6. Mechanical

Overview

Mechanical site visits were performed from February 9 through February 12, 2009 on typical floors 10, 15, 21; restricted floors 2, 3, 5, 17, 19; floor 1, penthouse, floor 12 and the parking garage. The mechanical team visually assessed these floors for potential upgrades, repairs, building code issues and fire/life safety requirements per the 2007 California Mechanical Code (CMC). The mechanical team also noted evidence of corrosion and service life issues and investigated any apparent noise, vibration and air and water flow concerns.

Building engineering staff accompanied the mechanical team, provided access and also pointed out known deficiencies with the mechanical systems.

The draft Retro-Commissioning Investigation Report dated July 21, 2007 was reviewed for issues of concern.

The following items listed below are considered major concerns that need to be addressed:

1. The frame corrosion at the chilled water coils in the two main mechanical rooms should be evaluated by a corrosion engineer to determine the estimated service life of the coils.
2. The corroded mist eliminators at the two main cooling tower discharges should be replaced.
3. Secondary containment of the water treatment chemical storage drums need to be added per code as well as clean-up and calibration of the chemical injection system.
4. The hot water piping flexible connector at each VAV reheat coil needs replacement based on the past history of leaks.
5. The hot water valve and operator at each VAV reheat coil needs replacement based on the past history of leaks and parts availability.
6. A complete air balance of the mechanical systems is needed for occupant comfort and air quality.
7. The obsolete flow measuring controls on the VAV units need to be replaced.
8. The non-operational exhaust hood in the day care food preparation area needs replacement.
9. The fire rated duct opening at the location of the previously removed water source heat pumps near the mail sort area needs to be repaired.
10. The hot water relief piping on Boiler No. 3 needs to be re-piped to an approved location per code.
11. The relief piping off the natural gas regulator near Boiler No. 3 needs to be upsized per code.
12. A complete upgrade of the Building Automated Control System is recommended because the system is obsolete, replacement components are not available for

many components, and an updated system will improve occupant comfort and energy savings.

13. The addition of outside air flow measurement and monitoring capability of the system is required to maintain an acceptable air quality.
14. The existing valve operator for the chilled water return diverter valve for CH-1 and 2 and CH-3 changeover requires repair.
15. A code compliant elevator room cooling system at the penthouse elevator equipment room is required.
16. The make-up air unit serving the first floor cafeteria is at the end of its service life and requires replacement.

A. Central Mechanical Cooling Systems

The central mechanical cooling system includes two 700-ton Trane centrifugal chillers, three chilled water pumps, two forced draft, counter-flow, cooling towers, three condenser water pumps, a water treatment system, two chilled water coil banks, and a smaller 90-ton reciprocating chiller to serve the computer room load when the building is unoccupied and the main chillers are off. The following observations and/or concerns were found for the cooling system.

Trane Centrifugal Chillers (CH-1 and 2).

Two 700-ton Trane centrifugal chillers are located at the 12th floor and appear to be in good service condition and well maintained. The chillers are monitored by building engineering staff and annual maintenance is performed by Trane Company. Trane was contacted regarding any concerns and potential upgrades for the chillers. The chillers use R-123 refrigerant which is a code compliant refrigerant. The following energy savings upgrades were offered and qualify for SMUD rebates and credits towards LEED:

1. A factory control panel upgrade is recommended for the chillers that provides upgraded capacity for the chiller. Energy paybacks in less than two years have been documented and SMUD rebates are available.
2. Factory condenser water temperature control optimization software is recommended to optimize chiller and tower operation.
3. An automatic condenser tube cleaning system is recommended to minimize fouling of the condenser tubes throughout the cooling season in lieu of only annual cleaning.

Chilled Water Pumping (CHWP-1, 2, and 3).

Three chilled water pumps are located at the 12th floor and appear to be in good service condition and well maintained. The pumps are nominal 1680 gpm, 40 hp. each and have high efficiency motors installed. The chilled water pumping arrangement is a primary pumping system between the chillers and the chilled water coil banks. An energy savings opportunity is available by converting the primary pumping system to a primary/secondary pumping system to reduce the pumping horsepower while maintaining the factory recommended flow through the chillers. Primary/secondary pumping is a

standard industry design practice. Further evaluation and energy savings payback analysis should be performed. The following energy savings upgrades and repair items are recommended:

1. Convert the primary pumping system to a primary/secondary pumping system.

Chilled Water Coils.

