OhioEPA

Office of Pollution Prevention

February 2000
Number 81

Governor's Pollution Prevention Award, 1999 Recipient

American Electric Power, Muskingum River Plant

The Governor's Awards for Outstanding Achievement in Pollution Prevention have been presented since 1986. American Electric Power, Muskingum River Plant was one of nine recipients to receive the award in 1999. These awards recognize outstanding commitments to improve Ohio's environment through pollution prevention. Evaluation criteria for the awards include: the reduction of waste at the source, recycling or recovery of materials, cost-effectiveness, ability of the program to serve as a model for others, and effectiveness in promoting pollution prevention as the preferred long-term approach for environmental management.

American Electric Power, Muskingum River Plant

American Electric Power (AEP), Muskingum River Plant located in Beverly, is one of 16 coal-fired generating plants that serves the American Electric Power Grid. The Muskingum River Plant maintains five generating units that have a combined generating capacity of 1,425,000 kilowatts.

The plant burns approximately 3.5 million tons of coal each year. Units one, two, three and four began operating in the 1950s. Unit five, which embodies more advanced techniques of power generation, began operating in 1968.

American Electric Power's Muskingum River Plant is recognized for:

- **implementing a process improvement effort that eliminated the need to burn 36,047 tons of coal (by using less coal, the plant reduced its sulfur dioxide emissions by 2,562 tons, ash by 4,370 tons, carbon dioxide by 88,848 tons, hydrochloric acid aerosol by 69,211 tons, and hydrofluoric acid aerosol by 5,047 tons);**
- **reducing river water consumption by 1.25 million gallons per day;**
- **reducing the use of sodium hydroxide by 92.5 tons and sulfuric acid by 114.8 tons from 1996 to 1997; and**
- **expanding the company's recycling efforts.**

Commitment to Pollution Prevention

The Muskingum River Plant is committed to excellence and leadership in protecting the environment, as stated previously by AEP's environmental principles, and as stated in AEP's position on pollution prevention issued in 1993 and 1994. These environmental principles include:

- protection of the biosphere;
- sustainable use of natural resources;
- reduction and disposal of wastes;
- energy conservation and efficiency;
- risk reduction;
- safe products and services;
- environmental restoration;
- informing the public;
- management commitment; and
- audits and reports.

This commitment is carried out by all employees in the Muskingum River Plant. In 1993, the plant incorporated environmental accountability in annual job reviews for all supervisors.

Pollution Prevention Activities

A formal pollution prevention program was established in September 1994. The program was developed in accordance with Ohio EPA's Facility Pollution Prevention Guide and assistance from Ohio EPA's Office of Pollution Prevention. The plant established a pollution prevention task force consisting of supervisory and hourly personnel. The task force was instrumental in implementing the pollution prevention program and integrating its principles into all phases of work planning.

All employees are challenged to identify and implement pollution prevention initiatives. Successful ideas are communicated throughout the plant, company and AEP System by "Pollution Prevention Success Stories." Employees are awarded gifts for submitting an original idea. Muskingum River Plant's program has been successfully modeled at other AEP power plants and facilities.

Efficiency Improvement

Over the past three years, personnel have been assigned to overall process improvement at Muskingum River Plant. Team meetings have discussed problems and new ideas for improvement that spurred projects. As a result, an increase in process improvement activity has occurred and the employees that focus on improvement has shifted from only the engineering group to the entire plant. The results from these changes can be measured in fuel savings and emission reductions over the past three years of implementation.

A fossil-fired power plant determines its unit efficiency in a measurement called heat rate. Heat rate, measured in Btu per kilowatt hours (kWh), is the total amount of heat energy supplied to the unit (the Btu) divided by the electric generation produced by the unit in Kilowatts over a given period of time. (A Btu is the amount of energy required to heat one pound of water one degree Fahrenheit.) By comparing a unit's heat rate to past conditions, the difference in heat rate can be used to determine additional fuel savings or cost in dollars.

