

## Dry Low Emissions (DLE) combustion system

energy

### Origins

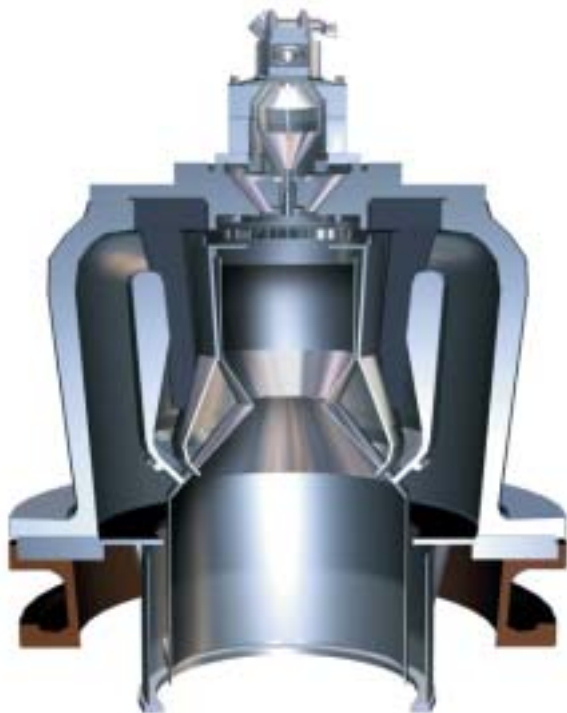
The conversion of fossil fuels into energy and power and the effects on the environment are serious concerns for everyone in the 21st century – for business, governments and the public. This growing ecological concern worldwide has brought the introduction of increasingly stringent legislation aimed at controlling and reducing emissions from gas turbine-driven equipment.

Since the 1960s Rolls-Royce has anticipated the need to reduce fossil fuel emissions. By the 1970s and 80s the development and introduction of effective measures had become a major priority for the company.

One major initiative pioneered by Rolls-Royce is the application of DLE, or Dry Low Emission, combustion – a technology that is gaining favour worldwide as a result of its guaranteed reduction of nitrous oxide and carbon monoxide levels to fewer than 25 vppm. DLE has the vital additional benefit of ensuring no compromise in performance and reliability.



RB211 DLE gas generator



RB211 DLE combustor

### Methodology

As its name suggests, DLE is a dry solution to NOx and CO problems, achieved without the injection of either water or steam. Significantly, not only can the DLE system be fitted to new generating sets and mechanical drive units but it also can be retrofitted to existing units, many of which have years of operational life still remaining.

The world's first gas turbine to offer DLE environmental benefits was the RB211. It pioneered the technology by maintaining its combustion temperature within a narrow band. This was achieved by developing three key processes: pre-mix lean burn combustion, fuel staging and series fuel staging.

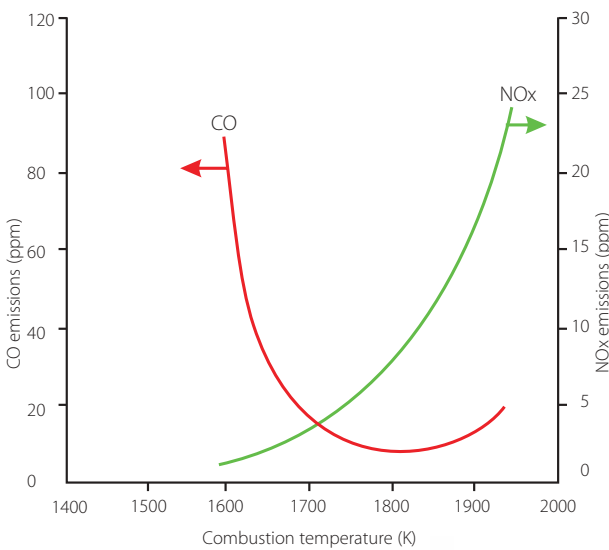
Pre-mix lean burn combustion controls the combustion temperature, while fuel staging provides turndown over the load and temperature range without flaming out. Series fuel staging generates a wide stability range and separate combustion zones.

## Fact sheet

### Experience

Rolls-Royce began the DLE development programme in 1989 and delivered the first retrofit DLE RB211 to Pacific Gas Transmission (PGT) in 1994. Within four months of its arrival at Station 7 at Starbuck, Washington State, the unit entered full commercial gas transmission duty with the extended PGT pipeline. Soon, Stations 3 and 5 were also to benefit from DLE technology as guaranteed emission levels were consistently demonstrated across the full operating profile.

Subsequent orders for DLE RB211 have provided engines for use in Canada (where TransCanada Pipelines has logged a total of more than 220,000 operating hours), Italy, the Philippines, the United States, Slovakia and the United Kingdom.

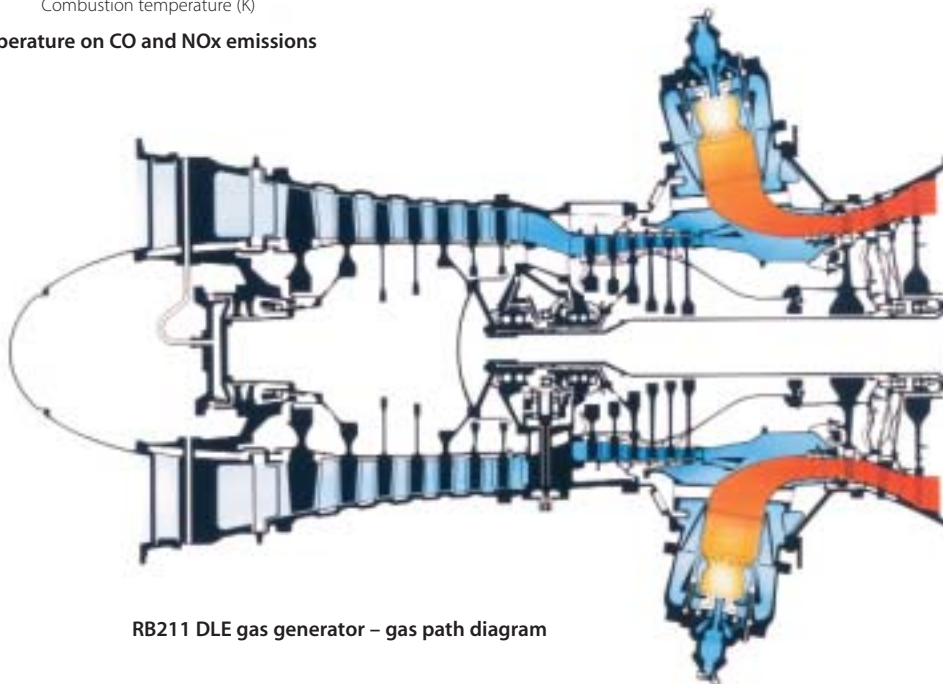


Influence of temperature on CO and NOx emissions



Avon DLE gas generator

Today DLE technology is available on the full range of Rolls-Royce industrial gas turbines, both from new and for the retrofit market. DLE technology, with its proven record of environmental and commercial success, is now a defining feature of gas turbine engines for industrial applications the world over.



RB211 DLE gas generator – gas path diagram



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