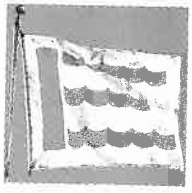
1985 Industrial Environmental Protection and Energy Conservation Awards

Environmental Protection Award
For outstanding achievement in controlling pollution at their powerplants, Sunkist Growers Inc Ontario Cogeneration Inc and Agrilectric Power Partners Ltd each earn POWER's 1985 Environmental Protection Award

Energy Conservation Award
For promoting the use of indigenous fuel resources by using them at their own powerplants, Midwest Grain Products of Illinois Inc and the Kaw Point municipal wastewater-treatment plant earn POWER's 1985 Energy Conservation Award

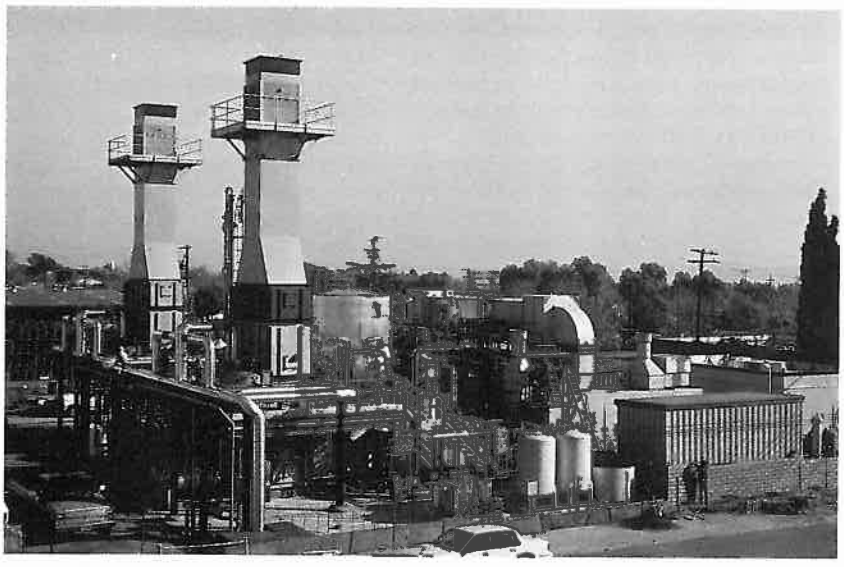
Steam injection enables gas turbine to meet strict NO_x limits

Cheng cogeneration cycle efficiently handles variable steam demand at citrus processor and, at the same time, reduces NO_x emissions

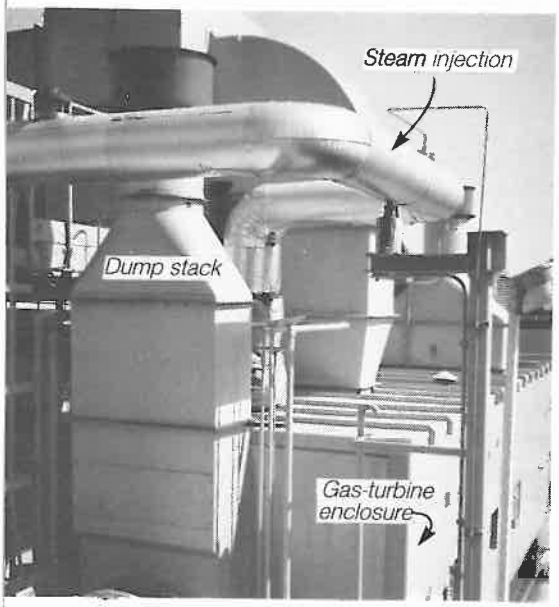


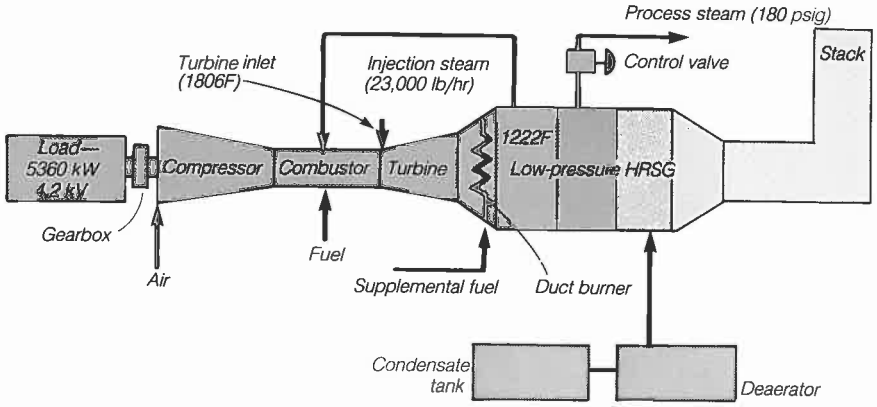
Air-quality regulations in California are acknowledged to be the strictest in the US. For one thing, concern about the environmental hazards of the photochemical oxidant ozone has focused particular attention on NO_x, a common combustion product which is suspected of being a precursor of this pollutant. Within the past year, NO_x-emissions-control requirements for gas turbines in California have been stiffened, with new limits of 25 ppm in the San Francisco area and 9 ppm in southern California. These limits are based on the level of control achievable with selective catalytic reduction (SCR), which the regulators consider to be the best-available control technology for NO_x.

