University of Washington
Seattle Main Campus

# Operations and Maintenance Program
# Campuswide Buildings

## University of Washington Seattle Main Campus

# Operations and Maintenance Program (6.2)

## Introduction

The Clean Buildings Performance Standards (CBPS) requires an active Operations & Maintenance Program (OMP) for public buildings in Washington. The OMP is campuswide and prioritizes preventive maintenance (PM) of assets so they meet their intended energy efficiencies throughout their service lives. The OMP is one part of a comprehensive approach that the University of Washington (UW) takes to manage energy and efficiency. Additional parts of the UW approach include a Decarbonization Plan and Energy Plan. They all complement each other.

In a large university setting like the University of Washington, buildings are considered collectively on a campus basis. This OMP helps the UW Seattle Main Campus maintain efficient energy-using systems, occupant comfort, and optimal performance. This plan documents operations and maintenance practices and procedures, including tenant improvement processes. Buildings are worked on over time and the work consists of current and future maintenance and future projects. Through annual equipment inspections, preventative maintenance to minimize equipment failure, and continuous improvement, UW Seattle Main Campus maintains its reputation in sustainability even as the campus expands in size and student population.

The UW works on improving buildings over time. During the past few years, a number of notable accomplishments have had us meeting efficiency objectives. Our efforts are ongoing. Some examples of projects include:

- Replacement of older lighting to the energy efficiency of LED.
- Standardized lighting controls and occupancy settings within building automation systems to maintain energy efficiency. Much headway has been made and it is an ongoing initiative.
- Street lighting control upgrade that allows for remote control and monitoring of street lights, enabling energy consumption tracking and adjustments through telemetry mobile app software to reduce energy use.
- One focus of the PM program involves monthly air filter checks of thousands of Air Handling Units to ensure the assets are running efficiently and avoiding drawing too much power because of dirty filters.
- Increased use of variable frequency drive (VFD) use in HVAC and plumbing systems to

control motor speeds with air changes within a building. A VFD PM program is in place to ensure longevity in motor life through minor fixes and avoiding large-scale disruptions.

- Installation of automatic window shades have been installed in new-generation buildings. Seasonal efficiencies are realized via heating and cooling through the use of glass windows and shades. As older buildings are renovated, automatic window shades are often a part of the improvement.
- Installation of solar panels on the roofs of newer and renovated buildings.
- Significant transition from fossil fuel vehicles to electric.
- Significantly increased installation of electric charging stations for vehicles, with 59 additional fleet chargers added since July 2025.

Future projects under consideration include:

- Upgrade/update switchgear, transformers, bus bars, and motor control centers (MCCs) to result in greater energy efficiencies.
- Power Plant transition of analog governors to digital governors to better monitor and control.

## Applicable Buildings

The practices and procedures in this Operations & Maintenance Program (OPM) is applied to all campus buildings. System approaches generally encompass buildings across the campus. The interconnectivity and sharing of many systems create energy efficiency. Sometimes the range of buildings can occur across the campus while others involve clusters of selected buildings.

### Overall Summary

| | |
|---|---|
| Number of Buildings | 176 |
| Average Gross Square Footage | 113,021 |
| Largest Building | 847,421 (stadium) |
| Smallest Building | 21,037 |
| Average Age | 51 years |
| Oldest Building | 139 years |
| Youngest Building | 3 years |

# Operations and Maintenance Implementation (6.3)

This OMP is established and implemented in accordance with Normative Annex I of the CBPS. The OMP is campuswide and prioritizes preventive maintenance (PM) of assets so they meet their intended energy efficiencies throughout their service lives. The OMP is one part of a comprehensive approach that the University of Washington (UW) takes to manage energy and efficiency. Additional parts of the UW approach include a Decarbonization Plan and Energy Plan. They all complement each other.

# Operations and Maintenance Tasks (6.4)

## Maintenance (6.4.1)

Equipment maintenance, including components and systems, is designed to meet applicable manufacturers' requirements. The objective is to minimize failures and maintain energy efficiencies. In the appendix of this OMP document, details are presented regarding preventive maintenance of building envelope, domestic hot water, HVAC, refrigeration, lighting, controls, and electric power distribution and on-site power generation.

## Safe and Reasonable Equipment Access (6.4.2)

Safe and reasonable access is provided to all equipment covered in this OMP for inspection, maintenance, and repairs.

### Building Use Changes (6.4.3)

Operations & Maintenance requirements are reevaluated when building use changes or renovations/alterations are made that affect the facility's operations.

## Tenant Improvements (6.5)

The campus has implemented a formal process to ensure that any tenant improvements involving a change in space use do not change the annual net energy use except to the extent that the annual net energy use change (increase or decrease) is consistent with any change in the building's energy target. Our Engineering Services department provides a Design Guide. Our Sustainability efforts use the Green Building Standards managed by our Asset Management group.

## Equipment and Component Replacement (6.6)

### HVAC, domestic water heating, refrigeration equipment, and appliance replacement (6.6.1)

HVAC, domestic water heating, refrigeration equipment, and appliances, when replaced, are replaced with energy-efficient equipment per our Engineering Services department assessments that meet or exceed federal standards, state equipment standards, and applicable building codes.

