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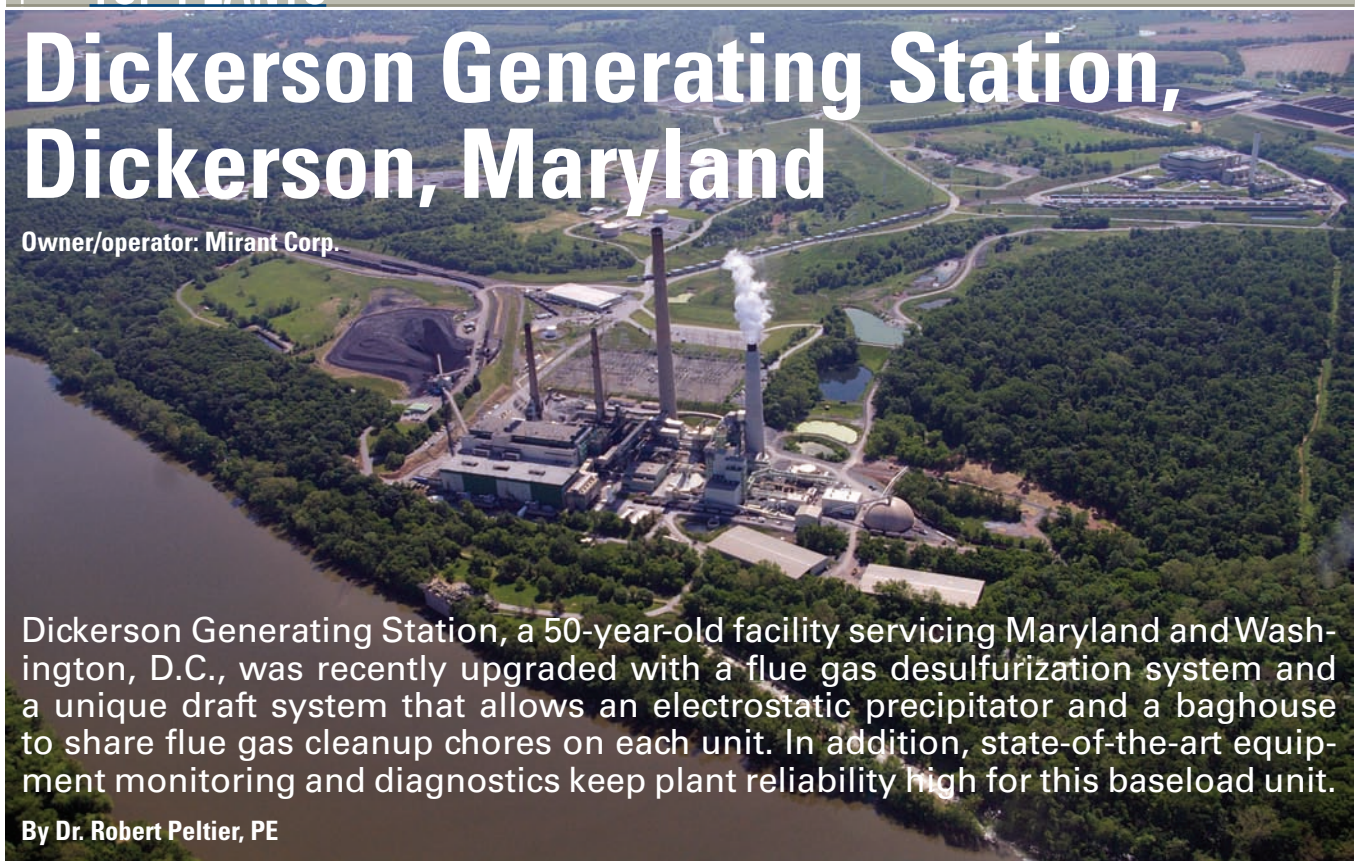
TOP PLANTS

# Dickerson Generating Station, Dickerson, Maryland

**Owner/operator: Mirant Corp.**



Dickerson Generating Station, a 50-year-old facility servicing Maryland and Washington, D.C., was recently upgraded with a flue gas desulfurization system and a unique draft system that allows an electrostatic precipitator and a baghouse to share flue gas cleanup chores on each unit. In addition, state-of-the-art equipment monitoring and diagnostics keep plant reliability high for this baseload unit.

