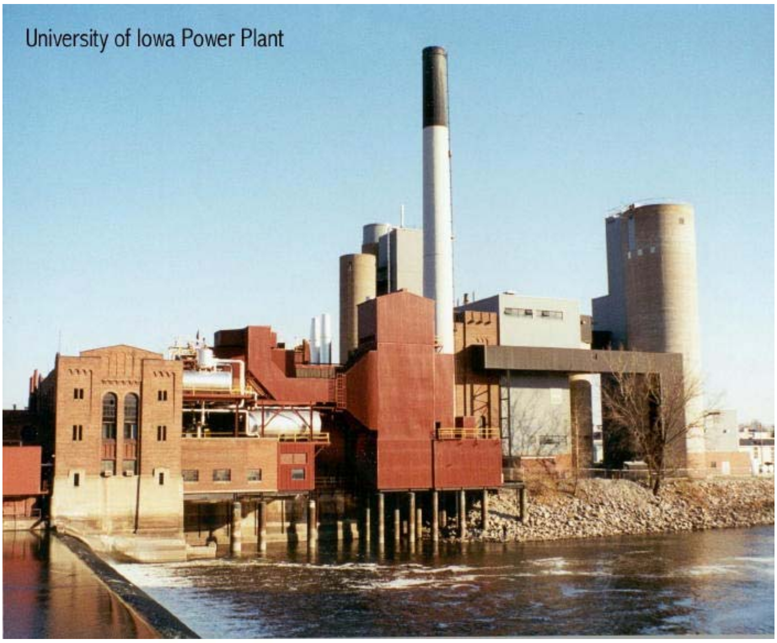
University of Iowa



Power Plant

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Purpose

The Power Plant's primary function is to convert fuel energy into thermal and electric energy for use on the University of Iowa campus and The University of Iowa Hospitals and Clinics. The Power Plant is a combined heat and power plant facility that generates about one-third of the University's electric power needs. Steam produced by the plant is used for **heating**, production of chilled water for **air conditioning**, **cooking**, **sterilizing**, **humidifying**, and **energizing** other research and process equipment.

History

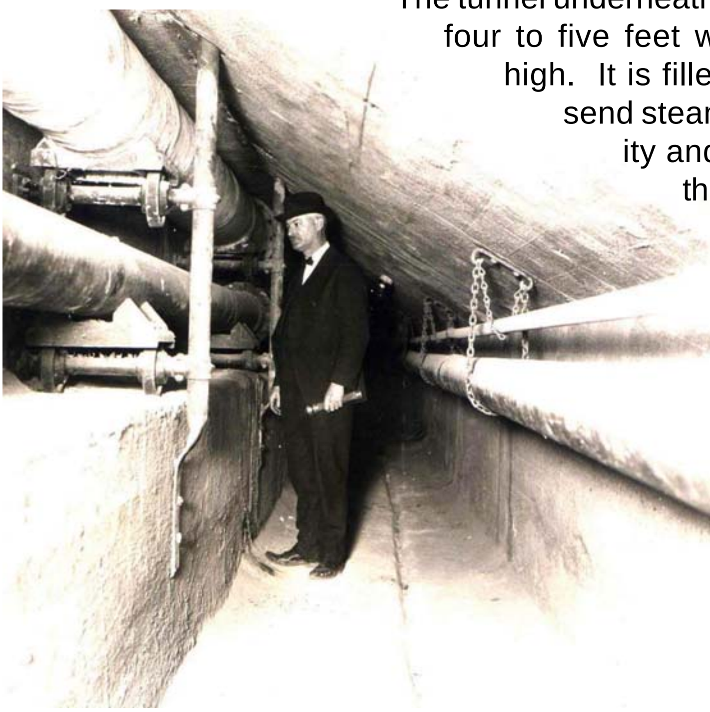
The original main power plant for the University was located on the corner of Washington and Madison streets. It remained the main power plant for the University until 1928. It was then demolished and made into a mechanical engineering lab. Before the construction of the current power plant and tunnel, two separate heating plants were needed on the west side of the river. One for Quadrangle which was built in 1918. The other was located where the current Steindler building stands and was used for the Children's Hospital.