Muskingum River Plant's process improvement projects include auxiliary power reduction, steam trap replacement, exit gas temperature balancing, exit gas temperature reduction, condenser boot coating, green lights replacement, and steam trap valve leakage testing. Together, these achieved a fuel savings of 36,047 tons of coal or 1.5 million dollars in cost, from the time each item was initiated through May 1999. These figures translate to avoiding 2,562 tons of SO_2, 88,848 tons of CO_2, 4,370 tons of ash, 69,211 pounds of HCl acid aerosol, and 5,047 pounds of HF acid aerosol from being generated. Ongoing additional benefits continue to be realized.

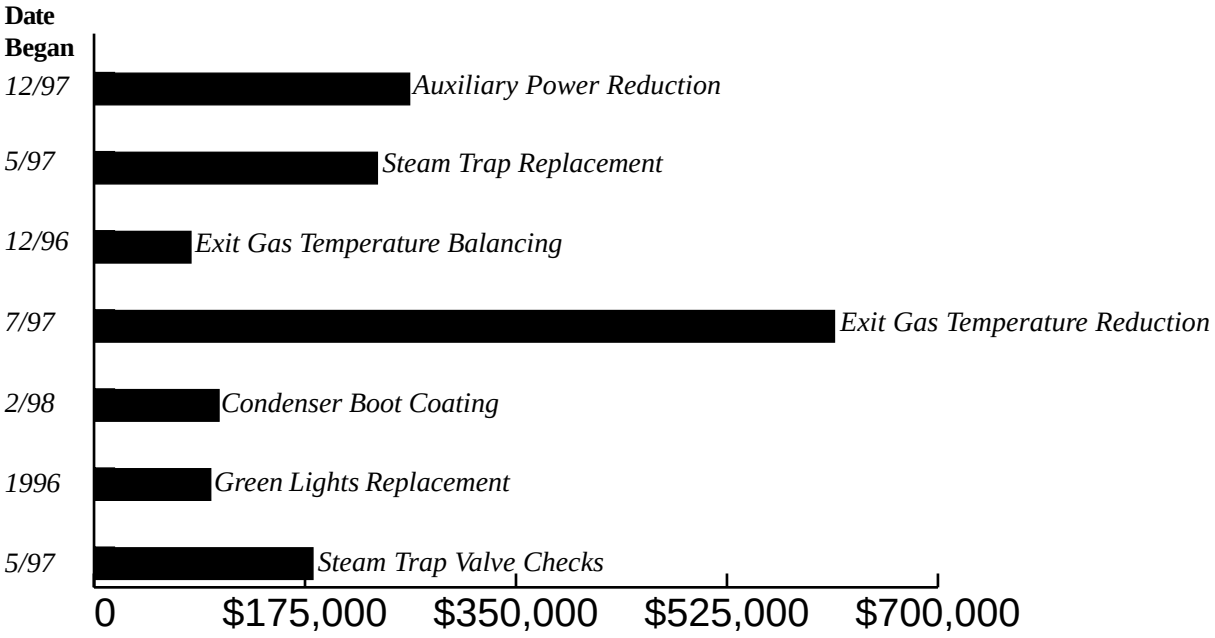
Reduction in Process Water Usage

Unit five at Muskingum River Plant is a 585-megawatt, fossil-fired generating unit with a closed-loop circulating water system. One function of this

