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CIGRE US National Committee
2022 Grid of the Future Symposium

Pine Grove Non-Wires Alternative (NWA)

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SUMMARY

The utility is an electricity, natural gas, and clean energy delivery company serving more than 20 million people through the networks in New York and Massachusetts. The utility is transforming the electricity and natural gas networks with smarter, cleaner, and more resilient energy solutions to meet the goal of reducing greenhouse gas emissions. Pine Gove is the first successful Non-Wires Alternative (NWA) Solution for the utility in NY with a Benefit-to-Cost analysis ratio (BCA) of above a 1.0. An NWA removes or defers the need to construct or upgrade components of a distribution and/or transmission system. As part of the planning process, New York is required to issue requests for proposals (RFPs) to solicit alternatives for capital projects that meet the NWA screening criteria. Energy storage (typically battery storage) is a type of NWA that offers utilities a way to increase capacity on the electric grid by charging the batteries when electricity demand is low and discharging when demand outstrips available delivery capacity. Through a competitive bidding process, the utility selected a third party to cost-effectively increase capacity and improve reliability at its Pine Grove substation, increasing benefits for customers while increasing the amount of solar energy delivered to the grid. The utility will utilize the system on peak days to provide seamless reliability to customers served by the substation in the case of a contingency. During off-peak days, the NWA solution will participate in retail markets to provide clean energy for the utility's customers. The project's scope of work will install (2) grid-tied 5MW solar arrays, each paired with 5MW/20MWh lithium-ion BESS (Total: 10MW/40MWh) By implementing this solution, the utility is able to defer a nearby substation upgrade for at least ten years. The benefits and costs are reflected in the BCA, including both revenue-based benefits as well as monetized societal values. The main use case for this NWA arises when the loading on the Pine Grove bank (TB1) is forecasted to be over 100% of the Summer Emergency Rating (42.2 MVA) in the event of an outage on the second bank or TB2 (given peak loading conditions). In the event of this outage, the low side bus tie would be closed, and the entire station's load would have to be supported by TB1, which could be overloaded by up to 10MW at peak according to the load forecast.

The selected Pine Grove NWA was a result of a 3-year process involving cross functional teams from the Company for creating a need statement, specifying and issuing an RFP, screening the multiple responses, negotiating the contract with a third party, testing the system and dispatch capabilities, running a BCA, and guiding the project to an in-service date. This third party solution is owned and operated by a third party. The utility executed a novel contract to call on the system so a dispatch protocol and integration has been created for this innovative project and solution (the utility implemented a real-time centralized dispatch). This paper will aim to analyze each phase that the Pine Grove project went through from need statement to implementation and operations.

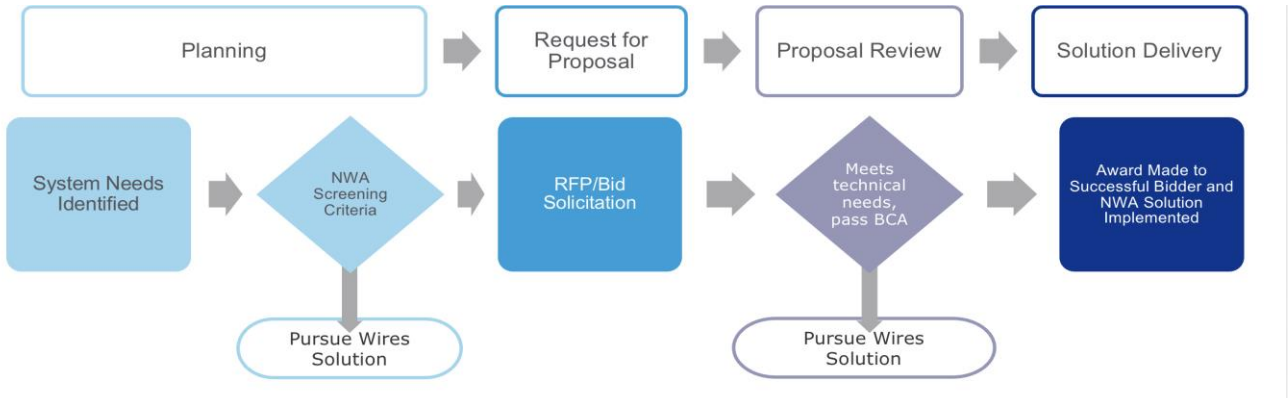
KEYWORDS

Non-Wires Alternatives (NWA), Distributed Energy Resources (DER), Resilience Planning, Battery Energy Storage System (BESS), Renewable Integration, DER Integration, PV.