**By Dr. Robert Peltier, PE**

Mirant Corp. (Mirant) is the prototypical independent power producer, with a history that closely parallels the triumphs and tragedies of merchant generation. Originally formed as Southern Energy Inc., a subsidiary of Southern Company, it focused on global investment opportunities in power generation. Southern Energy was spun off from Southern Company in 2000 and was subsequently renamed Mirant. By the end of 2001, Mirant joined other merchant generators facing financial hardships in the wake of Enron's collapse and an overbuilding of competitive generation. Chapter 11 bankruptcy filing resulted in July 2003. Reorganized with new management, Mirant emerged as a profitable merchant power competitor in 2006. The company divested its foreign businesses in 2007 and has since focused on producing and selling electricity in key, densely populated U.S. regions.

Mirant's 11 U.S. generating stations, nominally rated at 10,000 MW, are located in the San Francisco; Washington, D.C.; Boston; and New York City greater metropolitan areas. Mirant's Mid-Atlantic fleet consists of its Morgantown, Chalk Point, and Dickerson Generating Stations in Maryland, as well as its Potomac River Generating Station in Virginia. All burn coal, natural gas, or oil, or a combination of fuels.

## Modernizing Maryland Plants

Dickerson Generating Station (DGS) is located in Montgomery County, Md., on the Potomac River. DGS has three coal-fired 190-MW units that were constructed in 1959, 1960, and 1962 and two 147-MW combustion turbines constructed in 1992. DGS was originally built by the Potomac Electric Power Co. but was acquired in 2000 by Mirant. DGS is usually dispatched as baseload generation by the PJM Interconnection regional transmission organization.

Perhaps the principal challenge for merchant generators that own coal-fired assets is grappling with the incessant investment required for environmental upgrades. The Maryland Healthy Air Act (MHAA), effective in 2006, set the air emissions rules of the road for coal-fired plants in that state. The MHAA, while based on the U.S. Environmental Protection Agency's Clean Air Interstate Rule and Clean Air Mercury Rule, requires larger reductions in air emissions that apply year-round, unlike the seasonal $NO_x$ rules in other states. The Maryland Department of the Environment expects to meet federal ambient air qual-

**1. Fountain of youth.** Mirant's 50-year-old Dickerson Generating Station completed a $1.1 billion emissions upgrade project in December 2009. Those upgrades included a flue gas desulfurization upgrade capable of removing up to 97% of the $SO_2$ and a new 400-foot stack. Mirant has also standardized its machinery health and condition-monitoring functions with SmartSignal without adding to the control room's alarm workload. The plant is now ready for another half-century of service. *Courtesy: Mirant Corp.*

ity standards for particulates and ozone by requiring two-step reductions totaling 75% for $NO_x$ by 2012, 85% for $SO_2$ by 2013, and 90% for mercury by 2013, all compared to a 2002 baseline. The MHAA also closed another loophole: Out-of-state emissions allowances cannot be used to avoid the capital investment required to meet these air emissions requirements.

## Savvy Shopper

Mirant has invested about $1.67 billion over the past several years installing flue gas desulfurization (FGD) systems, selective catalytic reduction systems, and, in some cases, switching to low-sulfur coal at its three Maryland plants. The Shaw Group Inc. finalized an engineering, procurement, and construction contract with Mirant in August 2007 to retrofit all three of Mirant's Maryland coal plants (seven units) with FGD systems designed to reduce $SO_2$ by up to 98%. The systems are limestone forced oxidation FGD systems supplied by Babcock & Wilcox and are designed to produce wallboard-grade gypsum as a recyclable by-product. In addition, the co-benefits from the wet FGD system are expected to reduce ionic mercury emissions by approximately 90%. The value of the contract was $1.1 billion.

