

Contact: Joan Racki
Sheila Doyle

**UNIVERSITY OF IOWA UTILITY MASTER PLAN AND
PERMISSION TO PROCEED WITH SPECIFIC PROJECTS OF PLAN**

Actions Requested:

1. Receive the **Power Plant Systems Improvements Master Plan**.
2. Authorize permission to proceed with project planning for the following projects included in the Master Plan:
 - a. **Main Power Plant Boiler #10 – Replace Pollution Control Equipment;**
 - b. **Main Power Plant Boiler #10 – Conversion to Partial Biomass Fuel Capability;**
 - c. **University Hospitals Pomerantz Family Pavilion – Replace Gas Boiler**, and the selection of Henneman Raufeisen and Associates, Iowa City, Iowa, to provide engineering services for the project.

Executive Summary: The University presents for Board review the **Power Plant Systems Improvements Master Plan**, an interrelated multi-project strategy to increase steam generation capacity at the Main Power Plant, while also increasing plant efficiency and reliability and the use of renewable energy, while controlling utility system energy costs. The University's Master Plan exhibit is included as Attachment A.

The Master Plan outlines immediate needs for efficiency and reliability improvements at the Main Power Plant, as well as longer-term steam and power capacity expansion improvements which are subject to further review. The University requests permission to proceed with project planning for three projects to address a portion of the immediate needs of the Power Plant. Funding for the three projects is proposed from the sale of Utility Enterprise Revenue Bonds (with debt service payments from the sale of utilities to the users). The University will seek Board Office approval for other projects in the plan with estimated project costs of less than \$2 million, in accordance with Board procedures.

The **Main Power Plant Boiler #10 – Replace Pollution Control Equipment** project would install new pollution control equipment on the existing coal stoker Boiler #10 in the Main Power Plant. The boiler's existing pollution control equipment, installed in 1978, does not have the capability to remove pollutants produced from less expensive coal. Replacement of this equipment is expected to result in significant utility savings (up to \$2 million per year) by enabling the boiler to burn less expensive coal. The proposed upgrade would also improve the efficiency of the Power Plant operations, and provide greater assurance that the Power Plant will comply with future air emission regulations. The estimated project cost is between \$10 million and \$12 million; the University reports that project costs will be further refined during project planning based on further evaluation of the various pollution control technologies.

The **Main Power Plant Boiler #10 – Conversion to Partial Biomass Fuel Capability** project would install biomass (oat hull) in-plant piping and storage, and boiler injectors, for Boiler #10 in the Main Power Plant. The project would facilitate the use of lower cost, sustainable biomass fuel (which the University currently burns in Boiler #11) to supplement the stoker coal currently used in Boiler #10. This would reduce utility costs and greenhouse gas emissions, and would facilitate the goal of the University’s Energy Conservation Strategic Plan that 15 percent of all energy consumed on campus be produced from renewable resources by the year 2013. The estimated project cost is \$2.5 million.

The **University Hospitals Pomerantz Family Pavilion – Replace Gas Boiler** project would replace an existing stand-alone emergency boiler with a larger, more reliable gas boiler capable of providing a greater portion of UIHC’s steam needs in the event of a central plant steam interruption. The new boiler would also supplement the Main Power Plant’s steam capacity during periods of maximum campus load. The estimated project cost is \$2.5 million.

Details of Projects:

Main Power Plant Boiler #10 – Replace Pollution Control Equipment

<u>Project Summary</u>			
	<u>Amount</u>	<u>Date</u>	<u>Board Action</u>
Permission to Proceed		Aug. 2007	Requested

Main Power Plant Boiler #10 – Conversion to Partial Biomass Fuel Capability

<u>Project Summary</u>			
	<u>Amount</u>	<u>Date</u>	<u>Board Action</u>
Permission to Proceed		Aug. 2007	Requested

University Hospitals Pomerantz Family Pavilion – Replace Gas Boiler

<u>Project Summary</u>			
	<u>Amount</u>	<u>Date</u>	<u>Board Action</u>
Permission to Proceed		Aug. 2007	Requested

