Challenges in Review and Post-Installation Inspections of a Demand Response Program

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ABSTRACT

Demand Response programs accomplish their impacts through permanent demand reduction, load curtailment/shifting and distributed generation. For programs like the New York State Energy Research and Development Authority (NYSERDA) Peak Load Reduction Program, a project review and installation inspection must be conducted by pre-approved NYSERDA quality assurance consultants. Inspections assess consistency with design intent and compare 'as-built' to predicted load reduction, serving as a key aspect of the program. It is the mechanism of project scrutiny through inspection and associated trust in stated operational and control strategies that facilitates distribution of typically large incentives from NYSERDA to the applicants. While many projects are installed and perform in accordance with vendor and applicant statements, there are certainly others that demonstrate significant deviations from expectations.

This paper describes the review and inspection process, and presents key anecdotal case studies of installations representing good, bad and truly unique practices, offering real-world insights into the range of demand response projects. Case studies will provide a window into inspectors' scrutiny of projects, a process that seeks to verify true potential for demand impacts while concurrently addressing all parties' interests through the project approval process.

Case studies will assess different demand reduction efforts targeted by NYSERDA's program, demonstrating applications such as high performance lighting with advanced controls, Energy Management System (EMS) based load shedding, unique "steam-to-steam" chiller retrofits, natural-gas fired micro turbines, and a wide array of other technologies. These anecdotal studies cover installations ranging from exemplary demand response projects to embarrassing situations with little hope of achieving projected demand reductions.

Introduction

There are significant concerns in designated areas across the country with electric grid reliability, transmission constraints and electric power generation capacity issues. Given these concerns, interest in demand response programs as a component of the solution to overall electric system reliability has been increasing steadily. The recent U.S. Energy Policy Act of 2005 (EPACT) clearly indicates that demand response approaches should be incorporated into policy and that pricing based and incentive based programs should be included in an overall approach to facilitate and motivate end user participation. In many regions of the country where either transmission limitations or inadequate generation capacity exists, demand response programs are already in place - typically implemented by utility companies, grid operators or state governing entities. These programs are designed to help reduce peak load, either permanently, or at critical times and thus facilitate reliable operation of the electric system for all users.

One of the regions in the country that has capacity concerns is the New York City area served by the utility company Consolidated Edison (ConEd). For several years now, the New York State Energy & Research Authority (NYSERDA) has operated a statewide Peak Load Reduction Program (the Program) with a major focus on Manhattan and the surrounding boroughs. This Program is offered in concert with the New York Independent System Operators (NYISO) programs to ensure that customers have the resources to implement enabling technologies and have the ability to perform demand response strategies when required.

The overarching objective of NYSERDA's Program is to improve electric system reliability and system load factor, as well as reduce electric costs by providing incentives that result in system coincident electric summer peak demand reduction in New York State. A major target area is in New York City where there are serious capacity constraints. The integrated program consists of four sub-programs, as presented below. Smith et al. (2004) presented a more detailed explanation of NYSERDA demand reduction programs. Additional information concerning programmatic details can be found on the NYSERDA website.

- **Permanent Demand Reduction (PDR)** results in reduced peak demand year round as well as during the Summer Peak Demand Reduction Period, through the installation of equipment that provides long-term (expected to be in place and operational for at least five years), overall system coincident peak demand reduction.
- **Load Curtailment/Shifting (LC/S)** results in reduced peak demand either in response to an electric capacity shortfall or defined price signal. In order to participate in this NYSERDA initiative, a Facility must also register in a NYISO Installed Capacity Special Case Resource (ICAP/SCR) program, or a Time of Use (TOU) or Real Time Pricing (RTP) Program for at least two entire Summer Peak Demand Reduction Periods.
- **Distributed Generation (DG)** results in reduced peak demand by enabling Qualifying Generators in the Con Edison service territory to offload all or a percentage of a Facility's electric capacity. This component of the program supports both new and existing demand response generators and new distributed generators. Demand response generators are operated only in response to an event or test called by the NYISO through the ICAP/SCR program. Distributed Generators generally run when economical, either based on the cost of energy, or to manage the demand charge at the Facility and are expected to run a minimum of 500 hours per Summer Peak Demand Reduction Program. Recovery of waste heat from the generators is strongly encouraged.
- **Interval Meters (IM)** result in reduced peak demand by enabling participation in load reduction programs such as the NYISO's Demand Response programs, and/or an Acceptable Load Serving Entity (LSE) Load Management Program, including a TOU or RTP program for at least two entire Summer Peak Reduction Periods.

