BULK POWER ENERGY STORAGE PROCUREMENT OF SCHEDULING AND DISPATCH RIGHTS – REQUEST FOR PROPOSAL

National Grid September 30, 2019

APPENDIX F - STORAGE TRADING & DISPATCH SERVICES

INTRODUCTION

Niagara Mohawk Power Corporation d/b/a National Grid ("National Grid" or the "Company") seeks a reputable power marketer entity ("Marketer") to provide the Company with trading and optimal dispatch services for the bulk power energy storage ("storage") scheduling and dispatch rights to be procured by National Grid. The Marketer will be responsible for bidding, scheduling, and dispatching the storage technology into the New York Independent System Operator ("NYISO") wholesale market to maximize revenues to National Grid while prioritizing local grid support requirements[1] and observing any local grid limits[2] (see Appendix E for more details). In addition, the Marketer shall train National Grid staff in support of National Grid's development of future in-house Marketer capabilities[3] in alignment with the evolving role as the Distributed System Platform ("DSP") provider. In return for this service, National Grid will provide payment in alignment with the contract for this service. An Operational Agreement will define the roles and responsibilities of National Grid, the Marketer, and the storage owner(s) and shall be executed by all three parties (National Grid, storage owner and the Marketer) as part of the Marketer Contract and be subject to revisions thereafter as necessary.

The Marketer services provided must be offered for all four (4) storage opportunity sites and use cases as defined in the body and subsequent appendices of this RFP. Bid prices shall be based on a per storage project basis. National Grid will consider price discounts for services provided for multiple storage systems.

Both Bidders and non-Bidders to National Grid's Bulk Power Energy Storage Scheduling and Dispatch Rights RFP (*i.e.*, physical storage), may submit offers for this service.[4] Bidders offering Marketer services only, **do not** need to pre-Qualify to submit a proposal but must register with the National Grid's Procurement System "Ariba" (if not already registered).

NYISO MARKETS

The following markets have been preliminarily identified as potentially having the greatest revenue opportunities and may align well with the local grid needs identified at this time as described in detail in Appendix E. However, the Marketer shall optimize and consider other market products in consultation with National Grid as the markets evolve/change over time with consideration to the storage technical capabilities and warranties, distribution system conditions, and storage lifetime in mind:

- 10-minute spinning reserve

[1] N-0 and N-1 load and voltage support.
[2] Voltage, thermal, and protection limits.
[3] *E.g.*, software, resources, skills and knowledge, etc.
[4] Bidders to this Marketer RFP who are also responding to National Grid's *Bulk Power Energy Storage Scheduling and Dispatch Rights RFP* shall specify how they plan to mitigate and avoid any potential conflicts operating their own storage systems while providing trading and dispatch services for storage systems owned by others.

- Frequency regulation
- Day-ahead and real-time energy

The Marketer shall have the capability and experience[5] to optimize revenues for storage participating in the NYISO markets and simultaneously supporting local grid needs.

A periodic review by and among the Winning Bidder and National Grid shall take place to conduct a look-back and forward review of the evolving markets to (i) optimize near- and long-term market participation, (ii) optimize strategy, and (iii) review performance. For example, this review could result in the inclusion to dispatch a storage system as a load modifier (*i.e.*, to avoid wholesale procurement costs) in addition to participation in the NYISO markets, subject to evolving NYISO rules.

MARKETER REQUIREMENTS

The Marketer must demonstrate that they have software and an experienced team able to meet the following minimum requirements:

- Development of long-term and short-term storage dispatch plans with consideration of:
  - Local grid system needs
  - Local grid system limits
  - NYISO markets
- Ability to communicate plans to the responsible National Grid departments, including Operations and Planning.
- Forecasting of day-ahead, real-time energy, and ancillary services market prices and ability to trend the associated market signals and submit bids into the NYISO market.
- Have a 24-hour, 7 days a week scheduling desk.
- Use a non-proprietary software that could be acquired and integrated into National Grid's control center at a future time.
- Ability to factor asset lifetime in alignment with the storage owner warranties to adhere to the warranty requirements, *e.g.*, resting state of charge ("SoC"), operational SoC, depth of discharge ("DoD"), MWh discharge throughput.
- Provide, integrate and operate and maintain the appropriate communication and data channels between the Marketer and National Grid's Energy Management System ("EMS") or Advanced

[5] It is understood there are a limited number of companies with significant experience in conducting dual operation/participation. As such, demonstrated experience in non-simultaneous (*i.e.*, services provided separately) operation of such services will be considered in reviewing Bidders' Offers.

