Sequence of Operations (excerpt)

Chilled Water System

Consists of one (1) 600 cooling ton Trane CVHE 3 stage centrifugal chiller, with associated chilled water pumps, condenser water pumps and one (1) two stage cooling tower, supplies chilled water to all fan unit cold deck coils for building cooling.

Chiller plant on

When the out side air temperature is above 60 degrees with a hysteresis of 3 as sensed by the outside air temperature sensor and either SF1 or SF2 are enabled the system shall be enabled.

When the system is enabled, the lead chilled water pump (P-7 or P-8), the lead condenser water pump (P-9 or P-10) and the chiller shall be enabled. Once water flow has been proven through the chilled water flow switch and the condenser water flow switch, the chiller shall run and cycle from internal controls to maintain 51 degree (adjustable from chiller control panel located on the front of the chiller) chilled water supply temperature.

Cooling tower

The cooling tower fan shall be enabled and will cycle the tower motors from low to high to low speed to maintain a condenser water supply temperature of 72 to 75 degrees. At 72 degrees condenser water temperature the low speed motor shall be enabled. At 75 degrees condenser water temperature the low speed motor shall be disabled and the high speed motor enabled.

Chiller plant off

When the system is disabled, the chiller shall be disabled and the lead chilled water pump and lead condenser water pump shall be enabled for a period of 10 minutes after the chiller is disabled. The cooling tower shall be disabled along with the chilled water pump and condenser water pump after the 10 minute pump off delay. The pumps shall lead lag on the 18th of the month at 10:00 pm or as selected by the operator.

If either the lead chilled water pump fails or the lead condenser water pump fails, as sensed by the auxiliary contacts on the motor starter, the chiller shall be disabled and an alarm will be reported to the system computer.

The chiller is located in an enclosed room on the south side of the lower parking garage and the pumps are located in the sub-basement mechanical room.
The cooling tower is located on the roof of the building.

HVAC System

Supply Fan 1 (SF1) System

Supply fan 1 system controls heating and cooling air flow to floors 6 through 12th. Supply fan 1 system consists of one (1) 100 hp supply fan with interlocked and sequenced return air, exhaust air, and outside air dampers and two (2) control interlocked 10 hp return air fans. Supply Fan 1 is equipped with hot and cold air decks. The hot deck is heated with city supplied steam and the cold deck is cooled with building generated chilled water. Operation of this fan system is based on an occupied schedule of 6:30 am to 6:00 pm Tuesday through Friday and a start time of 6:00 am on Mondays during the heating season, as determined by current weather conditions. During cooling season a start time of 5:30 am Tuesday through Friday with a start time of 4:30 am on Mondays. SF1 and assoc. equip. is disabled on weekends and holidays

Fan OFF condition
N.O. Return air damper is open
N.C. Exhaust air damper is closed
N.C. Outside air damper is closed (exception: stack effect cooling)
N.C. Steam valve is closed
Stack effect cooling: If the outside air temperature is greater than 60 degrees and less than 100 degrees then the outside air dampers shall open.

Fan ON and mixed air temperature control
When the unit is enabled by a signal from the BAS (based on the occupied schedule) the out side and exhaust air dampers shall go to their minimum position. The mixed air temperature sensor shall modulate the economizer dampers to maintain a mixed air temperature of 60 degrees when the average zone temp is >72 degrees or maintain a mixed air temperature of 70 degrees when the average zone temp is < 70 degrees. The two return air fans shall be enabled. When the chiller plant is enabled, the unit dampers shall go to their minimum position.

Hot deck temperature control
The hot deck discharge air temperature sensor shall modulate the normally closed steam valve to maintain the hot deck temperature in accordance with the following reset schedule.

Outside air temperature	Hot deck supply air temperature
0	105
60	70

Cold deck temperature control
With the Chiller plant disabled the cold deck discharge air temperature control shall be the mixed air temperature as controlled by the mixed air sensor. When the chiller plant is enabled the economizer dampers will be modulated to their minimum position and the discharge air temperature shall be controlled by the chiller plant supplied water temperature.

Safeties

If the discharge air temperature drops below 38 degrees as sensed by the low temperature sensor (freeze stat), the unit shall be disabled and the outside air and exhaust air dampers shall close.
If either the supply or return air duct smoke detectors is activated locally or through the general fire alarm input the unit shall be disabled and the outside air and exhaust air dampers shall close.

Supply fan 1 is located in the upper mechanical room above the 12th floor.

Note: *All operational set-points and schedules are operator adjustable*.

Supply Fan 2 System

Supply fan 2 system controls heating and cooling air flow to floors basement through 5th. Supply fan 2 fan system consists of one (1) 100 hp supply fan with interlocked and sequenced return air, exhaust air, and out-side air dampers and one (1) control interlocked 20 hp return air fan. Supply Fan 2 is equipped with hot and cold air decks. The hot deck is heated with city supplied steam and the cold deck is cooled with building generated chilled water.
Operation of this fan system is based on an occupied schedule of 6:30 am to 6:00 pm Tuesday through Friday and a start time of 6:00 am on Monday and is disabled on weekends and holidays

Fan OFF condition
N.O. Return air damper is open
N.C. Exhaust air damper is closed
N.C. Outside air damper is closed (exception: stack effect cooling)
N.C. Steam valve is closed
Stack effect cooling: If the outside air temperature is greater than 60 degrees and less than 100 degrees then the outside air dampers shall open.

Fan ON and mixed air temperature control
When SF2 and interlocked return air fan is enabled, by a signal from the BAS (based on the occupied schedule) the outside and exhaust air dampers shall go to their minimum position. The mixed air temperature sensor shall modulate the economizer dampers to maintain a mixed air temperature of 60 degrees when the average zone temp is >72 degrees or maintain a mixed air temperature of 70 degrees when the average zone temp is < 70 degrees. When the chiller plant is enabled, the unit dampers shall go to their minimum position.