The University of Iowa

Main Power Plant
Master Plan/Renewable Energy Plant

Project Type

Power Plant Systems Improvements Master Plan

Background –
Main Power Plant

The University of Iowa's main campus, including the University of Iowa Hospital and Clinics complex, is served by a large district energy system. District energy involves the production of steam, electric power, and chilled water at central utility plants for distribution to buildings through a network of underground pipes and electric cables. The University of Iowa Power Plant is located at the corner of the Iowa River and Burlington Street (see attached map). It produces and supplies steam energy to the main campus, including the hospitals and clinics and student housing. The steam is used for heating and sterilization and also feeds turbines that drive electrical generators, pumps and centrifugal chillers for building air conditioning. The steam allows the University economically and efficiently to co-generate approximately 30% of the total electric power needs of the main campus.

The Power Plant has been at its current location since 1928, expanding over the years to its current footprint. It now operates two solid fuel boilers and two natural gas boilers, dating from 1975 to 1991, and three steam turbine electrical generators, dating from 1947 to 1973. The two solid fuel boilers are the primary energy sources and are of two types – boiler #10 (1975) is a stoker boiler and boiler #11 (1987) is a fluidized bed boiler. Fuels burned at the Power Plant include coal, natural gas, and oat hull biomass waste. Due to concern over one of the major boilers being unavailable during peak heating demand, the UI leased two emergency boilers, and installed them on the Main Power Plant grounds. (See attached energy supply and demand graph.)

Since July 2001, the University has been burning oat hull waste streams in its fluidized bed boiler. Quaker Oats ships oat hulls from Cedar Rapids where they are a by-product of cereal making. The oat hulls are injected into the boiler using a one-of-a kind unloading, transport and pneumatic fuel injection system that the UI designed and installed. The UI is now looking at modifications to its stoker boiler that would result in UI's use of more oat hull waste or other biomass material. The energy produced from biomass combustion replaces energy that would have been generated by burning coal. Biomass is a renewable fuel and has the further benefit of being considerably less expensive than coal. Because burning biomass does not result in new CO2 emissions to the atmosphere, using biomass has reduced UI's greenhouse gas emissions. UI's innovative use of oat hulls has earned national attention; including receiving two Governor's Awards, and an Effective and Innovative Practices Award from The Association of Higher Education Facilities Officers. UI's use of biomass technology has been featured on CNBC, and in articles in The Chronicle of Higher Education, Coal Power, Facilities Manager, and Buildings magazines. The collaboration with Quaker Oats has been a mutually beneficial partnership.

The University of Iowa was the second university to join the Chicago Climate Exchange (CCX), recognizing the UI's commitment to reducing greenhouse gas emissions. The UI has surpassed its CCX Phase I targeted greenhouse gas reduction of 4% below baseline (average 1998-2001 annual CO2 emissions), resulting in accumulating carbon credits on the exchange. The UI Power Plant is now in CCX Phase II and is on track to meet its goal for an additional 2% reduction, for a total greenhouse gas reduction of 6% below baseline by 2010. In addition, the University is a member of the United States Environmental Protection Agency's Combined Heat and Power Partnership, a voluntary program that seeks to reduce the environmental impact of power generation.

With direction from its Energy Conservation Advisory Council, the UI recently launched its most ambitious energy plan. The University of Iowa Energy Conservation and Management Strategic Plan has a goal that by July 2013, 15% of all energy (combination of purchased and self generated) consumed by the UI campus will be produced from renewable sources. Renewable energy sources include solar, wind, waste management, resource recovery, refuse-derived fuel, biomass, wood burning, small hydro, and other carbon neutral sources. The comprehensive plan is also designed to increase campus energy efficiency, support UI-wide energy conservation, reduce the consumption of energy in existing facilities, and leverage partnerships with local utilities and consumers. Executing the energy conservation and management plan will have a significant impact on reducing campus energy consumption, meeting ongoing campus energy demands, lowering operational costs, and expanding the University's sustainable energy portfolio.