Old Power Plant on Madison and Washington

History

In April 1903 the dam on the Iowa River was given to the University as a gift from Mrs. Saunders. It was decided that water power would be used at the University. Then, in 1920 talks began about constructing a central power plant with a tunnel next to the dam on Burlington Street. The construction began in 1926 and was completed in November 1927. The current central power plant provides heat and steam to both sides of the University's campus.

The tunnel underneath the dam is about four to five feet wide and six feet high. It is filled with pipes that send steam, water, electricity and compressed air throughout the campus.



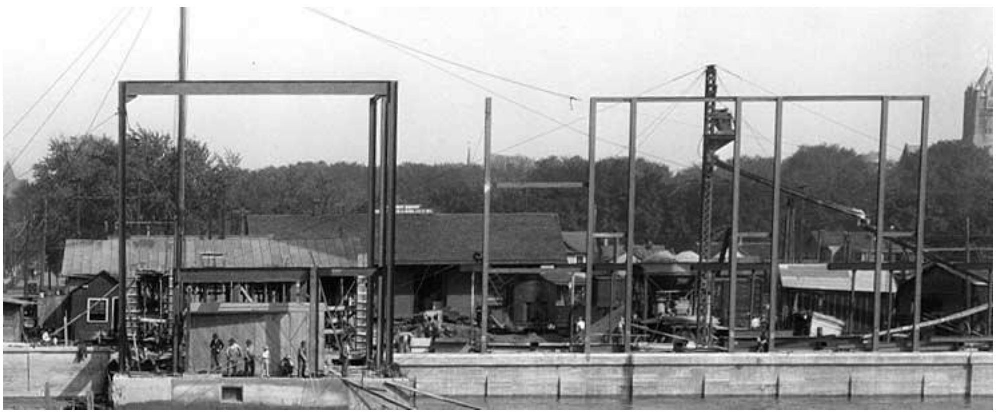
1927: Professor B.P. Flemming, designer, inside the tunnel

History

The current power plant began operation in November 1927. At that time the power plant housed four 650 horse-power boilers. The Hydro-Electric Power Laboratory was included in the new plant and contained the largest water turbine of any school laboratory in the United States. This turbine received water from the Iowa River. Approximately thirty thousand tons of coal were burned every year to maintain the services of the University. Today, about one hundred thousand tons of coal are burned each year.

The current power plant was designed by Proudfoot, Rawson, and Sauers. The contract for the tunnel, smoke stack, and the original building that was built with the tunnel was awarded to Tobeck and Co. for $21,000.00.

1926: the construction of the current power plant

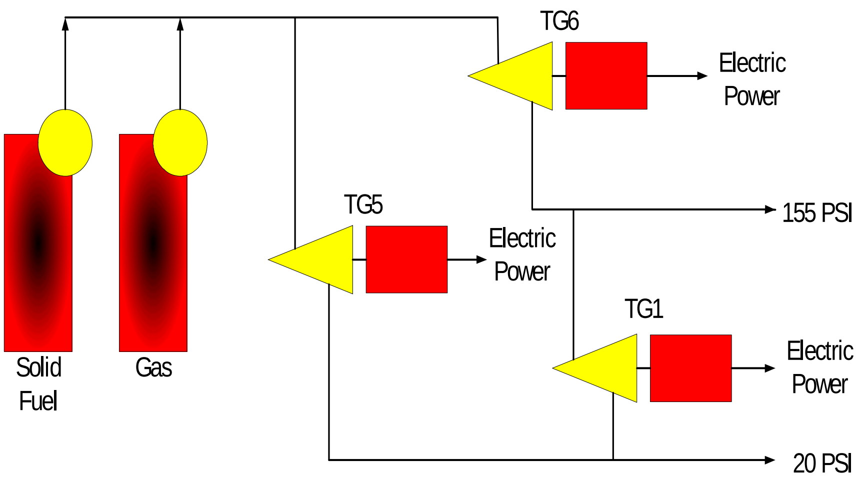


Cogeneration

Cogeneration is the process of using one combustion to produce two usable energy sources. It conserves money, the environment, and energy resources. Today, the term combined heat and power is used interchangeably with cogeneration.

Our combined heat and power plant converts fuel energy into steam and electricity. We supply all of the steam used by the campus and hospital complex by burning coal, natural gas, tires and bio-mass. Prior to being sent to the campus, the steam passes through turbine generators that generate electricity.