Substantial incentives are offered to develop and implement peak load reduction project(s) that meet the objectives of the Program and fit into one of the categories outlined above. Measures installed under the Program must perform as an integrated function without compromising applicable building code requirements or occupant health, comfort, or safety.

The customer baseline load profile and strategy for accomplishing peak load reductions must be clearly delineated in a Technical Assessment (TA) report. The participating facility or their contractor must provide the TA report. NYSERDA contracts the services of consultants to provide a quality assurance (QA) function for each project to ensure the proposed demand response technologies meet the program guidelines, are technically viable, will achieve the demand reductions proposed and actually get installed as expected. This requires a thorough review of the TA report to understand the proposed technologies and to verify that analytical methods are appropriate and accurately reflect the potential demand reduction. The final step in the process is the post-installation inspection to determine that the equipment is installed as intended and can meet the expected demand reduction.

This paper will discuss in detail the technical assessment review process, the post-installation inspection process and associated challenges. Subsequently, a series of case studies will be used to help present the concepts and interest points associated with the process.

Technical Assessment Review

Once an applicant to the Peak Load Reduction Program has received a purchase order from NYSERDA, they must submit a Technical Assessment (TA) report. This is a report that documents the demand reduction strategy, and discloses methodologies and assumptions used to determine kW reductions. The Technical Assistance Contractor ("Contractor") reviews the Technical Assessment for accuracy, reasonableness, and to confirm that the proposed demand reduction can be achieved.

This review process involves a methodical approach to ensure that all necessary information has been provided in the TA by the applicant and that the content of the analyses provided is representative of the true potential that can be achieved by the proposed installations. Achieving this goal often requires follow up requests for modifications to the provided analyses or additional content for further justification. Although NYSERDA clearly documents what is required from the applicant for the TA report, a wide range of quality and completeness has been observed in the TA reports. This is both a function of the capabilities of the applicant and the varying nature of the types of technologies that are eligible under the program. A TA report for a straightforward lighting project will differ in complexity from a complex chiller or distributed generation project.

Once the TA review has been finalized and the necessary information has been included, the Technical Assistance Contractor shall then make a recommendation to NYSERDA whether to approve the TA and at what demand reduction levels.

Post-Installation Inspection Process

When the applicant has an approved Technical Assessment, they may implement the project as proposed. Once the project installation has been completed, the applicant contacts the Technical Assistance Contractor assigned to that project to request that the project be inspected and field verified.

The inspection process starts with a meeting of the applicant, affiliated contractors and the Technical Assistance Contractor (inspector) to discuss the project and determine that all systems are operational and fully commissioned. This is followed by a visual inspection of the installed equipment and a review of any available relevant data if available – such as observation of a sequence of operations through an Energy Management System (EMS) interface. Pictures are taken and pertinent information on the installed equipment and performance (if available) is collected. If all is in order, the inspection process is concluded with a debriefing and a discussion of the final paperwork required (invoice documentation submissions). The Technical Assistance

Contractor then completes the process by writing an approval report for submission to NYSERDA that documents the process and indicates the final kW reduction values achieved by the project. Any necessary adjustments to the kW reduction values for weather or occupancy are considered by the inspector and addressed in the approval report. Once the approval is complete and all project invoices documenting the installation costs are submitted, the applicant may invoice NYSERDA for reimbursement of eligible incentives.

Case Study 1: Lighting Permanent Demand Reduction

Permanent Demand Reduction Project Requirements

Lighting projects participate in the Peak Load Reduction Program (the Program) through a Permanent Demand Reduction (PDR). Such a project must result in electric load reduction efforts that are expected to be in place for at least five years, must be coincident with system peaks, and must be activated in an automatic mode or as an integrated function of the operation of the building systems or equipment.

TA Review

The following case study is of a commercial retail facility north of New York City. A combination of T12 fixtures and incandescent bulbs lit the facility and were targeted for replacement in participation of NYSERDA's Peak Load Reduction, PDR program.

