

# Environmental Controls

## General

- A total of \$391,009,587 has been invested to date in emissions controls.

## NO<sub>x</sub>

- The unit's boiler was recently equipped with low NO<sub>x</sub> (nitrogen oxide) burners and an overfire air system for NO<sub>x</sub> emissions control to limit the formation of nitrous oxides. This is accomplished by precise control of the air and fuel mixture for each of the 70 burners. The result has been a 60% decrease in NO<sub>x</sub> emissions.
- Total capital cost to date for NO<sub>x</sub> emissions control is \$14,146,178.

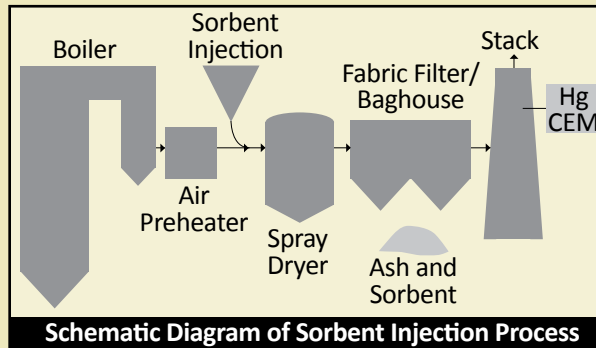
## SO<sub>2</sub> and Particulates

- Equipped with a state-of-the-art air quality control system (AQCS), the AQCS consists of twelve spray-dryer absorber (SDA) modules and a downstream reverse gas fabric filter otherwise known as a bag house. An SDA is equipment that uses a lime and water mixture to convert sulfur dioxide gases in the exhaust stream to a solid. A reverse gas fabric filter is an enclosed structure that uses filter bags to help remove these solid particles created in the spray dryer absorber system. The filters also remove fly ash. Essentially, a baghouse works like a vacuum cleaner. With this technology the AQCS is capable of removing up to 90% of the sulfur dioxide and over 99.8% of the particulate matter from the flue gas. The reverse gas fabric filters are being upgraded with filters that are expected to last 9 years.
- These capabilities, combined with the fact that the coal is low sulfur sub-bituminous western coal, which has less than 1% sulfur, makes Sherco 3 one of the cleanest coal-fired plants in the country. This capability gives SMMMPA flexibility to meet the requirements of the Clean Air Act Amendments of 1990 (CAAA) and manage SMMMPA's SO<sub>2</sub> allowances in the future.
- Total operation and maintenance cost for SO<sub>2</sub> removal in 2010 is budgeted at \$10,300,000 with SMMMPA's share at \$4,223,000.

## Mercury

- At the end of 2009, a sorbent injection system was installed on Sherco 3 that injects a sorbent (carbon based powder) into the flue gas flow upstream of

the existing dry scrubber and reverse gas fabric filter (SDA-FF) systems. The gas-phase mercury in the flue gas contacts the sorbent and attaches to its surface. Then the sorbent, with the mercury attached, is captured by the SDA-FF, removing it from the flue gas prior to release into the atmosphere, as shown in the figure below. Once the equipment is fine tuned, approximately 90 percent of the unit's mercury emissions will be removed.



- Total capital cost to date for the sorbent injection system to remove mercury has been \$3,117,231, with SMMMPA's share being \$1,278,065; \$5,000,000 has been budgeted in 2010 for operating cost.

## CO<sub>2</sub>

- SMMMPA has taken several steps to reduce CO<sub>2</sub> emissions. SMMMPA owns six of its own wind turbines; is purchasing all of the output of a 100.5 MW wind project in Southeastern Minnesota; and has a contract for 30 MW of hydro-power. A turbine efficiency upgrade at Sherco 3 scheduled for 2011 is expected to reduce CO<sub>2</sub> emissions by 1%. The scheduled retirement of several of the Agency's older fossil-fuel boilers is expected to reduce CO<sub>2</sub> emissions by another 3% to 4% by 2012. Aided by several potential smaller projects such as a future landfill gas generator and the possible installation of new high-efficiency natural gas fired engines, the Agency's overall carbon intensity is expected to decrease from 0.96 tons/MWh to 0.81 tons/MWh in 2012. These reductions in supply-side emissions are in addition to the reductions achieved through SMMMPA's programs that promote customer use of high-efficiency products. These programs are expected to reduce CO<sub>2</sub> emissions over the planning horizon by an additional 166,000 tons.