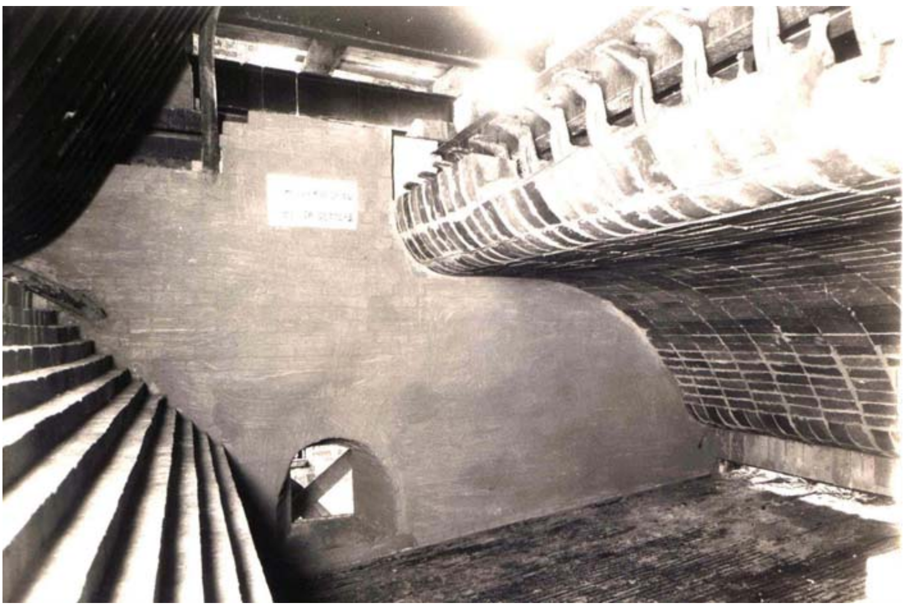
Steam is used year round for heating, chilled, water production, cooking, hot water, and other research and process loads. Combined heat and
power is more efficient than separate production of steam and electrical power. It uses less fuel, so in turn less pollutants are emitted into the environment.



Cogeneration Diagram

Boilers

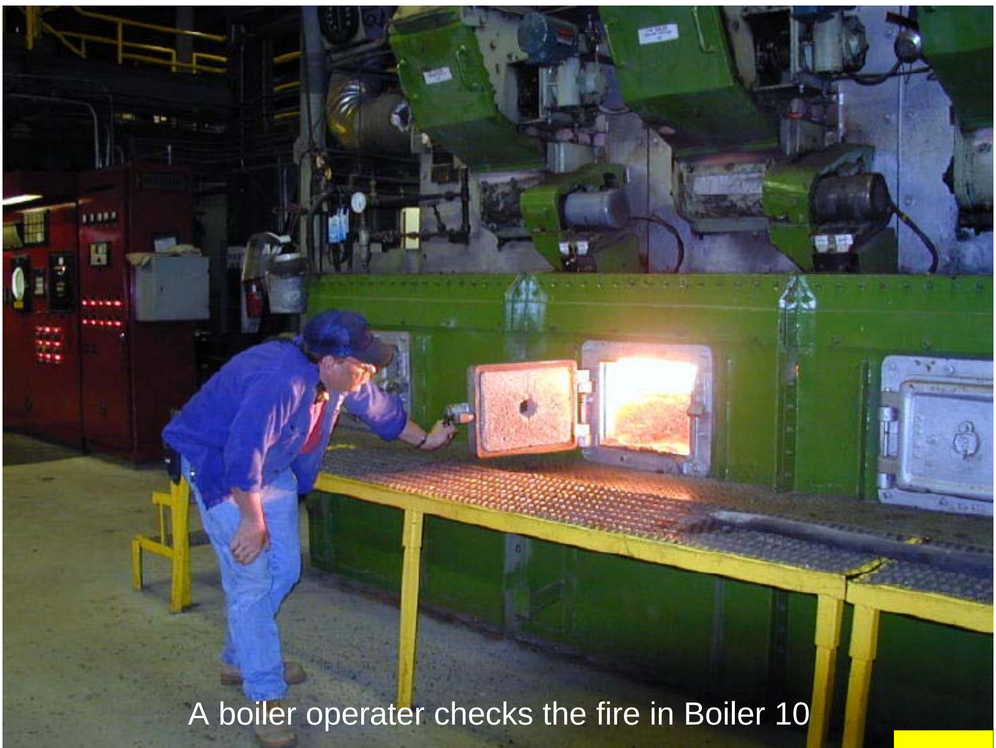
In 1928, four 650 horse-power boilers were used to supply campus needs. Approximately 30,000 tons of coal were burned every year to maintain the various services required by the University. Today, the heating plant burns about 100,000 tons of coal each year and has five boilers with over 400,000 horse-power of capacity.