Hot deck temperature control
The hot deck discharge air temperature sensor shall modulate the normally closed steam valve to maintain the hot deck temperature in accordance with the following reset schedule.

Outside air temperature	Hot deck supply air temperature
0	105
60	70

Cold deck temperature control
The cold deck air temperature control shall be the mixed air temperature as controlled by the mixed air sensor. When the chiller plant is enabled the economizer dampers will be modulated to their minimum position and the discharge air temperature shall be controlled by the chiller plant supplied water temperature.

Safeties
If the discharge air temperature drops below 34 degrees as sensed by the low temperature sensor (freeze-stat), the unit shall be disabled and the outside and exhaust air dampers shall close.
If either the supply or return air duct smoke detectors is activated locally or through the general fire alarm input the unit shall be disabled and the outside and exhaust air dampers shall close.

SF2 is located in the sub-basement mechanical room in the air chambers on the east side of the sub-basement.

Note: *All operational set-points and schedules are operator adjustable*.

Supply Fan 3 System

Supply fan 3 system controls heating and cooling air flow to floors basement through 2nd of the annex building. Also serves the core of The Colorado Trust building basement through 1st floors and The Colorado Trust perimeter 2nd floor. Supply fan 3 fan system consists of one (1) 40 hp supply fan with interlocked and sequenced return air, exhaust air, and out-side air dampers and one control interlocked 10 hp return air fan. Supply Fan 3 is equipped with hot and cold air decks. The hot deck is heated with city supplied steam and the cold deck is cooled with building generated chilled water.
Operation of this fan system is based on an occupied schedule of 6:30 am to 6:00 pm Tuesday through Friday and a start time of 6:00 am on Monday and is shut down on weekends and holidays

Fan OFF condition
N.O. Return air damper is open
N.C. Exhaust air damper is closed
N.C. Outside air damper is closed
N.C. Steam valve is closed

Fan ON and mixed air temperature control
When SF3 and interlocked return air fan is enabled, by a signal from the BAS (based on the occupied schedule) the outside and exhaust air dampers shall go to their minimum

position. The mixed air temperature sensor shall modulate the economizer dampers to maintain a mixed air temperature of 60 degrees when the average zone temp is >72 degrees or maintain a mixed air temperature of 70 degrees when the average zone temp is < 70 degrees. When the chiller plant is enabled, the unit dampers shall go to their minimum position.

Hot deck temperature control
The hot deck discharge air temperature sensor shall modulate the normally closed steam valve to maintain the hot deck temperature in accordance with the following reset schedule.

Outside air temperature	Hot deck supply air temperature
0	105
60	70

Cold deck temperature control
The cold deck air temperature control shall be the mixed air temperature as controlled by the mixed air sensor. When the chiller plant is enabled the economizer dampers will be modulated to their minimum position and the cold deck discharge air temperature shall be controlled by the chiller plant supplied water temperature.

Safeties
If the discharge air temperature drops below 36 degrees as sensed by the low temperature sensor, the unit shall be disabled and the outside and exhaust air dampers shall close.
If either the supply or return air duct smoke detectors is activated locally or through the general fire alarm input the unit shall be disabled and the outside and exhaust air dampers shall close.

SF3 is located in the sub-basement mechanical room along the west wall.

Supply Fan 4 System

Supply fan 4 system controls heating and cooling air flow to The Colorado Trust building perimeter of floors basement and 1st. Supply fan 4 fan system consists of one (1) 15 hp supply fan with interlocked and sequenced return air and outside air dampers. There is no return air fan associated with supply fan 4. Supply Fan 4 is equipped with hot and cold air decks. The hot deck is heated with city supplied steam and the cold deck is cooled with building generated chilled water.
Operation of this fan system is based on an occupied schedule of 6:30 am to 5:00 pm Tuesday through Friday and a start time of 6:00 am on Monday and is disabled on weekends and holidays

Fan OFF condition
N.O. Return air damper is open

N.C. Outside air damper is closed
N.C. Exhaust air damper
N.C. Steam valve is closed

Fan ON and mixed air temperature control
When the unit is enabled by a signal from the BAS (based on the occupied schedule) the outside and return air dampers shall go to their minimum position. The mixed air temperature sensor shall modulate the economizer dampers to maintain a mixed air temperature of 60 degrees when the average zone temp is >72 degrees or maintain a mixed air temperature of 70 degrees when the average zone temp is < 70 degrees. When the chiller plant is enabled, the unit dampers shall go to their minimum position.

Hot deck temperature control
The hot deck discharge air temperature shall be controlled and reset by the hot deck temperature sensor in accordance with the following reset schedule (adjustable).

Outside air temperature	Hot deck supply air temperature
0	105
60	70

Cold deck temperature control
With the Chiller plant disabled the cold deck air temperature control shall be the mixed air temperature as controlled by the mixed air sensor. When the chiller plant is enabled the economizer dampers will be modulated to their minimum position and the cold deck discharge air temperature shall be controlled by the chiller plant supplied water temperature.

Safeties
If the discharge air temperature drops below 38 degrees as sensed by the low temperature sensor (freeze-stat), the unit shall be disabled and the outside and exhaust air dampers shall close.
If either the supply or return air duct smoke detectors is activated locally or through the general fire alarm input the unit shall be disabled and the outside and exhaust air dampers shall close.

SF4 is located in the basement mechanical room on the north side of The Colorado Trust building.

Note: *All operational set-points and schedules are operator adjustable*