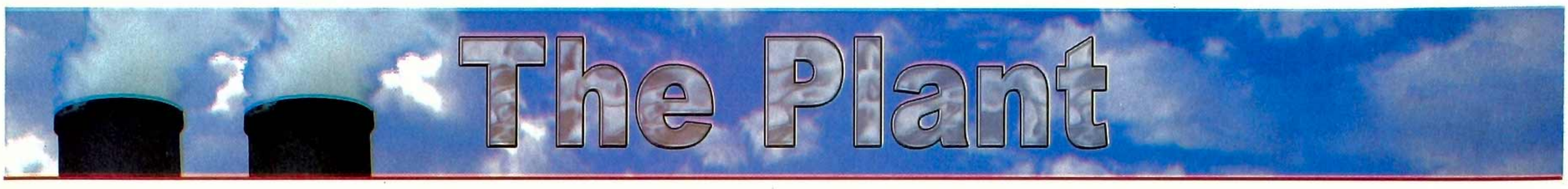

The ins and outs of a coal-fired plant

BY MONICA KEEN
STAFF WRITER

With Tenaska Inc. investigating the possibility of building a coal-fired power plant in Sallisaw, residents may be asking themselves how a coal-fired power plant works and what technologies Tenaska plans on using to limit pollutant emissions.

While there are varying types of coal-fired power plants, Mike Lebens, executive vice president of Tenaska's engineering, construction and operations, said the company is considering a pulverized coal power plant in Sallisaw, meaning the coal will be crushed before it is burned.

Lebens said the low-sulfur coal will be shipped by rail (100-plus cars per train) from Wyoming and then will be unloaded at the power plant site in an unloading building, which is equipped with dust collectors. Tenaska officials have estimated that the plant will need five trains per week to operate.

About concern with dust associated with coal, Lebens said as the coal is transferred within the plant, each transfer site has dust collectors. All the coal dust that is collected is coal that is ultimately burned in the power plant, he noted.

"The coal will be delivered by rail directly to the site with no requirement for stop off points," Lebens said. "We will build rail infrastructure at the power plant site to fully accommodate the 100-plus car unit trains.

"There will be no truck transportation of coal associated with the project. Tracks will be built from the existing rail lines in the area to the plant site."

THE PROCESS

After the coal is crushed, it is burned in the boiler furnace. Lebens explained that the furnace is surrounded by tubes filled with high-pressure water.

The water in the tubes boils and is sent to a turbine were it drives the electric generator, which produces power.

"The steam is then at low pressure and enters the condenser. The condenser is filled with tubes with cool circulating water flowing through the tubes," Lebens said. "The low-pressure steam condenses on the outside of the tubes and is collected in the bottom of the condenser.

"Nearly 100 percent of the water that is evaporated in the boiler is recovered as condensate (product of condensation) in the bottom of the condenser. The condensate is then pumped back up to high pressure and is returned to the boiler to be re-evaporated. This is a closed continuous system with very little water consumed."

Lebens said the cool circulating water that is used to condense the low-pressure steam is heated in the condensing process. That water is routed from the condenser to the cooling tower, where it is cascaded through ambient air, which is drawn through the cooling tower with fans.

"The air cools the circulating water as the water cascades through the cooling tower. In this process a portion of the water evaporates and that water vapor leaves the tower with the air and enters the atmosphere," Lebens said.

He explained that the cool water collects in the bottom of the cooling tower and is returned to the condenser where it is reused for condensing low pressure steam.

"This is also a continuous process," Lebens noted. "Additional water is added to the bottom of the cooling tower to make up for the water that is evaporated in the circulating water cooling process in the cooling tower."

How much water is needed to operate the plant on a daily basis? Lebens estimated that the plant will probably use in the range of eight to 12 million gallons of water a day. The water will be from a source in the region, but Lebens could not confirm if the plant will use water from the Arkansas River.

Lebens said the water used will probably be surface water, and the company will have to build a pipeline from the water source to the plant. The water ultimately released back to the water source will be in the range of a million gallons a day, he said.