Continued on page 4

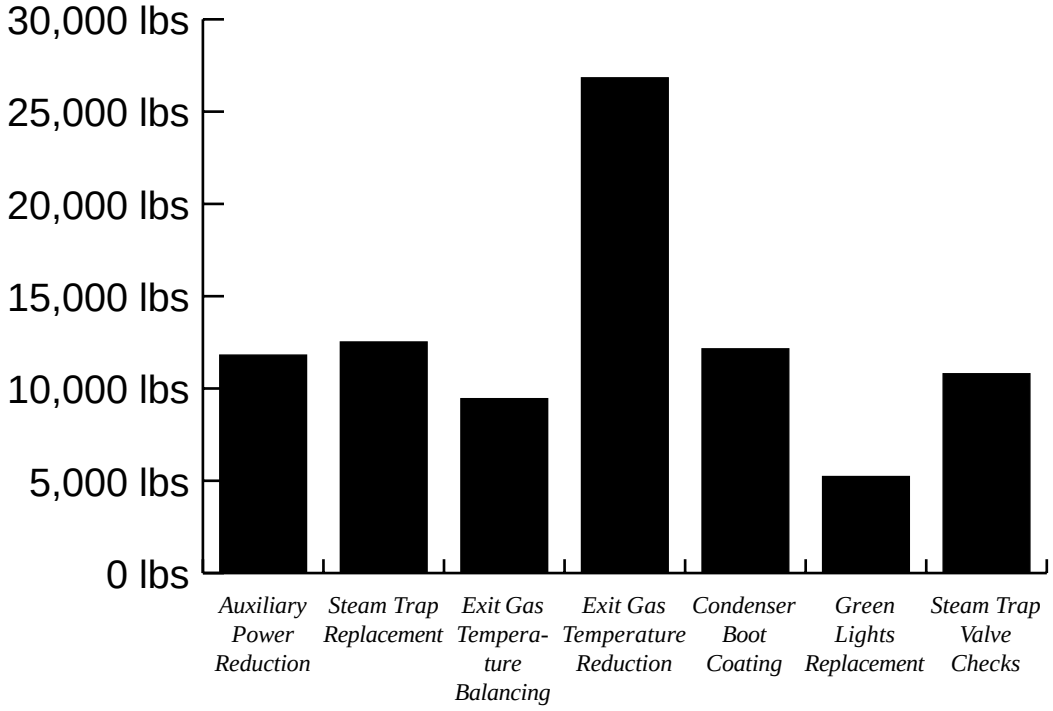
Muskingum River Plant's Process and Efficiency Improvements

Fuel Savings (Total of $1.5 million) from 1996 to May 1999*



***Total Fuel Savings = Coal Savings + SO_2 credit**

Carbon Dioxide (CO_2) Reductions (Total of 88,848 pounds) from 1996 to May 1999



Continued from page 2

system is to remove heat from the condenser and dissipate it by the evaporation process in the cooling tower. Evaporation, however, causes a high concentration of dissolved solids to collect in the circulating water system. These impurities must be removed to prevent fouling and scaling. This removal, called "blowdown," is achieved by continuously draining wastewater from the cooling-tower reservoir and pumping it to the bottom ash pond in an operation that requires approximately 1.44 million gallons of water daily (mgd).

Operation of Unit 5 also requires the removal of bottom ash that collects in the unit's bottom ash hopper. Approximately 20 percent of the ash developed during normal combustion collects in the hopper and is flushed out six times daily by river water, which carries the ash to the plant's bottom ash pond. Minimum bottom ash removal flow requires 1.25 mgd.

Removing dissolved solids and bottom ash simultaneously was accomplished by installing valves and piping to take suction from the condenser outlet with the river water used only as the alternate source. The added piping components effectively eliminate 1.25 mgd of river water consumption. Pump maintenance also is reduced and service is extended because pump operation is decreased by more than 50 percent. Finally, the potential of overflowing the wastewater pond and violating the NPDES permit is greatly reduced.

Reduction of Resin Use

Condensate feedwater is the extremely clean water produced to supply the boiler/turbine cycle. The purity prevents the harmful mineral deposits from accumulating in boiler tubes. Additions of condensate to the stream cycle from storage tanks are routinely needed in unit start-up operations. Further operating restrictions may necessitate dumping condensate to improve boiler water chemistry.

