OPTIMAL UPTIME: INCREASING CHP AVAILABILITY

Understanding the many factors that can influence uptime of a combined heat and power module are critical to a company's bottom line.

By
Christian Mueller
Manager Sales Engineering–
Gas Power Systems
MTU Onsite Energy

Combined heat and power (CHP), also known as cogeneration, is the simultaneous production of heat and electric power from the same source of fuel. The principle has been put to use for more than 130 years as a way to conserve resources, increase efficiency and save money. CHP systems are one of today's most efficient, reliable and cost-effective approaches to electricity and thermal energy generation, providing smart solutions for businesses seeking to control heating, lighting and cooling costs. In addition to cost-effectiveness, CHP systems provide benefits that not only serve the individual facility of service, but also reach the communities in which they operate by offering large-scale energy efficiency improvements.

In recent years, use of CHP technology has increased steadily all over the world due to growing efforts to reduce carbon emissions and mitigate climate change. CHP technology not only helps contribute to sustainability imperatives for many major corporations, but also may help earn points for facilities seeking LEED (Leadership in Energy and Environmental Design) certification. However, this technology is not new or untested. In 1882, Thomas Edison's first electric generating plant—the Pearl Street Station in New York City—used waste heat from the plant's steam engines to provide heating for nearby buildings. By supplying both heat and power, Edison was able to achieve an overall efficiency of 50 percent.

Historically, CHP was reserved for very large installations. For example, waste heat from a coal-fired power plant could be used for greenhouses or large apartment complexes. Today, significantly smaller facilities such as hospitals, hotels, commercial buildings or factories are reaping the benefits of utilizing heat that would otherwise be wasted from the production of electricity. Because CHP systems require less fuel than separate heat and power systems, a reduction in operating cost, despite rising energy cost, is guaranteed. Over the long term, CHP can significantly reduce energy expenditures that can be applied to the bottom line—as long as there is a simultaneous need for electric power and heating (or cooling) for most of the year.

To understand how to maximize uptime, it's important to first understand how CHP modules work.

HOW CHP WORKS

In a conventional facility, all electrical power is supplied by a local utility. If heat is needed, the facility would have a gas-fired boiler to supply hot water for space heating or process heat. Additionally, the facility would have separate water heaters running on natural gas or electricity for domestic hot water. In contrast, a facility with a properly sized CHP module running on natural gas would supply most of the electrical and heating loads, cutting energy usage —and expenditures—nearly in half.

A typical CHP module consists of a natural gas-fueled reciprocating engine, a generator/alternator, and a full heat recovery system integrated into the base frame of the module. Using a 12-cylinder 23-liter natural gas engine, for example, the engine-generator combination would produce 358 kW of electrical energy, and

CHP systems provide energy efficiently and independently to numerous applications worldwide.

1,791,000 BTU/hr of thermal energy in the form of 194 degrees Fahrenheit hot water. The heat is recovered from a low-temperature coolant circuit and a high-temperature exhaust circuit. The low-temperature coolant circuit recovers about 807,000 BTU/hr from the engine jacket water, intercooler and lubricating oil. The high-temperature circuit recovers heat from the engine exhaust, which has a higher specific heat content. Up to 914,000 BTU/hr can be recovered from 1,000-degree Fahrenheit exhaust gases. All told, this example CHP unit would produce 1,791,000 BTU/hr of heat and 358 kW of electricity at an overall energy efficiency of 90 percent. The electricity would be used to supply some or most of a facility's power needs, and the heat output could be used for space heating, heating domestic hot water or heating water for industrial processes. The heat output from the CHP unit can also be used for air conditioning by employing an absorption chiller.

Over the long term, CHP can significantly reduce energy expenditures that can be applied to the bottom line.

DEFINING UPTIME

Uptime is the uninterruptible availability of a system. It is often best described as the opposite of downtime—when a system becomes inoperable for any number of reasons, including malfunction, scheduled maintenance or a decision by the operator not to run a unit. Unexpected downtime can result in significant loss of business and revenue, and for data centers, critical information is put at risk during downtime.

