International Power Technology

IPT Nozzle Steam - Technical Specifications
Rolls-Royce/Allison KB5(x)

General Description: The IPT Nozzle Steam system is an ultra-low emissions technology that has been achieved in practice and is commercially available.

The nozzle steam technology can best be described as a significant improvement to an existing emissions control method. Rolls-Royce/Allison has been using steam injection for power augmentation and emissions control for over 20 years and there are over 135 Allison 501KB(x) engines worldwide that use steam for emissions control. The nozzle steam injection technology improves on the OEM's methods by mixing, off-engine, the steam and the fuel to a much higher degree of homogeneity and temperature thus achieving lower NOx while levelizing CO emissions. Simply stated, the IPT nozzle steam system enhances and improves on an existing turbine emissions control method that has been in operation since 1985.

For applications requiring no less than 15 ppm NOx, IPT supplies OEM hardware for all on-engine mounted components. For applications requiring between 5 and 15 ppm NOx (corrected to 15% O2), IPT will supply a set of 6 custom fuel nozzles, all other on-engine hardware is OEM. NOx reductions to 15 ppm and lower are achieved through application of the patented CLN© technology, provided by IPT under a licensing arrangement with the patent holder.

Emissions: (nominal for LE3.2 combustion liner)

IPT Nozzle steam	**NOx**	Down to 15 ppm, 1.75 steam-to-fuel (sf) ratio, 1895 Deg F. CTIT, OEM Low Btu Fuel Nozzle
	CO	less than 25 ppm
Enhanced Package (using CLN©)	**NOx**	15 to 5 ppm, 1.75/1 to 3.0/1 steam-to-fuel (sf) ratios, 1895 Deg F. CTIT, requires specialized IPT fuel nozzles.
	CO	less than 80 ppm

Benefits of Nozzle Stm: Ultra-low emissions down to the 5 ppm NOx, low cost, improved turbine heat rate, lower turbine CTIT and longer combustion liner lifetimes for constant power applications, improved BOT temperature pattern, peaking power capability, low maintenance cost, part load operation, ease of installation.

Engine Performance:

Water Injection: When converting from water injection to nozzle steam there will be a decrease in turbine heat rate and a decrease in maintenance costs. Fuel Consumption decreases by nominally 5-6% and there will be a decrease in turbine firing temperature for the same power and NOx level, resulting in improved liner durability. Additionally, nozzle steam-fuel mixing results in improved BOT flame pattern.

Constant Power	Decreased turbine heat rate, decreased turbine firing temperature, increased combustion liner lifetimes, improved BOT pattern, load following.
Constant CTIT	Peak shaving kW capability, decreased turbine heat rate, load following.

System Requirements:

Steam	Minimum 250 psig saturated, over 600 lb. applications require silica control in feedwater. Lower steam pressures acceptable for higher NOx applications.
Fuel	Natural gas (high or low btu) only, minimum 275 psig at turbine inlet, no fuel treatment required if pipeline natural gas.
Space	Minimum space requirements inside skid for fuel heater, steam/fuel mixer, and piping and control valves.
Combustion liners	Nozzle steam can be applied to engines employing LE-2 and LE-3 combustion liners.
Installation Time	Up to 90 days for delivery and nozzle steam systems installation, 3 day turbine downtime to interface nozzle steam components to engine and startup.

Candidates:

AQMD regulations requiring lower turbine NOx emissions.
DLE to nozzle steam conversion.
Water injection to nozzle steam conversion.
New installations.

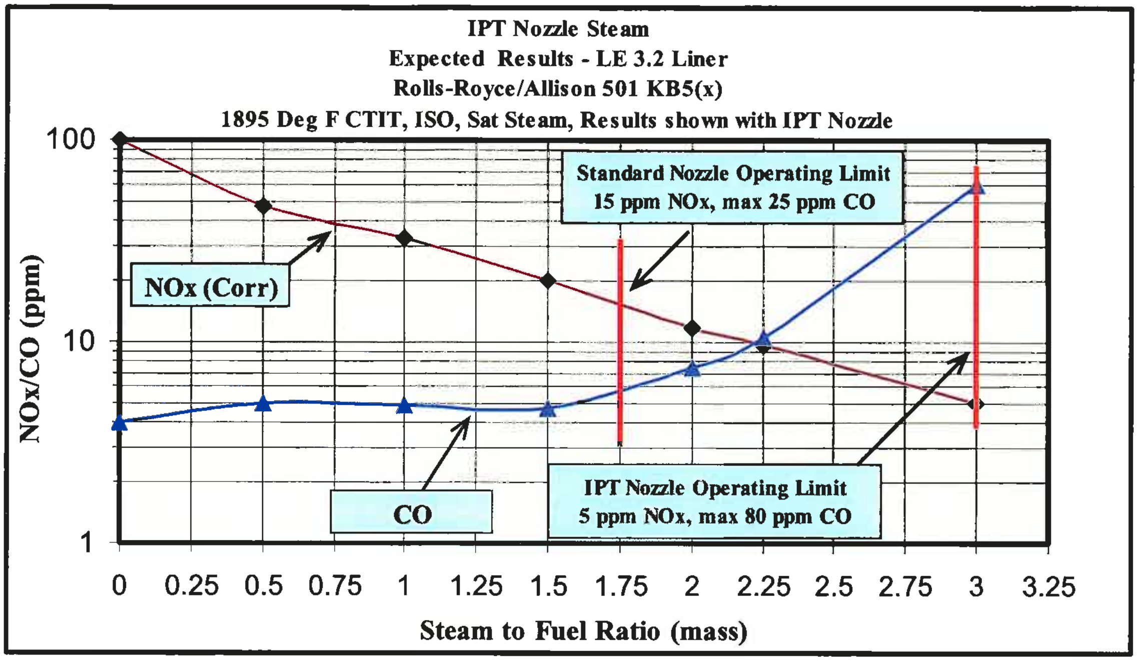
Pricing: (budgetary per unit, turn-key, installed and guaranteed-excludes combustion liners)

Components	\$185,000 - \$225,000
Nozzle Steam Piping	\$15,000 - \$55,000
Turbine Controls	\$5,000 - \$35,000

Contact Information:

Randy Turley – President & CEO
International Power Technology
1042 W. Hedding Street, Suite 100
San Jose, CA 95126

Phone: 408-246-9040
Web: www.intpower.com


IPT Nozzle Steam
Expected Results - LE 3.2 Liner
Rolls-Royce/Allison 501 KB5(x)
1895 Deg F CTIT, ISO, Sat Steam, Results shown with IPT Nozzle
NOx/CO (ppm)
100
10
1
Standard Nozzle Operating Limit
15 ppm NOx, max 25 ppm CO
NOx (Corr)
CO
IPT Nozzle Operating Limit
5 ppm NOx, max 80 ppm CO
0
0.25
0.5
0.75
1
1.25
1.5
1.75
2
2.25
2.5
2.75
3
3.25
Steam to Fuel Ratio (mass)