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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.

NASA'S MARSHALL SPACE FLIGHT CENTER SAVES WATER WITH HIGH-EFFICIENCY TOILET AND URINAL PROGRAM

Best Management Practice Case Study #6 — Toilets and Urinals

Established in 1960, the National Aeronautics and Space Administration's (NASA) Marshall Space Flight Center (MSFC) has a longstanding, successful sustainability program that focuses on energy and water efficiency as well as environmental protection. MSFC's key operations include propulsion and transportation systems for the space shuttle and Ares rockets. MSFC also provides advanced engineering and operations for International Space Station systems. Located in Huntsville, Alabama, adjacent to Redstone Arsenal, MSFC has more than 4.5 million square feet of building space occupied by 7,000 personnel. MSFC consumes approximately 240 million gallons of potable water annually, supplied through the City of Huntsville.

MSFC is known for breaking new ground and pushing the envelope on environmentally responsible operations. In 2005, for example, MSFC built Building 4600 as NASA's first building certified under the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) rating system, achieving a prestigious Silver rating. Since that time, a companion building constructed at MSFC achieved a Gold LEED rating. Both buildings are energy and water efficient, boast the use of renewable energy, and include other sustainable aspects such as recycled materials, daylighting, improved air quality, and reduction of waste. MSFC is also one of the first NASA sites to pursue LEED certification for Existing Buildings:

What is a high-efficiency plumbing fixture?

Current standards for toilets and urinals were established by the Energy Policy Act of 1992, setting the maximum allowable flush rate for toilets at 1.6 gallons per flush (gpf) and the maximum flush rate for urinals at 1.0 gpf. Fixtures must exceed these standards to be considered high efficiency. High-efficiency toilets (HET) can use no more than 1.28 gpf while high-efficiency urinals (HEU) cannot exceed 0.5 gpf.



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Building 4600 at the NASA Marshall Space Flight Center is the agency's first LEED Silver Building

Operation and Maintenance (LEED EB O&M). This certification requires that buildings are sustainably operated and maintained and include water-efficient technologies, energy system commissioning, green cleaning, and recycling.

Project Summary

Because MSFC was built in the 1960s, most of the buildings house outdated, inefficient restroom fixtures. The facility engineering team at MSFC developed an innovative efficiency model for replacing these older toilets and urinals.

Technology Research

The MSFC team began by researching available fixtures on the market. They compared current standard models with high-efficiency fixtures and investigated the performance and operational issues of each technology type. The team also examined operational constraints related to fixture replacement at MSFC. For example, many of the buildings at the flight center contain an old piping infrastructure with cast iron pipes. Because the pipe material may be in fragile condition, any waste left in the drain line could cause clogging and even fracture the old pipes. The team

MSFC Water Efficiency Program: Steps for Success:

1. Research high-efficiency technologies.
2. Develop new design specification based on research results.
3. Demonstrate technologies and measure results.
4. Identify buildings and implement technologies.

determined it was most appropriate to implement fixtures with adequate flow rates to ensure that waste fully clears the restroom's drain line through to the main sewer line.

Implementation of New Design Specification

Based on their technology research, MSFC engineers developed a new fixture specification to require the implementation of the high-efficiency toilets (HET) that use no more than 1.28 gallons per flush (gpf) and high-efficiency urinals (HEU) not exceeding 0.5 gpf. The specification also dictates the use of piston valves instead of diaphragm type valves. The team found a distinct advantage to piston valves, which fail "closed" in contrast to diaphragm valves, which fail "open." Valves that fail open leak water continuously until repairs are made. The MSFC design specifications also incorporate the use of Environmental Protection Agency (EPA) WaterSense products. These design standards are used on all new construction, renovations, and retrofits at MSFC.

Demonstration Projects

The MSFC team's next step was to test restroom fixtures in demonstration projects. Building 4203 on the MSFC campus was identified as the first demonstration of high-efficiency urinals and faucets. The demonstration was conducted along with a LEED EB O&M pilot project at Building 4203. The team working on the sustainability project implemented high-efficiency urinals rated at 0.5 gpf and faucets rated at 0.5 gallons per minute. These retrofits



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Native Loblolly pine trees at MSFC require no irrigation

reduced the plumbing fixture water use at Building 4203 by 30 percent and achieved three LEED points related to water efficiency.

Another demonstration project is currently underway at Building 4250 on the MSFC campus. This demonstration is testing high-efficiency plumbing products from multiple manufacturers of toilets and urinals as well as lavatory faucets. A water meter installed on the building monitors the building for pre- and post-retrofit water use so that water savings can be quantified. In addition to measuring water reduction, the MSFC facility engineering team is also examining the performance of fixtures. Toilet and urinal performance is monitored to ensure each model is flushing adequately. Faucets are monitored for the duration of time it takes for the automated sensors to turn on and off. The facility engineering team at MSFC will use the results of the water savings and performance monitoring to refine product specifications and help direct future purchasing at MSFC.

Implementation of Technology

Through the design specifications and results of the demonstrations, MSFC is implementing high-efficiency fixtures across the flight center. Key buildings are being identified as candidates for water efficiency retrofits, supporting the MSFC's campus-wide sustainable operations program.

Additional Water Efficiency Initiatives

Other successful aspects of MSFC's water efficiency program include extensive water metering, an active leak detection and repair program for the aging distribution system, water management for cooling towers, the use of non-potable water for limited irrigation, and native landscaping that requires no irrigation. MSFC also employs an outreach program to help educate staff members on water conservation.

Through these initiatives, MSFC is creating a culture of water efficiency and conservation. The long-term goal of the water efficiency program is to reduce water use by 50 percent across the entire center.

For More Information:

- Marshall Space Flight Center: www.nasa.gov/centers/marshall
- FEMP Water Efficiency Program: www.femp.energy.gov/program/waterefficiency.html
- EPA WaterSense Program: www.epa.gov/watersense/

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