Oakdale Campus
– Oakdale
Renewable
Energy Plant

While the bulk of this master plan summary addresses issues related to the main UI campus and main power plant, the University is also evaluating the energy and utility needs of the Oakdale Campus. Preliminary work has been undertaken to study the feasibility of constructing an Oakdale Renewable Energy Plant (OREP). The purpose of the project would be to demonstrate multiple technologies using locally available renewable fuel sources to meet the expanding energy needs at the Oakdale Campus.

Under consideration is constructing and operating an energy plant using alternative and renewable energy sources such as biomass, landfill gas, anaerobic digester methane, and gasifier syngas.

With this project, the existing utility infrastructure at Oakdale would be reused and converted into a renewable energy plant to power the University of Iowa Hygienic Lab and other Oakdale campus facilities. The Oakdale Renewal Energy Plant's (OREP) capacity could be large enough to supply all facility steam, cooling and electric requirements from renewable energy. The OREP would be expected to serve as an innovative model demonstrating the feasibility of using local materials for production of economical and sustainable quantities of renewable energy for local consumption. The OREP could provide research, education, and training opportunities for University faculty and students, as well as industry and the general public. The Office of the Vice President for Research and the College of Engineering will collaborate with UI's Utility Enterprise in pursuit of these academic goals to be achieved concurrently with energy production.

The local natural gas and electric utilities would remain connected to the Oakdale utility system to provide emergency back-up service and a market for excess renewable electric energy generated above campus requirements.

To improve the overall efficiency and benefits of the Oakdale central energy plant, this project will also study inclusion of a central chilled water production system at the energy plant, a chilled water distribution system and an electrical power distribution system serving facilities. The electrical distribution system would include a new substation and underground distribution loops to connect the energy plant with Alliant Energy's Campus electrical service, the UI Hygienic Lab and other future Oakdale Campus facility development.

The University will be doing additional feasibility work on this project and will return to the Board to seek permission to proceed with detailed planning and design.

Existing
Conditions – Main
Power Plant

The Main Power Plant has aging equipment to support energy demands of modern medical, research, and academic facilities. Since 1997, three boilers (coal boilers 5 & 6 and natural gas boiler 9) have reached the end of their useful service lives; they are no longer available for steam production and represent a decrease of 250,000 pounds of steam per hour (pph) of steam generation capacity. Four boilers (solid fuel boilers 10 & 11 and natural gas boilers 7 & 8) remain in service and provide an installed steam generation capacity of 580,000 pph. Peak winter heating loads have exceeded 440,000 pph during the last two winters. Thus, an unplanned outage of one or more of the largest existing boilers (generating 170,000 pph each) would leave the Main Power Plant with 410,000 pph; insufficient steam generation capacity to satisfy peak steam loads. Two natural gas, rental boilers have been installed to provide a total 140,000 pph of additional emergency capacity until new steam production capacity is available.

Current energy conservation efforts to reduce steam demand are most productive at non-peak heating times, when building HVAC systems can be tuned to run more efficiently. The high risk "firm capacity" issues described above occur during peak heating periods, when fine tuning building HVAC systems is not an effective option for shaving steam load. Thus, energy conservation measures that reduce the peak load have immediate impact on capital needs whereas other energy conservation measures generally do not affect capital requirements.

"Firm capacity" is an important concept for utility planning. Essentially, firm capacity is the amount of capacity needed to meet peak demand when the largest unit in the system is not operational. The Main Power Plant has enough capacity to meet peak demand if all boilers are operational, but not if the largest boiler is off-line. As an interim solution to inadequate firm capacity, two temporary, rented boilers were installed at the Power Plant to supplement the existing steam generation capacity. These gas boilers can provide a short-term resolution until a permanent solution is in place, but they are neither efficient nor economical to operate. The UI has evaluated solutions through power plant systems master planning to meet its longer-

term needs.

Over the last year, RMF Engineering, Inc. completed a study and assisted the University to determine a strategy for increasing steam production capacity. The need for this study was driven by decreasing boiler capacity, a need to address steam load growth linked with campus development, and the opportunity for greater, inexpensive cogeneration of electric power. A specialty consultant, IBE Engineering, Inc. was retained to review local fuel and electric pricing assumptions and projections for the RMF study. This aided the University in identifying the lowest total-cost-of-ownership option.