### Lighting Equipment Replacement (6.6.2.1 & 6.6.2.2)

When replaced, lighting equipment is replaced with energy-efficient equipment that meets or exceeds the most stringent energy efficiency requirements in the federal standards, state standards, and the applicable building code. Implementation of more efficient equipment is evaluated and included as specified for the capital management plan, Section 5.1.2.10.
The goal is that replacement lighting equipment does not increase the existing installed lighting power demand.

## Operations and Maintenance Program (L2)

Each building system has an OMP that preserves the condition of the system and its elements in a manner that enables the system to provide the intended thermal and visual comfort, energy efficiency, and helps to achieve the intended indoor environmental quality required for the building. For example,

our Shop 69 HVAC is included as a phase in work orders to verify the energy performance of systems.

The OMP contains an inventory of equipment, systems, and controls to be inspected and maintained and a maintenance plan describing the goals, objectives, and execution of the systems maintenance program.

## Inventory of Items to be Inspected and Maintained (L2.1)

The UW Facilities Seattle Campus maintains an up-to-date inventory of building systems and equipment items. Details on this inventory as well as performance objectives and condition indicators can be found below.

## Maintenance Plan Development (L2.2)

### Responsible Parties

The following maintenance activities are performed by several areas, including Maintenance & Construction's maintenance zones and Campus Energy, Utilities & Operations (CEUO). All maintenance activities are organized in an integrated workforce management system called AiM that integrates property, space, and asset management information into a real-time dynamic database. AiM is where required maintenance tasks are scheduled, monitored, and documented. The UWF Business Intelligence & Technology department is responsible for maintaining the functionality of the system. They can add new parameters and update existing procedures to meet our operational needs.

Maintenance activities are assigned to maintenance staff via work orders (WO) that are created and managed in the AiM system. Work orders are based on phases – from one to multiple – that are assigned to all appropriate areas of maintenance that need to do portions of the work. Once a maintenance activity is completed, the work order *phase* status changes from "active" to "work complete". After all phases indicate that work is complete, the *WO* status changes to "complete" and is sent for financial review for funding and final closure.

### Performance Objectives (L2.2.1)

The following systems are managed across campus buildings rather than on an individual building basis. The shared energy among buildings makes usage the most efficient. Systems include controls, electric power generation and distribution, heating/ventilation/air conditioning (HVAC), hot water, compressed air, and building envelope.

# Electric Power Distribution and On-Site Power Generation Systems

Campus Energy, Utilities & Operations (CEUO) provides continuous, reliable operations of building systems and the campus utilities infrastructure for the University of Washington. The department maintains and operates critical building systems including building environmental systems and controls and central clock systems. Campus Utilities produces steam, emergency electrical power, chilled water and compressed air for the Seattle campus.

## Heating, Ventilation, and Air-Conditioning (HVAC) Systems

Thermal comfort is achieved through constant adjustments to our thermal heating and cooling setpoints based on state and local energy protocols and occupant feedback. The targeted heating and cooling setpoints for occupied spaces are 70°F and 74°F, while the heating and cooling setpoints for unoccupied spaces are 55°F and 85°F. However, these setpoints can vary slightly between rooms depending on occupant comfort.

### Corrective Maintenance and Preventative Maintenance

Corrective maintenance is the maintenance performed after equipment failure, whereas preventive maintenance is scheduled maintenance performed prior to signs of equipment failure or degradation.

### Condition Indicators (L2.2.2)

All energy-using equipment components in state-funded buildings were inspected and scored by ISES Consulting. Each component was given a condition score based on life cycle costing, including a useful life estimate, a replacement cost. Good maintenance can extend its life, whereas no maintenance can shorten its life. These reports are used alongside our OMP to help the maintenance teams prioritize preventative maintenance for each building and equipment system. The maintenance teams are also responsible for maintaining future condition scores in our AiM system.

### Inspection and Maintenance Tasks (L2.2.3)

Inspection and maintenance tasks for inventoried equipment, systems, and controls have been reported in the Appendix. Inspections include the physical assessment of system components and

may include measurement of operating parameters and data provided by sensors or a building management system (BMS).

### Maintenance Task Frequencies (L2.2.4)

Preventive Maintenance (PM) templates are established for each asset type. The templates outline procedures to use while performing maintenance checks. Frequency of these PMs vary and can be once per week, once per month, quarterly, twice per year, annually, every three years, or every five years.

### Documentation (L2.2.5)

Inspections and maintenance documentation resides in the following locations: AiM Asset Management, Corrective Work Order Management, and Preventive Management modules. Reports are available to be pulled regarding checkpoints used for assets and systems per building as needed. The available information includes a section titled "related documents" per work order that contains documents about the work performed Tracked information includes:

1. Building systems and system components with associated performance criteria pertinent to the facility are in the Asset Management Module.
2. Inspections, Maintenance Tasks and tracking via templates are in the Preventive Maintenance Module.
3. Assets/buildings operating beyond their useful life are tracked in the Planning and Needs Analysis (ANA) Module.
4. Sufficient record detail and verification to demonstrate implementation of the maintenance plan are in the Asset Management Module and Preventive Maintenance Module.
5. Emergency Information is tracked in the Property Module and/or as a "related document" in any module.

### Maintenance Plan Authorization and Execution (L2.3)

Inspection and maintenance tasks listed in the Appendix are performed on an established frequency or upon documented observance of unacceptable conditions. The execution of the task is documented and archived for future reference.