Introduction

The utility is an electricity, natural gas, and clean energy delivery company serving more than 20 million people through the networks in New York. The utility is transforming the electricity and natural gas networks with smarter, cleaner, and more resilient energy solutions to meet the goal of reducing greenhouse gas emissions. Pine Gove is the first successful Non-Wires Alternative (NWA) Solution for the utility in New York with a Benefit-to-Cost analysis or ratio (BCA) of above a 1.0. An NWA removes or defers the need to construct or upgrade components of a distribution and/or transmission system.

An NWA project has multiple phases and starts out in the planning phase where emerging system needs are identified as early as possible. Early identifications allows for comprehensive consideration of the NWA and wires solutions as part of the electric distribution system planning process. This Pine Grove NWA project that will be discussed is a result of a 3-year process. An overview of the NWA process has been portrayed below in a flow chart form.



The system needs are identified as a result of area studies, operational issues, process safety issues, occupational safety issues, regulatory requirements, and/or customer requests. A needs case is developed by the planning team to fully detail the system and area needs and concerns based on the area study. Once a system need has been detailed, the planning team screens the opportunity based on the criteria listed below.

Criteria	New York
Project Type Suitability	Project types include Load Relief and Reliability. Other types have minimal suitability and will be reviewed as suitability changes
Timeline Suitability	>18 months
Cost Suitability	Greater than or equal to $500K

Note, the criteria presented in the table above is a result of a regulatory requirement for utilities to consider projects for NWA programs. Projects not meeting the criteria above will continue with the wires or traditional solutions, and projects meeting the criteria are considered for the next step in the NWA process as an NWA opportunity. An NWA opportunity is an area of electrical need for which an NWA could potentially displace, defer, or reduce the scope of a traditional poles and wires project. The table presented above considered systems needs in relation to project type, timeline, and cost to determine whether an NWA solution may be appropriate. If the team finds it suitable to pursue an NWA for that particular area, then a Request for Proposal (RFP) is developed and issued through the procurement platform for a distributed energy resource (DER) solution. NWA solutions are technology agnostic; the particular project discussed in this document utilizes a battery energy storage system (BESS) paired with solar as the NWA solution. Once an RFP has been drafted, it is sent out to the market for approximately 3 months, and developers submit proposals to help solve the need in the area. The submitted proposals are a response to the RFP and must meet the requirements listed in the RFP. Evaluation of the submitted proposals is completed by interdisciplinary teams, and if a proposal is found to successfully pass technical viability and the preliminary BCA, and found to be feasible and safe, then an award is made to the successful bidder. Once an award is made, contract negotiations are continued, and if terms are reached, then the project enters the solution delivery. Projects that do not pass technical viability and the BCA continue with the traditional solution. The solution delivery phase will work towards getting the NWA solution implemented and integrated into the electric grid; this phase also includes the testing and commissioning of the dispatch protocol to call on the NWA solution for grid purposes. The dispatch protocol created for the Pine Grove project is a novel system due to its centralized real-time dispatch signal.