The T12 fixtures were to be replaced with new efficient fixtures, T8 lamps and electronic ballasts. In many cases, two-lamp fixtures were to be replaced with one-lamp fixtures, or fixtures were to be removed entirely. This was initially a cause for concern that lighting levels would be reduced too low. However, through the TA approval process, we learned that the retailer had specified lighting levels of five foot-candles in their rear stock areas. As such, the low lighting requirements, and efficient lamp and fixture technology enabled an aggressive delamping. The incandescent bulbs were to be replaced by compact hard-wired fluorescent fixtures. In total, 1,150 fixtures were targeted for retrofits or delamping, all of which operate coincident with the system peak. The expected peak load demand reduction was 28 kW.

The vendor had submitted a TA with fixture type, quantity and existing and proposed fixture wattages. The fixtures were coded by technology (T8 versus compact fluorescents), ballast type, lamp length and quantity and ballast factor. This line-by-line inventory enabled easy verification that the vendor's wattages were inline with NYSERDA's recommended fixture wattages.

The TA also specified installation of motion sensors in some areas. Due to the large number of spaces and the occupancy of these spaces, it was thought likely that the motion sensors would contribute to further reductions of demand.

Post-Installation Inspection

Lighting fixture replacements were completed in about 130 different areas. Most of these areas had only a few fixtures installed. Due to the large quantity of areas with retrofits, time did not permit inspection of each area. This is a common challenge for lighting retrofit inspections. Because not all replacements can be inspected, a significant and random sample must be chosen for inspection. This involves selecting areas with each fixture type represented, inspecting large areas to maximize the actual kW load inspection, and spot-checking smaller areas. It is important to select these areas ahead of the inspection to efficiently use on-site inspection time. In this case the inspected areas represented approximately 52% of the peak load demand reduction. In addition, spot checks of the areas with smaller retrofit quantities were performed. While we discovered minor exceptions to the proposed installations, they were not enough to cause concern on a broad basis.

For example, in areas of de-lamping and ballast removal, and T12 to T8 retrofits, we verified lamp and fixture types and quantities. In one area we visited, eight-foot, two-lamp T8 fixtures were installed as opposed to four-foot, four-lamp T8 fixtures. The lighting level and power draw difference between these two technologies is negligible. We also verified installed ballast type.

We measured lighting levels in the stock areas retrofitted with a decreased quantity of lamps or fixtures. Lighting levels ranged from 15 to 30 foot-candles (fc). These levels fall well within the recommended 10 fc specified by the Illuminating Engineering Society for spaces with simple visual tasks (IESNA, 2000), and greatly exceed the five fc minimum required by the retailer. During our visit we also investigated areas with motion sensor controls. We found that these areas did have working controls installed. In a number of areas, we witnessed the controls turning lights on or off.

In the original TA review, replacement of large incandescent bulbs with compact fluorescent fixtures had been approved. Upon inspection, we observed that these bulbs were not permanently wired, but of the screw-in type. As there is no guarantee that these fixtures will be in place for the next five years, and as specified by NYSERDA guidelines, we did not include demand reduction from these fixtures. In fact, during our visit, two of the compact fluorescent bulbs had already been removed. While the resulting reduction in approved demand was small, this highlights the differences that can be discovered between TA specifications and actual installations.

While this inspection went fairly well, another challenge was the inability to check some stock rooms, as they were locked and the vendor did not have access. In other cases this could have been problematic, as there is no way to verify the installation behind locked doors. As stated, the approved demand reduction was lowered slightly from 28 kW to 26 kW, and the qualifying NYSERDA incentive reduced from $13,300 to $12,250.

Case Study 2: EMS Load Shedding

EMS Project Requirements

EMS and Demand Control (load shedding) projects are included in the Load Curtailment/ Shifting (LC/S) component of NYSERDA's program. This component of the program is associated with short-term load shedding and curtailment in response to an emergency curtailment call from the NYISO.

TA Review

A large retailer occupying over 2 million square feet has a demand approaching 8 MW and consumes close to five million dollars worth of electrical energy annually. Ninety-two Air Handling Units (AHUs) serve the facility, and are connected to a central control system.