Two large built up chilled water coil banks are located at the 12th floor. The coil sections are built-up with three nominal 12 ft wide by 12 ft high sections and one 10 ft wide by 12 ft high section. The coils are nominal six rows and eight fins/inch. The coils appear to have active frame corrosion in several areas are require repair or replacement in the near future. There was evidence of a tube repair in one section and it appears an aggressive chemical cleaning agent has been used for coil cleaning. It is recommended that further investigation by a qualified corrosion consultant be undertaken to determine the estimated remaining service life for the coils. The balance valves located at each coil section were all set in the open position which is an indication that a flow balance needs to be performed.

We considered the relationship between the cooling coils and the potential to contribute to mold growth and indoor air quality issues for the building occupants. Ultra violet light devices have been used in Medical, Food Processing, and Educational Buildings for over fifty years to prevent the growth of mold. An added benefit to the use of UV light is to reduce the build on the coils which restricts air flow and creates an added pressure drop across the coils which increases fan energy consumption. A LEED point has been awarded for UV retrofits. A site visit was arranged to investigate adding a UV system by the Sterile Air factory representative. Adding UV treatment appears to be a viable option for indoor air quality and energy savings. The following recommendations for repair and upgrade of the chilled water coils are listed below:

1. Evaluation of the extent of corrosion by a corrosion engineer to determine estimated coil service.
2. Replace coil sections with active frame corrosion.
3. Balance chilled water flow for each coil section.
4. Add ultraviolet lamp system to reduce static pressure drop for energy savings and eliminate mold growth at the coils.

York Reciprocating Chiller (CH-3).

1. A nominal 90-ton reciprocating R-22 chiller was added to the original cooling system located at the 12th floor. The purpose of adding the chiller was to serve the computer room load when the building is unoccupied and the main chillers are off. The chiller appears to be in good service condition and well maintained. The chilled water distribution piping is interconnected between the three chillers with automatic valve actuators. There were no concerns noted with CH-3 however the valve actuator and linkage at the chilled water return diverter valve requires repair.

Chilled Water Pumping for CH-3

1. Two chilled water pumps are located at the 12th floor to serve CH-3. The pumps appear to be in good service condition. The pumps are inline type and mounted high inside the mechanical room alongside the main exhaust fan serving half the building. Service access and code clearance for electrical components is an issue.

Cooling Towers (CT-1 and 2).

Two "Baltimore Aircoil", vertical forced draft, counter-flow, cooling towers are located at the penthouse roof level with the vertical discharge extending to the helistop level. The cooling towers appear to be adequately maintained however corrosion and a build-up of organic growth was noted at the discharge mist eliminators. An upgrade to extend the service life of the cooling towers is to add an automatic sump cleaning system. The system operates similar to a pool cleaning system to help remove the build-up of solids in the cooling tower sump basin. The service life of cooling towers is variable depending on the correct application of water treatment chemicals, bleed rate, and quality of the make-up water, and normal corrosion due to air/water contact surfaces and outdoor environment. Added benefit to maintaining a good water quality at the cooling towers is that it will extend the service life of the chiller condensers and increase heat transfer efficiency. The following recommendations for repair and upgrade of the cooling towers are listed below:

1. Add a sump cleaning system to the tower basins.
2. Replace the corroded mist eliminator sections at the tower discharge.
3. Closely monitor the water quality and water treatment system to extend tower service life.

Condenser Water Pumping (CWP-1, 2 and 3).

Three condenser water pumps are located at the 12th floor and appear to be in good service condition and well maintained. The pumps are nominal 2,015 gpm, 50 hp. each and have high efficiency motors installed. The condenser water pumps have variable frequency drives installed. The 12th floor location of the condenser water pumps presents a piping leak potential due to the pressure head to boost to the penthouse level cooling towers. The following energy upgrade is recommended.