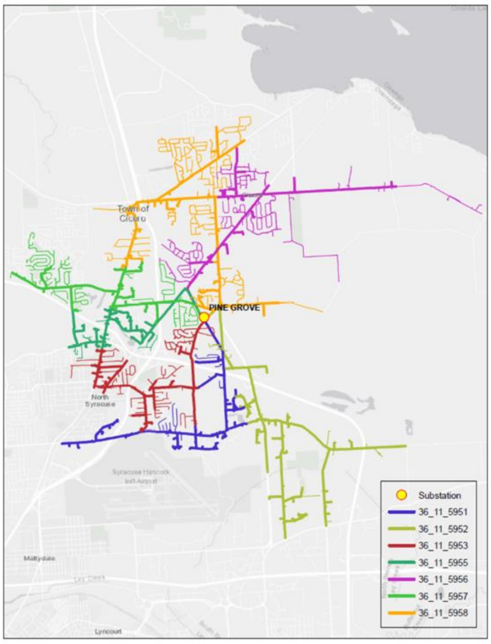
Advanced Forecasting

A key application of enhanced data is through the forecasting process and associated integration within the planning process. Creating a need statement prior to an RFP release requires detailed analysis of the load and generation forecast for the particular area. The detailed feeder-level, 8760 hour/year forecasts allow planners to hone into specific areas and feeders and plan upgrades to accommodate future renewable projects like the Pine Grove NWA. The utility plans to take a more integrated approach to identifying new opportunities for NWAs whenever they can provide customer value as the definition of an NWA further expands. For example, through integrated transmission and distribution (T&D) modeling and analysis, NWAs that can solve T&D needs may be identified, thereby creating new opportunities for DER. DERs can be any electricity supply or demand resources that are connected to the electric grid so this can range from solar, storage, demand response, energy efficacy, and more.

At the system level, forecasts provide important information to ensure that the utility procures sufficient energy and load products as well as system capacity, to serve its customers. The forecasts are also utilized to understand when a substation needs to be augmented/rebuilt or a new substation is needed in a particular area. Substations are a critical infrastructures in a utility and electric grid as they serve as nodes between the electric generation, transmission, and distribution components of the system. Voltage is transformed from high to low or vice-versa in a substation. Substations serve several other critical functions such as delivering power to communities and areas. Peak demand is the highest amount of electric power demand in a particular situation for a set period of time. Peak demand is critical to understand because the utility must ensure that these peaks can be met and enough power can be provided to handle days that include those peaks. The annual peak load forecasts incorporate projected economic and demographic impacts as well as anticipated technological advances and policy objectives. Current forecasts consider projected customer load growth, energy efficiency (EE) measures, solar PV generation, electric vehicles (EV), energy storage (ES), and demand response (DR) programs. Forecasting outputs directly feed into the work of procuring NWA solutions to identify the type, timing, and size of a system need or the studies which underpin the beneficial locations of DERs. These forecasts allow the team to screen projects based on the suitability criteria presented earlier.

Feeder level hourly forecasts illustrate the changing magnitude of peak loads and are also valuable for showing the change in peak over time. Examining the timing of loads across the day is important for assessing the impacts of different types of DERs and what type of solutions can help mitigate the risk in the area. Not all technologies can meet all kinds of peaks so it is important to model solutions based on the need in the area that is developed.

A map of the Pine Grove substation and feeders of interest is shown below.



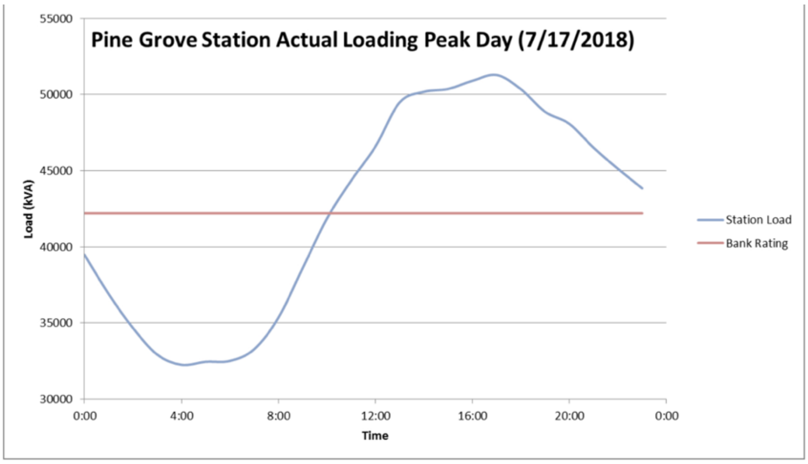
Thae targeted substation is Pine Grove substation, and the targeted feeders are the surrounding feeders (5951, 5952, 5953, 5955, 5956, 5957, 5958). For the Pine Grove project, the NWA solution will need to target those feeders to be able to supply the load to the area need. Any DER solution location downstream of the targeted feeders getaways (where the feeder leaves the substation) has the potential to solve the loading issue.

