Energy Program
WASHINGTON STATE UNIVERSITY

Clean Buildings—Getting to Efficiency Webinar 4

Operations and Maintenance for Clean Buildings

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WSU Energy Program

June 9, 2021

Audio and Questions

Join audio:

- Choose "Telephone" and dial using the information provided (ADD PIN NUMBER)

OR

- Choose "Mic & Speakers" to use Computer Audio

Questions/comments:

- Submit questions and comments via the Questions Panel throughout the webinar
- Q&A will be held after the presentation

Recording

- This webinar is being recorded and will appear within a few days at:

http://www.energy.wsu.edu/PublicFacilitiesSupport/ResourceConservation

Thank You

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Thank you to Neil Bavins for developing the webinar series!

Clean Buildings – Getting to Efficiency Webinar Series

- Efficiency Through the Clean Buildings Performance Standard (CBPS)
  - 3/30/21
- Tune-ups for Clean Buildings
  - 4/21/21, 11:30 am
- Energy Management Plans for Clean Buildings
  - 5/19/21, 11:30 am
- **Operations & Maintenance for Clean Buildings**
  - **6/9/21, 11:30 am**

http://www.energy.wsu.edu/PublicFacilitiesSupport/ResourceConservation

Terms & Abbreviations

- The Standard or CBPS = Washington State Clean Buildings Performance Standard
- ASHRAE = American Society of Heating, Refrigeration and Air-Conditioning Engineers
- ASHRAE Standard = ASHRAE 100-2018 Standard
- AHJ = Authority Having Jurisdiction = Commerce
- Commerce = Washington State Department of Commerce
- EMP = Energy Management Plan
- O&M = Operations and Maintenance
- EEMs = Energy Efficiency Measures (asset improvement measures)
- ECMs = Energy Conservation Measures (O&M measures)
- EUI = Energy Use Intensity as kBtu/gsf/yr
- EUIt = Energy Use Intensity Target
- WNEUI = Weather Normalized EUI
- GSF = Gross Square Feet, also gross floor area, measured to exterior walls, excluding parking
- kBtu = kilo (thousand) British thermal units, a common energy unit used for different sources such as kWh (kilowatt hours) and therms

Requirements of the Clean Buildings Performance Standard

- Energy Management Plan (EMP)
- Operations & Maintenance (O&M) Program
- Compliance through one of these performance metrics:
  - Meet Energy Use Intensity Target (EUIt)
  - Implement All Cost-effective Energy Efficiency Measures

The O&M program must be implemented at least one year prior to compliance date!

WA Department of Commerce Clean Buildings Web Page

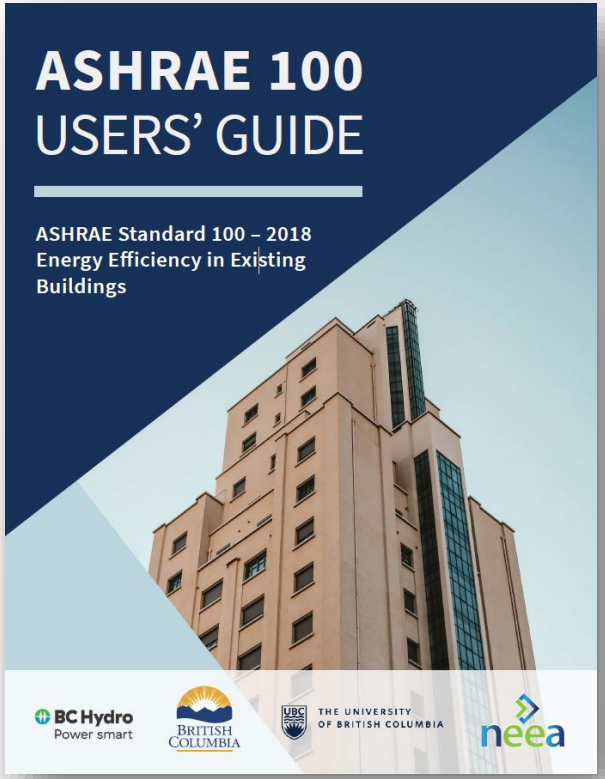
https://www.commerce.wa.gov/growing-the-economy/energy/buildings/