Distribution Management System ("ADMS")[6] and the NYISO to the Marketer and the Marketer to the Storage Management System per Figure 1 below.[7]

- Meet the National Grid Cyber Security and IT requirements (see Data Privacy and Cyber Security section below).
- Guarantee priority dispatch for local reliability needs over participation in the NYISO market.
- Data acquisition and management capabilities to capture data associated with historical storage dispatch events, market signals, and bids.[8]

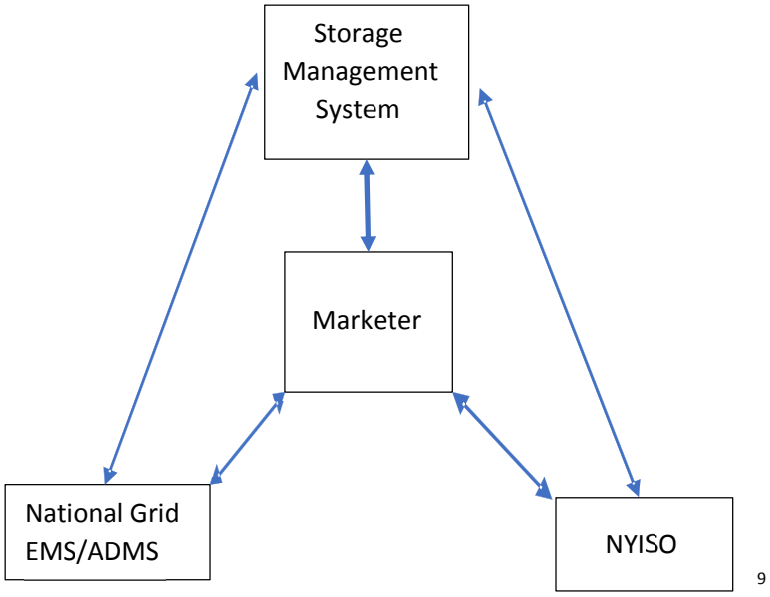
Proposals that offer the most automated approach to dispatching storage systems by combining and processing basepoints from the NYISO with local grid needs, and limits from National Grid's EMS/ADMS will have an advantage. The Marketer may self-schedule to participate dually (local grid needs and NYISO markets) in accordance with FERC and NYISO rules (*i.e.*, separate and distinct services).

National Grid will have override capability to disconnect/re-connect and dispatch the storage for local grid needs (*i.e.*, following an N-1 contingency event), consistent with the terms of the Interconnection Agreements and Operational Agreements.

[6] Over the next two-three years National Grid has plans to deploy an ADMS and such system will likely become the system to manage energy storage systems at the macro level (*i.e.*, simple monitoring and control) by the end of 2022.

[7] National Grid shall provide support to integrate the communications and data paths between the Company's EMS/ADMS and the Marketer and the Storage Management System only.

[8] This data will be ported to the National Grid's PI historian and will be used for M&V of performance.



[9]

Figure 1 – Communication and Data Paths between Entities

TECHNICAL REQUIREMENTS & ROLES

Each entity in Figure 1 shall perform roles and provide the following technical requirements that will be documented in detail along with rules and scenarios in an Operational Agreement executed as part of the Contract:

- Marketer shall provide the following:
  - Bi-monthly NYISO performance and review.
  - Provision, O&M, and integration of the bi-directional communications and associated mediums between with the Marketer and NYISO, the Marketer and National Grid's EMS/ADMS, and the Marketer and the Storage Management System.[10]

[9] Depending on the NYISO market product, the dispatch communication path to the Storage Management System may change, *e.g.*, for frequency regulation and real-time markets the NYISO will likely communicate directly with the Storage Management System, while for other market products the path will likely be from the NYISO to the Storage Management System via the Marketer or National Grid EMS/ADMS.

[10] Any costs associated with the decommissioning of these three communication pathways after the contract term shall be borne by the Marketer.