Lebens said he is not sure about the salt content of the Arkansas River water, but he said if it is high in minerals, as the water evaporated, those minerals get concentrated. He said they won't know the details until they look at the water, but he emphasized that the water released will have to be in compliance with the plant's permit.

FLUE GAS

During the burning of fossil fuels, flue gas, which is a gas that contains various pollutants and particles, is produced, according to the U.S. Environmental Protection Agency (EPA). That gas goes through various processes or control devices so those pollutants can be removed or reduced before the gas goes out the plant stack and into the environment.

Tenaska will be using scrubbers, a type of control used to remove various pollutants from flue gas, but Lebens said a final selection has not been made about whether Tenaska will use wet or dry scrubbers.

According to the EPA, scrubbers are actually air pollution devices that use a spray of water or reactant or a dry process to trap pollutants in emissions. The EPA has indicated that scrubbers can remove up 80 to 95 percent of sulfur dioxide from power plant emissions, and other advanced controls can strip 90 to 95 percent of nitrogen oxides.

Many plants built in the 1970s didn't install scrubbers because they used low-sulfur western coal, Lebens pointed out. Today's regulations require plants to install scrubbers even if they use low-sulfur coal.

One way to remove sulfur dioxide from the flue gas is to spray a type of limestone material or slurry into the gas, reacting with and absorbing the sulfur dioxide. The lime dries and the powder is ultimately collected at the baghouse, known as a particulate collector, or device that catches particles from industrial emissions.

"All materials get collected in the baghouse," Lebens said. He equated the baghouse to a big air filter or bag through which the flue gas passes.

Another process, selective catalytic reduction, reduces nitrogen oxides from the flue gas. This process turns nitrogen oxide back to nitrogen gas, which Lebens said is consistent with nitrogen gas in the air. Lebens said the Sallisaw plant will also have a mercury removal system.

As for the fly ash, Lebens said coal has a certain ash content. When burning coal as fuel, carbon is also burned, and in addition to carbon, there is ash.

Lebens said ash is really residue after they burn the coal. "So, it doesn't go up the stack."

The fly ash will then be disposed of at the landfill site, which Lebens pointed out is one of the benefits of the city property.

Lebens said residents won't see anything coming from the plant, but he said flue gas can hold a lot of water because it's hot so what people might see is water vapor. On some days, people won't see anything, he said.

He said the plant must obtain state and federal permits for air and water and the current requirements are to use the "best available technology" controls.

There are no current plans for the Sallisaw plant to be a co-generation plant, Lebens said. AES Shady Point in Panama is a co-generation, coal-fired power plant that turns carbon dioxide, known as a greenhouse gas that some scientists believe contributes to global warming, into dry ice.

In October, Tenaska officials said the Sallisaw plant will not be a coal gasification plant, which uses coal and turns it into gas. Coal gasification is considered by some as the cleanest of all coal-based power technologies and has lower levels of air emissions, solid wastes and wastewater.

