Accelerator Systems Division keeps nation's brightest X-rays beaming

September 20 2004

Argonne is home to the Advanced Photon Source, this hemisphere's most brilliant source of X-rays for scientific research. The Accelerator Systems Division maintains the equipment to provide optimal X-ray quality with few interruptions to scientists. Researchers come from a variety of disciplines and from industry, academia and national and international laboratories. Research at this national facility, which is funded by the U.S. Department of Energy's Office of Basic Energy Sciences, ranges from materials science to structural biology.

Recent findings include:

Creating the fastest movies ever made of electron motion,
Determining the crystal structure of sortase B, an enzyme found in the bacteria that cause staph and anthrax, and
Showing that materials as thin as 1.2 nanometers can retain electric polarization.
An APS priority is to provide consistent, high-quality X-ray beams for the more than 6,000 researchers – more than any other scientific user facility in the nation – who conduct experiments there.

The APS storage ring is 1,104-meters in circumference and wide enough around to encircle a baseball stadium. The Accelerator Systems Division maintains the APS' technologically sophisticated accelerator complex, including the linear accelerator, the booster, the radio frequency system and the storage ring. These machines and devices produce, accelerate and store the beam of electrons that is the source of the APS X-ray

beam. The facility's thousands of instruments range from computer controls and vacuum pumps to radio frequency cavities and safety systems, all of which must be kept in perfect alignment and tolerances to provide optimal beam quality for research.

During fiscal year 2004, employees engaged in developing, maintaining and operating the APS accelerators broke their own operations records. “APS ran at a near 98 percent reliability with a mean time between failures of 57 hours,” said Accelerator Systems Division Director Rod Gerig. “We reached these goal years before we expected to. Our goal for 2004 was 95 percent reliability and 40 hours mean time between failures.

"This achievement is important,” Gerig said, “because even short faults interrupt experiments at the facility, much like a small glitch in the electric power grid can reset an answering machine, except at the APS it could ruin a new sample that took hundreds of hours to create.

“In addition to maintaining and upgrading the facility as needed,” he said, “ASD employees also plan for the future and develop upgrades for quality and cost-effectiveness.” Recently the ASD Mechanical Engineering Group began a series of modifications to the accelerator water-supply system that is already cutting costs significantly — with even greater savings to come.

Water-wise engineers

Next to electricity, water is perhaps the most critical and costly ingredient needed to operate the APS beam acceleration and storage complex. The APS accelerator complex depends on a reliable, year-round supply of 10,000 gallons per minute of processed deionized and chilled water to cool technical components that can generate intense levels of heat. This cooling level must be kept within stringent parameters by maintaining the temperature, pressure and chemical

properties of the cooling water.

To control and reduce costs, John Dench, Cheryl Fusco, Ric Putnam and Gene Swetin of the Mechanical Engineering Group evaluated the design of the complex system of pumps that deliver water to the accelerators. The group installed override switches on the existing valves that regulate water temperature control. The result changes the pumping system from one of constant water volume to a more controlled, variable volume.

With the changeover about 60 percent complete, water flow to the accelerators has been decreased by more than 2,000 gallons per minute in the primary water-pumping loop that operates year-round. The final modifications, scheduled for the end of 2004, are expected to reduce water flow by a total of 3,000 gallons per minute. Additional savings will come from heavier use of low-cost water from the APS cooling tower, rather than the current higher-cost, two-stage system that uses tower water and then chilled water.

The modifications are projected to cost less than $2,000 and to save the laboratory more than $30,000 per year in energy costs.

Source: Argonne