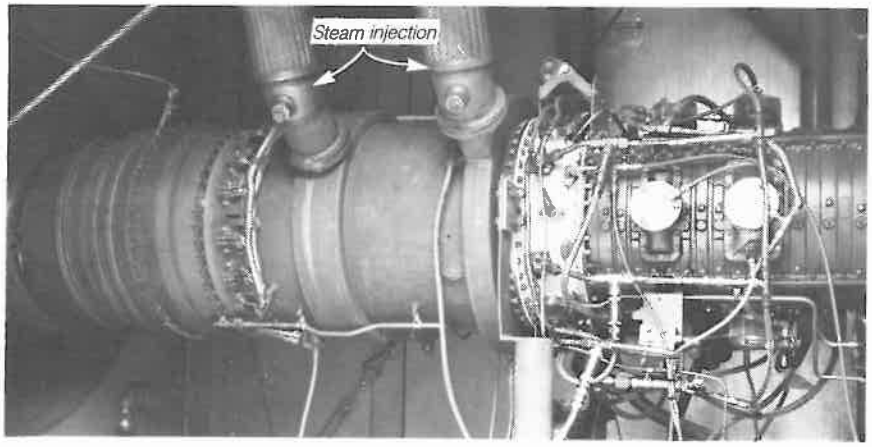
The new regulations were proposed retroactively, nearly forcing a delay in start-



1. Cheng-cycle cogeneration system meets NO_x emissions limits at citrus processor; it injects steam into a gas turbine, reducing operating temperatures







2. Steam injection avoids energy waste while meeting erratic loads (above)

3. Two modified turbine/generators produce a total of 12 MW, twice Sunkist's requirements (upper right)

4. Duct burner increases steam capacity by 30,000 lb/hr, allowing greater operating flexibility (right)

ing up a new gas-turbine cogeneration system at Sunkist Growers Inc, a citrus-processing plant in Ontario, Calif. The system's developer, International Power Technology (IPT), Palo Alto, Calif, proved to the air-quality regulators that its technology—the Cheng cycle—was capable of maintaining satisfactory NO_x emissions without SCR, and the Sunkist facility began operation (Fig 1).

The Cheng cycle is particularly suitable for handling the highly variable loads so often encountered in food processing. At Sunkist, more than 100 pieces of process equipment may require steam to prepare as much as 3600 tons/day of citrus.

Instead of discharging the steam that Sunkist may not need at any point in its operation, the Cheng cycle injects it back into the gas turbine to produce additional electricity (Fig 2), which is then sold to the utility at an average price of about 4.6¢/kWh.

This injection steam provides an additional benefit to the system's operators: It reduces gas-turbine combustion temperatures and inhibits the formation of NO_x enough to meet California's air-quality limits.

Sunkist's powerplant, operated independently by an IPT subsidiary, Ontario Cogeneration Inc, has supplied Sunkist from 2.5 to 7 MW of electricity and steam ranging from 15,000 to 80,000 lb/hr since late December 1984. Nearly a year of successful operation has earned Ontario Cogeneration and Sunkist Power's 1985 Environmental Protection Award.

Cheng-cycle operation

The system operated by Ontario Cogeneration has two identical Cheng-cycle units—needed to supply Sunkist its maximum 80,000-lb/hr demand—and was engineered by Ebasco Services Inc, Santa Ana, Calif. Each unit consists of a gas-fired turbine/generator (Fig 3)—a modified 6-MW unit from General Motors Corp's Allison Gas Turbine Div, incorporating the steam-injection manifold—and a custom-built heat-recovery steam generator with a duct burner installed between the superheater and evaporator for supplementary firing. The powerplant staff uses the burners to fill Sunkist's process-steam demands when peak buyback rates are available and the facility must operate at maximum capacity. The burners can provide up to 30,000 lb/hr of additional steam per unit (Fig 4). Depending on how they are operating, generating efficiencies range from 27% to 39%.

Meets NO_x limits

Even without SCR, the Cheng cycle can keep NO_x emissions below an average of 25 ppm, ranging from 10 to 30 ppm during normal operation. This compares to emissions between 30 and 40 ppm for a conventional gas turbine using water injection to control NO_x. As a result, the Cheng-cycle units offer efficient power generation with some significant environmental benefits.

IPT gained the authority to operate the Sunkist plant by demonstrating that SCR was neither economical nor technically feasible for the Cheng-cycle cogenerating system. SCR systems have been commercialized only in Japan and are unproven for Cheng's modified gas turbine. Even if it were feasible, IPT claims, SCR would incur incremental costs of over $30,000/ton of NO_x removed—far exceeding the regulator's cost-effectiveness limit of $9000/ton.

Financial savings

As with many cogeneration facilities, the Sunkist plant was financed through third parties. Sunkist made no capital outlay at all for the powerplant and buys both steam and electricity from Ontario Cogeneration. The price of electricity is comparable to utility rates—about 7.3¢/kWh. Ontario Cogeneration charges Sunkist about 5% less than it would have cost to produce the steam internally. The profits from the excess power sold to the utility along with the savings produced by the cogeneration system's operation are shared by Sunkist and IPT until 1999. The citrus processor's savings are expected to total about 10% of its energy bills. ■