  - Historian software to capture NYISO prices, bidding information, and storage dispatch signals[11]
  - Monthly storage status reports with actuals compared with warranty limitations
  - Optimal storage dispatch with local grid needs as the priority and associated management of the storage project's SoC
  - Bids and settlement in the NYISO wholesale market
  - Periodic evaluation of optimal wholesale market products for the storage project(s)
- Storage owner and associated Storage Management System shall provide the following:
  - Real-time monitoring data (*i.e.*, alarms, status, SoC, real and reactive power flow, etc.)
  - Full storage control (including remote connect and disconnect) and dispatch capability
  - Provide, integrate and operate and maintain the bi-directional communications and associated mediums between EMS/ADMS to Storage Management System, NYISO to Storage Management System[12] [13]
  - Storage maintenance schedule and notifications
  - Capability to set up prioritized remote access control of the storage systems (*e.g.*, between National Grid and the Marketer)
  - Planned outage schedules and any storage-related unplanned outage event notifications provided to National Grid and the Marketer
- National Grid shall provide the following:
  - Planning:
    - Year-ahead seasonal local grid needs factoring probability of N-1 event occurring
    - Year-ahead seasonal local grid operational limits
    - One-time warranty and asset life requirements (per agreement with storage owner)
    - One-time storage technical description (*e.g.*, MW, MWH, VAR (Volt Amps Reactive), ramp rates, location, use cases, etc.)
    - Review periodic evaluation of optimal markets with the Marketer
  - Control Center:
    - Notification as far in advance as possible of local grid needs and operational limits as necessary to support the Marketer with day-ahead storage dispatch optimization
    - Dispatch of the storage following an N-1 reliability event and coordinate with the Marketer
    - Monitor and review the Marketer dispatch plans as necessary[14]

[11] All data shall be easily accessible and provided upon request by National Grid for the term of the Marketer contract plus one full calendar year thereafter.
[12] Some locations require hardwire communications due to poor cellular coverage.
[13] Any costs associated with the decommissioning of these two communication pathways after the contract term shall be borne by the storage owner.
[14] Via EMS/ADMS integration to the Marketer.

- Make changes to the Storage Management System settings as necessary via EMS/ADMS
- Real-time Supervisory Control and Data Acquisition ("SCADA") refresh rates of local grid conditions from EMS/ADMS to the Marketer (*e.g.*, switching device status, voltage, real and reactive power flow, etc.)
- Periodic planned storage outages
- Notification of storage control takeover by National Grid
- Periodic voltage control setpoints for VAR control

CONTRACT AND PAYMENT

The Marketer Contract with National Grid will be for a two-year term, renewable at National Grid's discretion.

The fee will be on a fixed rate based on agreed performance targets, with a commission for over-performance and a potential holdback for poor performance or non-performance. All relevant details will be captured in the Marketer Contract and the Operational Agreement(s).

Penalties imposed by the NYISO for non-performance or any other penalty associated with participation in the NYISO will be the liability of the Marketer excluding any penalties resulting from circumstances beyond the Marketer's control (*i.e.*, N-1 contingency outage or an unplanned failure of the storage project).

The terms of the Marketer Contract will include a dispute resolution process to resolve any issues associated with calculation of payments.

DATA & COMMUNICATION REQUIREMENTS

Data and communications requirements between the Marketer to the Storage Management System and between the NYISO and the Storage Management System are at the discretion of said entities and responsible parties. Data and communications requirements for the paths to National Grids EMS/ADMS are described in the Table 1 below.

Information and data shall be communicated by all entities as far in advance as possible.

Table 1 – Communications and Data Paths to National Grid's EMS/ADMS

Data Items	**National Grid EMS/ADMS and Marketer Software**	**National Grid EMS/ADMS and Storage Owner's Storage Management System**
Bi-directional or Uni-directional?	Bi-directional	Bi-directional

Types of Information	• Seasonal, local grid-operational limits
	• Day-ahead, local grid-operational limits
	• Real-time, local grid-operational limits
	• Day-ahead, local grid load relief needs
	• Day-ahead local grid N-1 contingency pre-dispatch
	• Real-time local grid N-1 contingency dispatch
	• Periodic planned and unplanned storage outages
	• Bi-monthly NYISO performance and review
	• One-time warranty and asset life requirements
	• Monthly storage status report against warranty requirements (*i.e.*, M&V)
	• One-time storage technical description (*i.e.*, MW, MWH, Power Factor, location, use cases, etc.) and optimal markets
	• Shared day-ahead and real-time storage operation and dispatch screen
	• Real-time notification of control takeover by National Grid
	• Periodic voltage control setpoints for VAR control
		• Real-time status of all storage project measurements (*e.g.*, temp., SoC, voltage, active and reactive power, current, frequency, cell status, etc.)
		• Real-time open/close storage circuit breaker command
		• Real-time dispatch of active and reactive power (charging and discharging)
		• Microgrid systems only (*i.e.*, Old Forge):
		  ○ Black-start commands
		  ○ Island control signals (likely decentralized control)
		  ○ Re-synchronization
		• Protection coordination (includes microgrid coordination)