Interior of an original coal boiler

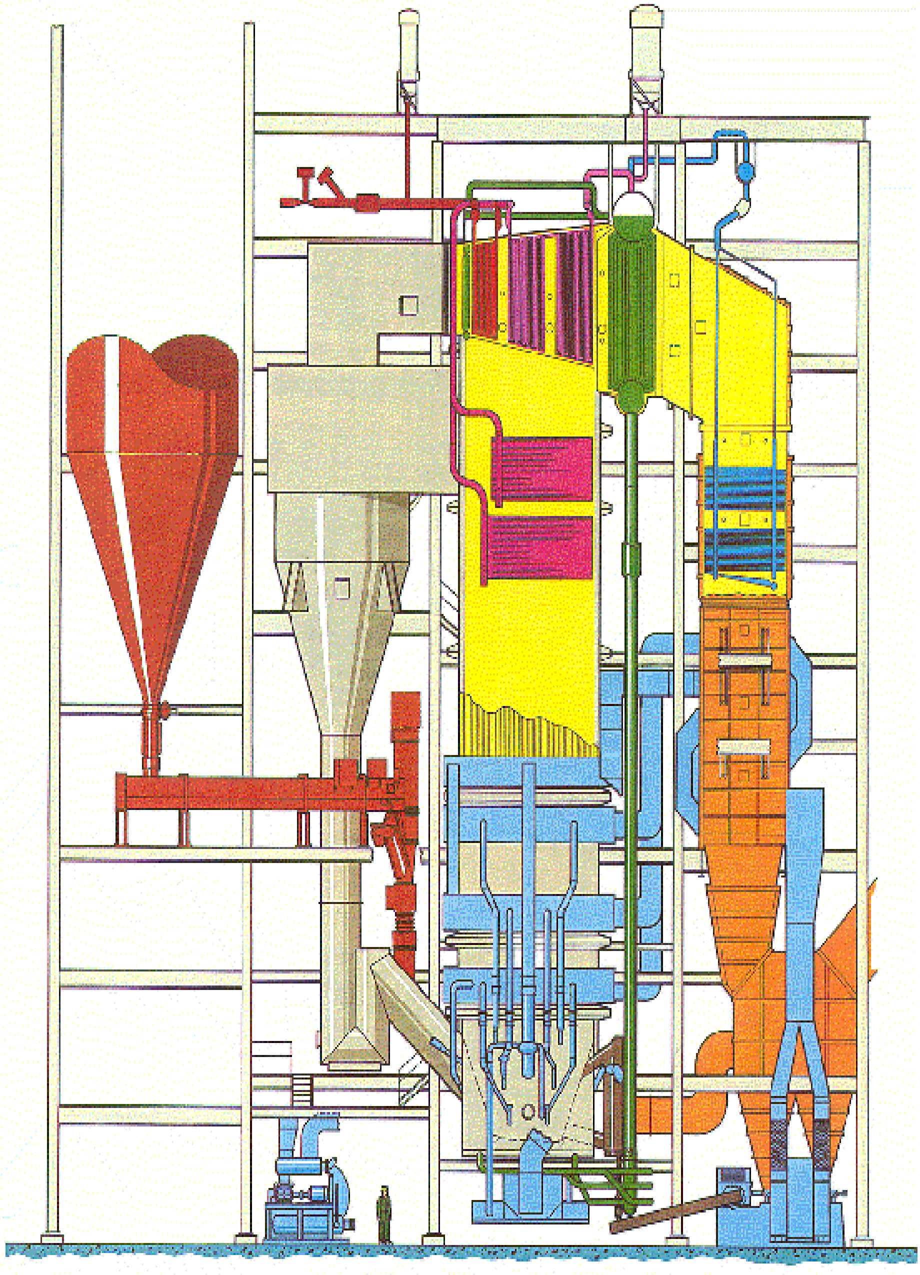
Boilers

Boiler	Installed	Fuel	Capacity	Emissions Control
7	1991	Gas	100,000 lbs/hour	Low Nox Burners
8	1991	Gas	100,000 lbs/hour	Low Nox Burners
10	1975	Coal	170,000 lbs/hour	Electrostatic Precipitator
11	1987: modified in 1996	Coal & Biomass	170,000 lbs/hour	Baghouse and SO_2 Emissions Control