The approach used by the proposed demand management system involved controlling various heating, ventilation and air-conditioning (HVAC) fan and pumping loads in the facility. Control of these loads was to be achieved through interfacing with existing and proposed Variable Frequency Drives (VFDs) connected to the specific loads under consideration. The proposed system would be programmed to curtail prioritized loads to achieve the predetermined load levels required for the curtailment. Upon an appropriate curtailment call, the system will be invoked by building operators and then will function automatically to achieve the kW reduction. The individual and combined demand contributions of the controlled systems are continually evaluated and compared to the target setpoint.

The software system for the control allows for each piece of equipment to have a control priority established. Through the combination of schedules and priorities for each connected system, control decisions can be made to achieve the desired demand impact. The applicant's contractor conducted a comprehensive load study and an assessment of the demand impacts that can be achieved through control of the stated equipment.

Based on the load study, demand control factors were developed that indicate the effective percentage of time that these systems can be controlled to limit aggregate controlled system demand contribution.

In the TA analysis, estimates of the contribution to the overall demand reduction for each controlled piece of equipment were developed. These individual demand reductions are then aggregated to determine the total demand reduction.

Based on the approach presented, some modifications to specific analytical calculations for equipment reductions were requested associated with VFD savings algorithms. This included requesting appropriate motor efficiencies and load factors as well as adjustments to the exponents used for the affinity law analyses. The TA was approved and it was determined that a demand reduction of 575 kW was feasible for the proposed system and that it was in accordance with the requirements of the program

Post-Installation Inspection

During the on-site inspection, numerous control and monitoring points for the system were inspected in their various locations throughout the facility and all points were verified through the central control system. Additionally, all points were cycled through a test curtailment from the centralized workstation located in the facility operations office and spot checks were conducted at the equipment to verify the load shed. It was readily apparent that all elements were complete and operational. The points of control that were indicated in the Technical Assessment were effectively implemented and inspected. Minor substitutions were noted; however these did not impact the overall curtailment magnitude. A listing of the points was presented in the final approval document.

Additionally, the main control panel was inspected. This panel is tied into all of the control points, as well as the PC-based software control unit. The system is also setup so that it is capable of being fully run from a remote PC system connected through a modem to the control unit.

The system was programmed to shed prioritized loads to achieve the predetermined load levels required for the curtailment. Upon notification of a curtailment call, the system would be invoked by building operators and then would function automatically to achieve the kW reduction as proposed.

All aspects of the inspection went well and were easy to verify. The central control system provided all of the required information concerning the points associated with the invoked curtailment – including demand levels at the building meter. Additionally, all equipment was readily accessible and most VFDs at the individual loads had display panels that clearly indicated the reaction of the unit to the control signal. In summary the project was approved as proposed. The approved demand reduction was 575 kW, qualifying for a NYSERDA incentive of $103,500.

Case Study 3: Steam-to-Steam

Steam-to-Steam Project Requirements

New York City has an existing citywide steam distribution system. Many of the buildings operate mechanical equipment such as chillers off of steam generation. As these chillers reach their end of life, equipment cost leads building owners to consider electrically driven alternatives. NYSERDA offers incentives to keep steam-driven equipment powered by steam. Steam-to-steam projects participate in the Program as a PDR, Steam-to-Steam Cooling project. Avoided peak load (kW) efforts must be in place for at least five years, and must be coincident with system peaks.

For these projects, it must be demonstrated that the modeled peak load (kW) for the electric alternative (including parasitic loads) would be greater than the modeled peak load (kW) for the steam alternative. The difference between these is the avoided peak load demand kW. Additionally, it must be demonstrated that the electric alternative offers a lower installation and/or operating cost compared to the steam-driven system. The purpose of the incentive is to help offset the additional cost of the steam system. Additionally, the NYSERDA incentive must be coupled with a negotiated steam service contract under Con Edison's SC-5 service tariff.

TA Review

A 300,000 square foot commercial office building located in Manhattan has a central chilled water plant located in the basement mechanical room. The central plant consisted of two 540-ton steam turbine driveline chillers, both original to the building from 1956. Typical operation consists of the lead chiller handling the load up to an outdoor air temperature of approximately 75 F and a peak load of 540 tons (297 kW), at which point the second chiller turns on and then they run in parallel at the same load.