Data Protocols	• Distributed Network Protocol (“DNP3”) or Inter-Control Center Communications Protocol (“ICCP”) for real-time monitoring and control (“M&C”) • Internet protocol for cloud-based data • Email for day-ahead • Email and meetings for durations greater than day-ahead	• Protection protocols • DNP3 or ICCP for real-time M&C
Communication medium	• Cell or internet (*i.e.,* cloud-based data, email, etc.) for all ≥ five (5) minutes latency data requirements • Private fiber or radio frequency (“RF”) for all < five (5) minutes latency data requirements	• Cell or internet (*i.e.*, cloud-based data, email, etc.) for all ≥ five (5) minutes latency data requirements • Private fiber or RF for all < five (5) minutes latency data requirements • Fiber or other low-latency medium for protection requirements
Latency requirements	• 4-6 seconds for real-time scan rate with 15 milliseconds (“msec”) round trip • 24 hrs. for day ahead • 24 hrs. + for other data	• milliseconds for protection • 4-6 seconds for real time

Bandwidth/Data sizes	Will be determined once Winning Bidders of storage projects are selected and data packet sizes are known	
Auto or manual[15]	• Auto for all real-time and day-ahead data • Manual for all other data items	• Auto for all protection, real-time, and day-ahead data
Software types (*e.g.*, server, cloud, etc.)	• EMS/ADMS – local server • Trading & Dispatch software – cloud[16] or local server-based	• EMS/ADMS – local server • Storage Management System - dependent on storage owner

DATA PRIVACY & CYBER SECURITY

Data exchanges between National Grid and the Winning Bidder for Marketer services shall be considered confidential and shall adhere to National Grid's data and cyber security policies. The associated costs to meet the Data Privacy and Cyber Security items listed below should be considered in the Bidder's proposal. Bidders shall complete the IT Architecture and Cyber Security questionnaire in Appendix J and K, respectively.

The following items will be required to comply with National Grid's Data Privacy and Cyber Security requirements at a minimum:

- National Grid standard cybersecurity requirements shall apply to the Marketer and the Marketer shall be required to execute a Data Security Agreement with the Company.
- National Grid shall have access to and retain ownership of all operational data applicable to the Project.
- The Marketer and any associated contractors and subcontactors will need to comply with all Applicable Laws and Regulations and to Personal and/or Confidential Information received from National Grid and the storage owner(s).
- The Marketer shall ensure that its contractors and subcontractors who have access to National Grid's Personal and/or Confidential Information implement and maintain appropriate physical, technical, and administrative security measures for the protection of such Personal Information and/or Confidential Information as required by all Applicable Laws and Regulations, or as required by National Grid.
- The Marketer shall not, directly or indirectly, divulge, disclose or communicate any Personal Information and/or Confidential Information it receives from National Grid and storage owner to any person, firm, or corporation, except with the advance written permission of National Grid and the storage owner(s).
- All records pertaining to Personal Information and/or Confidential Information received from National Grid, whether developed by National Grid or others, are and shall remain the property of National Grid.

[15] "Auto" is machine-to-machine whereas "Manual" is human intervention.
[16] Subject to cyber security requirements.

- National Grid shall have access to and retain ownership of all operational data applicable to the storage systems.
- The Marketer shall adopt, implement and maintain security procedures sufficient to protect Personal Information and/or Confidential Information from improper access, disclosure, use, or premature destruction. Such security procedures shall be reasonably acceptable to the Company and in compliance with all Applicable Laws and Regulations as they are promulgated or amended.
    - The Marketer shall ensure that its Information Security Program covers all networks, systems, servers, computers, notebooks, laptops, mobile phones, and other devices and media that processes Customer Information or that provides access to Customer networks, systems or information.
    - The Marketer shall ensure that its Information Security Program includes industry standard password protections, firewalls and anti-virus and malware protections to protect Customer Information stored on computer systems.
    - The Marketer shall ensure that all systems, appliances, operating systems, applications, firmware, middleware and any other form of software have the LATEST patches applied.
    - The Marketer will ensure that all systems, appliances, operating systems, applications, firmware, middleware and any other form of software & hardware is properly hardened to the latest appropriate benchmarking methodology.
- The Marketer will conduct and provide a risk assessment to identify and assess reasonably foreseeable internal and external risks to the security, confidentiality and integrity of electronic, paper and other records containing Customer Information and evaluate and improve, where necessary, the effectiveness of its safeguards for limiting those internal and external risks.
- The Marketer may need to setup and configure various firewalls to sufficiently protect all Parties.
- National Grid will need to conduct a thorough investigation into the associated Storage Management System software architecture and associated controls and may need to conduct “penetration” testing.
- Maintain, and provide for National Grid’s review, at National Grid’s request, (a) Written Information Security Program (“WISP”); and (b) other applicable security program documents, including summaries of its incident response policies, encryption standards and/or other computer security protection policies or procedures, that constitute compliance with the Massachusetts security regulations (“MA Security Regs”) and the Rhode Island security regulations (“RI Security Regs”).
- The Marketer agrees to apply the standards and requirements of the MA Security Regs and RI Security Regs to all such Personal Information, regardless of the jurisdiction in which the subject of Personal Information resides.
- The Marketer shall have a process for managing both minor and major security incidents.
- The Marketer shall notify National Grid promptly, but in no event later than twenty-four (24) hours, upon discovery of a security vulnerability and in no event later than five (5) days after discovery of any unauthorized access, possession, use, destruction or disclosure of Personal Information (“Security Breach”).