### Revision of the Maintenance Program (L2.4)

This Operations & Maintenance Program shall be reviewed and revised in the event of the following situations:

1. Modifications to the building that impact building system performance objectives have occurred.
2. The building function or its use has changed in a way that impacts building

system performance objectives. Our CEUO department is responsible for systems performance documentation.

3. Building system component changes have occurred. Our Maintenance & Construction department performs the maintenance and tracks corrective work orders that make changes to systems.
4. One or more systems are found to be incapable of achieving their performance objectives.
5. Upon documented recommendation from the maintenance provider.

# Appendix

## Building Envelope

This system includes doors, roofs, walls, and windows. These components act as barriers against outside elements like moisture and humidity to preserve the indoor environment of a building.

### Door Operator & Pressure Inspection, Annual, PM

1. Check with operating or area personnel for deficiencies.
2. Check for proper operation, binding or misalignment; adjust as necessary.
3. Check and lubricate door guides, pulleys, and hinges.
4. Inspect and lubricate motor gearbox, drive chain (or belt), and motor; adjust as necessary.
5. Check operation of limit switch; adjust as necessary.
6. Check electrical operator, wiring, connections and contacts; adjust as necessary.
7. Clean area around door.
8. Fill out maintenance checklist and report deficiencies.

### Roof, Annual, PM

1. Check for safe access.
2. Ensure the roof is free of debris and vegetation if applicable.
3. Clear gutter.
4. Check flashing, vents, and drainage systems.
5. Check for physical damage such as holes, punctures, blisters in membrane material if applicable.
6. Check for structural deformation.
7. Check for material pulling away from the roof.
8. Check for puddles of standing water if applicable.

## Controls Systems

Controls Systems include all types of control and energy management systems and components used to control conditioned spaces within buildings. The O&M requirements for these systems and their components should minimize energy use over time while providing control of equipment and systems as needed for building operations and occupant needs. The O&M requirements for these systems should be reevaluated when building use or other changes are made that negatively affect the systems' operations.

### Panel Board, Annual PM

1. Check for safe equipment access. Isolate equipment and lock out if needed.
2. Check for proper clearance in the front panel. Vacuum and remove debris from space near panel.
3. IR Imaging: Remove panel front and scan the panel with IR camera. Save the results to the phase of the work order. (Compare to previous results, if available.)

**Security, Intrusion Alarm System, Annual PM**

1. Check in and out with area security officer, notify operating/facility personnel, obtain necessary alarm keys, alarm codes and escort when required.
2. Inspect alarm control panel and conduct operational test of initiating and signal transmitting devices; make minor adjustments as required.
3. Check indicating lamps for proper operation, replace if necessary.
4. Check battery voltages where installed, replace as required.
5. Restore system to proper operating condition and notify personnel upon completion of tests.
6. Clean exterior of cabinet and surrounding area.
7. Fill out maintenance checklist and report deficiencies.

**Controls, Central System, Electro/Pneumatic, Annual PM**

1. With panel disconnected from power source, clean patrol panel compartment with a vacuum.
2. Inspect wiring/components for loose connections; tighten, as required.
3. Check set point of controls temperature, humidity or pressure.
4. Check unit over its range of control.
5. Check for correct pressure differential on all two position controllers.
6. Check source of the signal and its amplification on electronic controls.
7. Check air systems for leaks; repair as necessary.
8. Check relays, pilot valves and pressure regulators for proper operation; repair or replace as necessary.
9. Replace air filters in sensors, controllers, and thermostats as necessary.
10. Clean area around equipment.
11. Fill out maintenance checklist and report deficiencies.

**Building Automation System UPS Supervisory Controllers, Annual PM**

1. Check in with site contact person.
2. Perform safety walkdown and verify safe access to UPS.
3. Document all work performed. Enter notes in Extra Description.
4. Access front display panel. Check battery charge status. If battery is less than 90%, wait until battery is fully charged before proceeding.
5. Perform UPS self-test from the TEST and DIAGNOSTIC menu.
6. Check for alarms. If any are found, refer to Original Equipment Manufacturer for resolution.

7. Check out with site contact.

## Domestic Hot Water Systems

Domestic hot water systems refer to the systems involved in the generation and distribution of hot water for domestic use within a building.

### On Demand Hot Water Heater, Steam, Domestic Hot Water Converter, Semi-Annual PM

1. Check in with site contact person.
2. Perform safety walkdown and verify safe access to equipment.
3. Isolate equipment & initiate Lock Out Tag Out (LOTO) when applicable.
4. Check control valves for proper operation.
5. Check solenoid safety system for proper operation.
6. Check for proper output temps and recalibrate if needed.
7. Lift LOTO if applicable.
8. Verify unit is operational and online.
9. Perform good housekeeping/tools.
10. Check out with site contact.

### On Demand Hot Water Heater, Steam, PLUMBERS, Domestic Hot Water Converter, Semi-Annual PM

1. Check in with site contact person.
2. Perform safety walkdown and verify safe access to equipment.
3. Isolate equipment & initiate Lock Out Tag Out (LOTO) when applicable.
4. Check circulating pump for proper operation.
5. Check pressure and temperature gauges for proper operation.
6. Check for leaks in unit housing.
7. Check inlet, outlet and return lines for leaks.
8. Inspect pressure relief valve.
9. Clean strainers.
10. Check vacuum breaker and over temp switch alarm.
11. Check steam traps for proper operation.
12. Lift LOTO.
13. Verify unit is operational and online.
14. Chek out with site contact.