A unique feature of the fleet FGD retrofit concept was the maximum use of design and control replication across the three distinctly different sites to leverage the economic advantage of a multiple unit order. For example, at Morgantown each unit received a separate FGD absorber, but at Chalk Point the two units share a common FGD absorber. At DGS, the three 190-MW units were retrofitted with a single FGD absorber and lime preparation system and a new 400-foot single flue stack. The other three stacks were retired in place. The common design approach meant DGS got a supersized 650-MW-sized scrubber for the price of a much smaller unit. The expected $SO_2$ removal rate is up to 97%.

The original wet particulate scrubbers were unable to meet opacity limits, so in 2003 a very peculiar split system was retrofitted. A common baghouse takes 60% of the gas flow from each of the three units. The remainder of the gas from each unit goes to separate electrostatic precipitators. All the flue gas ductwork converges and exits up the new common stack. Without a doubt, the draft control system for this arrangement is complicated.

## SmartSignal Upgrades

A staff of 24 operators (17 of them hired since 2006) operates DGS. One force multiplier employed by DGS was to systematize machinery health monitoring by adopting SmartSignal technology. In essence, SmartSignal detects, diagnoses, and reports machinery problems before the plant's digital control system (DCS) alarms are triggered. The software, consisting of numerous equipment models developed using historical data, compares expected performance with the actual data to give advance notification of subtle changes and scarcely detectable trends in machinery health. Productivity has increased because plant staff can be proactive with maintenance that is focused on avoiding future failures rather than reacting after a failure occurs. SmartSignal technology, piloted at DGS, has now been adopted at three of Mirant's Mid-Atlantic plants (Figure 1).

At DGS, the necessary plant operating data are captured directly in the plant OSIsoft PI long-term data historian that is part of the DCS. SmartSignal, which monitors DGS from its Chicago-based Availability & Performance Center (APC), receives routine data dumps from the PI historian, performs the necessary predictive data analysis, and manages the "watch list" of hundreds of plant variables. A weekly report on important trends is submitted to the plant operations manager and performance and reliability engineers for action. If rapid changes occur so that any point on the watch list exceeds expected values, an emergency report is generated and immediately sent via email to designated plant staff members for action.

The true measure of any machinery health–monitoring system is how early a potential fault can be detected by the APC before a DCS alarm goes off in the control room. Here's a short list of successful "catches" and forensic uses:

- A shift in the Unit 3 boiler feed pump turbine main hydraulic oil pump pressure was observed by the APC when the pressure unexpectedly approached that of the motor-driven hydraulic pump used during start-up. An inspection revealed a damaged gear drive in the motor-driven pump.
- A 2-mil step change in the Unit 3 generator bearing vibration was observed by the APC, although no other abnormal transients were observed. Additional testing by Mirant's Condition Monitoring team confirmed the readings, so a preventive generator inspection and alignment is scheduled for the next planned outage.
- An APC observation of lower-than-expected pressure in the baghouse air receiver (that was still above alarm limits) pointed operators to a failed diaphragm in a baghouse cleaning valve.
- SmartSignal historical data have also been used to examine very gradual decreases in steam flow and pressure through the high-pressure turbine to estimate a date when the degradation caused by blade deposits began.

## Whitewater Training

As a final note, DGS's cooling water discharge enters the Potomac River at the end of a 900-by-30-foot canal. Concrete boulders to simulate gates have transformed the canal into the Dickerson Whitewater Course. This whitewater training destination has been used by several Olympic teams and will be the scene of the 2010 U.S. National Championships of Whitewater canoeing and kayaking. ■

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