The clean condensate water transfer system at Muskingum River Plant interconnects the storage tanks of Units one-four and Unit five. This provides the ability to transfer condensate between the units and best meet demands. As of 1994, condensate requirements on Unit five restricted iron levels to less than 50 parts-per-billion (ppb). This did, in most cases, disqualified condensate transfers from other units to Unit five, as iron levels in the Units one-four condensate most often averaged from 50 to 200 ppb.

In 1994, a Pall filter with Profile II filtering elements on the condensate transfer system eliminated the need to restrict condensate flow between units. The Profile II filters, sized at five microns, effectively eliminate 95 percent of particulate in one cycle pass. In-service testing of the filter system indicated that iron levels fell from 100-250 ppb at the filter inlet to 0-10 ppb at the outlet, well below the 50 ppb limit.

Muskingum River Plant is saving at least $100,000 annually in avoided costs, for a $16,800 investment and $1,800 annual cost for filter replacement. The filter system significantly decreases the amount of contaminants that enter the condensate. This quality improvement means lower cost for regenerant chemicals, namely sulfuric acid and sodium hydroxides. Fewer chemicals reduce contaminants to the resin beds, minimizing acidic (sulfuric acid) and caustic (sodium hydroxide) waste as well as extending resin life, reducing resin disposal to landfills.

Caustic and Sulfuric Acid Reduction

Caustic and sulfuric acid reduction was actively pursued during the years 1993-1995 to reduce annual usage amounts for feedwater treatment. As a result of the filter system process improvement, caustic (20 percent sodium hydroxide) usage was reduced to 71.9 tons in 1994 and 11.1 tons in 1995 from 85.9 tons in 1993. Sulfuric acid usage was reduced to 902 tons in 1994 and 597 tons in 1995 from 1,294 tons in 1993.

Procedure changes for Unit five implemented in May 1997 also reduced caustic (50 percent sodium hydroxide) and sulfuric acid usage. An oxygenated feedwater treatment scheme calls for the injection of oxygen into the cycle water to control corrosion. This treatment results in less corrosion and corrosion product transport as compared to previous feedwater chemical control. Caustic (50 percent sodium hydroxide) usage was reduced to 127.6 tons in 1996, 35.1 tons in 1997, and 38 tons in 1998, from 201 tons in 1995. Sulfuric acid usage was reduced to 528.2 tons in 1996, 413.4 tons in 1997, and 553 tons in 1998, from 597 tons in 1995.

Since 1993 there has been a usage reduction of 87 percent of the 20 percent sodium hydroxide, 82.5 percent of the 50 percent sodium hydroxide, and 68.1 percent of the sulfuric acid. Employee exposure to both caustic and sulfuric acid environment have likewise been reduced.

Hazardous Solvents

Solvent usage at the Muskingum River Plant is restricted to general degreasing and parts washing operations. A general blanket service order was set up with a contractor in August 1985 to provide service for parts washers utilizing a combustible liquid solvent #105. This low flashpoint solvent was hazardous due to the ignitable characteristic. The last full year of this solvent usage was 1992. During this calender year 1,287 gallons of hazardous waste solvent was generated. During 1993 this solvent was phased out and replaced with the nonhazardous solvent petroleum naphtha #150. The generation of nonhazardous recyclable waste was 631.5 gallons for the first half of 1995.

During summer 1995, 16 parts washer work stations were reduced to six. This was made possible by the introduction of two Hydro-Blast automatic cabinet parts washers at a cost to the plant of $15,888.60. This water-based parts washer produces no hazardous waste and offers a "nothing down the drain" wastewater disposal system via forced evaporation. The oil that may be generated can be removed by an oil wheel allowing recycling of this waste.

Since 1992 the solvent management program has evolved from generation of hazardous waste to generation of nonhazardous waste to generation of limited nonhazardous waste and aqueous based evaporative waste. Elimination of hazardous solvents reduces exposure to the employees and potential environmental releases.

Mercury Reduction

Muskingum River Plant has utilized many measuring devices that contained mercury during the life of the facility. Many mercury filled thermometers, barometers, manometers, level meters, flow meters, and pressure switches have had noted reliability and quality traits. However, due to the hazardous characteristics of mercury, steps have been taken to eliminate its use.