An NWA Solution is any strategy that addresses an electrical system need, such as peak demand management or reliability, with a solution that does not involve building new T&D lines or substation infrastructure. In the Pine Grove case, the infrastructure that would be deferred through the NWA solution is a substation rebuild. The area planners found that the loading at the utilty's Pine Grove Substation serving the Town of Cicero area had increased to a level at which it is projected to be overloaded to 100% (or higher) of its emergency rating (given an outage on one of the station transformer banks). Loading on the Pine Grove transformer bank (TB1) is forecasted to be over 100% of the Summer Emergency Rating (42.2 MVA) over the span of 2022-2032 in the event of an outage on the second transformer bank (TB2), given peak loading conditions. In the event of an outage, the low side bus tie would be closed, and the entire station's load would have to be supported by TB1. The load forecast in 2032 (highest projected in the forecasted period) is 52 MVA which exceeds the bank's loading. The forecast utilizes a technique called weather normalization, a process that assumes future year peaks will occur given high loading condition (e.g., a June peak will occur on hot day, where the temperature in the 95th percentile of hottest years). An example of what the forecast looks like is presented below.

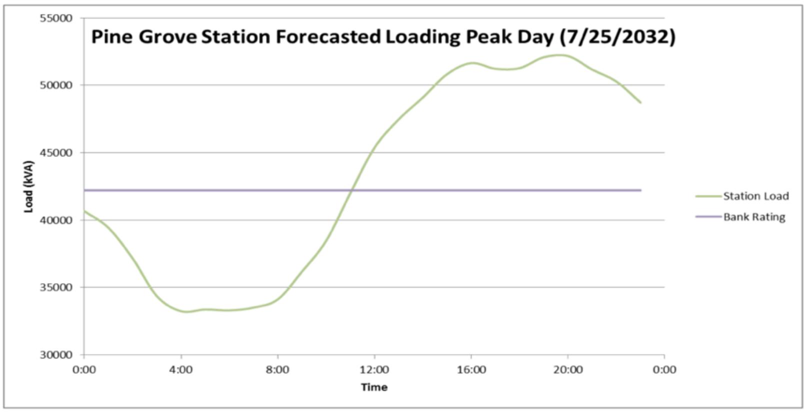
	Feeder							
Time	5951 (kW)	5952 (kW)	5953 (kW)	5955 (kW)	5956 (kW)	5957 (kW)	5958 (kW)	Total (kW)
7/17/18 16:00	6659	2544	7155	6777	7436	10016	10311	50901
7/17/18 17:00	6587	2446	7344	6927	7459	10047	10471	51284

The table above shows that the forecast is estimated to exceed the summer emergency rating on that particular day by 8.7 MWs when comparing to the summer emergency rating; analysis similar to this is how the team got to the final 10 MW need for the NWA solution by studying the ten year forecast.

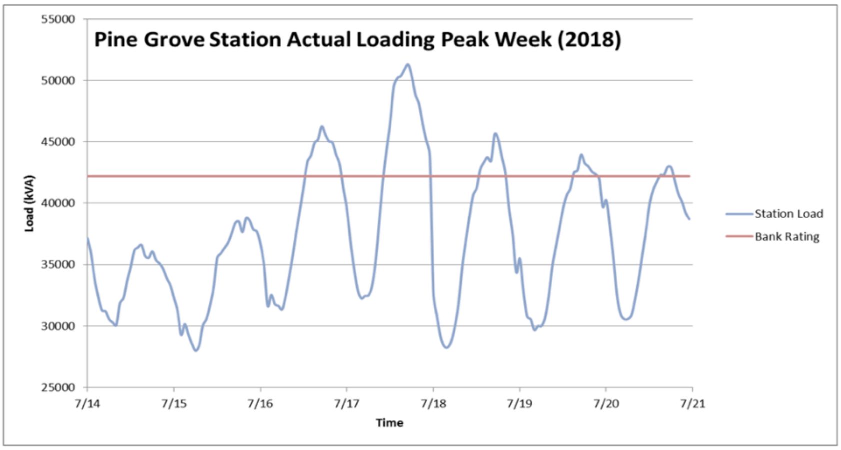
The charts below show the projected load on the transformer bank (peak day and week) and the peak loading on the utility-owned transformer from a previous summer (peak day and week). The first chart shows the Pine Grove station's actual loading, and the horizontal line shows the bank's loading. Note, around 12:00 is when the station loading exceeds the bank loading with a peak around 5 PM; the x-axis shows the time of day while the y-axis shows the load measured in kVA.