How a coal plant WORKS

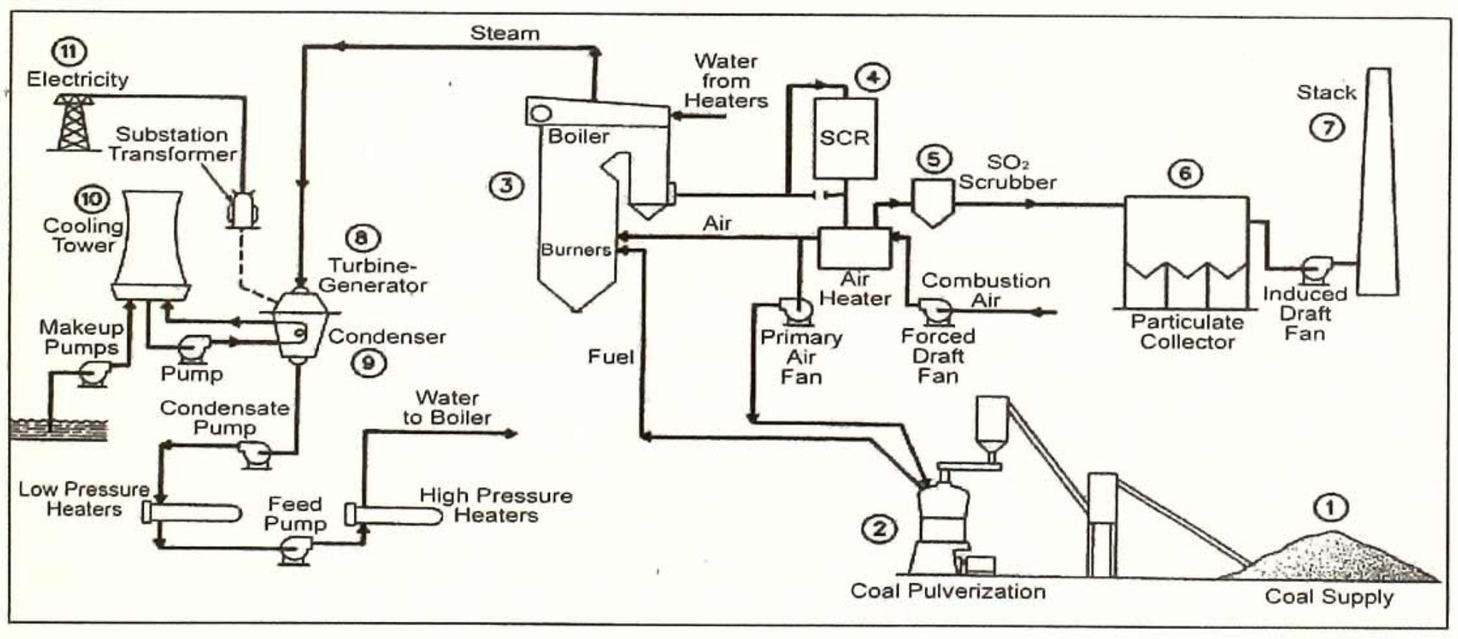

DIAGRAM AND EXPLANATION PROVIDED BY TENASKA INC.

Tenaska officials said the diagram is not an exact replica of the Sallisaw plant, which will also have a mercury removal system that is not shown in the diagram.

1. **Coal supply** — Coal from the mine is transported, via railway, to the coal yard. Through a series of transfer belts, the coal is delivered to the coal hopper where it is crushed to two inches in size. The coal is processed and delivered by a conveyor belt to the generating plant.
2. **Coal pulverizer** — The coal is then pulverized, or crushed, to a fine powder, mixed with air and blown into the boiler for combustion.
3. **Boiler** — The coal/air mixture is ignited in the boiler. Millions of gallons per hour of purified water are pumped through tubes inside the boiler. Intense heat from the burning coal turns the water in the boiler tubes into steam, which spins the turbine (8) to create electricity.
4. **SCR** — Selective catalytic reduction is the state-of-the-art technology for the reduction of nitrogen oxide from flue gas. This process uses contact with ammonia to reduce the nitrogen oxide to nitrogen and water. Flue gas is the gas produced from burning fossil fuels and contains various pollutants and particles, according to the EPA.
5. **Sulfur dioxide scrubber** — The process is known as flue gas desulfurization. The flue gas will come in contact with a lime slurry. This will help remove sulfur dioxide and other acid gases from the exiting flue gas.
6. **Baghouse** — Fly ash, which is very light, exits in the boiler, along with the hot gases. A baghouse (a huge air filter) removes the fly ash before the flue gases are expelled into the atmosphere through the stack.
7. **Stack** — After the flue gas goes through the series of cooling and cleaning processes, it is vented to the atmosphere.
8. **Turbines and generator** — Water in the boiler tubes picks up heat from the boiler and turns to steam. The high-pressure steam from the boiler passes into the turbine. Once the steam hits the turbine blades, it causes the turbine to spin rapidly. The spinning turbine causes a shaft to turn inside the generator, creating an electric current.
9. **Condenser** — Cooling water is drawn into the plant and passes through the condensers, which cools the exiting steam from the turbine. Steam from the turbine also passes through the condensers in separate pipes from cooling water. The cold water is warmed by the steam, which condenses back into liquid water and returns to the boiler to begin the process of generating electricity again.
10. **Cooling tower** — The cooling tower is used to return the temperature of the circulating cooling water to a temperature cool enough to condense the steam. This water is recycled through the system. Additional water is added to the system to make up for evaporation and ventilation loss.
11. **Substation, transformer and transmission lines** — Once the electricity is generated, transformers increase the voltage so it can be carried across the transmission lines. Once electricity reaches the substations in various cities and towns, the voltage applied to the distribution lines is reduced to distribute electricity to customers.