1. Optimize the variable pumping rate.

Condenser Water Treatment

The condenser water treatment system is located at the 12th floor and appears to be in good service condition. It is recommended that the chemical treatment system be closely monitored to extend the service life of the cooling towers and chiller condensers. It was also noted that the open chemical injection vessel had a scum floating on top and requires general clean-up. The following energy savings upgrades and repair items are recommended:

1. Clean-up and calibrate open chemical injection system.

B. Central Mechanical Heating Systems

The central mechanical heating system includes two hot water boilers, three hot water pumps, hot water expansion tank, distribution piping and hot water reheat coils located in the terminal air boxes along the perimeter zones. The following observations and/or concerns were found for the heating system.

Hot Water Boilers (B-1 and 2).

Two "Cleaver Brooks" flexible water tube boilers rated at 6,000 MBTU input are located at the penthouse floor level. The boilers appear to be in good service condition and well maintained. The burner controls appear to be the original installed equipment with standard burner turn down ratios. The following energy savings upgrades and repair items are recommended:

1. Retrofit burner control system to allow a broader range of burner turn down ratio.

Hot Water Pumping (HWP-1, 2, and 3).

Three hot water pumps are located at the penthouse floor level and appear to be in good service condition and well maintained. The pumps are nominal 220 gpm, 20 hp. each. The hot water pumps should be equipped with high efficiency motors and upgraded with variable frequency controls and high efficiency motors. The following energy savings upgrades and repair items are recommended:

1. Install variable frequency drives on each pump.
2. Install high efficiency motors.

Hot Water Distribution Piping and Reheat Coils

Hot water distribution piping is routed above the ceiling space to reheat coils located at various VAV terminal units serving perimeter zones. There is a concern that there has been a past history of leaks at the hot water connections to the reheat coils and the use of improper pipe fittings. The leaks are evident from stained ceiling panels below the reheat coils. The following repair items are recommended:

1. Replace flexible connectors at each VAV reheat coil.
2. Replace hot water valve and operator at each VAV reheat coil.

C. Air Distribution Systems

Supply fans (SF1, 2, 3, and 4)

The central mechanical air distribution systems includes four supply fans, SF-1, 2, 3, and 4, each rated at a nominal 125,000 cfm, 4.25" ESP, and 125 hp. The centrifugal fans are double width, double inlet and installed as two parallel systems with SF-1 and 2 serving

half the building on floors 2 to 24 and SF-3 and 4 serving the other half the building on floors 2 to 24. The supply fans have variable frequency drives installed.

The following energy savings upgrades and repair items are recommended:

1. It is recommended that a complete air balance be performed on the core supply air systems, especially a floor by floor rebalance of each system.

Return fans (RF-1, 2, 3, and 4)

There are four return fans RF-1, 2, 3, and 4 each rated at a nominal 110,000 cfm, 2.5" ESP, and 60 hp. The centrifugal fans are double width, double inlet configured in two parallel systems with SF-1 and 2 serving half the building on floors 2 to 24 and SF-3 and 4 serving the other half the building on floors 2 to 24. The return fans have variable frequency drives installed. The following energy savings upgrades and repair items are recommended:

1. It is recommended that a complete air balance be performed on the core return air systems, especially a floor by floor rebalance of each system.

Core Exhaust Fans (EF-1 and 2)

There are two exhaust fans EF-1 and 2 serving the core exhaust; EF-1 is rated at 25,800 cfm and EF-2 is rated at 20,500 cfm, both are 2.0" ESP, and 15 hp. The following energy savings upgrades and repair items are recommended.

1. It is recommended that a complete air balance be performed on the core exhaust air systems, especially a floor by floor rebalance of each system.

Filtration (FB-1 and 2)

1. Two main filter banks house replaceable, pleated, 30% efficient panel filters located upstream of each chilled water coil. The filters are arranged in an angular pattern to allow sufficient free area. It was noted that there is an uneven airflow across the filter bank with less airflow toward the outside edges of the rack and higher airflows toward the center. An upgrade to the filtration system is available which will increase the air quality within the building and reduce maintenance time for frequent filter change-out. Replacing the 30% panel filters with 65% efficient, extended bag filters would improve the filter efficiency and extend the filter life. The following energy savings upgrades and repair items are recommended.
2. Replace 30% efficient panel filters with 65% efficient extended bag filters.

