CASE STUDY

DRY AIR PROTECTION FOR A GAS TURBINE

SANTEE COOPER — HILTON HEAD ISLAND

BACKGROUND

Santee Cooper operates a peaking plant on Hilton Head Island in South Carolina. The plant consists of two General Electric Frame 5 Gas Turbine Generating units installed in 1973 and 1974, and a Frame 7 unit, which was installed in 1979.

The plant produces power only during periods of peak load. For most of the year, the equipment is off line and exposed to the salty, humid marine environment of coastal South Carolina.

The plant stands ready, however, to start within two minutes and to come on line in less than ten minutes. So all equipment must be maintained in exceptional condition for maximum reliability. Failure to start on signal is very costly because it can mean that power must be purchased at expensive peak rates.

THE PROBLEM

Because the units stand open and ready for instant response, they are subject to corrosion. In a similar gas turbine plant operators encountered costly problems. The turbine rotor buckets corroded severely, forcing a complete rotor replacement.

To avoid these costs at Hilton Head, project engineers considered treating the turbines with a high-temperature, corrosion-resistant coating. This alternative is cost-effective for rotors that need major overhaul for other reasons. But if corrosion is the only issue, coating requires disassembly of the rotors, which may cost between $200,000 and $300,000. Then the coating process adds another $60,000 to $80,000. So in this case, dry air protection was much more cost-effective than coating.

Above: At the Hilton Head generating station, a General Electric Frame 5 gas turbine peaking unit is protected by a Munters Cargocaire desiccant dehumidifier.

THE SOLUTION

At Hilton Head, one of the Frame 5 units was already scheduled for rebuilding. Project engineers decided to coat that rotor, while the turbine was disassembled.

On the second Frame 5 unit, Santee Cooper worked with application engineers from Munters Cargocaire to design and install a dry air protection system to halt corrosion at a much lower cost than coatings.

The installation presented an interesting challenge. Most dry air protection systems recirculate air through the equipment in a closed loop, and any openings are kept sealed by covers. At Hilton Head, however, the units are often activated remotely. The staff on site is minimal, and personnel would not have time to remove covers in less than two minutes.

Consequently, Santee Cooper engineers designed a "purge" dry air protection system. The discharge duct leaving the turbine is covered with an automatic cover, similar to a motorized garage door. Dry air produced by a Munters Cargocaire desiccant dehumidifier is fed to the covered discharge duct, where it flows backward through the turbine and eventually out through the filters at the turbine inlet. With this arrangement, there is no need to obstruct the turbine inlet with covers and duct connections. The unit can be started as soon as the automatic cover over the exhaust is retracted.

The dry air is connected to the turbine discharge plenum through a simple ten-inch round duct, which enters the exhaust plenum in a single connection. To prevent any exhaust gas from blowing back through that duct to the dehumidifier, the engineers installed a stainless steel damper which closes automatically, blocking the duct before the turbine is started.

Because the unit must come on line within ten minutes of standing start, the dry air system simply purges the turbine, avoiding the return air duct work that would obstruct the air inlet.

The Munters dehumidifier is weather tight so it was installed outdoors at low cost.

THE DEHUMIDIFIER

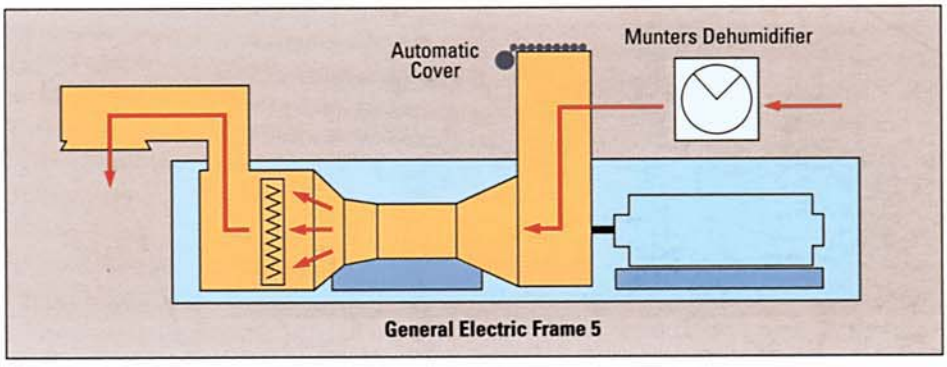
The dehumidifier is sized so it maintains a conservative "out-flow" velocity of 150 feet per minute at the turbine inlet when the inlet vanes are in the full-closed position. Maintaining that velocity prevents any humid air from leaking back into the turbine against the dry air flow.

At the Hilton Head plant, there is no room to install a dehumidifier inside the turbine housings. Munters Cargocaire supplied a weather tight unit modified for outside operation, avoiding the cost of constructing an equipment shelter.

The electrical control cabinet is built to NEMA 4 standards. Air inlets for both process and reactivation air streams are equipped with weather hoods, washable filters and dampers for setting airflows. The process air fan discharge is provided with a transition for easy on-site connection of duct work. And reactivation heaters are equipped with automatic energy modulation, so the dehumidifier uses only the energy needed to meet the moisture load. That feature is especially useful in this case, where the environmental conditions vary quite widely.

BENEFITS

- **50% Capital Cost Saving**
  The dry air protection system provided more than a 50% saving compared to the cost of disassembling the turbine and coating with heat-resistant material.
- **Complete Protection**
  Although coatings can protect the turbine, dry air goes further by protecting the entire system, including corrosion-prone exhaust baffles.
- **No Outage**
  By choosing the dry air method instead of coating, the unit did not have to be out of service for the 10 to 12-week period needed for turbine disassembly, coating, reassembly and realignment.
- **Avoids Potential Million-dollar Rotor Replacement**
  The cost of corrosion is very high in peaking plants, since any outage may mean power purchased at on-peak rates. And a new rotor can mean costs of well over a million dollars in addition to the cost of the lost capacity. Dry air protection reduces corrosion to virtually undetectable rates, as shown in dozens of studies in high-reliability installations.



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