

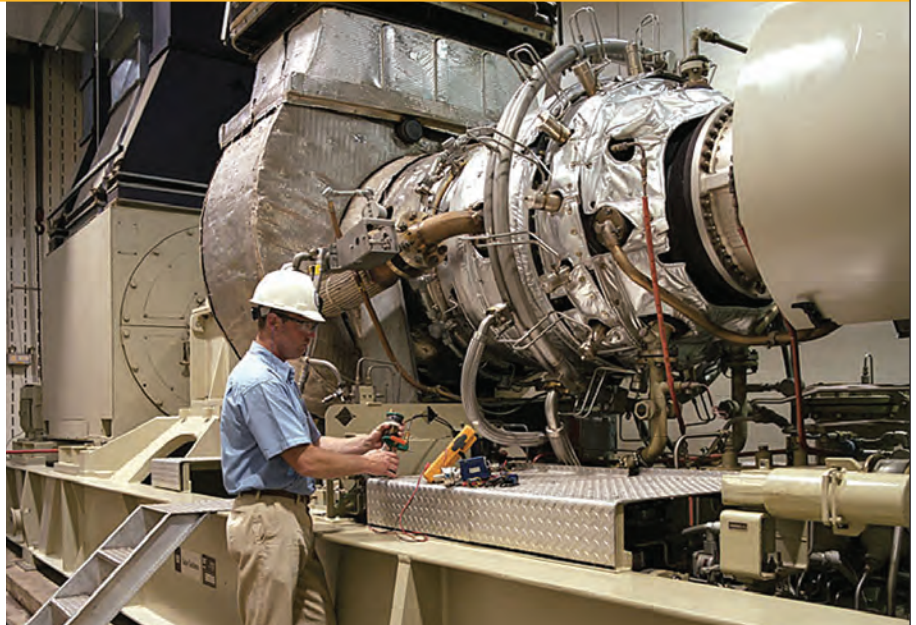
# Solar® Turbines

A Caterpillar Company

Worldwide Turbomachinery Support

## Combustion Technology

*Solar has a long history of installing gas turbines around the world using a broad range of gaseous and liquid fuels, while at the same time reducing emissions.*



As the world's energy demands expand, concerns about gas turbine emissions and fuel consumption have likewise grown. Maintaining its industry leadership position, Solar continues to improve its conventional combustion system and SoLoNOx™ dry low-emission combustion system—developing new products and adapting existing units to utilize a broader range of fuels and operate more efficiently while minimizing emissions.

### Benefits

- Reducing emissions decreases costs to stay compliant today, while meeting more stringent emission standards in the future.
- Combustion improvements add to operational flexibility while maintaining or increasing reliability, availability and maintainability.
- Adaptability to a broad range of fuels, providing more flexibility when operating in isolated regions where conventional fuels are unavailable.
- Ability to use less costly fuels.

### Technology Advancements for Cleaner Combustion

Driven by the concept that it's more efficient to prevent pollution up front rather than clean up exhaust emissions at the tail end, Solar has developed a robust set of emission control tools that enable its gas turbines to operate more cleanly.

#### Augmented Backside-Cooled Liner

The most significant change to reducing emissions on Solar® gas turbines has been the introduction of the Augmented Backside-Cooled (ABC) liner. With backside cooling, the cooling air does not mix with the combusting mixture in the combustor primary zone. This eliminates a significant amount of quenching, which means inherently lower CO emissions. This allows the combustor to be designed for a cooler flame that reduces NO<sub>x</sub> emissions as well.

#### More Precise Fuel Controls

Fuel control for pilot and main fuel has been designed to provide more accurate and precise control of pilot fuel flow—key to achieving consistently low emissions.

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The fuel system has been further improved by introducing closed loop pilot control, where the amount of pilot is determined by measuring main and pilot flow rates as opposed to proportioning pilot and main fuel valve position.

In addition, the new fuel module allows the use of higher pressure drop pilot that provide tighter control of the pilot fuel distribution between the fuel injectors, resulting in improved emissions and stability.

Electronic actuators also provide quick, accurate and repeatable response of the compressor inlet variable guide vanes, bleed valves and fuel valves to more tightly control emission levels over the operating range.

### Burner Acoustic Monitor

To enable the monitoring of combustion instabilities, Solar developed the Burner Acoustic Monitor (BAM) that utilizes a dynamic pressure probe to measure combustor pressure instabilities. Results are displayed on the HMI display for analysis and troubleshooting. The BAM is available as a retrofit kit and is standard on new SoLoNOx shipments.

### Lower Emissions at Lower Ambient Temperatures

As a result of these many improvements at cold ambient temperatures, SoLoNOx low emissions range has been expanded to -20F (-29C) at a tiered NOx guarantee level from 0F to -20F.



Conventional and SoLoNOx ABC Combustor Liners

### Using Alternate Gaseous Fuels

Conventional combustion gas turbines can use a broad range of gaseous fuels including gases associated with oil production, biogas, coke oven gas, natural gas liquid and liquefied petroleum gas. SoLoNOx qualification for a broader range of fuels including the higher BTU associated gases and the lower BTU landfill and digester gases continues.

### Improved Liquid Fuel System Robustness

While much attention has been focused on gaseous fuel operation, Solar is also developing new solutions to cleaner, more efficient operation of liquid-fueled systems.

- SoLoNOx injectors have been improved to increase the amount of insulation around the liquid fuel passageways to lower wall temperatures, which reduces injector coking.
- On conventional combustion and SoLoNOx systems, the purge system is being improved to make sure that all liquid fuel is removed on shutdowns and fuel transfers to prevent injector coking.



Parallel Fuel Valve Module

### Making Your Move to Cleaner, More Versatile Combustion

Several conversions are possible to upgrade your existing Solar gas turbine packages to SoLoNOx or dual-fuel capabilities, or to improve your existing SoLoNOx system.

### Additional Information

For more information about Solar's combustion system improvements and retrofits, contact Solar's Field Office nearest you or visit us at [www.solarturbines.com](http://www.solarturbines.com).



Conventional Low BTU Fuel Injector