- National Grid's data, including Personal Information, may not be maintained, stored, or transmitted outside of the United States of America.
- The Marketer shall permit National Grid or its representatives to perform audits of the Marketer's facilities, equipment, books, and records (electronic or otherwise), and operational systems, and such other audits as may be deemed necessary by National Grid.
- The Marketer shall participate in any audits and information disclosure in the event the National Grid is audited.
- An annual written self-certification shall be provided to National Grid by the Marketer based on an independent third-party audit that scrutinizes and confirms the effectiveness of controls (*i.e.*, penetration testing).
- The Marketer shall have an established process for verification of software integrity and authenticity of all software provided by the Marketer.
- The Marketer shall adopt a Secure System Development Life Cycle program ("Secure SDLC") methodology.
- The Marketer shall configure each component of the Marketer software to operate using the principle of least privilege. This includes operating system permissions, file access, user accounts, application-to-application communications, and power supplies.
- The Marketer shall notify National Grid when remote or onsite access should no longer be granted to authorized representatives of the Marketer.
- The Marketer shall obtain National Grid's prior approval and require all third parties engaged by the Marketer to adhere to the applicable Cybersecurity requirements and access termination rights.
- For any work that requires access to the Physical Security Perimeter at a current control house as identified by the Company, or is in the process of constructing a new control house environment, the Marketer shall require its contractors and subcontractors to:
    - Complete the contract document containing National Grid Contractor Requirements for Compliance with NERC Cyber Security Standards
    - Comply with the terms and conditions and obligations of the Marketer with respect to NERC CIP. The Marketer shall be responsible hereunder for any breach of such terms and conditions and obligations of the Marketer with respect to NERC CIP under this Agreement to the extent caused by its subcontractors.
- In the event of non-compliance or breach on the part of Marketer, its employees, agents or subcontractors with or of any or all of the NERC Cyber Security Standards, the Marketer shall be solely liable for any and all resulting costs, losses, penalties, damages and liabilities, including any costs, losses, penalties, damages or liabilities incurred by National Grid, and National Grid may terminate this Marketer Contract for cause, pursuant to the termination provisions contained herein.

NYISO REGISTRATION & ASSOCIATED COSTS

All steps required to conduct bidding services into the NYISO market will be the responsibility of the Marketer.[17] Registration of the storage project with the NYISO is the responsibility of the storage owner. The Marketer is responsible for reviewing the bidding service details (*e.g.*, participation model, resource attributes) with National Grid prior to submitting to the NYISO.

All charging costs inclusive of losses for the storage project shall be the responsibility of National Grid.[18]

EXPERIENCE

Experience bidding into the NYISO, especially for the market products described previously, and experience bidding energy storage projects into the NYISO markets is highly preferred for the Marketer.

TRAINING

The winning Bidder shall provide National Grid staff with training on the dispatch software and associated operations in support of National Grid's development of future in-house marketer capabilities in alignment with the evolving role as the DSP provider.

CONTRACT ENHANCEMENT

National Grid, at its discretion, may seek to expand the Marketer Agreement with the Winning Bidder for other energy storage projects outside of this RFP (*i.e.*, non-wires alternatives ("NWA") projects).

[17] The storage owner shall be responsible for all steps required to register the storage project with the NYISO and provide all metering requirements and communications to the NYISO.

[18] Storage ancillary load supply and delivery costs will be paid for by the storage owner.