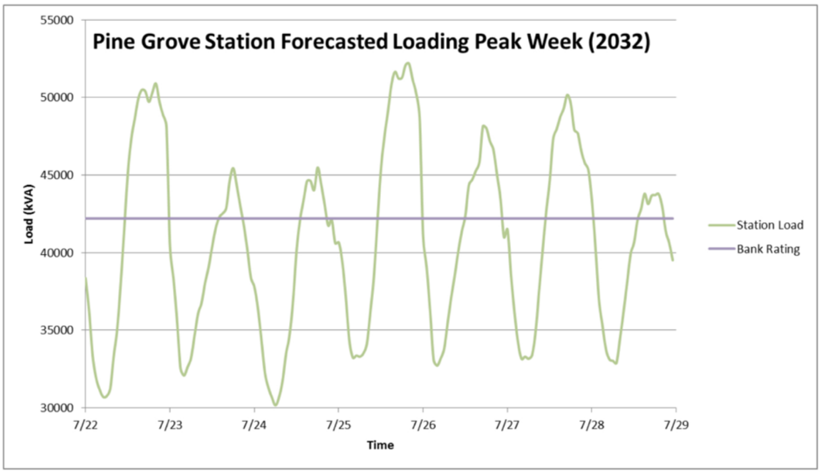
The chart above shows the actual loading that occurred in 2018 which is around when the need statement was created and the RFP was released. The proceeding chart below shows the forecasted loading in 2032 on a loading peak day.



The charts above are used to create the need statement provided in the RFP and provide information towards what kind of, and when, a solution is needed. The peaks of the charts are used to create the MW and the area under the curve can give the MWh needed by the NWA solution. The charts above show the data for a particular day, but the NWA solution may be responsible to help solve a need on multiple consecutive days. It was studied that the station load did exceed the bank rating on consecutive days late July in 2018.



The chart above shows the actual Pine Grove station loading on a peak week where one can see that the rating is exceeded for five consecutive days. A similar pattern is seen in 2032 where multiple consecutive days are also exceeding the bank loading as shown below.



The installation and/or procurement of a DER could reduce the overall demand at critical periods and thereby address the emergency (N-1) overload at the Pine Grove Substation. Integration of the 10 MW BESS paired with PV would reduce the peak loading on the Pine Grove TB1 below 100% of its summer emergency rating (given an outage of TB2) for the next ten years given the present load forecast. The DER would be notified when loads were forecasted to exceed 100% of the transformer's summer emergency rating (day-ahead notice). The DER would then be called upon given an outage of TB2 and an overload of TB1 (over the emergency rating according to the aforementioned day-ahead forecast). Starting in summer of 2022, the NWA could be utilized to keep the transformer loading within its summer emergency rating. Using the charts above and an extensive 10 year load forecast, the following table was created.

Problem Statement	
Description	Load on the Pine Grove Transformer Bank (TB) 1 will be at or over 100% summer emergency rating at peak over the next ten (10) years upon a loss of TB2
Technical Information	Summer Emergency = 42.22 MVA

The table above introduces the problem statement around the Pine Grove substation with the associated thresholds and limits for the transformer bank. Based on extensive analysis of the load forecast, the utility was able to detail the requirements needed by the NWA solution.

Solution Requirements	
Technical Requirements	Maintain loading on Pine Grove Substation below TB1 Summer Emergency rating, such that in the event of an outage on TB2, TB1 is not overloaded Need: 10 MW of Load Relief from 2022 – 2032
In Service Date[1]	June 2021
Maximum MWh need per day[2]	40 MWh
Duration per call[3]	Up to 12 hours
Lifetime[4]	10 years minimum
Call Response Time[5]	24 hours load notice
Time of Day[6]	12:00-23:00
Number of Times Called per Year[7]	Up to 44
Minimum Period between Calls[8]	24 hours
Consecutive Days Called[9]	Up to 19

The table above set requirements for the NWA solution to follow to ensure that it is meeting the grid reliability needs. It was studied that the time of day that the overloads could occur would be between noon and 11 PM EST, and the number of overloads the system may see could be up to 44 times a year with 19 consecutive days. The NWA solution that was selected is a BESS paired with PV, and this solution is

[1] The date the NWA solution must be placed to meet the need.
[2] Largest continuous 24-hour need of DER (calculated by adding average hourly demand over every 24 hour period, assuming average demand would be reduced by the feeder tie capacity after 4 hours).
[3] Longest continuous need of DER (calculated from projections).
[4]Term of contract or time period for the NWA solution to defer traditional asset(s) solution.
[5] Lead time between a request coming in from the utility's operator to when the DER asset can provide relief. In this case, the developer would be notified of a potential overload 24 hours ahead of time, but would only be required to operate given a contingency event.
[6]Earliest and latest possible times of need by utility (based on projections, not continuous hours)
[7] Calls per year based on annual overloads seen in projections.
[8] Least amount of time vendor would be given between operator calls.
[9] Most consecutive days needed by utility (based on projections).

capable of meeting the above requirements. The lifetime of the NWA solution also allows the planning team further flexibility to re-study the area in ten years.