Terminal Air Units

There are approximately 479 single-duct variable air volume (VAV) terminal units that serve the various zones throughout the building. The VAV terminal units serving the perimeter zones are typically equipped with 2-row hot water reheat coils and are typically configured as parallel fan powered units with hot water reheat. Some VAV units are

equipped with electric reheat coils. Interior zones are typically equipped as series fan powered terminal units without reheat or as standard VAV terminal units without reheat coils. The various VAV units and configurations can be observed through the EMCS host computer. A snapshot of a typical floor is included in this report under the BACS – Building Automation Control Section of the report.

There is a concern with the VAV units equipped with reheat coils due to a history of leaks at the flex connectors and the hot water control valves at each unit no longer have replacement parts available from the manufacturer for repair. It was reported during our site visit that some of the VAV units required repair of actuators and air flow measuring controls at the unit.

There does not appear to be a justification for the installation of electric reheat coils in lieu of hot water coils other than first cost. The comfort control of modulating hot water reheat coils and energy performance is superior to that of electric reheat coils.

It was noted during our survey that the building occupancy requirements have changed especially in Training Rooms with large concentrations of computers which require more airflow to offset the computer heat output. Upsized replacement VAV terminal units are needed for these areas.

It is also recommended that an air balance of the low pressure distribution systems be done to compare the actual airflows with those reported to the EMCS system. The following repair items are recommended:

1. Replace electric resistance reheat with hot water reheat coils.
2. Replace obsolete controls on VAV units with updated controls.
3. Replace VAV terminal units serving high concentration of computer or equipment loads with larger VAV terminal units.
4. Repair and rebalance VAV terminal unit air flows.

Air Distribution

Air is distributed through medium pressure galvanized ductwork that is externally insulated upstream of VAV terminal units and low pressure galvanized ductwork, externally insulated downstream of VAV terminal units. Conventional lay-in supply diffusers and return registers are uniformly spaced at open office areas with lay-in ceilings and office areas. Gypsum board ceiling areas have surface mounted supply diffusers and return registers. Exposed areas typically have exposed ductwork with sidewall registers. It was noted during our walkthrough that excessive noise from the air distribution system was prevalent along the south perimeter zones especially on the upper floors. This should be further investigated to determine if the source of noise is either from too high of a velocity in the low pressure ductwork or from the fan powered VAV boxes. It was also noted that some building occupants elected to cover their supply diffusers due to excessive airflow, or temperature control in some areas. This is typical of areas that require an air balance for comfort conditions. The following energy savings upgrades and repair items are recommended:

1. Rebalance low pressure air quantities.
2. Investigate source of noise noted at south perimeter zones.

Ancillary Exhaust Systems

Ancillary exhaust systems are located through-out the building for specialty applications including heat removal from areas such as electrical equipment rooms and elevator equipment rooms and odor control in area such as the printing area. The exhaust hood system located on the first floor serving the daycare food prep area was not operational. In general the ancillary exhaust systems appeared to be undersized for the intended design. The following repair items are recommended:

1. Upsize or supplement the exhaust air system for the Printing Room.
2. Replace kitchen exhaust hood in the daycare kitchen area.

D. Water Source Heat Pump System

The water source heat pump system provides the first floor heating and cooling and includes fourteen nominal 10-ton water-source heat pump units. The heat pumps are connected to a common hydronic water loop that either rejects the heat of compression during the cooling cycle or absorbs heat during the heating cycle. A natural gas-fired boiler injects heat into the loop and a fluid cooler rejects from the loop to maintain the loop temperature within range.

Water Source Heat Pump Units (HP1-14)

The water source heat pump units are all nominal 10-ton capacity units manufactured by "Climatemaster" and are located at two mezzanine level areas on the first floor. The heat pump units located near the mail sort operation are vertical units and the heat pump units near shipping and receiving are horizontal units. It was noted during our site visit that two vertical units have been decommissioned and that the compressors and controls have been replaced in about 25% of the units. The heat pump units are standard efficiency units and are nearing the end of their service life. Additionally the evaporator coils appear to require cleaning of organic debris. It was noted that the hydronic loop connected to each unit is piped without solenoid shut off valves interlocked to compressor operation and there is flow through the units at all times. It was also noted that one of the decommissioned units removed above the Mail Sort Room has wall openings that require sealing to maintain the fire rating of the wall. The units are connected to a common outside duct for ventilation air but the volume of outside air is not being measured. The following upgrades and repair items are recommended:

1. Replace water source heat pump units with high efficiency model units.
2. Add ultraviolet lamp system to reduce static pressure drop for energy savings and eliminate mold growth at the coils.
3. Add solenoid shut-off valves and controls for variable pumping.

