



Holding tanks for the Sandia water reclamation system.

The U.S. Department of Energy's (DOE) Federal Energy Management Program (FEMP) facilitates the Federal Government's implementation of sound, cost-effective energy management and investment practices to enhance the nation's energy security and environmental stewardship.

## MICROELECTRONICS PLANT WATER EFFICIENCY IMPROVEMENTS AT SANDIA NATIONAL LABORATORIES

Best Management Practice  
Case Study #13 — Other Water Use



Sandia National Laboratories has developed extensive water efficiency improvements at its Microsystems and Engineering Sciences Applications (MESA) complex in Albuquerque, New Mexico. Since 1949, Sandia has developed science-based technologies that support national security: nuclear weapons, energy and infrastructure assurance, nonproliferation, defense systems and assessments, and homeland security.

The laboratory sits on 8,699 acres of land and employs more than 10,000 employees and contractors. Altogether, it owns 871 buildings encompassing more than 5.8 million square feet.

The MESA complex houses research in microelectronics, including designing and prototyping microsystem-based components. The complex consumes about 28% of the total water used at Sandia. The processes used to create microelectronics systems require high-purity water for cleaning.

Over the last several years, Sandia has initiated projects that have saved 80 million gallons annually, which represents 18% of the current water use at the laboratory. These savings were achieved by increasing the efficiency of the system, recycling higher-quality spent rinsewater, and reclaiming water to use for acid waste scrubbers and cooling towers.

Much of Sandia's success is due to proactively identifying conservation opportunities before plant upgrades are undertaken. That way, water conservation can be quickly included into new construction projects. After the upgrade is completed, a customer team takes over responsibility to find additional opportunities for reducing water consumption.

### Project Summary

#### *High-Efficiency Reverse Osmosis*

The MESA complex requires water with a high-purity level for its processes. This water goes through several pretreatment processes before being delivered to a reverse-osmosis system. Water impurities are removed by sending the water under high pressure through a semi-permeable membrane that filters out dissolved minerals and pollutants. A traditional reverse osmosis system has a recovery rate of about 65%. In other words, for every 100 gallons of water entering a traditional system, it produces 65 gallons of pure water called "permeate" and 35 gallons of discharged wastewater called "concentrate".



The HERO™ system consists of horizontal high-pressure pumps made of stainless steel that force spent water through a reverse osmosis membrane, which is inside the cylinder with the white housing.

Sandia upgraded the older water plant to a patented water treatment system, called High Efficiency Reverse Osmosis (HERO™). The HERO system pre-treats the feed water entering the system to remove calcium, magnesium, and silica from the water and raise the water's pH level. Removing these minerals from the water reduces hardness and makes the water more alkaline. This increased alkalinity, in turn, reduces scaling on the reverse osmosis membrane and increases the recovery rate. With HERO, Sandia is able to recover 95% of the total water entering the system and rejects only 5%. In 2008, this increased efficiency resulted in savings of 34 million gallons of water.

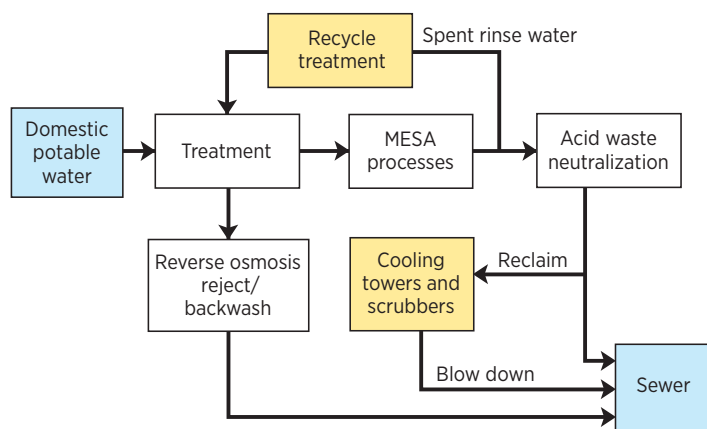
### Water Recycling

Sandia also recycles a portion of the spent rinse water from microelectronics cleaning at the MESA complex. There are multiple discharge water streams in the plant processes, and not all of them are suitable for reuse. With proper treatment, however, some of these spent water streams can be recycled back to clean microelectronics. MESA recycles approximately 6 million gallons of water annually in this manner.

### Water Reclamation

Water is also reclaimed from the microelectronics processes and is used in the system's acid waste scrubbers and in nearby cooling towers. The water that is reclaimed from the system for these two applications is of lower quality than water that is selected for the recycle treatment.

## Water Recycling and Reclamation at the MESA Plant, Sandia National Laboratories



This simplified flow chart shows the general path of the recycled and reclaimed water in the MESA plant.

Scrubbers remove contaminants from the exhaust of the microelectronic processes. Reclaimed water is used for these scrubbers in place of potable water. Reclaimed water from the microelectronics plant is also used in cooling towers for makeup water. A portion of the spent water is pumped from the plant to three holding tanks. The storage tanks are connected to several cooling tower systems and reclaimed water is pumped to the cooling towers. There is an automatic system that uses city water as a back-up to the reclaimed water. Annually, Sandia reclaims 40 million gallons of water to be used in the acid waste scrubbers and the cooling towers.

A simplified flow chart below shows the general path of the recycled and reclaimed water in the MESA plant.

### Cost and Savings Summary

Using a “system engineering” approach that looks at all potential uses of water and that considers opportunities for reduction, recycling, and reclamation has resulted in significant water conservation opportunities for Sandia National Laboratories; these are summarized below:

- Through a higher efficiency reverse osmosis process, the HERO system saves 34 million gallons per year.
- By recycling spent rinse water from the microelectronics' processes for retreatment in the HERO system, Sandia saves 6 million gallons per year.
- By replacing potable water with reclaimed water from the microelectronics' processes for acid waste scrubbers and cooling towers, Sandia saves 40 million gallons per year.

Efficiency improvements in the production of high-purity water and the reuse of spent rinsewaters through recycling and reclamation has saved 80 million gallons of water per year, which represents about 18% of the total water use at Sandia. The estimated value in water and sewer costs is \$160,000 annually.

### For More Information

FEMP Water Efficiency: <http://www.eere.energy.gov/femp/program/waterefficiency.html>

Water Efficiency Best Management Practices: [http://www.eere.energy.gov/femp/program/waterefficiency\\_bmp.html](http://www.eere.energy.gov/femp/program/waterefficiency_bmp.html)

Sandia Water Efficiency: <http://www.sandia.gov/aqua/default.htm>