- Links to Legislation and Reference Standards
- Early Adopter Incentive Program
- Determining if your Building Must Comply
- Steps to Comply
- Personnel Roles
- Resource and Support Links
- Links to Trainings, ENERGY STAR Portfolio Manager Trainings
- Building Owner Portal (coming July)

Contact your utility – they may have resources and incentives to help comply with the Standard

Additional Resource

- 96 page users guide, avail. 5/10/21
- Not an ASHRAE publication
- Supports ASHRAE 100
- Does not reflect all CBPS amendments
- Explains core concepts
- Provides helpful process flow charts
- Organizes the Standard by roles
  - Owner, Qualified Person, Energy Mgr., etc.



Available to download at NEEA website:

- https://neea.org/resources/ashrae-100-users-guide

- A single combined standard is being created
- Available free of charge by July 1, 2021 on the Commerce Clean Buildings website
- The ASHRAE Standard combined with Clean Buildings Performance Standard amendments

Yeah!

Poll Question 1

What is your relationship to O&M Programs?

1. Directly involved in O&M practices at my organization
2. Indirectly involved in O&M practices at my organization
3. Work for a firm that provides O&M services
4. Work for an organization that consults/advises on O&M work
5. None of the above

Poll Question 2

If you have a current O&M Program, does it include reviewing energy use?

1. Yes, annually or as needed
2. Yes, several times per year
3. No, but it would if we had better access to energy info
4. No, but we would like to add it
5. No, energy use is reviewed by others outside of O&M

Learning Objectives

- Understand O&M Program requirements & implementation
- Review O&M Program timing
- Identify covered systems & equipment
- Define Performance Objectives & Condition Indicators
- Understand impact to tenant improvements
- Understand requirements for equip. and system replacement
- O&M tasking, revisions and documentation
- Additional operational ECM's

Please Submit Questions in the Q&A

O&M Program Requirements

- O&M Program requirements are defined in Section 6
- O&M Program implementation is defined in Normative Annex L
- Additional O&M guidance is provided in Informative Annex D
  - This annex is informative only and not a requirement of the CBPS
- O&M Program Plan elements are part of the Energy Management Plan as well

O&M Program Requirements

From Section 6.2:

"A formal operation and maintenance program shall be established and implemented in order that the building energy-using systems achieve their intended energy efficiency throughout their service life."

Does your existing O&M program meet the Standards requirements?

O&M Program Requirements

From Normative Annex L (1):

"The building owner shall be responsible for meeting the requirements of this standard. The owner may designate other parties that shall be authorized and contractually obligated to fulfill the owner's responsibility."

Do your current contracts obligate vendors & tenants to meet the CBPS requirements?

O&M Program Implementation

From Normative Annex L (2):

"At a minimum the O&M program shall contain 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."

Does your existing O&M program include lighting?

O&M Program Implementation

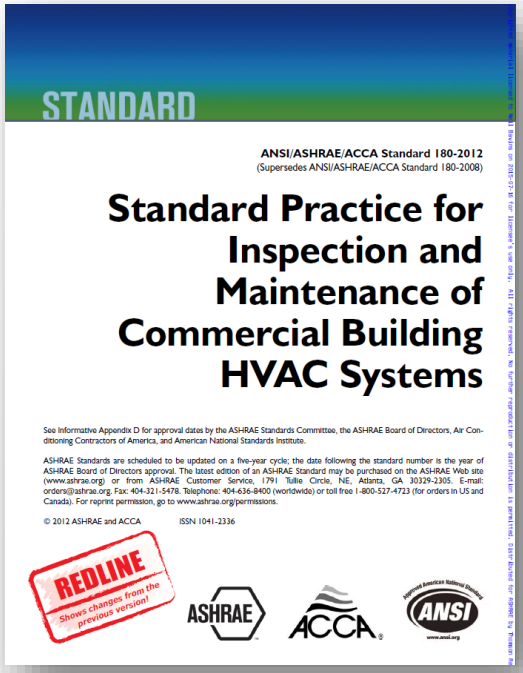
1. Inventory of equipment, systems and controls (L2.1)
2. List of performance objectives (L2.2.1)
3. List of condition indicators (L2.2.2)
4. List of inspection and maintenance tasks (L2.2.3) & frequency of each task (L2.2.4)
5. Corrective action policy for O&M deficiencies (L2.2.4)
6. Tenant improvement process to insure efficiency (6.5)
7. Equipment & lighting replacement policy (6.6.1 and 6.6.2.1)