At one time, approximately 1,500 pounds of mercury was in service. If a problem occurred with a flowmeter or a manometer, the mercury would be drained, the device would be cleaned and repaired, then the mercury would be poured back into the instrument. In the later 1980s the approach toward mercury-filled devices changed. Rather than repair mercury-filled equipment, the mercury would be sent away in flasks and instruments would be replaced with an electronic device. Control system upgrades also yielded opportunities to replace mercury items.

In 1993, a mercury control program was developed. Extensive training in handling mercury and mercury spills was conducted for those who would work with it. Also beginning in 1993, a much more aggressive approach to eliminating mercury took effect. In that year, $13,000 was budgeted for replacing mercury devices. In 1994, $65,000 went toward mercury meter replacement. Further budgeting of $60,000 and $46,000 were expended in 1995 and 1996, respectively, for mercury reduction. By the end of 1996, all

instruments containing large quantities of mercury were eliminated. All that remains are small quantities in switches and thermometers.

All mercury recyclable materials in 55 gallon debris drums are retorted to recover all mercury from the scrap items. Mercury recovered into flasks is triple distilled for reuse by a contractor. Since 1993 there has been 1,006.5 pounds of elemental mercury removed from the plant, a reduction of more than 67 percent. This has reduced employee exposure and potential for release to the environment.

Other Activities

During the fourth quarter of 1998, the use of Betz Polymer CDP-91708 was replaced by Betz Klar IC 1172, which was more efficient. Both polymers are alum (aluminum sulfate) based compounds. They are added to river water for purification and solid removal. By changing the polymer used to treat river water for units 1-4, projected annual polymer usage rates will drop from 11,288 gallons per year to 6,773 gallons per year, a 40 percent reduction. This will limit employees exposure to these aluminum-based polymers and reduce potential aluminum compound release to the environment.

During the fourth quarter of 1991, the use of chlorine gas was eliminated at Muskingum River Plant. This gas used to be injected into the circulating water to prevent biofouling of the steam condensers, with a recorded annual use rate of 12 tons per year from 1989 to 1991. The new system uses sodium hydrochlorite, which is safer and less toxic. Not using this toxic gas eliminates the potential exposure and health risks to the many plant employees and potential impacts on nearby communities.

The chemical hydrazine (with an annual use of 3,361 pounds) was eliminated from the plant in 1995. Since this chemical is such a strong oxidizer, employee exposure posed a serious concern. This chemical was replaced by a safer chemical called Eliminox, which does the scavenging of oxygen from boiler water without the former hazards.

Muskingum River Plant reused and recycled 834 tons of flyash, 54,151 tons of bottom ash, and 2,130,738 tons of boiler slag between 1988 and 1998; recycled 40,304 gallons of used oil between 1994 and 1998; recycled 9,000 pounds of expired paint through reformulation in 1998; recycled 125,160 pounds of waste batteries since 1987; and recycled 5,925 tubes of fluorescent light bulbs since 1995. The plant also has a recycling program that includes waste paper and cardboard in Gaylord boxes (84 annually), pallets (360 cubic yards annually), and aluminum cans.

For more information

American Electric Power
Muskingum River Plant
P.O. Box 310
Waterford, Ohio 45786

James D. Ludwig
Plant Environmental Coordinator
(740) 984-3468

www.epa.state.oh.us/opp

The Office of Pollution Prevention was created to encourage multi-media pollution prevention activities in Ohio to reduce risk to public health, safety, welfare and the environment. Pollution prevention stresses source reduction and, as a second choice, environmentally sound recycling while avoiding cross media transfers. The Office develops information related to pollution prevention, increases awareness of pollution prevention opportunities, and can offer technical assistance to business, government, and the public.

Printed on recycled and recyclable paper with soy-based inks

Ohio EPA is an Equal Opportunity Employer.