### Expansion Tank Maintenance, Annual PM

1. Check equipment for safe access, Lock Out Tag Out (LOTO) as needed.

2. Check and record pre-charge pressure (if available).
3. Check and record system pressure prior to the expansion tank.
4. Check and record system pressure after expansion tank (if available).
5. Record fluid temperature (if available).
6. Check air separator for leakage. Check the separator drain valve. Check the air eliminator for proper operation.
7. Check the isolation valves for leaks. Check the isolation valves for proper operation. Check strainer for debris and clean as needed.

### Water Heater, Gas, Semi-Annual PM

1. Check with operating or area personnel for deficiencies.
2. Check for water leaks to tank and piping. Check for fuel system leaks.
3. Check gas burner and pilot for proper flame; adjust if required.
4. Check operation and condition of pressure relief valve.
5. Check automatic controls for proper operation (temperature regulators, thermostatic devices, automatic fuel shut off valve, etc.).
6. Check draft diverter and clear openings, if clogged.
7. Check electrical wiring for fraying and loose connections on oil burner.
8. Check for proper water temperature setting; adjust as required.
9. Check condition of flue pipe, and chimney.
10. Clean up area around unit.
11. Fill out maintenance checklist and report deficiencies.

## Electric Power Distribution and On-Site Power Generation Systems

This section covers building electrical power systems that relate to a facility's energy efficiency.

### Automatic Transfer Switch, Annual PM

1. Make the transfer switch equipment safe for inspection and/or maintenance. Disconnect the line power from the equipment being serviced by opening the next highest disconnect device. Make certain that any accessory control power is switched off.
2. Inspect the structure area for safety hazards or potential maintenance problems. Inspect the area, especially where the contractor is installed, for any safety hazards, including personal safety and fire hazards.
3. Inspect the contractor for dust, dirt, soot, grease, moisture, or corrosion,
4. Check for material integrity, uneven wear, discoloration, or loose hardware. Severe material cracking will require replacement, and loose hardware will need to be tightened.
5. Check the terminals and connectors for looseness or signs of overheating. Overheating will show as discoloration, melting or blistering of the conductor insulation. Connections that do not have signs of

looseness or overheating should not be disturbed.

6. Exercise the contractor if it is not often exercised while in operation. This will permit the wiping action by the contacts. If a switching device is used for frequent switching during normal operation, this step can be disregarded.
7. Return the transfer switch equipment to service. Make certain all barriers are in place, and the door is closed. Re-apply generator (Source 2) and utility (Source 1) power.

**Emergency Diesel or Gas Generator, up to 15 KVA, Annual PM**

1. Check with the operating or area personnel for any obvious deficiencies.
2. Check engine oil level. Add as required.
3. Change engine oil and oil filter.
4. Check battery charge and electrolyte specific gravity. Add water as required. Check terminals for corrosion. Clean as required.
5. Check belt tension and wear. Adjust as required, if applicable.
6. Check engine air filter. Change as required.
7. Check spark plug or injector nozzle condition. Service or replace as required.
8. Check wiring, connections, switches, etc. Adjust as required.
9. Perform 30-minute generator test run. Check for proper operation.
10. Check fuel level. Add as required.
11. Wipe dust and dirt from engine and generator.
12. Clean area around generator.
13. Fill out maintenance checklist and report deficiencies.

**Emergency Diesel or Gas Generator, up to 15 KVA, Monthly PM**

1. Check with the operating or area personnel for any obvious deficiencies.
2. Check engine oil level. Add as required.
3. Check battery charge and electrolyte specific gravity. Add water as required. Check terminals for corrosion. Clean as required.
4. Check belt tension and wear. Adjust as required, if applicable.
5. Check wiring, connections, switches, etc. Adjust as required.
6. Perform 30-minute generator test run. Check for proper operation.
7. Check fuel level. Add as required.
8. Wipe dust and dirt from engine and generator.
9. Clean area around generator.
10. Fill out maintenance checklist and report deficiencies.

**Emergency Diesel Generator, Turbine, Annual PM**

1. Check with the operating or area personnel for any obvious deficiencies.
2. Check turbine oil level. Add oil as required.
3. Change turbine oil and oil filter. Check transmission oil level.
4. Check that the crankcase heater is operating properly.
5. Replace turbine air filter.
6. Check wiring, connections, switches, etc. Adjust as required.
7. Check starter for proper operation. Lubricate as necessary.
8. Check fuel nozzles, fuel regulator and ignition device condition. Service or replace as required.
9. Perform 30-minute generator test run. Check for proper operation.
10. Check and record transmission oil pressure and temperature, and natural gas pressure:
    - Oil pressure: ____
    - Oil temperature: ____
    - Gas pressure: ____
11. Record running time:
    - Beginning: ____ hours
    - Ending: ____ hours
12. Check that the charger is operating properly.
13. Check for any signs of corrosion on battery terminals or wires.
14. Check the electrolyte level in the batteries. Add if required.
15. Check the specific gravity of the electrolyte in a 10% sample of the batteries.
16. Check 25% of terminal-to-cell connection resistance. Rehabilitate connections as required. Add anti-corrosion grease to battery terminals and connections.
17. Measure and record individual cell and string float voltages.
18. Clean area around generator.
19. Fill out maintenance checklist and report deficiencies.