CAUSES OF DOWNTIME

Natural Wear and Tear

It should come as no surprise that simple wear and tear can create unexpected downtime. There is not much that can be done to prevent downtime in these cases, but the first line of defense is preparation. The goal of any instance of downtime should be returning to uptime as quickly as possible. Operation training can be a key factor in this. As the first person that arrives during a shutdown, the facility operator should have some basic troubleshooting knowledge of the system. Also, it is important to establish a Long Term Service Agreement (LTSA) with a local distributor from the start to ensure a record of parts and their scheduled replacement timing. The fixed cost of an LTSA can also help control overhead spending for a facility.

Ambient Conditions

Certain climates create harsher ambient conditions than others. With proper planning, downtime because of hot or cool temperatures, or extreme altitude, is lessened. Designing a CHP should be customized to ambient conditions. MTU Onsite Energy specifies each CHP unit to the unique needs of its customers, giving critical consideration to the region, installation location and start time requirements and cooling temperatures.

Fuel

CHP modules are dependent upon fuel arriving through a pipeline. Many factors can affect operability. In addition to ensuring optimal pressure, operators must safeguard the composition of fuel, particularly in biogas or landfill applications because constant fluctuations in gas may inhibit the engine's ability to perform. Impurities like sulfur and siloxane can also contaminate the engine if above ideal limits, leading to corrosion. To combat against this, gas treatment cleaning systems are needed to remove contaminants before they reach the engine.

Demand of Output (Electricity and Heat)
Appropriately sizing a CHP for the specific application has a major impact on system reliability. CHPs are designed to run when needed, meaning a 50-100% load is the optimal operating range and a load between 80-100% load is where the greatest efficiency is achieved. If there is a large range in electricity load, sizing becomes even more critical to carry those wide ranges. Careful load match is key to ensure the unit is not over- or under-sized.

Peripheral Equipment
Heat recovery, cooling, ventilation, electrical and control systems are examples of peripheral equipment that help a CHP operate. Operability of a CHP is dependent on this complex network of highly engineered modular pieces and components communicating and working together seamlessly. For example, if the sizing is incorrect on one piece of equipment, the entire CHP unit suffers.

To ensure equipment performance and customer profitability, MTU Onsite Energy offers hands-on training to help operators adjust to their new CHP system and make customer and distributor service teams proficient maintenance technicians.

Scheduled Service and Maintenance
As with any standby power system, CHP modules require regular service and maintenance at the recommendations of the manufacturer. Scheduled parts updates, visual inspection, hose replacement, filter changes and other routine systems checks safeguard against downtime. Parts availability is also integral in system maintenance. In order to maintain uptime, it's important to have various levels of stocked parts in close proximity to the unit.

Support from a trained technician with mechanical and electrical systems knowledge is vital. Operators and technicians should undergo specialized training based on manufacturer specifications for a units generator, engine, controls and heat recovery system to be fully prepared for the inevitable.

Even with capable on-site support, remote access is recommended. Web access is ideal as it grants the manufacturer access to the control unit from anywhere in the world. With the ability to view key information, such as operating conditions, power output and other historical data, the factory can troubleshoot many issues remotely, helping return to uptime quickly.

CONCLUSION

Power disruptions can cost more than $1 million a day in lost revenue for some enterprises. As a key factor in the economic viability of a business, ensuring power reliability is imperative for facilities that demand continuous power 24 hours a day, 365 days a year.

From data centers to universities, CHP systems are quickly becoming the number one choice for sustainable standby power across the world. However, a standby power system is only as reliable as its design and maintenance. Preventative planning measures, contingency planning and establishing a collaborative relationship with the factory and local distributor will ensure continuous uptime and availability of a CHP system.

MTU Onsite Energy
A Rolls-Royce Power Systems Company

www.mtuonsiteenergy.com

MTU Onsite Energy is a brand of Rolls-Royce Power Systems. It provides diesel and gas-based power system solutions: from mission-critical to standby power to continuous power, heating and cooling. MTU Onsite Energy power systems are based on diesel engines with up to 3,250 kilowatts power output (kWe), gas engines up to 2,530 kWe and gas turbines up to 50,000 kWe.