incorporate discrepancy based on the ESS Project's mode
May 2024	Transitioned operating system to new management system and the ESS Project devices were not included	Resolved	The ESS Project devices were added to the management system change scope and connectivity issues were resolved
July 2025	Maximum storage capacity on servers causing BPPM to power down	Resolved	ESS servers upgraded by O&M Vendor

July 2025	ESS batteries discharged below lower limit	Resolved	Batteries were recharged on-site and recovered by on-site contractors
August 2025	O&M Vendor communications cable was unsecured, and became pinched in the door hinge, which caused intermittent communications with National Grid's Control Center	In process	Existing cable has been properly secured as an interim solution. National Grid Stations team will pull a new communications cable and secure properly
September 2025	O&M Vendor Control Center unable to diagnose on-site ESS through virtual desktop computer methods	In process	National Grid to review O&M Vendor Control Center's operating procedures, staffing requirements, and response plan
September 2025	Communications testing with NYISO for Regulation Flag	Resolved	Successfully completed testing. NYISO to confirm authorization for bidding privileges to allow bids, then National Grid to update bidding strategy with Power Marketer

Operations Plan

As planned, the ESS Project has been operated as any other resource that participates in the NYISO wholesale market. During normal operations, the ESS has followed the basepoints provided by the NYISO through the Company's EMS to both discharge and charge. On several occasions the Power Marketer was notified of off-normal operations that made the ESS unavailable, and the Power Marketer ensured that the wholesale market bids reflected the capabilities of the ESS Project.

For local reliability needs that can be anticipated, the Company has worked with the Power Marketer to bid the required charge or discharge as needed to secure the ESS. For emergent local reliability issues, the Company follows the NYISO rules for Out of Merit ("OOM"), Day-Ahead Reliability Units ("DARU"), or Supplemental Resource Evaluation ("SRE") as necessary based on the timing. To date, National Grid has not needed to implement the NYISO rules for taking the unit OOM.

Communication Pathways

Data requirements and communication pathways have played a critical role in the day-to-day operation of the ESS in the NYISO wholesale market. A major achievement since commencing participation in the NYISO market is a high standard of communication maintained across all the ESS Project's stakeholders including the Company's internal teams, East Pulaski ESS, Power Marketer, ESS O&M Vendor, and NYISO. The Company has continued to review and revise its Data Requirements and Communication Pathways, presented in Table 3. As mentioned above, a major revision included in this report is the inclusion of the ESS O&M Vendor in communication protocols.

Table 3 provides a comprehensive summary of the data requirements and communication pathways the Company maintains for market participation. The direction of the communication pathway indicates whether it is one way (">") or bi-directional ("<>"). National Grid reviews and annually revises this table should there be any additions or revisions.

Table 3: Data Requirements and Communication Pathways

Information / Data	Frequency	Auto / Manual	Communication Pathway						
			Originator	Direction	Stakeholder	Direction	Stakeholder	Direction	Stakeholder
Real-time status and measurements of ESS (i.e., MW, MVAR, kV, etc.)	Real time	Auto	East Pulaski ESS	>	National Grid				
			East Pulaski ESS	>	O&M Vendor				
Real-time dispatch signals (e.g., NYISO or utility basepoints)	Real time	Auto	NYISO	>	Power Marketer	>	East Pulaski ESS		
Battery alarms (including individual and grouped alarms)	Real time	Auto	East Pulaski ESS	>	National Grid	>	Power Marketer		
			East Pulaski ESS	>	O&M Vendor	>	Power Marketer		
Unplanned (forced) outage notification (full or partial (i.e., de-rate))	Real time	Manual	East Pulaski ESS	>	National Grid	>	Power Marketer	>	NYISO
Communication failure between ESS and National Grid	Real time	Manual	O&M Vendor	<>	National Grid	<>	Power Marketer	<>	NYISO
Unplanned outage notification for National Grid asset that causes battery to disconnect	As soon as practically possible	Manual	National Grid	>	O&M Vendor				
			National Grid	>	Power Marketer	>	NYISO		
Battery Emergency Event (e.g., fire)	Within 1 hour of the event	Manual	East Pulaski ESS	>	National Grid				
			East Pulaski ESS	>	Power Marketer	>	NYISO		
			East Pulaski ESS	>	O&M Vendor				
Local Grid Battery Reliability Event Notification	Day of reliability event	Manual	National Grid	>	Power Marketer	>	NYISO		
Intra Day Operating Plan	Day ahead 5 AM through to real time	Manual	National Grid	<>	Power Marketer	<>	NYISO		
Day Ahead Operating Plan	Daily	Manual	National Grid	<>	Power Marketer	<>	NYISO		
Short Term Day-Ahead Plan	Two days ahead of dispatch day	Auto	National Grid	<>	Power Marketer	<>	NYISO		
Battery Return to Service	Two days ahead prior to return to service for planned outage and two hours for unplanned	Manual	O&M Vendor	>	National Grid	>	Power Marketer	>	NYISO
			National Grid	>	Power Marketer	>	NYISO		
			National Grid	>	O&M Vendor				
Planned Outage Notification	At least 5 Business Days Prior to Outage	Manual	O&M Vendor	>	National Grid				
			National Grid	>	Power Marketer	>	NYISO		
Planned outage notification for National Grid asset that causes battery to disconnect	5 days notification	Manual	National Grid	>	Power Marketer	>	NYISO		
			National Grid	>	O&M Vendor				
Annual Planning for reliability and maintenance	Yearly	Manual	O&M Vendor	<>	National Grid	<>	Power Marketer		
Long-term Planning data for operational consideration	At least 2 months prior to start of annual operation	Manual	National Grid	<>	Power Marketer				
Operating limits of the ESS Project	After Execution of Contract Between ESS and National Grid	Manual	O&M Vendor	<>	National Grid	<>	Power Marketer		

