222 South Riverside Plaza

Mechanical Value-Add Improvements

Building Data: 1,237,455-square-foot, 34-story office building in downtown Chicago. Originally constructed in 1971, the building sits atop the terminal for Chicago Union Station.

Scope of Project: G/BA performed an energy study, created a full-building energy model, designed the recommended improvements, and commissioned the new systems. These changes have resulted in major reductions in both resource usage and costs.

Project Summary:

222 South Riverside Plaza has more than 1.23 million square feet of conditioned space. The first floor consists of the main building entry and retail space. The second floor is mechanical space for equipment serving floors 3 through 19, also known as the "low-rise." The "high-rise" consists of floors 20 through 34, served by mechanical equipment on the 35th floor.

The current owner acquired the property in December 2014. As part of the purchsing process, a number of MEP upgrade projects were identified. Grumman/Butkus Associates was retained by JLL, the owner's representative, to perform an energy study, create a full-building energy model, design the recommended improvements, and commission the new systems. These changes have resulted in major reductions in both resource usage and costs.

Facility **renovation and upgrade** projects included the following:

- Install VFDs on all supply and exhaust/return fans and integrate to BAS.
- Install air flow measuring stations for all AHUs and integrate to BAS.
- Install variable air volume terminal units including air flow measuring for floor-by-floor quadrant control, converting the total air distribution system to VAV. Future floor renovations will include VAV terminal units.
- Seal supply air risers up to and around new terminal units and downstream reheat coils.
- Replace control panels and motor starters and add VFDs to two chillers to convert to variable speed.
- Add VFDs to the five 200-hp primary chilled water pumps
- Install modulating control valves and magnetic flow meters on evaporator side of each chiller.
- Install modulating control valves and differential pressure sensors on condenser side of each chiller.
- Replace motors and install VFDs on high-rise tenant condenser water system cooling tower fans.
- Replace fill on high-rise tenant condenser water system cooling towers.
- Replace four elevator machine room HVAC systems.
- Replace four river water pumps and add VFDs to four new river water pumps and integrate to BAS.
- Replace river water piping from water inlet to strainers.

In addition, the engineers devised numerous **improvements to control strategies:**

- Implement a discharge air temperature reset controls strategy to all fan systems.
- Implement a static pressure reset to all core fan systems to a minimum static pressure of 0.5-in. w.c.
- Convert chilled water system to variable volume.
- Implement a chilled water differential pressure setpoint reset strategy based on cooling coil valve position.
- Complete conversion of existing Barber Colman BAS to new Niagara system.
- Convert river water system to variable volume and optimize pump staging through enhanced controls.
- Reduce over-pumping of river water system through flow-limiting devices and enhanced controls.
- AHU control sequences were modified to optimize free cooling.
- AHU sequences were modified to include a morning warm-up cycle to prevent excess humidity from entering the spaces.

Energy Efficiency: Since changes began to be implemented, **the building's electricity use is down 15%.** On a peak cooling day, the high-rise core AHUs operated at 85% speed, and the low-rise core AHUs operated at 53% (compared with 100% speed and constant volume). Peak chiller operation has reduced from three chillers to two.

Not all of the savings have been achieved since a full year has not passed since implementation was completed. G/BA anticipates that the savings will reach 22% of total energy consumption. The Annual Electricity Consumption chart below provides details.

Year	Annual Energy Consumption (kWh/yr)	Energy Consumption (MMBtu/yr)	Energy Usage Intensity (kBtu/ft² - yr)	Electric Energy Cost ($/yr)	Cooling Degree Days
2014	12,171,592	41,542	37.7	$1,095,443	2,130.6
2016	10,289,221	35,117	31.9	$926,030	2,655.3
Savings	**1,882,371**	**6,425**	**5.8**	**$169,413**	**-524.7**

Indoor Air Quality: No system changes were made that would compromise the indoor air quality. Space temperature sensors were replaced to provide better temperature control, and CO_2 sensors were upgraded.

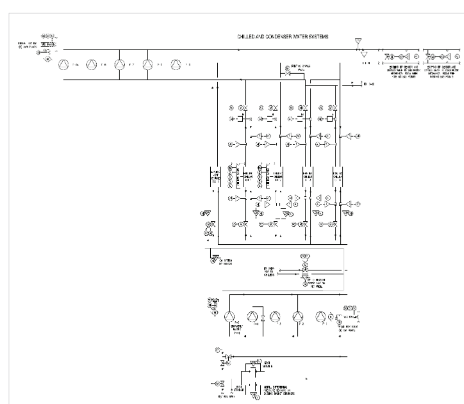
Innovation: The project was a collaborative effort that involved not only management and design engineers, but also significant input from the facilities staff and controls contractors. Weekly meetings were held as implementation progressed, allowing the team to discuss how to resolve issues effectively while maintaining design integrity and optimizing energy efficiency.

Operations and Maintenance: Operating and maintenance costs were reduced in several areas. Four elevator machine room HVAC units that were at their end of life were replaced with new, higher efficiency models. Adding VFDs on two of the chillers, the chilled water pumps, river water pumps, tenant condenser water pumps, cooling tower fans, and supply and exhaust/return fans increased operational efficiency. This upgrade will also prolong the life of the chillers, pumps, and fans.

More equipment is now accessible via the building automation system, which also includes new alarms. An "override page" shows the building operators any setpoint changes or override commands that are preventing the BAS from operating in full automation per the design. Staff can assess, and quickly respond to, any system changes or issues detected.

Cost Effectiveness: Projects were divided between operations and capital funds. Operations projects included upgrading equipment and replacing units that were at the end of their useful life. Capital projects included long-term energy measures, such as adding VFDs to chillers. Through the building automation system upgrade, additional short-term energy saving measures were implemented, such as discharge air temperature reset and static pressure reset.

Environmental Impact: The project's energy use reductions have obvious positive environmental effects. Fans operating at lower speeds result in reduced filter replacements and waste. Optimization of the discharge air temperature control reduces chiller run time and therefore cuts refrigerant use. Reduced chiller operation also cuts water use, accompanied by reductions in condensate waste, sewer discharge, and related treatment.



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