Soil moisture sensor could enhance irrigation efficiency

SANDIA LAB NEWS, November 16, 2001 [page 3]

By Nancy Garcia

Two big-ticket items in California, agriculture and water, could both benefit from a soil moisture sensor invented by Ken Condreva of Telemetry Systems Engineering Dept. 8416.

Rainless for months at a stretch, the state carefully monitors and marshals out its water supply -- partially provided by runoff from snow melt.

Ken spent about a month this summer testing his new invention, which he hopes will help growers optimize irrigation efficiency. Ralph Boehmer and Danny Dominguez (both 8512) drilled a five-foot-deep hole to bury the sensor, which is about the size of two coffee cans placed end-to-end. Like an earlier sensor Ken created to measure water in the snowpack (now being commercialized by Canberra Industries), the device detects how water attenuates incoming cosmic radiation. A reference sensor mounted above ground measures the total incoming cosmic radiation (which fluctuates over time).

Ken says he'd thought about applying this approach to soil moisture and wondered if the attenuation of cosmic rays by the soil itself might decrease the sensitivity. In a couple of 10-day-long tests, he found that by averaging the signal over time, he could see differences in moisture amounting to as little as an inch or less of water, applied at the surface with a sprinkler.

He gathered his data on a computer in a small outbuilding provided by Herb Woelffer and Ed Diemer (both of 8511). He envisions the agricultural version will have a battery and transmit data to a collection point, possibly even controlling irrigation automatically.

Several systems exist that detect moisture at, or near, the surface of the soil. However, none have been developed to detect moisture this far down, which Ken hopes will be especially useful for crops with deep root systems in vineyards or orchards.

His summer research project was paid for with $2,500 from a royalty fund that Sandia collects and re-invests in R&D and related activities, such as promotion, training, and cost-sharing. The project has led to a recently filed patent application.

"There has been a long-felt need for a simple, inexpensive, reliable, and practical method for determining water content," says Sandia patent agent Tim Evans (11600). Ken says another advantage of the sensor is that it measures moisture over a relatively wide area, which is proportional to the depth of the buried sensor. At five feet deep, the sensor measures moisture from about a 10-foot-wide circle at the surface.

To study the feasibility of the device, Ken watered the surface with about six inches of water, applied with a garden sprinkler. Over the next few days, he observed as the water shielded incoming cosmic radiation, then slowly dried or percolated away, returning to the baseline reading.

Like the automated snowpack water sensor, he says, the new soil moisture device "can contribute to better water management."

This matters in relatively arid areas like parts of California that only receive 15 inches of rain a year (all between November and March). The state Department of Water Resources has a division devoted exclusively to water efficiency, and water-use planning is a high priority in the state's $25 billion annual agricultural industry. Grapes, typically grown in some of those drier regions, are the state's second-leading commodity, produced at more than 300,000 tons a year. Among orchard crops, meanwhile, almonds represent the state's leading export. -- *Nancy Garcia*