Public will have opportunities to comment about proposed plant

DEQ outlines steps for permitting process

BY MONICA KEEN
STAFF WRITER

When and if Tenaska Inc. decides to move forward with plans to build a coal-fired power plant in Sallisaw, air quality permits will be among the applications the company files. And applying for those permits means that the public will have the opportunity to comment about the proposed plant.

Kyle Arthur, Oklahoma Department of Environmental Quality (DEQ) spokesperson, said that the DEQ issues a lot of different air quality permits, and those permits fall in one of three tiers — Tier I, Tier II, and Tier III.

The size of a facility and the type of pollution controls that the facility will have determines which tier, or category, a facility will fall under. Arthur said most power plants are Tier III.

"The bigger the facility, the more opportunity there is for public participation," Arthur said.

Without knowing the exact size of the proposed Sallisaw plant, Arthur speculated that, if plans continue, the plant will be a Tier III.

AES Shady Point power plant in Panama and Oklahoma Gas & Electric Muskogee power plant are both Tier IIIs, he said.

The opportunities for the public to comment to the DEQ about the proposed plant come after the company files their application for air quality permits. Water discharge permits also fall into tiers, and those have a separate permit process, similar to air quality permits.

Residents will have the opportunity to comment three times during the air quality permitting process, if Tenaska's permit is a Tier III.

"If it (the Sallisaw plant) is a Tier III, there will be three opportunities for public input," Arthur said.

The input will occur during step three when the process meeting notice is given, during step eight when another 30-day public comment period is held, and during step 12 when the notice of proposed permit is published.

He said the DEQ meetings are usually held in a community building somewhere local to the planned facility, like a library, senior citizens, center, or vo-tech.

"We have to consider all comments," Arthur said.

Arthur said how long the permitting process takes depends on the type of permit. For a Tier III permit, it usually takes at least six months.

Arthur noted that the company, on its own, may have general meetings for the public before the DEQ permitting process begins. The following are the 14 different steps in DEQ's air quality permitting process for a Tier III permit:

STEPS

1. Applicant (the company) files application and pays any required fee. Applicant may meet with DEQ staff prior to filing application.
2. Notice of filing — Applicant publishes a notice in one newspaper local to site.
3. Process meeting notice — 30-day opportunity (for public comment) is published with notice of filing. DEQ holds meeting if requested and sufficient interest is shown. Arthur noted that this step is taken before the permit is drafted to discuss the permit, such as the type of facility planned, permit requirements, etc.
4. DEQ reviews application and asks applicant to supply any missing information.
5. Technical review — DEQ reviews application for technical compliance and requests applicant to cure any deficiencies.
6. Draft permit or denial — DEQ prepares this after completing review.
7. Notice of draft permit, public comment period and public meeting request opportunity — Applicant publishes this in one newspaper local to the site. DEQ publishes notice of draft denial, if applicable.
8. Public comment period — 45 days for hazardous waste treatment, storage or disposal draft permits; 30 days for all others. Arthur said during this period the proposed permit is available for review on DEQ's Web site. The public may make comment to DEQ in writing during this 30-day period or they can also request a public meeting. He noted that when most companies publish their notice, they will say they are having a public meeting. The public can give oral comments at the meeting.
9. Public meeting — Conducted by DEQ, if held.
10. Review comments — DEQ reviews comments and must provide a written response to comments.
11. Proposed permit — DEQ prepares this in response to comments on draft permit
12. Notice of proposed permit — Applicant publishes, in one newspaper local to site, a notice of 20-day opportunity to review permit and request administrative hearing. This is another chance for public participation, Arthur said.
13. Administrative permit hearing — conducted by DEQ if held. Results in final order.
14. Issuance or denial — DEQ's final decision.