A boiler operater checks the fire in Boiler 10

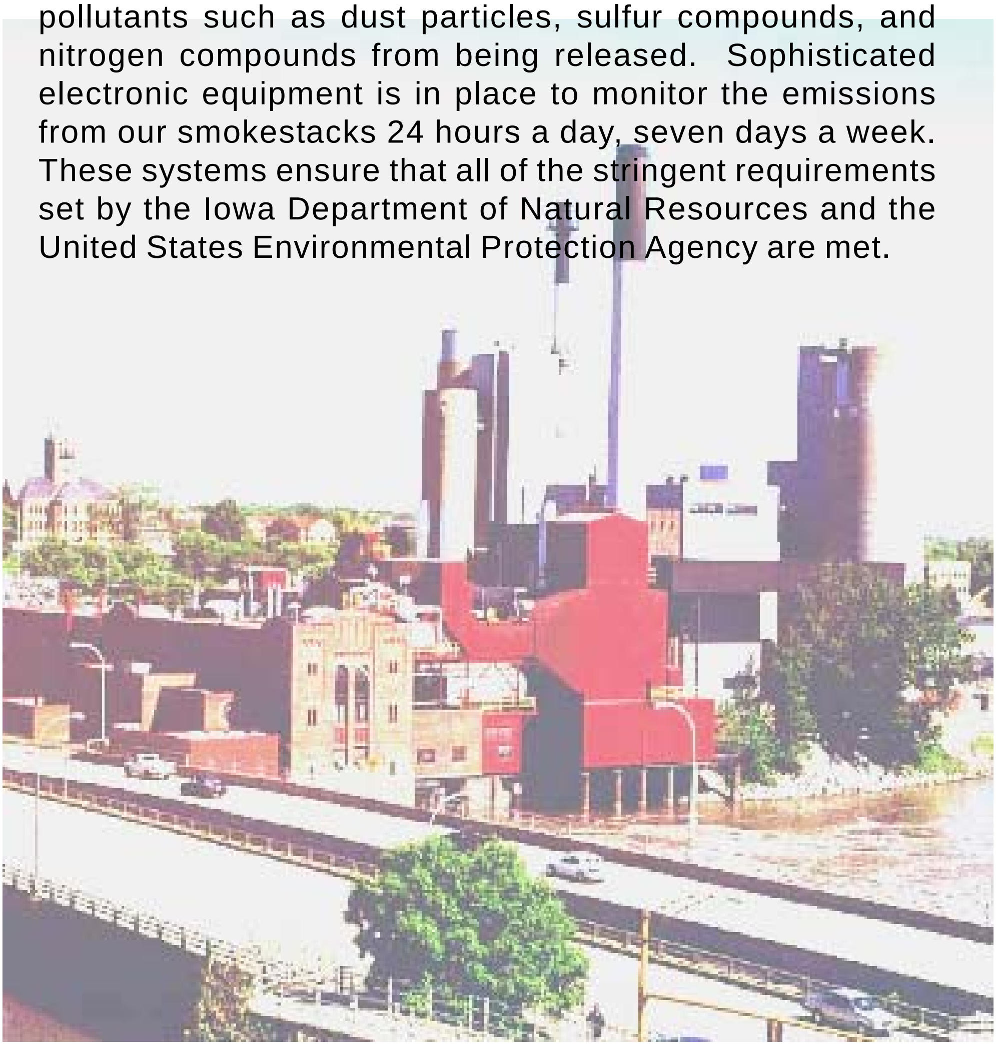
Boilers



A cross-section of our fluidized bed boiler. This boilers reduces emissions of sulfur dioxide by more than 90%.