The facility proposed to remove both 540-ton steam-driven centrifugal chiller plants and replace them with two new 600-ton steam-driven centrifugal chiller plants. The project upgrade also involved a new compressor, evaporator and condenser water sections. The cooling tower, condenser water pump and chilled water pump would remain the same and are assumed to operate with the same control strategies.

The modeled alternative electric chillers are two 600-ton electric centrifugal units with a nameplate efficiency of 0.55 kW/ton. Thus, the combined full-load power draw of these units would be approximately 660 kW.

Post-Installation Inspection

The steam-to-steam inspection went well and was straightforward. The two new 600-ton chillers were installed and operating as proposed. In summary the project was approved as proposed. The approved demand reduction was 649 kW as both chillers are not fully loaded at peak demand periods. The project qualified for a total NYSERDA incentive of $308,275.

Case Study 4: Gas-Fired Micro-turbine

Micro Turbine Project Requirements

Micro-turbine projects participate in the Program through the Distributed Generation (DG) sub-program. DG projects classify as either Demand Reduction (DR) generators or Distributed Generation (DG) generators. Micro-turbines qualify as Distributed Generation. DG micro-turbines must operate at least 500 hours from May 1st through October 31st each year. The turbine must be capable of carrying a minimum load of 100 kW when operating.

The turbine must not exceed NOx emissions of 1.3 lbs per MWh and project documentation must provide proof that all required environmental and building permits have been obtained by the facility. The application for an incentive through the DG program component may be concurrent with PDR incentives for heat recovery equipment that displaces electrical load.

TA Review

A refrigerated food distribution company and plastic injection-molding manufacturer shared a 200,000 square foot, single floor facility. The injection-molding firm occupies 100,000 square feet of the facility and operates 24 hours per day and 5 days per week. In addition to production equipment, the company also air-conditions the plant and has office equipment.

The refrigerated food distributor uses 75,000 square feet of the facility for cold-storage warehousing. Electricity is used mainly for refrigeration equipment, but also for HVAC and office equipment. The refrigeration equipment operates 24 hours per day.

The facility proposed to install three 60-kW natural gas fired micro-turbine generators. The micro-turbine generators were to run at least the full On-Peak period of 8 AM to 10 PM during the summer. During the summer, the generators may operate 24 hours per day and seven days per week. In addition, electrical disconnects, step-down transformers and other electrical equipment were to be installed. A hot water heat recovery system was to be installed in the future and the recovered energy may be used to provide thermal input for an absorption chiller system, but was not a part of this demand reduction project. NYSERDA requires all distributed generation equipment to meet certain NOx emissions requirements. The manufacturer's emissions data showed that the NOx emissions were within program requirements.

Post-Installation Inspection

During the post-installation inspection, the micro-turbine generators were installed and operating. The equipment operating panels showed that two of the generators provided 60 kW each to the facility, after powering parasitic generator loads. The third generator provided approximately 57 kW to the facility, for a total power of 177 kW. The generators were operating at 95,675 rpm during our visit. According to the facility manager, in the summer the generators will operate at 98,000 rpm, which will enable them to provide the rated 180 kW to the facility. This inspection went well. All primary and secondary equipment were installed and operating as proposed. In addition, user interfaces on the micro turbine assisted in evaluating generator power draw and rpm. In summary the project was approved as proposed. The approved demand reduction was 180 kW, qualifying for a NYSERDA incentive of $49,500.

Case Study 5: Diesel Generator Distributed Energy Generation

Diesel Generator Project Requirements

This project proposed to participate in the Program through the DG sub-program. Such an effort must result in the ability to enable an emergency generator in response to NYISO's request for generation. The generator must be capable of operating at least 12 times from May 1st through October 31st each year, not to exceed 200 total hours.

The project must have the necessary installed equipment to be enabled solely on the request of NYISO. A strategy for communication with NYISO must be presented. The generator must not exceed NOx emissions of 18 lbs per MWh and PM10 emissions of 0.7 lbs per MWh. The project must: provide proof of obtaining the required environmental permits; have an installed interval meter, with data available to NYISO; be registered for no less than one SPDRP in NYISO's EDRP, ICAP/SCR or Transmission Owner Load Management Program and have a minimum load reduction of 100 kW.

