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Turning Steam to Gold

Without spend a penny of capital, this processor will save $300,000 a year in energy.

For some food companies, cogeneration is both appealing and elusive. Appealing, because it offers sensible relief from ever increasing utility bills. Elusive, because to date, venders have had a difficult time following the ups and downs of seasonal processing.

The problem is steam demand. When demand is high, conventional cogeneration systems work very well. But when demand falls, coventional generators do not remain efficient.

There is nothing wrong with the generator itself. Usually a cogeneration system is sized to accommodate peak loads. However, when loads drop significantly below rated output, excess thermal energy is lost, and cogeneration economics are adversely affected.

A large Cailifornia juice processor knows the dilemma all too well. The plant produces orange juice, orange juice concentrates, citrus by-products, and dried meal. At any given time, as many as 130 steam-loading machines are running, processing up to 3,600 tons per day. Lines run all year long, but steam demand fluctuates from month to month, and in some cases, week to week. Citrus arrives at different times from different growers. In addition, monthly tonnage varies.

Vincente Bendanillo, energy coordinator, elaborates. "Our plant is ideal for cogeneration because we use so much steam and electricity. We even researched a few systems, but it seems our steam loads vary too much. For example, over a weekend, it drops 17%. We'd like to find the right system, because there's potential for large energy savings."

Bendanillo found the answer when a recently formed company called International Power Technology, Sunnyvale, Calif., approached the juice processor with a development called the Cheng Cycle Cogeneration System. The Cheng Cycle successfully follows widely changing steam and electricity demands. What's more, it remains efficient doing so.

The processor and IPT shortly will install the Cheng Cycle System under a shared-benefit agreement. The processor will benefit from cash participation in the project, and reduce operating costs. Immediate savings will be realized. By year's end, 5-10% is expected to be shaved off energy expenditures.

Expected first-year savings are over $300,000, escalating to over $1.6 million after 15 years. These cash flows translate into a present value of over $4-million *without any capital investment.*

IPT will finance the system and sell steam and power back to the processor. Construction is expected to begin in early 1984, with start-up later in the year.

IPT is the brainchild of Dr. Dah Yu Cheng, who spent ten years perfecting the technology. Robert Schroeder, president since December, 1982, feels the company could grow to $200 million within ten years.

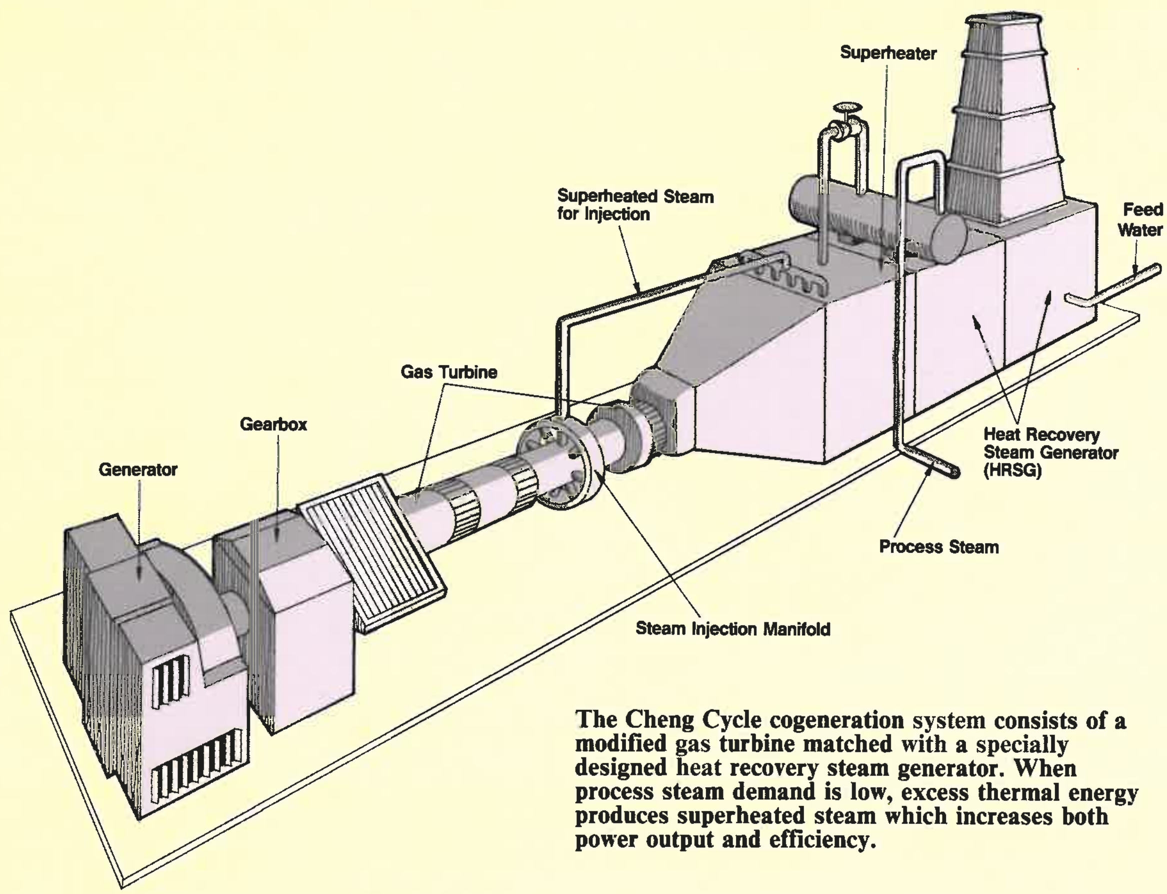
The Cheng Cycle system will benefit the processor because it can follow the plant's up and down steam demand. In brief, when thermal loads drop, excess thermal energy is used to produce more electricity more efficiently.