4. Repair fire rated wall duct openings at location of removed heat pump system.
5. Add outside air monitoring controls to each system

Fluid Cooler (FC-1)

A "Baltimore Aircoil" vertical forced draft fluid cooler is located inside a mechanical room on the first floor in the garage area. The fluid cooler appears to be adequately maintained however corrosion and a build-up of organic growth was noted at the discharge mist eliminators. An upgrade to extend the service life of the fluid cooler is to add an automatic sump cleaning system. The system operates similar to a pool cleaning system to help remove the build-up of solids in the fluid sump basin. The service life of fluid cooler is variable depending on the correct application of water treatment chemicals, bleed rate, and quality of the make-up water, and normal corrosion due to air water contact surfaces and outdoor environment. Added benefit to maintaining a good water quality at the cooling towers is that it will extend the service life of the chiller condensers and increase heat transfer efficiency. The following recommendations for repair and upgrade of the cooling towers are listed below:

1. Add a sump cleaning system to the tower basins.
2. Replace the corroded mist eliminator sections at the fluid cooler discharge.
3. Closely monitor the water quality and water treatment system to extend tower service life.

Hydronic Loop Water Treatment

The hydronic loop water treatment system is located in the first floor mechanical room near the fluid cooler and appears to be in good service condition. It is recommended that the chemical treatment system be closely monitored to extend the service life of the fluid cooler and water source heat pump condensers. The following energy savings upgrades and repair items are recommended:

1. Calibrate water treatment system.

Hot Water Boiler (B-3)

A "Teledyne Laars" natural gas fired Mighty Therm boiler is installed in the first floor mechanical room off the parking garage. The boiler is rated a 3,050 MBH and 2,501 MBH output at an 82% efficiency rating. The boiler appears to be in good service condition considering its service life. It was noted that the hot water relief piping off the boiler is terminated with an open pipe adjacent to the boiler. The isolation valves for the hot water piping are located above 8 ft from the finished floor and require chain operators to be code compliant. The relief piping off the natural gas regulator is undersized for the horizontal distance the piping is routed. The following are recommendations for repair and upgrade of the hot water boiler:

1. Replace the boiler with high efficiency condensing boiler with a combustion efficiency of 93%.
2. Re-pipe the hot water relief piping to an approved location.

3. Install chain operators for valves located above 8 ft from the finished floor.
4. Upsize the relief piping off the natural gas regulator to account for the extended horizontal piping run.

Fluid Cooler Pumps (FCP-1 and 2).

Two fluid cooler water pumps are located at the first mechanical room adjacent to boiler No. 3. The pumps are nominal 360 gpm, 15 hp. each. The fluid cooler water pumps should be equipped with high efficiency motors and upgraded with variable frequency controls and high efficiency motors. The following energy savings upgrades and repair items are recommended:

1. Install variable frequency drives on each pump.
2. Install high efficiency motors.

E. Building Automated Control System (BACS)

The BACS at the Board of Equalization is a Barber Colman Network 8000 system with an OS2 front end. The front end runs the Ultivist software to provide a graphical user interface (GUI) with the BACS.
The central Global Control Module with modem is located in the penthouse mechanical room near the chillers. A signal host computer is located in the Facility Control Operators Room at the penthouse level. The Network 8000 BACS is several generations behind the latest devices released by Invensys (formerly Barber Colman). The BACS was functional; however, the host computer and software are well beyond their serviceable life. The front end runs on an outdated OS2 operating system that cannot be replaced if the system fails. Additionally replacement parts for signal devices including flow measurement at terminal air units and hot water valve operators are no longer available and facility staff is relocating replacement parts from less critical zones to more critical areas. It is recommended that a complete BACS Upgrade be completed to allow future reliability and trending capability to properly control and monitor the HVAC equipment and reduce energy consumption. Several Network 8000 systems have been replaced in similar buildings recently for the same issues that are noted above. Added benefits of replacing the system include a more user friendly system with more trained operators available to troubleshoot and operate the system.