TA Review

A kosher food product facility was to install a diesel generator for emergency power generation and peak load operation. The facility occupies an 82,000 square foot refrigeration facility that operates 12 hours per day and six days per week, although the refrigeration systems operate non-stop.

A 300-kW generator was to be installed for this facility. NYSERDA requires that installed generators be equipped with proper transfer switches and that the facility be enrolled in the NYISO's curtailment programs. As such, the facility should have interval meters, which can be read by a Curtailment Service Provider (CSP) who provides data to the NYISO and NYSERDA upon request. As with micro-turbines, NYSERDA requires that diesel generators meet NOx and PM10 emissions requirements. Manufacturer emissions data showed that NOx and PM10 emissions were within program requirements.

A key component of generator installation is ensuring that the facilities are enrolled in NYISO curtailment programs, are contracted with a CSP, and have the capability to provide metered data to the NYISO and NYSERDA.

Post-Installation Inspection

During our post-installation site inspection, we first verified that the correct generator had been installed. The next step was to conduct a full generator test, in which the generator would be turned on and the building load switched from the grid to the generator. To verify that successful switching has occurred, it is typically necessary to view the transfer switch during the test. Subsequently, the CSP should provide data from the interval meter that shows the grid load dropping to zero during the test period. With a good installation and proper test planning, this entire inspection process and test can be done in a half hour. This particular case exemplifies the challenges of the post-installation inspection.

During the site visit, while the generator was at the site and installed, testing was delayed repeatedly. Upon inspection of the transfer switches, it was apparent that the generators were still being physically wired to the transfer switches! We had been called to perform the post-installation inspection, when the installation was not yet complete. This issue arose from business arrangements that can be common with demand reduction projects. Namely, a third-party familiar with NYSERDA's programs assists customers in filing applications, submitting TAs and fulfilling program requirements. As such, the customer is shielded from actually having to learn program requirements, and instead relies on the third-party as a translator. Normally this is a beneficial relationship. However, in this case the third-party was less concerned with the quality of the installation than getting the project approved, so that they could collect incentive money sooner. In these situations, it is imperative that the post-installation inspector pays strong attention to the fundamental project requirements, as pressure will be intense from the customer and the third-party to approve the project.

In this case, the generator could not be connected in time, and the post-installation inspection was rescheduled. During the second site visit, the generator was connected to the building and able to take the load from the grid. However, another obstacle to verification became apparent during this process. Due to space limitations, the main transfer switch was located nearly ten feet off the ground, with no access. As such, it was impossible to tell if the building load had switched to the generator or not. Luckily in this case, the building had two electrical feeds, and the second transfer switch could be verified. Additionally, the CSP was able to provide data from the interval meter verifying that the grid-connected load had dropped to zero.

While the interval meter was installed and operational with this project, most other generator projects we inspected through this third-party applicant did not have proper metering devices during the first inspection. With several generator projects multiple inspections were completed to verify installation of metering devices.

This project inspection had many challenges. Due to vendor pressure, the project was inspected before it was completed, requiring an additional site visit. In addition, the physical location of equipment made the inspection difficult. In summary the project was approved as proposed. The approved demand reduction was 259 kW, qualifying for a NYSERDA incentive of $32,375.

Case Study 6: Building Fan Variable Frequency Drive Installations

VFD Project Requirements

Supply-air fan VFD projects participate in the Program as a PDR.

TA Review

A 42-story, 1.4 million square-foot office building with some retail space targeted its supply and return air fans (SAF/RAF), and cooling tower fans, for retrofit with variable frequency drives (VFDs). In addition, the cooling tower fan motors were to be upgraded to premium-efficiency motors. As NYSERDA calculates peak demand reductions based on their Summer Peak Demand Response Period (SPDRP), the cooling tower and SAF/RAF demand reduction was averaged over a number of temperature bins.

The SAF/RAF airflow is adjusted using variable-pitch inlet blades and by staging the fan operation. Eight 125-hp SAF and eight 50-hp RAF serve the area known as the "upper house". The "lower house" is served by eight 100-hp SAF and eight 40-hp RAF. As the fans were installed oversized even at very warm temperatures, installing VFDs will always have an affect on peak demand.