Lessons Learned

The Company has continued to record all lessons learned from the ESS Project to date. Table 4 below consolidates key lessons learned and best practices identified since the additional scope of NYISO market participation began. In subsequent annual reports, National Grid will expand upon this table based on continued experiences with market participation of the ESS Project.

Table 4: Market Participation Lessons

#	Category	Situation	Lesson Learned
1	NYISO Coordination	The Company had limited experience in market participation or the applicability of NYISO rules to a utility.	Early engagement with the NYISO should be a priority to ensure project success and work through problems with the help of NYISO.
2	NYISO Coordination	Direct communication pathway from ESS to Power Marketer was needed.	Confirmed with NYISO and with the Company's approval, NYISO to share monitored values with Power Marketer. This eliminated the need to create a direct communication pathway from the ESS to the Power Marketer by utilizing a pathway that already existed.
3	NYISO Coordination	The Company's NYISO account is designated as Purchaser, but ESS Project requires Seller designation account for Market Participant.	Registered East Pulaski ESS with Power Marketer account as Market Participant and set up account transfer.
4	NYISO Coordination	A new meter was required to be installed at East Pulaski ESS to comply with NYISO requirements.	Encountered issue of not being able to install a third meter due to battery structure; reached agreement with NYISO to use two meters and deduct one meter from the other meter.
5	Power Marketer Procurement	Need for a Power Marketer to support multiple ESS projects within the Company	Generalize Power Marketer contract across more than one ESS opportunity to find efficiencies in costs and learnings.
6	Revenue Allocation / Cost Recovery	Key requirement for Commission approval to bid the ESS Project into the wholesale market was requirement that 100% of net revenues go back to all delivery customers.	Worked with National Grid's Electric Pricing team to create a tariff change to provide a pathway to meet requirement for allocating net revenues back to customers through the LTC surcharge.
7	Technical Challenges	Retrofitting an existing ESS was complex and required attention to detail and modification.	Built to suit applications should consider all NYISO requirements to the extent possible during development to avoid retrofitting needs at a later date.
8	NYISO End-to-End ("E2E") Testing	Several tests were conducted with NYISO that identified issues that could have perhaps been identified without NYISO participation.	Test all communications pathways and ESS dispatching for all pathways that do not require NYISO to send basepoint signal ahead of the NYISO E2E tests.

Table 4: Market Participation Lessons (continued.)

#	Category	Situation	Lesson Learned
9	Market Participation	Originally planned to use Limited Energy Storage Resource ("LESR") model but pivoted to ESR	Shift from LESR to ESR participation model required some changes to NYISO EMS modeling and registration forms.
10	Communications Plan	O&M Vendor was not included in data requirements and communication pathways mapping resulting in coordination challenges	O&M Vendor is a key stakeholder in NYISO market participation as ESS Project maintenance impacts site availability
11	Communications Plan	Site availability depends on system reliability, market participation, and downtime needed for maintenance	National Grid continues to modify its operating procedures and communications plans to optimize maintenance operations and promote site availability for reliability and market participation.
12	Power Marketer	Distributed cycle limits across 12-month calendar year which limited revenue generation in summer and winter months	Implement greater cycling in summer and winter months.
13	Technical Challenges	Upgrading existing ESS server communication system was complex and time-sensitive	National Grid needs to upgrade server equipment in timely, prioritized manner in future, in close coordination with O&M Vendor and on-site teams.
14	Power Marketer	Transition of customer-facing purchase order accounting numbers may have caused invoice confusion	National Grid should consider improving communication with Power Marketer to reduce potential invoice confusion.
15	Technical Challenges	The ESS Project asset is aging and requiring increased frequency of site visits from O&M Vendor and other contractors	National Grid should consider a battery health monitoring application to better understand root causes of potential battery health issues and plan for asset aging.
16	Communications Plan	National Grid Control Center has difficulty contacting O&M Vendor's Control Center	National Grid review of O&M Vendor's Control Center operating procedures, staffing requirements, and response plan.
17	Communications Plan	O&M Vendor's support teams and subcontractors have increased frequency of site visits and changed arrival/departure times frequently	National Grid Stations Team and Asset Management Team have improved communications protocols for internal alignment
18	Revenue Allocation / Cost Recovery	Invoicing from National Grid's Power Marketer has been erratic for the East Pulaski billing period and is often missing the East Pulaski-ESR NYISO Monthly Settlement Data spreadsheet.	Having a scheduled monthly date for invoice submittals will assist with more efficient payment processing. Also having the East Pulaski-ESR NYISO Monthly Settlement Data spreadsheet included with each invoice helps with the settlement.