Environmental Impact

The University of Iowa Power Plant recognizes the necessity of minimizing the release of pollutants into Iowa City's skies while at the same time providing the steam and electricity the University needs to function. Control technologies are in place throughout the plant to prevent air pollutants such as dust particles, sulfur compounds, and nitrogen compounds from being released. Sophisticated electronic equipment is in place to monitor the emissions from our smokestacks 24 hours a day, seven days a week. These systems ensure that all of the stringent requirements set by the Iowa Department of Natural Resources and the United States Environmental Protection Agency are met.



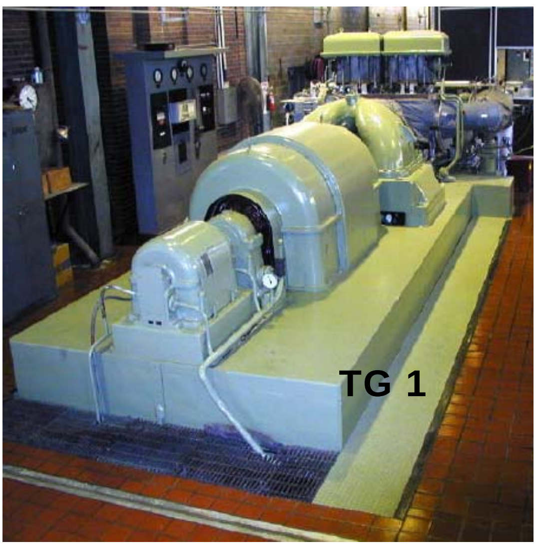
Environmental Impact

The emission of particulate matter is strictly controlled throughout the plant. Coal, ash, and limestone handling systems use bag filters, which act like large vacuum cleaner bags to prevent the release of dust from these processes. Boiler 10 uses a large unit called an electrostatic precipitator to prevent dust and ash from escaping through the smokestack. In Boiler 11, a fluidized bed boiler, limestone is fed into the boiler along with the coal. The limestone causes chemical reactions to occur inside the boiler that greatly reduce the amount of sulfur dioxide that is released through the smokestack. Two of our natural gas boilers are equipped with low NOx burners.

Steam Turbine Generators

Our facility contains three controlled extraction steam generators with a total electric generating capacity of 24.7 MW. We also have one diesel generator. These generators use the steam produced from the boilers to spin the turbine which creates electricity. All of the steam turbines can extract steam partway through the turbine. This steam is then sent to campus buildings for space and process heating.

Electricity is made by passing a magnet over copper wires. As the magnet passes over the wires the electrons are excited. If a light bulb is attached, the excited electrons will flow into the light bulb making it light.



Steam Turbine Generators

Electricity in the Power Plant:

Steam is generated in the boilers and leaves the boilers to enter a header. The header is a line that all of the boilers send their steam into. From there it either goes to campus or to a turbine-generator. As the steam enters the turbine it causes the shaft of the turbine to spin. The shaft is made up of two interconnected parts: the Turbine Shaft and the Generator Shaft. The Turbine Shaft converts steam power into mechanical power by spinning. As the Generator Shaft spins through the generator housing a magnetic field is put on the shaft. As the magnetic field passes through the wires in the generator housing electricity is made.

Basic Parts of a Turbine Generator:

Turbine: device that converts steam energy into mechanical energy

Generator: converts mechanical energy into electricity

Oil System: provides lubrication for turbine generator

Extraction: the steam that is removed and sent to campus throughout the plant

Condenser: condenses the steam that goes through the turbine and isn't extracted

Condensate System: removes the condensed stem from the hotwell

Cooling System: cools the parts of the turbine generator

Protection Devices: stop the turbine generator's operation upon dangerous conditions

