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INSPIRING INNOVATIONS

Customer Case Study

Power Generation

Modules and Connectors Cut Construction Costs

Summary

- Turbine Air Systems Energy's Turbine Inlet Chilling (TIC) is an innovative technology used to cool gas turbines, but installing these TIC systems on site can be a challenge
- TAS is constantly looking for ways to simplify the installation for the end user, and hard wiring connections was a particularly time-consuming issue
- TAS developed a modular system that uses Phoenix Contact's Pluscon connectors, reducing installation time and the number of wiring errors

Turbine inlet chilling systems are constructed in modules like these and shipped to the site. The total system is split up into container-size modules for transport, cutting conveyance costs.

Customer Profile

TAS economic. clean. energy.

Turbine Air Systems (www.tas.com) located in Houston, Texas, created Turbine Inlet Chilling (TIC). The company has pioneered and patented the technology and is recognized as the world leader in the industry with over 60 percent of the world's TIC market share. Since 1999, TAS Energy has chilled more gas turbines than all other providers, combined.

Challenge

Rising energy prices make efficiency a primary objective for many industries, particularly power generation. One of the fastest growing power generation technologies is the high efficiency gas turbine (GT).

In many utility systems, GTs are used to provide power on demand. Unlike relatively larger coal-fired and nuclear base load generation facilities, the power output from GTs can be ramped up and down very quickly. This characteristic is especially important in modern electrical power systems for two reasons.

First, utilities need peaking power that can be ramped up rapidly to temporarily satisfy high demand, typically experienced on the hottest summer days. Second, utilities need a power source that can be quickly ramped up or down to compensate for the intermittent nature of renewable power sources such as wind and solar.

To satisfy peak power demands, utilities worldwide are increasingly turning to GTs, but these versatile power sources have an Achilles heel. The power output from a GT decreases as the outside ambient air temperature and humidity increases, so peak power may not be available when it's most needed.

Solution

Fortunately, there's a solution. If the inlet air of the gas turbine is cooled, the output power lost due to high inlet air temperature can be recovered. To accomplish this air cooling, TAS Energy pioneered turbine inlet chilling (TIC) in the mid-1980's in commercial and industrial markets. Power producers worldwide now use this technology to increase the output and efficiency of power generating GTs.

As the demand for power increases, current infrastructures are often inadequate to meet energy needs, and site-built infrastructure solutions tend to be costly and time intensive. TAS had to not only make the existing systems more efficient, but also build it in the shortest and most economical time frame possible. Modular construction was the solution, provided via packaged TIC systems built by TAS in the Houston facility.

Installing TAS's TIC systems on site can be a challenge, particularly as many systems are retrofitted and must often be shoehorned into existing facilities. Consequently, TAS wanted to simplify and expedite on-site installation, with modularization of the TIC systems being the preferred solution.

TIC modules require three types of connections: process, power and signal. Process connections are primarily chilled water piping from the module(s) to the GT and condensing water piping to on-site cooling towers.

A hardwired three-phase connection is required from the existing plant utility system to provide primary operating power to the modules. For projects with multiple modules, the bulk of the TIC systems, the modules then need to be connected to each other for primary three-phase power, secondary single phase power and control signals.

On each TIC multi-module system, they designate one module as the primary power source, and this master module's Motor Control Center (MCC) is hardwired to the plant's power source.

Power and signal connectors mate to junction boxes mounted on Turbine Inlet Chilling modules, cutting on-site installation time and costs.

Primary three-phase operating power is then hardwired from this master module to each of the other modules.

Secondary single-phase power for module utilities such as air conditioning and lighting is also distributed from the MCC to each module. This secondary power distribution among the modules is accomplished using Phoenix Contact Pluscon connector systems.

The master module also contains the programmable logic controller (PLC) needed by each TIC system to provide control and monitoring. Wiring to and from this PLC is distributed to other modules as needed, also using the Pluscon connectors.

Before TAS started using connectors, the secondary power and control connections among the containers were made using hard wiring. A combination of wires and cables in flexible conduit was landed to terminal blocks in a junction box installed between the modules. These fully tagged wires and cables were disconnected from the terminal block when the modules were split before shipment.

At the site, it took about three days for the module connections to be re-terminated, with a couple of days more to clear out any improper connections before final commissioning could take place. This on-site activity is undertaken by an outside contractor, and time and cost became issues.

Using connectors considerably reduced the time it took to reconnect the modules, down to about a day or less, from five days or more using hard wiring. In addition, the connectors greatly reduced the incidence of incorrect wire terminations.

Before selecting the Phoenix Contact connectors, TAS evaluated competing solutions. At the time of selection, they were already using Phoenix Contact terminal blocks and were pleased with their performance, so it was natural for them to consider the company as a connector supplier. "Taking into account the different types of signal wiring as well as power needs, we found that no other supplier offered industrially rugged connectors that could meet our requirements," said Gil Ajero, controls engineer at TAS.

There were some design challenges, including identifying the higher ampacity connectors with the correct size hub to accommodate the increased cable sizes. Also, they were initially using too many different types of connectors, which complicated the designs. But since then, TAS has standardized on just three types: 6-pin, 12-pin and 24-pin.

Finally, TAS also needed to ensure that all power sources would always end with female rather than male connectors. This guarantees that connectors are still touch-safe in the event of an accidental disconnect while power is live. If a power source ends with a male connector and the same situation occurs, an OSHA-reportable incident would likely occur due to the presence of unprotected live connector pins.

Most recently, TAS used the Pluscon products on an outdoor application for a two-level system. In this particular application, the connectors were used for three-phase primary power as well as single-phase secondary power and control system wiring.

Results

Now that the connector design is standardized and implemented, TAS has realized multiple benefits in addition to the aforementioned installation advantages. Once the connections are tested at the shop, splitting the modules is clean and easy, and on-site reconnection is quick and accurate. Connectors lend themselves to spare capacity, so future additions have become much easier to wire.

TAS said they have found the Pluscon connectors to be robust, heavy duty and well suited to the TIC application. Termination onto the male/female pins requires extra hours at the shop, but the reduced time needed in the field during installation and start up more than compensates.

"Phoenix Contact and its distributor Graybar have been very supportive and always respond promptly when assistance is needed," said Ajero. "In fact, Phoenix Contact has several employees who are very familiar with our application and only a phone call away for any needed support."

TAS is seeing new customer demand that will require them to develop non-standard products, both smaller and larger in overall total system footprint. For larger capacity projects, that translates to more modules and more split points, further driving the need for expanded use of connectors.

"TIC systems help customers run more efficiently. Delivering these systems as modules provides a host of benefits to customers, and also helps the companyies control the construction process more closely while reducing costs. Using connectors to link these modules at customers' sites provides further benefits to our company, and most importantly to the customers," Ajero concluded.