**Transformer, Dry Type, Annual PM**

1. Check in with site contact person.
2. Perform safety walkdown and verify safe access to transformer.
3. Isolate transformer and initiate Lock Out Tag Out (LOTO) when applicable.
4. Examine the exterior of the transformer for any damage.
5. Remove the covers or open the doors.
6. Check for signs of moisture or overheating.
7. Check for voltage creeping over insulated surfaces, such as evidenced by tracking or carbonization.
8. Check fans, motors and other auxiliary devices for proper operation, where applicable.

9. Check the condition of the ground system.
10. Replace the covers or close the doors.
11. Fill out maintenance checklist and report deficiencies.
12. Lift LOTO.
13. Perform good housekeeping/tools.
14. Check out with site contact.

### Variable Frequency Drive Maintenance, Annual PM

1. Check for safe equipment access.
2. Isolate and lock out equipment when needed.
3. Note any abnormal vibration or noise. Verify the overall operation. Check LEDs. Check internal axial exhaust fan. Check faults through display. Check ventilation fan operation.
4. Record voltage.
5. Record amperage.
6. Check all termination in control panel. Where pneumatic, exercise controls. Where DDC, notify control shop to exercise controls.
7. Inspect and tighten terminals. Vacuum out accumulated dust/debris. Clean ventilation fans.

## Heating, Ventilation, and Air-Conditioning (HVAC) Systems

This section includes HVAC systems and components used to condition spaces within buildings. These maintenance tasks minimize energy use over time, while providing heating, ventilation, and cooling as needed for building operations and occupant needs.

### Air Compressor, Reciprocating (Machine), Annual PM

1. Check oil level. Maintain between High and Low level marks on the gauge. CAUTION: Do not overfill.
2. Drain moisture accumulation from the air receiver.
3. Drain drop legs in air distribution system.
4. Give compressor an overall visual inspection and be sure the safety guards are in place.
5. Check for any unusual noise or vibration.
6. Check for oil leaks.
7. Operate the safety valves to be certain they are functioning.
8. Clean the cooling surfaces of the intercooler, aftercooler, and compressor.
9. Replace or clean air intake filter. Check more often if dirty condition exists.
10. Check the air distribution system for air leaks.
11. Inspect oil for contamination and change if necessary.
12. Check belt tension.
13. Check pulley and pulley clamp screws or set screws for tightness.

14. Inspect compressor valves.
15. Inspect pressure switch diaphragm and contacts. Inspect contact points in motor starter.

**Air Compressor, Reciprocating (Electrical), Annual PM**

1. Check amperage and record results.
2. Check voltage and record results.
3. Check starter and contactors.

**Split System Heat Pump / Heat Pump Water Source, Annual PM**

1. Check in with site contact person.
2. Perform safety walkdown. Check for safe equipment access.
3. Isolate equipment and initiate Lock Out Tag Out (LOTO) when applicable.
4. Document work done during inspection. Enter notes in Extra Description.
5. Operational Overview: Note current outside air temperature and weather conditions.
6. Operational Overview: Verify overall operation. Check heating/cooling operation.
7. Operational Overview: Check/record supply air temperature.
8. Operational Overview: Check/record return air temperature.
9. Operational Overview: Note any abnormal vibration or noise.
10. Compressors: Note cleanliness/condition.
11. Compressors: Record operating voltage.
12. Compressors: Record operating amps.
13. Compressors: Check crankcase heater.
14. Compressors: Check for refrigerant/oil leaks.
15. Compressors: Check crankcase oil level.
16. Refrigeration System: Verify reversing valve operation.
17. Refrigeration System: Verify metering device operation.
18. Refrigeration System: Check cap tube condition.
19. Refrigeration System: Check for refrigerant/oil leaks.
20. Refrigeration System: Check sight glass.
21. Controls: Check all terminations in control panel.
22. Controls: Exercise controls.
23. Controls: Check safeties and trip points.
24. Controls: Check ambient controls.
25. Controls: Check operation of water reg valve.
26. Supply Fan Section: Inspect bearings for excessive wear and end play. Tighten set screws.
27. Supply Fan Section: Adjust pulleys and belts.

28. Supply Fan Section: Record operating volts.
29. Supply Fan Section: Record operating amps.
30. Supply Fan Section: Inspect fan blade and tighten set screws.
31. Supply Fan Section: Lubricate fan and motor.
32. Indoor Coils: Note cleanliness of coils. Add to Extra Description.
33. Indoor Coils: Record Delta P across coil.
34. Indoor Coils: Record Delta T across coil.
35. Indoor Coils: Check for refrigerant leaks.
36. Indoor Coils: Check condensate plan and drain.
37. Filter section: Note filter condition.
38. Filter section: Change filters per schedule.
39. Filter section: Note condition of outside air filters/screens.
40. Heating section: Inspect controls and sequencer operations.
41. Heating section: Record voltage.
42. Heating section: Record amperage.
43. Heating section: Check overload and safeties.
44. Heat Exchanger (Waterside Coil): Record Delta P across coil.
45. Heat Exchanger (Waterside Coil): Record Delta T across coil.
46. Heat Exchanger (Waterside Coil): Check for refrigerant leaks.
47. Perform good housekeeping/tools. Check for safe equipment access.
48. Lift LOTO if applicable.
49. Verify unit is back online and operating properly.
50. Check out with site contact person.