RFP and Evaluation

An RFP was put together based on the information above, and developers responded with several types of solutions. The RFP is open to all NWA approaches that have the potential to provide NWA solutions in the area identified in the problem description. The utility has several long term goals in consideration (in alignment with state, federal, and internal ambitions) that impact the viability of any given proposal.

The utility conducted a systematic evaluation process to reach a feasible, cost-effective, and safe solution. The evaluation considers technical and economic factors. A BCA was performed to determine the cost-effectiveness of each NWA solution. NWA projects must provide a safe, reliable, and cost-effective solution when compared to the wires solution.

The evaluation has been categorized to include four rounds where each aims to trim down the numbers of proposals being evaluated as shown below.

Proposals are ranked based on their criteria scores. The number of projects which will make up the NWA solution is a function of the proposal price, scoring of proposals based on evaluation criteria, and the capability of each proposal to fully or partially address the NWA solution requirements. The first round aims to ensure that the proposals are in the range of the cost that is feasible and that the solution is reliable and safe. The second rounds dives into the technical components of the solution to ensure that the technical requirements are met and the solutions are able to meet the utility's needs. All proposals passing Round 1 will go through a thorough technical assessment and screening process to ensure safety and reliability. A subset of preferred proposals will move to the next stage for BCA before a final decision is made to pursue the NWA winning proposal(s) or continue with a traditional upgrade. Further details will be shared on the BCA as this tends to be a large roadblock for NWA projects (NWAs are required to have a BCA of above a 1.0). The final round is compromised of the final selection if a solution is found feasible. The NWA team then chooses the preferred bidder(s) who offer the non-wires solution that maintains electrical system reliability, delivery standards, and safety, and scores a 1.0 or higher according to the BCA calculation. If an award is made to the preferred bidder(s), then contract negotiations and terms are discussed. If contract terms are reached, then the NWA solution may be implemented

See below for a summary of the criteria by which the review team will evaluate and prioritize bids.

	Solution Approach	Economics	Schedule	Engineering	Control, Comms, Ops
CRITERIA	Bidder References	Pricing Structure	Permitting	Load Reduction	Safety
	Community Impact	Financial Stability	Timeline	Project Implementation	Comms & Controls
	Environmental Impact	Cost		Availability	Operability
				Measurement and Verification	

The BCA leads the economic review of a successful NWA and dictates whether the project is cost-effective. A methodology has been set for the BCA so it can be applied for procurement of DERs through competitive solicitation which was used for the Pine Grove NWA project. The BCA Handbook[10] provides a methodology for calculating the benefits and costs resulting from utility investments for individual projects or programs, as well as portfolios. This section will give an overview of the BCA methodology. The main test of interest for the NWA BCA is the societal cost test (SCT) as this is the primary measure of cost-effectiveness for NWAs. The SCT compares the costs incurred to design and deliver projects, including customer costs with avoided electricity and other supply-side resource costs (e.g., generation and transmission); the SCT also includes the cost of externalities (e.g., carbon emissions and other net non-energy benefits). The SCT is the primary cost-effectiveness measure because it evaluates impact on society as a whole. The largest cost usually seen is the implementation or contract cost associated with building the NWA solution, followed by the interconnection cost and related grid-integration costs, and the main benefit tends to be the deferral value and the associated avoided benefits.