The building engineering staff was very helpful in explaining the capabilities and limitations of the control system. An example of graphical data available from the signal host computer is the floor by floor representation of the building and the various terminal unit operation including air flow and temperature monitoring capability. The control system is a hybrid system that utilizes pneumatic operators for most actuators through PE switches and DDC interface. A typical example of controllers that are no longer available as a replacement parts are the TAC Microflow II controllers at each terminal unit. It was noted on our walkthrough that the control compressor at the 12th level has a discharge pan with compressor oil that is pumped by a sump pump to the sanitary sewer system. This is not allowed by current code.

It was also noted during our visit that the outside air ventilation is not monitored and is controlled by a minimum damper setting for each system. The outside air quantity should be monitored to maintain adequate air quality within the building, especially with a VAV system. It is recommended that air flow measurement stations be added to the system. The following recommendations for repair and energy upgrade of the BACS are listed below:

1. A complete upgrade of the BACS is recommended.
2. Repair or replace and calibrate all pneumatic actuators.
3. Re-pipe compressed air system blow-down to an approved collection and termination.
4. Add outside air flow measurement and monitoring capability to the control system.
5. Repair or replace the exiting valve operator for the chiller water return diverter valve for CH-1 and 2 and CH-3 changeover.

F. Specialized Data and Equipment Room Cooling Systems

The specialized data and equipment cooling system include the four ”Liebert” chilled water computer room units, the two elevator equipment room cooling systems located at the first floor and penthouse floor and the central telecom rooms which are cooled with smaller capacity Liebert computer room units.

Computer Room Units (CRU 1, 2, 3, and 4)

Computer Room Units 1 through 4 are “Liebert" System 3” chilled water units. The units are mounted on a raised floor and distribute air through conventional perforated floor panels. The equipment capacity appears to be adequate for cooling the data equipment and the units are supplied with two sources of chilled water for redundant cooling supply. The primary cooling source is from CH1 and 2 and from CH-3 during off operation of CH-1 and 2. It was noted that the computer room spaces were maintained at a constant 72 degrees. It was also noted that the halon fire suppression system and extinguishing agent is no longer available as a code compliant suppression agent. The following recommendations for repair and energy upgrade of the computer room cooling are listed below:

1. Raise setpoint of computer room units to control at 75 degrees instead of 72 degrees to save energy.
2. Replace halon extinguishing agent with a current code compliant extinguishing agent.

Elevator Equipment Room Cooling Systems

There are three elevator equipment rooms and their corresponding cooling systems were observed at the penthouse level, 12th floor and at the first floor level. The 12th floor elevator equipment room is currently cooled with a combination of a ducted supply

system off the main supply distribution ductwork and a portable move-and-cool unit with flexible ductwork routed toward the elevator equipment control panels. It is a code violation to have portable cooling units located inside an elevator equipment room and this condition needs to be addressed with a new elevator cooling system.

The first floor elevator equipment room houses a hydraulic unit that is currently cooled with a small supply and exhaust register off the main cooling system. The room was observed to be running warm and requires additional cooling. The following recommendations for repair and upgrade of the elevator room cooling systems are listed below:

1. Install new code compliant elevator room cooling systems at the 12th floor and first floor elevator equipment room locations.

Kitchen Mechanical Systems

The main kitchen area is conditioned with an "Ares" model gas fired heating, evaporative cooling unit, nominal 5,400 cfm, 300 MBH heating input. The unit is located on the low roof area above the kitchen space. The make-up air unit is at the end of its service life due to corrosion and leaks at the unit where the water is stored for evaporative cooling. The kitchen grease exhaust hood and system appears to be in good condition but the roof exhaust fan should be cleaned and serviced to remove excess grease accumulation. The following recommendations for repair and upgrade of the kitchen mechanical systems are listed below:

1. Install a new replacement make-up air unit and specify the unit with a stainless steel pan for corrosion resistance.
2. Clean and remove grease accumulation at the roof-top grease exhaust fan.