# TECHNOLOGY

## Unusual heat-pump systems

Residents of a future Chicago housing project may find a "modular heat-pump system" heating and cooling their homes. A team at Argonne National Laboratory, headed by Wyman Harrison, designed the system. Compared with more conventional systems, such as electric heating and cooling, they found it could save the equivalent of up to 450,000 barrels of oil annually, and offered environmental advantages.

Each of the 13,500 apartments would have an individually controlled heat pump to exchange heat between the community's water-distribution system and a water-distribution loop in each apartment. Lake Michigan water and cooling water from a nearby power plant feed the community system; by varying the proportion of each, incoming water temperature remains between 55° and 65° F. In summer, heat would be exchanged from the apartment to the cooler lake water; in winter, the power plant's water would supply heat.

A related system that may offer greater energy savings was designed by W. Richard Powell at Johns Hopkins University's Applied Physics Laboratory. Underground community aquifers replace the two water sources in the Argonne system. Instead of one community water-distribution system, there are two. One, at 40°, cools buildings by passing water through cooling coils. The other, at 60°, is used for heating, via heat pumps. The Argonne system uses heat pumps in both modes, consuming more fuel.

In summer, buildings serve as solar collectors; water that cools them absorbs their heat and empties into the warm aquifer. When the community uses this water for heating in winter, it cools (via the heat pump) to about 40°, and flows into the aquifer; most 40° water is cooled this way or by exposing it during winter to chill air.

## Listening with fiber optics

The U.S. Navy, interested in hearing more of what's happening under water, is developing an acousto-optic hydrophone. The most promising model under study, says Charles M. Davis of the Naval Research Laboratory, suspends a coil of optical fiber (the ends of which remain above water), perhaps 100 meters long, into the water. Sound waves in water really consist of a series of oscillating pressures, Davis says; the refractive index of the optical fiber fluctuates with the oscillations, causing phase modulations in coherent (laser) light beamed through the fiber. To listen, a photodetector compares light from the underwater coil with light from the same source beamed through an identical, reference fiber.

Geometrical flexibility is the real advantage to these systems, Davis says. For example, thin fibers can be wound onto a spool or suspended in a long loop; as a planar alternative, the fiber material can be rolled into large sheets, 100 microns thick, Davis says. And when desired, fiber density can be varied.

## Irradiating sewage sludge

The presence of toxic pathogens is one factor limiting the use of sewage sludge as a conditioner on croplands or garden soil. Sandia Laboratories is tackling the problem with radiation. In a pilot plant soon to be constructed, buckets carrying 30 to 60 pounds of dried or composted sewage sludge will pass over and under intense gamma-radiation sources — approximately one megacurie of cesium-137 — to kill pathogens. Sandia promises the end product will be safe enough to eat. And it will be. In a related program, Stan Smith, a nutritionist in New Mexico State University's Range and Animal Sciences Department, is experimentally feeding sludge products "cleansed" by the Sandia process to cattle and sheep as a food supplement.

# SPACE SCIENCES

## Space shuttle engine probed

Difficulties with the main engine being developed for the space shuttle, which have been under study by NASA's in-house review process and by the Aerospace Safety Advisory Panel, are now being examined as well by a specially formed committee of the National Research Council. The committee was formed at NASA request, following a request to the agency from the Senate Subcommittee on Science, Technology and Space for an independent review of the program.

In a letter to NASA Administrator Robert Frosch, subcommittee chairman Adlai Stevenson (D-Ill.) and ranking minority member (and former astronaut) Harrison Schmitt (R-N.M.) had written, "Recognizing... that the main engine represents a major technology advance and the fact that the engine development continues to experience difficulties, we are concerned whether everything possible is being done to assure development of a safe and reliable main engine system."

On Jan. 25, National Academy of Sciences president Philip Handler spoke of the matter before the House Committee on Science and Technology. "It is my understanding," he said, "that progress in the development and testing of this engine — which pushes current technology to its limit — is now paced by the performance of its liquid hydrogen pump. The immediate principal purpose of our committee is to ascertain whether, in their view, these difficulties are of the sort that are encountered and resolved during the course of the development of every major new technology, or whether they reflect some problem so profound as to be likely to necessitate some as yet unplanned special development program or to occasion significant delay in the date of the first full-powered flight of the shuttle."

## Hardened CMOS circuits for spacecraft

Integrated circuits capable of withstanding radiation doses of one million rads are now ready for use in satellites and deep-space probes according to the Solid State Division of RCA Corp., which says that the new components represent "a ten-fold increase in radiation resistance over previous devices made by the industry." The highly "hardened" CMOS (complementary metal-oxide semiconductor) devices could have applications in a variety of earth-orbiting as well as interplanetary probes.

The increased radiation resistance is obtained by lowering the annealing temperature of the devices' gate oxide, and apparently works by changing the characteristics of the silicon-silicon oxide interface. The technique was developed under contract to the U.S. Air Force.

In what may be the first application of the new devices, Jet Propulsion Laboratory is considering their use in the spacecraft of Project Galileo, formerly known as the Jupiter Orbiter and Probe mission, to be launched in 1981. One vehicle is to orbit the giant planet for a planned 20 months, taking close looks at the satellites as well, while the other craft is targeted for a quick, deep dive into the Jovian atmosphere.

## Airborne control of satellites

In a test series conducted by the U.S. Air Force, two of the earth-orbiting Lincoln Experimental Satellites (LES 8 and 9) have been controlled from an aircraft flying over the North Pole. The only previous airborne control test for the two probes was conducted in 1977 near Wright-Patterson AFB. In the polar tests, the satellites relayed more than 5,000 error-free messages between a ground station and a C-135 jet, and responded to commands from the plane to change their communications configuration. Conventional high-frequency links without satellites, officials say, suffer ionospheric distortion.