O&M Program Timing

- O&M Program must have a year of implementation prior to compliance date
- O&M Program is a living document involving continuous updates
- Start as early as possible, most existing O&M programs will need to be revised

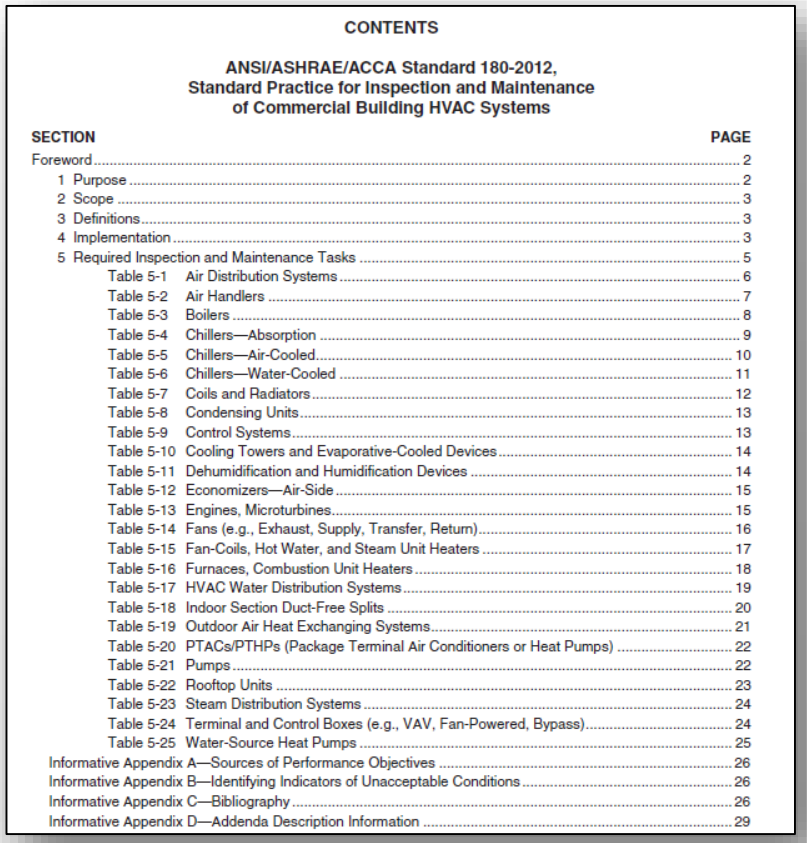
Normative Annex L

- Normative Annex L is based on section 4 of *ASHRAE Standard 180-2012 Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems*
- Informative Annex D provides O&M guidance on other systems (and HVAC)
- Other Resources:
  - Federal Energy Mgmt. Program (FEMP)
  - GSA Sustainable Facilities Tool



ASHRAE/ANSI/ACCA Standard 180-2012

- Standard 180-2012 provides maintenance tasking & recommended frequency
- Includes both equipment & systems
- Includes control systems
- Includes helpful informative appendix & references to other relevant ASHRAE standards
  - Note: 180-2018 is the newest version of the Standard



CONTENTS

ANSI/ASHRAE/ACCA Standard 180-2012,
Standard Practice for Inspection and Maintenance
of Commercial Building HVAC Systems