# Sherco 3



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## General Information

- Sherco Unit 3 was put into service in 1987 two months ahead of schedule and \$68 million under the original estimate.
- At the time of construction Sherco 3 was the largest construction project ever in the state of Minnesota. Unit 3 cost approximately \$1 billion to build and involved more than 1,000 craft workers in construction.
- Approximately 30% of the \$1.072 billion construction budget for Sherco 3, \$321,600,000, was used on environmental controls.
- Since construction, total capital cost for equipment to remove SO<sub>2</sub> and NO<sub>x</sub> (besides the low-NO<sub>x</sub> burners) and particulates has been \$52,146,178 with SMMPA's share at \$21,379,933.
- Total to date invested in emissions controls is \$391,009,587.
- Annual operating cost for emissions controls is budgeted at \$15,300,000.
- The building which houses the Sherco 3 equipment is 300 ft high by 300 ft wide by 1,000 ft long. The stack for unit 3 is 650 feet tall.
- The boiler is a subcritical, wall fired boiler that burns subbituminous coal, operating under balanced draft conditions. The steam turbine consists of a high pressure turbine section, a reheat intermediate pressure turbine section, and a dual flow low pressure turbine section.
- Coal is the world's most plentiful fossil fuel. The United States leads the world in proven, recoverable coal reserves with 225.67 billion tons equal to 35.1 percent of the world total.

## Ownership

- Owned 59% by Xcel Energy; 41% by SMMPA. Xcel operates the plant.
- Capacity of 884 megawatts - 522 for Xcel Energy and 362 for SMMPA.

	2004	2005*	2006	2007	2008*	2009
Availability Factor	96.20%	70.80%	92.20%	96.80%	76.70%	94.7%
Coal Burned (Tons)	1,649,565	1,193,029	1,615,648	1,651,350	1,240,000	1,410,378
Generation (MWH)	2,816,006	2,042,442	2,773,775	2,827,161	2,108,294	2,392,775
Forced Outage Rate	0.8	5.8	1.8	2.5	8.3	2.3

\*Denotes a planned outage year.

## Electricity Generation - Operation

- In 2009 the unit produced 6,110 million kWhs and burned 3.6 million tons of coal. The unit had a capacity factor of 79% and an availability rate of 95%. SMMPA received 2,393 million kWh from Unit 3, which comprised approximately 81% of SMMPA's 2009 sales of 2,952 million kWh.
- Sherco 3 is a pulverized-coal steam unit. The unit burns low-sulfur (sulfur content of less than 1%) western coal from Montana and Wyoming, which is delivered by rail cars. The coal unloading system can empty one car every two minutes. The unit can burn up to 500 tons per hour, 12,000 tons per day, of coal.
- Sherco currently has a MISO UCAP rating of 350 MW which represents 58% of SMMPA's total capacity registered with MISO. The MISO UCAP capacity rating system replaces the MAPP URGE rating process as the method of measuring generator capacity. In 2012, Sherco's MISO UCAP will increase to 356 MW or about 59% of our total MISO capacity after the 2011 turbine upgrade project is completed.

## Electricity Generation - Low Cost

- In addition to Sherco 3 being one of the lowest emitting coal-fired power plants in the country, it is also one of the most economical plants in the state. SMMPA purchases low-cost western coal through its involvement with Western Fuels Association, a fuel-purchasing cooperative of public power companies

and not-for-profit companies. This low-cost western coal, combined with a low unit heat rate, makes Sherco 3 the low-cost energy producer it is.

- A capacity upgrade is planned that will boost output by an estimated 2% with no fuel consumption or emissions increase. New turbines sections and step-up transformer are planned for Fall of 2011.

## Grid Stability

- The electric grid must maintain a perfect balance of generation and load at all times. A minor deviation could cause wide spread blackouts. As more and more wind generation is added to the grid, Sherco 3 plays a critical role in maintaining this balance. As wind generation increases and decreases throughout the day, Sherco 3 can ramp up and down quickly in order to maintain grid balance. Wind generation in Minnesota would not be possible without units like Sherco 3 on line to absorb these swings.

## Taxes

- For Sherco 3, SMMPA pays \$3 million to \$4 million in property tax annually.

## Employment

- Sherco 3 employs 112 full time equivalent employees.