Modernization

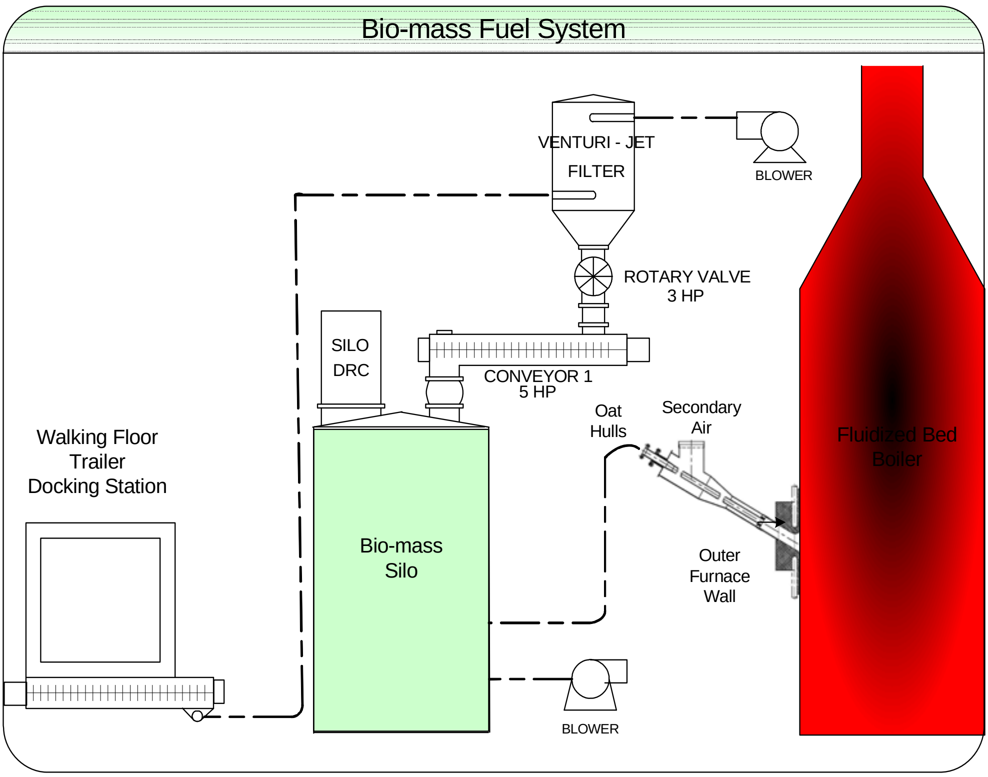
Our Heating and Power Plant has made many recent changes to modernize our facility and keep the technology at the highest current standards.

Year Complete	Description	Cost ($)
1996	20 psig steam supply to deaerator 3. This allows for further steam expansion in low - pressure turbine stages	250,000
1997	Turbine Generator 6 efficiency improvements. This reworks the steam path components to reduce throttling losses associated with high pressure inlet valve assembly.	500,000
1999	Boiler Blowdown heat recovery. This captures heat lost by the boiler drum surface blow by the addition of a heat exchanger to preheat make-up water.	65,000
Winter 2000/Fall 2001	Feedwater heater boiler 11 and 10. This is a method to increase overall cycle effciency by increasing the average temperature of the heat supply, which reduces the irreversibiltiy at the economizer section of the boiler	500,000
Fall 2001	Turbine Generator 5 efficiency improvements. This will increase the available energy to the turbine by increasing the main steam header pressure.	1,000,000
2003	Converted boiler 11 to co-fire biomass	1,000,000

Bio-mass Fuel Initiative

Since July of 2001 we have been burning oat hulls in our fluidized bed boiler. Quaker Oats ships us oat hulls from Cedar Rapids where they are a by-product of their cereal making. This project required us to design and install a one-of-a kind unloading, transport and pneumatic fuel injection system to deliver the hulls to the boiler. This has resulted in a win-win partnership between Quaker Oats and the University of Iowa with the following benefits:

- **$500,000/year annual savings to the University of Iowa**
- **Reduction of greater than 50,000 tons/year global CO_2**
- **Displacement of 30,000 tons/year of coal**
- **Reduced emissions of NO_x, SO_2, CO and particulates**



Oakdale Campus

The University of Iowa has a satellite campus known as Oakdale located in Coralville, a nearby suburb. Oakdale is a research campus; some of the experiments they conduct are irreplaceable. It is essential that steam service be provided without interruption to these areas. The Oakdale heating plant provides heat and steam to all of the Oakdale Campus. It is equipped with four boilers burning natural gas. The two smaller boilers are rated at 15,000 pounds per hour and the two larger boilers are rated at 30,000 pounds per hour. Recently, a new steam line was installed to provide service to the Multi-tenant Facility.

Power Plant at Oakdale