High efficiency and operating flexibility translates to dollars. The Cheng Cycle system fares much better than conventional systems during periods of low thermal load. Cash flow remains high despite load fluctuations. And where conventional cogeneration systems typically strike investment hurdles, the Cheng Cycle stays attractive. Typical payback is less than four years, with after-tax rate of return of over 25%. This can be significantly higher depending on site economics.

One size fits all

In terms of size, the Cheng Cycle system is an "one size fits all" turn key installation. A single unit handles steam loads between 6,000 and 40,000 pounds per hour. It produces up to six megawatts of power. Power produced over and above processor requirements is sold to electrical utilities.

The Cheng Cycle Series 7-Cogen system always has the same components. These are: Allison (Division of General Motors) 501-KH industrial gas turbine, heat recovery



The Cheng Cycle cogeneration system consists of a modified gas turbine matched with a specially designed heat recovery steam generator. When process steam demand is low, excess thermal energy produces superheated steam which increases both power output and efficiency.

steam generator (HRSG), secondary combustor, gear box, electrical generator, controls, and miscellaneous support equipment.

Basically, the Cheng Cycle system recovers energy in the form of steam from the gas turbine exhaust stream. The steam is either sent to process, or through a superheater and back to the turbine. Though it sounds simple, it took IPT seven years to optimize the thermodynamic principles.

When the Cheng Cycle is running, saturated steam from a drum in the waste heat boiler is taken off through two lines: one supplies process steam, the other feeds the superheater. Steam going from the superheater and back to the turbine makes the Cheng Cycle different from conventional cogeneration systems. Steam injected from the superheater into the turbine produces increased power, higher efficiency, and NOx emissions control.

A secondary combustor between superheater and evaporator provides better flexibility. It will meet peak steam demand up to 45-million BTU's (or about 40,000 lbs.) per hour per single unit.

When steam loads vary, the amount of steam available to the engine changes too. So does generator power output, as well as efficiency. How the system handles these changes reflects its differences with conventional cogenerators.

The first and most obvious difference is when steam is *not* required for processing. It is not necessary to decrease the turbine's power output to follow steam demand. In fact, when steam is not needed for processing, it's redirected to the turbine. As described above, the extra steam helps increase the turbine's power output.

Conventional plants operate the opposite way. A conventional generating system has two options when thermal loads vary. One is to vent excess thermal energy, wasting the valuable commodity. The other is to derate the turbine, resulting in lower power output and efficiency.

Computer controlled

Computer-based, real time economic controls are primarily responsible for fast payback. Although operator action is minimal, the system is constantly adjusted by the control system to maximize returns. Inputs are primarily energy rates. Outputs include detailed system performance and accounting data.

In real time, the computerized control system looks at the process steam and electricity requirements, economic conditions, and system constraints. After checking against limits, the system makes a control output move to economically optimize the cogeneration plant while maintaining process energy requirements.

While the turbine provides more than enough power to run a food processing plant, it is not considered the primary power source. The reason why is simply that no cogeneration plant matches the availability of power from utilities.

Further information about the Cheng Cycle System can be obtained from International Power Technology, 506 Oakmead Parkway, Sunnyvale, Calif. Or, Circle 583 on the Product Information Card in the back of the magazine.