**Refrigerated Air Dryer, Annual PM**

1. Check in with site contact person.
2. Perform safety walkdown. Verify safe access to unit.
3. Note: Before attempting any maintenance operation on the dryer, shut it down and wait at least 30 minutes. Some components can reach high temperature during operation. Avoid contact until system or component has dissipated heat.
4. Isolate dryer and initiate Lock Out Tag Out (LOTO) when applicable.
5. Inspect refrigerating circuit for signs of oil and refrigerant leakage.
6. Inspect flexible hoses and replace if necessary.
7. Lift LOTO.
8. Verify operation of the machine.
9. Perform good housekeeping/tools.
10. Check out with site contact person.

### Air Handling Unit (Mechanical), Annual PM

1. Inspect the casing panels for corrosion and gaskets. Check the Plug Fans friction and balancing. Check that the anti-vibration mounts are secure.
2. Inspect the outdoor grille. Ensure that it is mounted properly. Check for air flow obstruction and remove debris.
3. Check and record the filter pressure gauge.
4. Check the dampers for proper operation, mobility and tightness.
5. Inspect the Condensate Pan for corrosion and cleanliness. Clean as necessary.
6. Inspect the Sound Attenuator for tearing and cleanliness. Repair tears as necessary.
7. Inspect the coils for leaks, air bleed, fin fouling, and corrosion. Clean if dirty. Check the siphon for cleanliness. Verify the operation of the valves.
8. Check and record the glycol concentration, depending on the temperature.
9. In the Wheel Heat Recovery Unit, test the operation of the motor. Inspect belts for tension or wear, and the correct seating of gaskets on the wheel. Check the fins for corrosion and fouling level, and the operation of the treads.
10. For the Plate Recovery Unit, check the fouling level.
11. Check the frost protection of the water coils by testing the thermostat operation.

### Air Handling Unit (Electrical), Annual PM

1. Check the electrical connections and operation of heating elements and thermostats.
2. Check operating amperage and record results.
3. Check operating voltage and record results.

### Air Handling Unit (Controls), Annual PM

1. Check the servomotor for operation and end of travel positions.
2. Examine outside air intakes and write corrective work orders as needed.
3. Check all terminations in control panels.
4. Exercise all controls and confirm operation.
5. Check unloader operation.
6. Check for unreliable or out of range inputs.
7. Exercise all outputs.
8. Run through sequence checks.

### Boiler Gas, Annual PM

1. Inspect for fouling or scaling. If there is a marked increase in pressure drop and/or reduction in performance, a cleaning is necessary.
2. To clean inside of tubes, remove all heads and covers. Caution: Do not loosen heads until you are sure all pressure is off the equipment and the unit is drained.

3. When cleaning a tube bundle, tubes should not be hammered on. If it is necessary to use scrapers, take care to ensure that the tubes are not damaged.
4. Before it is necessary to apply mechanical means for cleaning, try to clean the unit using the following methods:
   a. Circulate hot fresh water at a reasonable velocity
   b. Try spraying with a water hose
   c. Consult with manufacturers of cleaning company.
5. Do not clean tubes by blowing steam through individual tubes.
6. To tighten a loose tube joint, use a suitable roller type tube expander. Do not roll tubes that are not leading. If double wall tubes are supplied, return to the factory for repairs.
7. If the unit is dismantled for any reason, it should be reassembled using new gaskets.
8. Do not tighten bolts until gaskets are properly seated.
9. Exterior of unit should be cleaned and, if necessary, repainted.
10. When tightening bolts in the element head, tighten the bolts in a crisscross pattern. This will evenly distribute pressure around the flange and help prevent warping.
11. If unit is supplied with anode rod, inspect if for excessive wear.
12. Packing on valves and regulators should be checked for leaks and repaired or replaced as necessary.
13. Drain and flush the tank as follows:
    a. Shut down the unit.
    b. Close valve on hot water outlet piping.
    c. Open valve on drain piping.
    d. Cold water inlet line pressure will be strong enough to flush sediment from the bottom of the tank out through the blow-down valve of the pressure vessel.

**Air Cooled Chiller (Refrigeration), Annual PM**

1. Check in with site contact person.
2. Check for safe equipment access.
3. Verify operation, document performance and deficiencies in Extra Description of checkpoint log.
4. Record run time.
5. Record start counts.
6. Check and record evaporator pressure.
7. Check a record chilled water temperatures.
8. Check refrigerant charge.
9. Check and record superheat.
10. Check and record sub cooling.
11. Check and record condenser pressure.
12. Check and record condenser temperatures.
13. Check sight glass.

14. Review microprocessor alarm history.
15. Review microprocessor programming.
16. Check pressure switches for leaks.
17. Check pressure relief valves and check all safeties.
18. Check all contacts, including the starter contact, for wear or pitting.
19. Check and record amperages.
20. Check and record voltages.
21. Check for loose or burnt wiring.
22. Check and torque all electrical connections.
23. Check overloads.
24. Check condenser and fans for vibration, and visually inspect fan blades for cracks, fan clearance, mounting bolts, coils for dirt buildup and coils for leaks. Verify proper fan rotation and visually check bearing, collar, sheave and pulley.
25. Lubricate fan motor as required.
26. Check evaporator for leaks and inspect the expansion valve for proper operation. Check the liquid line filter dryer.
27. Visually inspect the compressor for leaks and check the crankcase heater operation.
28. Check and record the compressor oil pressure.
29. Check and record the compressor oil level.
30. Lube motor bearings as required.
31. Check all hold down bolts on the drive motor, and check end bells for dirt and debris. Clean if necessary.
32. Check and record compressor SPM.
33. Clean condenser coils.
34. Open and inspect evaporator tubes.
35. Eddy current evaporator tubes.
36. Check internal interlocks.
37. If the unit does not have Automatic Leak Detection, perform sniffer tests around units and lines to ensure that no leaks are found. If leaks are found, report loss of refrigerant. Note where the leak is and make necessary repairs.
38. Wipe off excess lubricants. Clean up work area.
39. Check out with site contact person.

**Air Cooled Chiller (Controls), Annual PM**

1. Check all terminations in the control panels. Exercise controls and confirm operation. Check and clean debris from cabinets.
2. Check unloader operations. Check for unreliable or out of range inputs. Exercise all outputs.
3. Run through sequence checks.

4. If the unit does not have Automatic Leak Detection, perform sniffer tests around units and lines to ensure that no leaks are found. If leaks are found, report loss of refrigerant. Note where the leak is and make necessary repairs.
5. Wipe off excess lubricants. Clean up work area.
6. Check out with site contact person.

### Heat Recovery Chiller (Electrical), Quarterly PM

1. Check all external interlocks. Inspect compressor terminals. Check compressor crankcase heater operation. Tighten all contactor, relay and circuit breaker terminals. Check and calibrate all compressor safety controls.
2. Check and record compressor voltages.
3. Check and record compressor amperages.
4. Check and record pump amperages.
5. Check and record condenser fan amperages.
6. Inspect relay contacts for damage or pitting.
7. If the unit does not have Automatic Leak Detection, perform sniffer tests around units and lines to ensure that no leaks are found. If leaks are found, report loss of refrigerant. Note where the leak is and make necessary repairs.
8. Wipe off excess lubricants. Clean up work area.
9. Check out with site contact person.

### Heat Recovery Chiller (Refrigeration), Quarterly PM

1. Check and record refrigerant sub-cooling.
2. Check and record refrigerant superheat.
3. Check liquid solenoid valves. Check expansion valve and sensing bulb connections.
4. If the unit does not have Automatic Leak Detection, perform sniffer tests around units and lines to ensure that no leaks are found. If leaks are found, report loss of refrigerant. Note where the leak is and make necessary repairs.
5. Wipe off excess lubricants. Clean up work area.
6. Check out with site contact person.

### Heat Recovery Chiller (Mechanical), Quarterly PM

1. Clean the pump and heat exchanger strainers. Remove header caps and clean the entering chilled water and entering condenser water strainers. Note: Annually, clean condenser strainer.
2. Check system chilled water glycol, inhibitor content.
3. If the unit does not have Automatic Leak Detection, perform sniffer tests around units and lines to ensure that no leaks are found. If leaks are found, report loss of refrigerant. Note where the leak is and make necessary repairs.
4. Wipe off excess lubricants. Clean up work area.

5. Check out with site contact person.

**Plate and Frame Heat Exchanger, Annual PM**

1. Check in with site contact person.
2. Perform safety walkdown. Check for safe equipment access.
3. Document work done during inspection. Add notes to Extra Description.
4. Check temperature gauges for proper operating temperatures.
5. Check steam modulating valve for proper operation.
6. Check steam condensate trap for proper operation.
7. Inspect heat exchanger for torn/deteriorated insulation.
8. Inspect adjacent piping for torn/deteriorated insulation.
9. Report deficiencies. Add notes to Extra Description.
10. Record inlet Delta T temperatures.
11. Record outlet Delta T temperatures.
12. Blow down mud legs and record observed findings. Add notes to Extra Description.
13. Exercise controls, damper valves, and temperature sensors.
14. Perform good housekeeping/tools.
15. Check out with site contact person, if applicable.

**Unit Heater, Annual PM**

1. Check in with site contact person.
2. Perform safety walkdown. Verify safe access to unit.
3. Isolate equipment and initiate Lock Out Tag Out (LOTO) when applicable.
4. Note current outside air temperature and weather conditions.
5. Verify overall operation.
6. Check heating operation.
7. Check/record supply air temperature.
8. Note any abnormal vibration or noise.
9. Change air filters as needed.
10. Inspect fan blade.
11. Verify proper operation of fans.
12. Lubricate fan and motor.
13. Check belt tensions and wear.
14. Inspect bearings for wear and deterioration.
15. Lift LOTO when applicable.
16. Perform good housekeeping/tools.

17. Verify overall operation.
18. Check out with site contact person.

### Vacuum Pump, Annual PM

1. Operate the pump for approximately ten minutes to warm the oil, then switch the pump off.
2. Isolate the pump from the electrical supply and disconnect from the vacuum system.
3. Drain the oil. If the oil is dirty or contaminated, pour clean oil into the pump and allow it to drain out. Repeat this step until the oil reservoir is clean.
4. Refit the drain plug and reconnect the pump to the vacuum system. Add oil until the oil level reaches the Max level on the bezel of the sight glass. Allow a few minutes for the oil to drain into the pump. If necessary, add more oil.
5. Inspect and clean the inlet filter. Unscrew the inlet adaptor and remove the inlet filter and O-ring.
6. Wash the filter in a suitable cleaning solution. Allow the filter to dry. Once dry, reassemble.
7. Clean or replace the gas ballast O-ring. Unscrew and remove the gas ballast control. Remove the O-ring from the control. Wash the O-ring in a suitable cleaning solution. Replace if the O-ring is damaged. Replace the O-ring carefully on its seat.
8. Screw the gas ballast control back into the pump and reset to the required position. Clean the motor fan cover and enclosure. While the pump is off and disconnected from the electrical supply, use a dry cloth and soft brush to remove dirt and deposits.
9. Lift LOTO if applicable.
10. Verify pump functions properly.

### Condensate Pump Maintenance (Mechanical), Annual PM

1. Check for safe equipment access.
2. Lock Out Tag Out (LOTO) if needed.
3. Check the pump capacity.
4. Check and record the pump pressure.
5. Check the pump power.
6. If the pump's performance does not satisfy your process requirements, and the process requirements have not changed, then disassemble the pump. Inspect it. Replace worn parts. Record date if replacement parts are installed.

### Condensate Pump Maintenance (Electrical), Annual PM

1. Check and record amperage.
2. Check and record voltage.
3. Inspect and clean connections.

### Circulating Pump (Mechanical), Annual PM

1. Verify operation. Note any abnormal vibration or noise in the Extra Description box in the checkpoint measurement.

2. Record pump discharge pressure, if practical.
3. Record pump suction pressure, if practical.
4. Check safeties for any loose or burned wiring. Check all trip points.
5. Lubricate motor bearings and solid coupling, if needed.
6. Exercise isolation valves and check them for leaks.
7. Inspect the drive motors. Check for dirt and debris around the end bell. Check the motor fan and check all hold down bolts for tightness.
8. Inspect the drive components. Check the coupling alignment. Ensure the coupling guard is secure.
9. Check the pump packing or mechanical seals for leaks. Repack if needed. Inspect gaskets for leaks or deterioration. Check all hold down bolts. Verify impellor clearance.

### Circulating Pump (Controls), Annual PM

1. Check all terminations in the control panels.
2. Check level controls for proper operation.
3. Check temperature sensor.
4. Check for lead-lag pump failure.
5. Pneumatic Systems: Check for air leaks.
6. DDC Systems: Check inputs and outputs.

### Circulating Pump (Electrical), Annual PM

1. Check electrical contacts for wear and pitting.
2. Check starter contactors.
3. Check and tighten electrical connections.
4. Check amperage and record results.
5. Check voltage and record results.

### Supply Fan (Mechanical), Semi-Annual PM

1. Check for safe equipment access.
2. Isolate and Lock Out Tag Out (LOTO) if needed.
3. Verify the operation of unit. Note any abnormal vibration or noise.
4. Check and record fan speed.
5. Check drive motor for dirt and debris around end bell. Check the motor cooling fan. Check the motor mounting fasteners. Check bearings for wear and end play.
6. Check fan for correct rotation during wind down. Check and clear fan obstructions and debris. Check fan blades for cracks and dirt buildup. Check fan to housing clearances. Tighten bearing collar screw sets. Check rain guard.
7. Check sheaves for wear. Check sheave set screws. Check drive belts for wear and cracking. Verify sheave and belt guard alignment. Check bearings for wear and end play.

8. Lubricate motor and fan bearings. Wipe off any excess lubricants.

### Supply Fan (Controls), Semi-Annual PM

1. Check all terminations in the control panels.
2. Exercise dampers.
3. Exercise start/stop.

### Supply Fan (Electrical), Semi-Annual PM

1. Check all safeties trip points. Check for loose or burnt wiring.
2. Check electrical contacts for wear and pitting.
3. Check and tighten electrical connections.
4. Check and calibrate overloads.

## Lighting

This section includes lighting involving pathways and emergency exits.

### Emergency Lighting Testing, Annual PM

1. Inform maintenance supervisor and building manager that maintenance is being done.
2. Visually inspect emergency exit lights for damage or bad battery light. Record results.
3. Place magnet on test point to verify that light switches to battery mode. Note any that do not switch modes.
4. Turn off power to emergency lights at breaker and verify that emergency lights come on. Note any that do not. Restore power.
5. Submit a repair work order for any issue noted during testing and inspection.

### Pathway Lighting, Egress Lighting, Battery Check, Annual PM

1. Check in with site contact person.
2. Perform safety walkdown. Check for safe equipment access.
3. This procedure assumes that the pathway lights to be tested have been on AC power for at least 2 hours and that the batteries are fully charged.
4. All pathway lights on a floor level are powered from a single circuit breaker located in a panel on the same floor. Locate the panel and the circuit breaker. Make note of the start time of the test.
5. Open the circuit breaker serving the pathway lighting.
6. Begin a floor round to observe the pathway lighting. Where equipped, the red LED indicators should be off, the LED board should be on, and the lamps should be on.
7. Note fixtures out for corrective work order.

8. After 60 minutes, make a second round and confirm that all lights are in the same condition as at the start of the test.
9. Note fixtures out for corrective work order.
10. Return to the breaker panel and close the previously opened breaker serving the lights.
11. Perform a round to confirm return to normal. Where equipped, the LED indicator light should come back on, the LED board should stay on, and the lamps should turn off.
12. Perform good housekeeping.
13. Check out with site contact person.