Implementing Combined Heat and Power In New York City

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ABSTRACT

This article provides information about the challenges and opportunities for combined heat and power (CHP) in New York City. Some of the up front engineering processes that must be done to successfully implement CHP projects are identified. Included are some of the cost savings and other financial incentives that motivate the decision to design CHP systems. Detail is provided on the technical challenges that companies face in developing CHP projects.

OVERCOMING HURDLES

To overcome significant hurdles, a specific methodology for implementing combined heat and power (CHP) in New York City needs to be developed. To begin, a survey of the site is conducted to determine if it is a good candidate for cogeneration or CHP. Next, energy use profiles are reviewed in detail to accurately determine the level of temporal coincidence between thermal and electrical loads to be satisfied by the CHP system. A spreadsheet-based model that describes system operation, including electricity produced and heat recovered on a daily basis is developed for each project. Thermal usage and electricity profiles are illustrated for variance by month for one year and by hour on a summer, winter and shoulder day. Thermal demands are shown for the specific heat sinks to be satisfied by the CHP system.

The type and rating of the prime mover and an energy balance around the prime mover needs to be assessed. The energy balance is applied to a schematic of the system showing all major components,

Figure 1. Example of Low Emission Natural Gas Internal Combustion CHP System for a Health Care Facility.

Figure 2. Microturbine Installation at the Clinton Hill Apartments, Brooklyn NY

including the uses for the recovered heat. Annual totals for each energy input and output are shown along with maximum, minimum and average instantaneous values. Temperatures for each waste heat transfer fluid and sink are also indicated.

Figure 3. Pure Comfort™ Trigeneration Installation at Aviator Sports and Recreation, Brooklyn, NY

CHP system efficiency is described. The annual thermal utilization percentage is given (i.e., the annual amount of heat that is recovered for space and/or process heating and/or cooling divided by the annual recoverable thermal output from the prime movers). Then the fuel conversion efficiency (FCE) for the prime movers is provided. FCE is defined as the ratio expressed as a percentage of the total usable energy produced by a technology to the sum of all fuel or other energy inputs to the technology measured at each fuel's higher heating value.

Next the description of the proposed system, which includes a floor plan indicating equipment location, is developed. Any structural modifications are included, including the capital cost of the system. Because natural gas is used for the CHP, the pressure and availability of gas is evaluated.

For the controls of the CHP system, an operational sequence that specifies the control system to be used, its integration with other onsite controls systems and who will have responsibility for this systems operation is developed.

For timelines, a construction schedule is outlined that includes engineering, permitting, construction, start-up and commissioning tasks.

Next the economics of the proposed project are assessed. Electricity, fuel, operation and maintenance costs are developed before and after

Figure 4. Thermal Heat Sink Tie-in at a Health Care Facility for Use with CHP.

the proposed installation, along with a summary of project economics. Economics are presented in a simple payback format. Additionally, both a cash flow analysis and life-cycle cost analysis is presented that includes information of depreciation, capacity payments, special incentives and tax credits. The operational costs include any impact to the customer's energy tariffs. The maintenance costs are listed in $/kWh, and are annualized. Capital costs include any necessary one time costs such as permitting, interconnection costs or electrical distribution system changes. Capital costs include any structural changes necessary to house the prime movers. As part of the economic analysis described above, a detailed description of the relationship between the proposed CHP facility and the customer's existing energy tariffs is reviewed. The reliability and availability of the CHP system is quantified in the economic analysis (e.g., number of hours the system would be available at less than full capacity). This is compared to the existing electric and thermal service and discussed in the context of the customer's core business and tolerance for risk.

Detailed literature that describes the maintenance items should be developed. The source of the maintenance costs is included along with a list of what would be covered (i.e., annual major overhaul of prime mover, oil changes, etc.). The necessary environmental and building permits for the customer should be obtained.

HURDLES

New York City is a very constrained area with little free land available for new CHP systems. After reviewing the above parameters, one hurdle we need to overcome is where to site the systems. After the customer has made a decision to move ahead, it is necessary to structure the optimum transaction with the customer. This may be in the form of a capital lease, direct ownership, a power purchase agreement or some other form of transaction.

OVERCOMING BARRIERS

The first barrier is one of lack of education on the specific cogeneration technology and its intended application. Hours educating local code officials on cogeneration technology need to be budgeted.

The client must be involved in the design and development of the CHP system from the beginning. They need to be familiar with electric and gas reliability and site-issues and how their facility can be converted to most adequately use the CHP. For example, one of Energy Spectrum's clients needed to change their building management system (BMS) system to allow longer ramp times for compressor equipment so there would be smoother ramp rates both up and down.

The client must also be aware that the local utilities priority is not CHP. As such, interaction with the utility by the client may be required to move things forward. For example, one of Energy Spectrum's clients involved the local councilperson to allow the local building code official to approve the project. Finally, the use of knowledgeable, experienced professionals in the industry to address questions on interconnection, local code issues, and other issues is a pre-requisite.

ABOUT THE AUTHOR

David Ahrens, P.E. is a director of projects with Energy Spectrum Developers, LLC. He has over 20 years of experience with energy consulting, distributed generation and CHP. He has experience in designing, developing and running power plants large and small. A licensed Professional Engineer in three states, David has a Bachelor of Engineering degree and a Masters in Business Administration (MBA).

Figure 5. At Montefiore Medical Center in the Bronx NY, 90% of the Patient Areas are Powered by CHP.

David has worked for utilities including Con Edison in the field of energy innovation. David has analyzed and installed energy systems including cogeneration systems for clients throughout the country. He was instrumental in demonstrating micro-CHP in New York City last year. His projects include the largest residential micro-turbine installation in the country, one of the first uses of large tri-generation in the northeast and dozens of healthcare facility CHP systems. For more about Energy Spectrum, visit www.energyspec.com. David may be contacted at dahrens@energyspec.com.