SECTION		PAGE
Foreword		2
1 Purpose		2
2 Scope		3
3 Definitions		3
4 Implementation		3
5 Required Inspection and Maintenance Tasks		5
Table 5-1	Air Distribution Systems	6
Table 5-2	Air Handlers	7
Table 5-3	Boilers	8
Table 5-4	Chillers—Absorption	9
Table 5-5	Chillers—Air-Cooled	10
Table 5-6	Chillers—Water-Cooled	11
Table 5-7	Coils and Radiators	12
Table 5-8	Condensing Units	13
Table 5-9	Control Systems	13
Table 5-10	Cooling Towers and Evaporative-Cooled Devices	14
Table 5-11	Dehumidification and Humidification Devices	14
Table 5-12	Economizers—Air-Side	15
Table 5-13	Engines, Microturbines	15
Table 5-14	Fans (e.g., Exhaust, Supply, Transfer, Return)	16
Table 5-15	Fan-Coils, Hot Water, and Steam Unit Heaters	17
Table 5-16	Furnaces, Combustion Unit Heaters	18
Table 5-17	HVAC Water Distribution Systems	19
Table 5-18	Indoor Section Duct-Free Splits	20
Table 5-19	Outdoor Air Heat Exchanging Systems	21
Table 5-20	PTACs/PTHPs (Package Terminal Air Conditioners or Heat Pumps)	22
Table 5-21	Pumps	22
Table 5-22	Rooftop Units	23
Table 5-23	Steam Distribution Systems	24
Table 5-24	Terminal and Control Boxes (e.g., VAV, Fan-Powered, Bypass)	24
Table 5-25	Water-Source Heat Pumps	25
Informative Appendix A—Sources of Performance Objectives		26
Informative Appendix B—Identifying Indicators of Unacceptable Conditions		26
Informative Appendix C—Bibliography		26
Informative Appendix D—Addenda Description Information		29

Courtesy ASHRAE

O&M Program Covered Systems

- Building envelope
- Domestic hot water
- HVAC
- Refrigeration
- Lighting
- Controls
- Electric power dist. & on site generation

A useful tool is the Asset Score https://buildingenergyscore.energy.gov
Look for the Data Collection Form – Long

O&M Program

- Maintenance Plan:
  - Who performs & who authorizes
  - Documentation required
  - Monitoring of results
- Manufacturer's maintenance requirements for:
  - Equipment
  - Components
  - Systems
- BMS/BAS/EMS maintenance
  - Set points, schedules, & sequence of operation
- Safe and reasonable access for inspection, maintenance and repair

Performance Objectives (L2.2.1)

- Must include:
  - Thermal comfort
  - Visual comfort
  - Energy efficiency
  - Indoor environmental quality
- Based on design intent & operational objectives and note the source or basis
  - Lease agreements
  - ASHRAE or Code standards
  - Voluntary programs

Performance Objectives Examples

- Thermal comfort
  - Temp: ex. 70^0F-75^0F
  - Humidity: ex. 40%-60% RH
- Visual comfort
  - Lighting levels office: ex. 40-60 fc (foot candles)
  - Lighting levels corridors: ex. 15-25 fc

Performance Objectives Examples

- Energy efficiency
  - EUIt: ex. 55 kWh/ft^2/yr
  - Energy Star score: ex. 70
  - Chiller plant: ex. 1.2 kW/ton

- Indoor environmental quality
  - Carbon Dioxide (CO^2) level: ex. 500-900 ppm
  - Air changes: ex. 6-8 AC/hr
  - Outside air intake: ex. 20 CFM/person

Condition Indicators (L2.2.2)

- Conditions for acceptable & unacceptable equipment or systems operation
- Provided by equipment manuf. or established during start up & commissioning of the system
- Could lead to failure or energy waste if unacceptable conditions persist

Condition Indicators Examples

- HVAC
  - Amperage: ex. Fan motor amps vs rated full load amps (FLA)
  - Pressure (air or water): ex. Air handler discharge air pressure (DAP)
  - Flow (air or water): ex. chiller condenser flow vs manuf. rated range
- Domestic hot water
  - Supply water temperature: ex. water temp at faucet vs design temp
  - Supply water pressure: ex. water pressure vs allowable booster pump range
- Lighting
  - Office lamp color temperature: ex. 4200K
  - Lumen maintenance: ex. replacement of lamp at 70% lumen depreciation

Tenant Improvements (sect. 6.5)

- Formal process for tenant improvement (TI)
- Insure TI's don't negatively impact net energy use (WNEUI)
  - Except in cases where the target EUI (EUIt) has changed
- Recommend landlord TI specification, to include:
  - Design review process, including energy impact
  - Equip. efficiency & performance requirements
  - Mechanical, lighting & control system drawings
  - