ORNL's New Cooling, Heating, and Power Integration Laboratory

ORNL is testing the performance of a commercial microturbine—along with various configurations to recover and use waste heat from it—in a new Cooling, Heating, and Power (CHP) Integration Laboratory. The laboratory and the research are part of a DOE effort to encourage the use of distributed generation (DG) systems.

About two-thirds of the fuel energy used to generate electricity in power plants is wasted as discarded heat and through losses incurred in power transmission and distribution; by the time the power gets to its point of use, total efficiency can go as low as 30%. By productively using waste heat to provide heating, cooling, and humidity control in commercial and institutional buildings, DG/CHP systems can improve total (resource) efficiency levels to 70% or greater.

Four phases of testing are planned initially for the microturbine system:

- Phase 1 examined startup and shutdown capabilities and limitations of the microturbine and its load following performance. Baseline performance testing determined the variability of the microturbine's operating performance variables, such as power output, voltage, current, and heat output. Nominally, the microturbine's maximum power output and efficiency without waste heat recovery are 28.5 kW and 23%, respectively. In addition, exhaust gas backpressure tests were conducted to determine how the expected backpressure of the thermal recovery technologies will impact the performance of the microturbine.
- Phase 2 testing will include a heat exchanger for waste heat recovery. Ducting has been installed to route exhaust gas from the microturbine to the heat exchanger, as have water pipes. Water heated by the exhaust gas is piped to an indirectly fired desiccant dehumidification system to test regeneration of the desiccant wheel.
- Phase 3 will include a directly fired desiccant dehumidification system fed directly from the microturbine exhaust gas, instead of through the heat exchanger/hot water setup. In addition, the directly fired desiccant unit could be tested in series with the heat exchanger/hot water setup.
- Phase 4 will include an indirectly fired absorption chiller. Water heated by the heat exchanger will be fed to a 10-ton absorption chiller. The capacity for providing space cooling will be measured, and the effect of providing inlet air cooling from the chiller to the microturbine will be tested.

Abdi Zaltash checks equipment inside ORNL's new CHP Integration Laboratory.

These initial laboratory evaluations will focus on effective integration of current CHP thermal recovery and thermally activated cooling and humidity technologies.

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Continued from page 3

7 years of use in a home. Testing to the equivalent of 10 years of real-world use (7000 cycles) continues. The HPWH is also undergoing a national field demonstration study that began this spring.

A more recent water heating invention from the BTC—the "Hot Rod"—offers the prospect of an even faster investment payback. The Hot Rod allows easy conversion of a standard electric water heater into an HPWH. It is a small packaged system containing a bayonet condenser (the hot rod) that can be inserted through the threaded fitting at the top of a conventional water tank. The Hot Rod, heated by a small, efficient heat pump, heats the water in the tank. The resistance elements are retained for backup heating in the case of heavy hot water draws. Research, development, and testing of designs for the Hot Rod concept are under way, and a design suitable for commercialization is expected to be ready by 2004.

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