The VFD vendor calculated baseline and proposed kW demand at different outdoor dry-bulb temperature using a proprietary spreadsheet. In this case, the vendor would not share the proprietary spreadsheet, and instead provided simplified equations and graphical profiles of baseline and proposed operation. This was an upfront challenge to the TA review process. Without the proprietary spreadsheet, the equation of the system profile had to be recreated by the reviewer, and calibrated to the vendor's data.

Post-Installation Inspection

VFDs were installed on the eight cooling tower fan motors. However, the premium-efficient motors were not installed on the cooling tower fan motors. During our visit, we observed that all eight cooling towers were active and operating at nearly 100% of maximum speed, although they should have been approximately 86% according to the TA algorithm. Thus, the VFDs were operating approximately 10% higher than expected.

During our visit, we observed that all 32 supply-air fans (SAFs) and return-air fans (RAFs) had VFD controls installed, although some were not yet operational. During this time, we inspected a sample of the VFD control panels, and noted the amperage, frequency (Hertz) and percent operating speed. According to the TA, at the observed temperature the average system speed should have been approximately 70%. This is slightly lower than the observed operating speed. Based on these observations, we had submitted a final approval of 307 kW reduction, opposed to the expected 390 kW reduction.

Subsequent to our site visit, the VFD vendor further calibrated VFD operation with the SAF/RAF blade pitch to optimize operation. In addition, the non-operational VFDs were fixed. As such, we were requested to conduct a second site inspection. During this inspection, we obtained trended data from the facility energy management system (EMS). The trended data documents power draw for each cooling tower fan, SAF and RAF. With this data, we plotted hourly fan power for peak weekday hours versus hourly outdoor temperature. While the TA had presented a strong expected relationship between power and outdoor temperature, the data did not support this conclusion. Based on the data available, we constructed a second order polynomial profile of SAF/RAF power draw versus outdoor temperature based on measured data. Based on the this curve, we further revised expected demand reduction to be 329 kW, higher than our first approval, but still much lower than predicted by the vendor's TA.

Challenges in the inspection included vendor requests to inspect the project before the installation was complete. The complexity of the VFD and pitch-blade algorithms, plus the unwillingness of the vendor to share calculations, made for difficult evaluation and increased the project evaluation cost. The approved demand reduction was reduced from the TA approved 390 kW to 329 kW, and qualifying NYSERDA incentives were reduced from $185,250 of $156,275.

TA Review and Post-Installation Inspection Process Challenges

Numerous challenges exist in reviewing TAs and conducting post-installation inspections. First is the quality of the submitted TA. Often vendors submit TAs on behalf of the applicants to ensure that required information is submitted. Sometime however, vendors are an obstacle to TA review. As discussed in this paper, some vendors may not educate their clients on program requirements, and thus submit TAs without all the necessary information. Other vendor obstacles include proprietary spreadsheets. Unwillingness to share calculations leads to increased project costs, as the inspector must independently reproduce the vendor results to review their methodology.

The post-installation inspection process offers its own set of challenges. In a rush to obtain incentive money, customers sometimes claim a project is fully installed and bring in inspectors, when in actuality the project is not yet finished. The result is that an additional site visit must be conducted to verify the installation. In these cases, another challenge arises. The customer and vendors expect their projects to be approved, and desire quick dispersing of incentive money. Both customers and vendors can apply intense pressure during the inspection to approve the project, knowingly avoiding uncompleted parts. As such, it is paramount that the inspectors have a pre-determined list of project implementation details that must be verified. Finally, another frequent challenge is gaining access to designated areas. Often the vendors facilitate the post-installation inspections. As such, sometimes they do not have access cards or keys for all project areas. This challenge often occurs with PDR lighting projects. Areas with significant quantities of fixture replacements may lie behind closed, locked doors.

Summary

This paper described the review and inspection process, and presented anecdotal case studies of installations representing good, bad and truly unique practices. We evaluated several case studies, including high performance lighting retrofits with advanced controls, EMS-based load shedding, unique "steam-to-steam" chiller retrofits, natural-gas fired micro turbines, and others. The case studies showed that many installation inspections are straightforward, while others have unique challenges. Demanding challenges include obtaining needed data and information, accessing the project location, completeness of the project and navigating the vendor/customer relationship. The challenges encountered in the post-installation inspection process show that the inspections are imperative to ensure that projects are installed correctly.

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