Converting dual fuel nozzles to single fuel gives Aquila 250 kW

By Irwin Stambler

Converting from dual fuel to a single fuel (gas) machine will increase power output without burning more fuel by eliminating parasitic purge-air compressor losses.

Many gas turbine plants are designed with dual fuel (gas and liquid) capability, but rarely, if ever, use the liquid fuel option. Nevertheless, liquid fuel lines and atomizing air passages require continuous purging with pressurized air to prevent backflow of hot combustion gases.

Gas turbine operators running dual fuel plants on natural gas can retrofit a field modification to convert from dual to single fuel system. Benefits and cost:

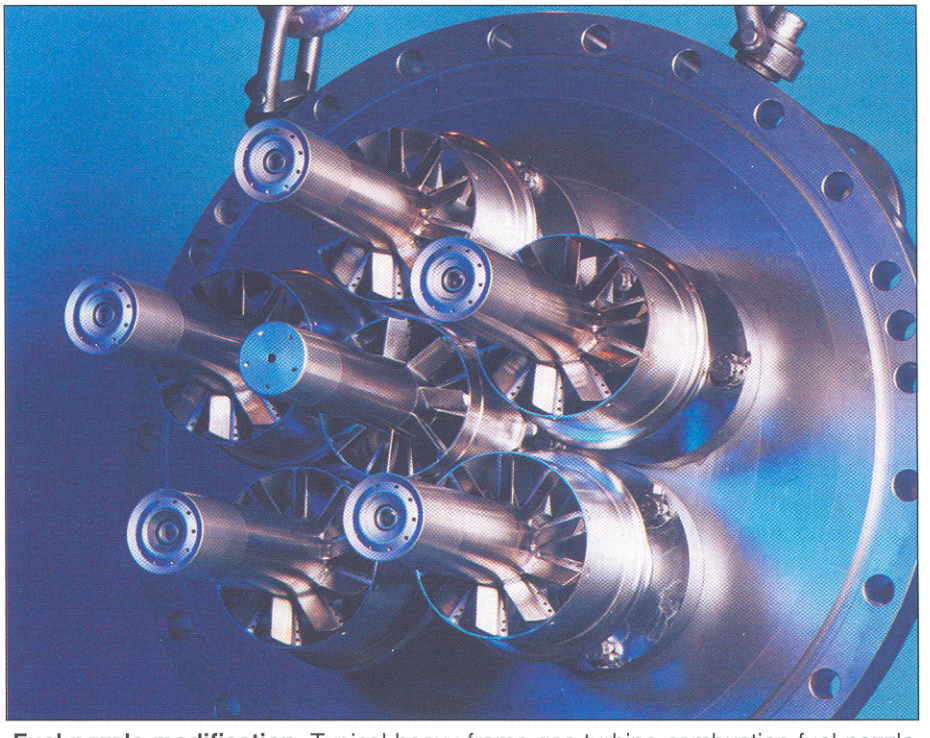
☐ **More power.** Depending on the gas turbine size, purge-air compressors (which operate continuously) can draw anywhere from 100 kW to 300 kW or more off the accessory gearbox drive.

☐ **Leak-proof.** Retrofit kit has welded-on cap that plugs off the liquid fuel and atomizing air passages of the fuel nozzles and does not allow backflow of combustion gases into the liquid fuel passages.

☐ **Installed costs.** User-installed kits run about $5,000 for a typical Fr 7E or Fr 7F machine. Turnkey retrofit kit that includes nozzle flow testing, installed by a service provider, costs under $10,000.

Electric power utility Aquila (formerly UtiliCorp United) was one of the first operators to make this modification on one of its GE Fr 7 base load plants.

Company learned that Fern Engineering had come up with a "cap blocking system" system for GE Fr 7



Fuel nozzle modification. Typical heavy frame gas turbine combustion fuel nozzle assembly. For conversion, cap plug is seal welded to the nozzle body to eliminate potential leak paths for gas fuel within the nozzle assembly.

Greenwood Energy Center. Aquila has been operating an 85-MW Fr 7EA gas turbine with fuel nozzle conversion at this plant since the mid-1990s. Plant has since logged over 8,000 hours of operations without any problems and increased power output by 250 kW in the process without burning any more fuel.

dual fuel nozzles that could plug off the liquid fuel and atomizing air passages.

Fern engineers installed these caps on an Aquila MS7001E generator set back in May 1995. Experience to date, with about 8,000 fired hours, has been problem-free according to Alan Dancy, the plant manager at Aquila's Greenwood Energy Center in Greenwood, Missouri.

Dancy reports that by removing the atomizing air compressor from the gearbox, Greenwood is able to get an additional 250 kW from the gas turbine generator without burning any additional fuel.

Leak-proof design

Modification kit provides a cap seal welded to the nozzle body to eliminate potential (and hazardous) leak paths for gas fuel within the nozzle assembly.

The nozzle cap plug is specially designed so that it precisely positions the fuel nozzle swirl tip in the proper axial location. In effect, the nozzle cap plug eliminates the outer tip and liquid fuel transition piece, say Fern engineers.

Designs using 'transition piece plugs' are prone to combustion flashback, the engineers claim, which is known to cause nozzle carbonizing (or plugging) that can eventually lead to burning and severe nozzle component damage.

Fern says that its design is safest because it eliminates potential leak paths. Also, the retrofit modification is reversible to restore the original dual fuel capability.

All the old components can be stored for re-use in case natural gas prices get out of hand or supplies are curtailed.

Ditto the purge air compressor. It can be left on-site, mothballed, or removed and placed in storage. If removed, the gearbox power takeoff port should also be plugged.

Project economics

Kit conversion costs depend on how many fuel nozzles the gas turbine has installed. And on whether an operator wants to outsource a turnkey modification or carry it out in-house.

Paul Simas, who heads up nozzle conversion projects for Fern, says that the complete cost of a typical Fr 7E or 7F gas turbine conversion is less than $10,000 — and less than $5,000 (for the modification kit) if you choose to do it yourself.

Disconnecting the booster air compressor, once the liquid fuel ports are plugged, translates into an immediate power gain. On a GE Fr 6 engine, for example, the booster compressor is rated at 194 hp (144 kW).

If you can eliminate this power drain for $10,000, you can effectively pick up 144 kW of output at an incremental cost of $69 per kW installed, Simas points out, without any further investment or fuel.

Another way of looking at it, he continues, is that "you could supply an equivalent 144 kW of generating capacity that is lost to run the purge compressor, by buying five Capstone microturbines at a cost of $30,000 each.

"Those five microturbines would consume about 4.1 MMBtu/hr of fuel which, at today's natural gas prices, would cost about $20 per hr to run. In contrast, our conversion caps would cost fifteen times less than installing microturbines — and consume no fuel."

To date, he reports, Fern has modified a total of ten dual fuel gas turbine nozzle assemblies, all of which have since been operating without any complaints or problems.

Right now the conversions are limited to General Electric dual-fuel heavy frame machines with standard (not DLE) combustors. Conversions are available for the Frame 3, 5, 6, 7 and 9.

Fern is said to be working on similar kits for the Siemens Westinghouse product line of heavy frame gas turbines. Kits for the Alstom heavy frame machines should be available later this year. ■