The deferral value is the value of deferring the traditional poles and wires solution for the length of the NWA solution or contract; this benefit accounts for the time value of money and accounts for factors like inflation and avoided costs associated with the traditional poles and wires solution. Other benefits such as avoided generation capacity costs (AGCC) and avoided locational based marginal price (A-LBMP) may also be included in the BCA; however, the BCA must be designed to avoid double counting of benefits and costs. Doubling-counting can be avoided by (1) careful tracking of the value streams resulting from multiple investment elements in a project, program, or portfolio and 2) clearly defining and differentiating between the benefits and costs included in the analysis. AGCC is due to reduced coincident system peak demand and avoided LBMP is avoided energy purchased at the LBMP. AGCC and A-LBMP takes into account market revenue streams. Other benefits that may be counted for are net avoided carbon dioxide, as well as avoided Nitrogen Oxides and Sulphur Oxides. The NWA solution aims to use locally sourced “green” energy sources to meet energy needs as opposed to using carbon intensive sources like gas and coal to meet those same needs. Note, the BCA takes in the net present value (NPV) of all the benefits and costs associated.

Solution Overview

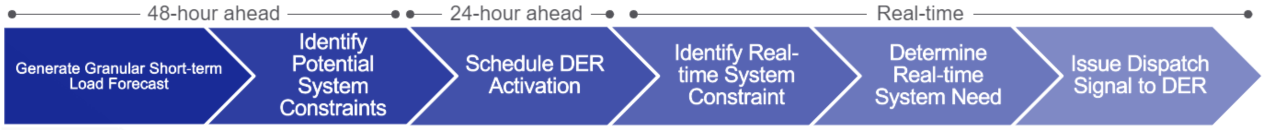
Energy storage is a type of NWA that offers utilities a way to increase capacity into the electric grid by charging the batteries when electricity demand is low and discharging when demand outweighs the supply. When a battery is paired with solar, this offers added benefits and flexibility. Through the competitive procurement described in the previous section, the utility was able to select a cost effective solution of two systems, each compromised of a 5 MW/20 MWh BESS (total: 10 MW/ 40 MWh) storage paired with 15 MWdc of solar (PV plus BESS) that will increase the capacity at the Pine Grove substation. The NWA solution increases the benefits to customers while also increasing the amount of solar energy on the grid and ultimately defers a substation rebuild. The NWA solution will be utilized on peak days to provide reliability to the customers served by the substation. During off-peak days, the system will participate in the markers to provide clean energy for the utility customers.

Implementation

A unique attribute and novelty of this NWA project is the telemetry and dispatch protocol. This NWA will be dispatched using a live and real-time system need as opposed to a forecasted set schedule.. The NWA solution is given a 24-hour ahead notification ensures that the solution will be fully charged for the need day.

The chart below gives a high-level overview of the dispatch and notification structure.

[10] https://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=16-M-0412



The process starts by generating a granular short term load forecast and then identifies a potential system constraint. When the system constraint is identified, that schedules a DER activation by sending a notification to the NWA solution at least 24 hours ahead. The short term forecasting is actively running 24/7 and sends out a notification to the NWA solution when a possible overload is studied within the next 24-hours. The next step is when the NWA solution continues to study the dispatch signal coming from the utility and load follows during the NWA event. Note, a steady signal is sent 24/7 and this is referred to as a heartbeat signal to ensure that a healthy communication medium is set up between both parties. The NWA solution is only required to load follow the signal if a notification is sent out beforehand; the NWA solution will notice that the heartbeat signal will change from 0 MWs to the required load relief needed on an event day. If the NWA solution does not see a heartbeat signal, this is a sign that the communication system is not set up properly. The next step is during the event dispatch, and this is when the NWA solution will provide load reduction as requested by the utility. The real-time signal compares the substation load (factors in any generation the NWA is dispatching as well) to the bank loading, and sends the difference to the NWA solution. Proper measurement and verification will be conducted to ensure that the dispatched load request was delivered as the final step.

Conclusion

The Pine Grove NWA solution provides planners and the utility greater flexibility to make a more permanent solution for the area in the future. The utility evaluated alternative solutions (to building a new permanent substation) to reduce the area load in order to maintain and improve the reliability performance in the Pine Grove area. Advanced forecasting is crucial for NWAs, as both short- and long-term load forecasts were required to integrate this NWA solution into system planning and operations, in aggregate as well as at the feeder and substation levels. The utility leveraged feeder-level detailed forecasts with base, low, and high DER probability levels in planning studies to create the Pine Grove forecast and needs statement. The NWA scope of work, discussed above, installed (2) grid-tied 5MW solar arrays, each paired with 5MW/20MWh lithium-ion BESS (Total: 10MW/40MWh). By implementing the NWA solution, the utility is able to defer a nearby substation upgrade for ten years.

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