The University of Iowa is well positioned as a leader in its use of oat hulls for energy production. As the University looked at the current and future power plant needs, the timing was right to undertake the development of an overall power plant systems improvements master plan to provide a framework for capital and maintenance projects, renewable conversion plans for the existing equipment, and for meeting the University's current and future power needs. This was done with consideration to remaining flexible enough to adopt emerging technologies for renewable fuels. It was also done in consideration of the University being a national leader in the use of sustainable energy sources.

General
Description

The power plant systems improvements master plan is an interrelated multi-project strategy that will increase steam generation capacity at the Main Power Plant, increase use of renewable energy, increase plant efficiency and reliability, and control University of Iowa utility system energy costs. The following is an outline of that master plan. A graph depicting the projects and prospective time table in attached.

A. Efficiency and Reliability Improvement Projects

These projects represent immediate needs at the Power Plant to make existing equipment more effective and enable greater use of green power:

1. Modify fans on gas boilers 7 & 8 to regain 60,000 pph capacity and reduce reliance on the temporary boilers.
2. Replace the emergency boiler located at UIHC to ensure higher reliability and capacity.
3. Convert coal-fired boiler #10 to biomass fuel (similar to boiler #11). The result will increase biomass fuel from 20% to 40% of UI's total fuel consumption.
4. Construct a biomass unloading and storage system to support increased consumption of biomass.
5. Replace and modernize obsolete pollution control equipment on coal-fired Boiler #10 to broaden fuel portfolio, decrease emissions, and reduce costs.

6. Upgrade and replace the existing boiler make-up water system using reverse osmosis technology.
 7. Modify Turbine Generator #6 to increase efficiency and lower operational costs.
 8. Replace Turbine Generator 1, installed in 1947.
 9. Replace Power Plant support space displaced by other projects.
- B. Steam and Power Capacity Expansion
These projects require more analysis, which is underway.
1. Install new solid fuel steam generating equipment. Currently, the UI is considering alternatives that range from a combination coal/biomass circulating fluidized bed boiler (like boiler #11) to a 100% biomass fuel gasification power plant addition. In pursuing gasification power plant option, private sector partners will be critical to take full advantage of federal tax incentives for these facilities. The UI also proposes to use its leadership position to create research, demonstration, training and certification opportunities in intermediate scale business power technology. The UI Green Power Task Force has just completed its report on this subject for the Vice President for Research and Senior Vice President & Treasurer.
 2. Installation of new electrical generating equipment compatible with the new steam generating equipment. This will produce additional co-generated electric power at higher efficiencies than possible with existing equipment, increasing the overall efficiency of the combined heat and power plant. The amount of self generated power could be increased from 30% to more than 80%.

Justification/Need Having the capacity to reliably meet the current and the foreseeable future demand for steam, electric power, chilled water and other utilities is critical to ensuring continued business operations and the avoidance of costly interruptions on the main campus and hospital complex.

Innovative approaches to plant operations and utilizing alternative fuel sources will help lower costs and advance the UI's reputation for environmental stewardship. The plan will provide additional steam generation capacity such that the Power Plant is able to reliably satisfy University and UIHC peak steam loads. It will also capitalize on an opportunity to increase use of renewable biomass fuel energy, improve efficiency of the combined heat and power plant, and reduce purchased energy costs. The intention is also to collaborate with the University's Office of VP for Research, and College of Engineering to create learning and research opportunities.

Anticipated
Master Plan Cost

As identified in the FY 2008 UI Capital Plan, projects included within the Main Power Plant master plan account for total capital costs over \$100,000,000 during a five to seven year period. Some of the capital costs could be borne by private sector partners. This is a topic of ongoing review.

Anticipated
Source of Funds

Program capital funds will be provided from Utility System revenues – including issuance of revenue bonds, state and federal grant funds, and possibly through private partners. Annual operating costs are part of the Utility System. All utility costs, whether bond repayment or operating and maintenance expenses, are recovered through the sale of utilities to units of the University including UIHC.

Permission for
Consultant
Selection

The University plans to bring individual projects within the master plan to the Board of Regents to request “permission to proceed” authorization. Several that can be judged independently from the larger steam capacity expansion will be pursued now.