UPGRADED GENERATOR YIELDS 25 PERCENT MORE POWER

By Hector Bourgeois

In order to obtain a 30 MW increase in output, Hydro Quebec has implemented an upgrade of three double-ended "MOD-POD" gas turbine generator sets at its power station in Cadillac, Quebec. The upgrade featured power turbine modifications provided by Fern Engineering, Inc.

Curtiss-Wright (C-W), originally supplied the MOD-POD packaged power systems with gas turbines from Rolls Royce and Pratt & Whitney paired with power turbines designed and built by C-W. In total, more than 50 of the MOD-POD units were sold.

While Hydro Quebec's MOD-PODs have been fairly reliable, the company was concerned because other MOD-POD owners have experienced serious failures or near-failures of power turbine components. Casing distortion and cracks have appeared in some units after fewer than 500 hours of operation.

Old casing from a Cadillac gas turbine.

Additional problems have also occurred at the transition section between the gas generator and the power turbine. The expansion joint experienced failures from low cycle fatigue. In addition, the rear flange that mates with the power turbine often became severely distorted. Other units have experienced bolt head failures, in less than 300 hours of operation, at the flange between the transition piece and turbine.

OEM-mandated De-rating

To minimize these problems, Curtiss-Wright had imposed a restriction on the firing temperature of the units. This helped, but it did result in a 20% reduction in maximum power output. As a consequence, the Cadillac power station was restricted to only 120 MW rather than its original rating of 150 MW. To recover the lost power, Hydro Quebec contracted with Fern Engineering for the upgrade.

Fern, located in Pocasset, MA, had purchased the OEM's entire spare parts inventory when C-W dropped out of the gas turbine business. In addition, the company had redesigned or reverse-engineered many other components.

To address the design problems, and restore the Hydro Quebec units to their original power rating, Fern supplied new designs for several portions of the MOD-PODs:

- Gas turbine casing
- Blade tip seals
- Inlet housing (transition piece) rear flange
- Expansion joint in the transition piece

The designs are not reverse-engineered replicas of the OEM parts but are new designs that feature upgraded materials and design elements to resist failures from fatigue. As an example, the gas turbine casing uses Inconel 625. This provides high creep and stress rupture strength and good resistance to low cycle fatigue. In addition, the design includes isolating elements and radiation shields that reduce the casing shell temperature compared to the original design.

Fern supplied new turbine casings, upgraded seals, modified the inlet housing rear flange and replaced the transition piece expansion joint on the three units at Cadillac. Each unit has two gas turbines driving a common generator. With the $3.5 million upgrade Hydro Quebec has been able to increase the rating of the station from 120 to 150 MW. At a cost of $120/kW this is significantly less than the cost of installing a new 30 MW simple cycle gas turbine.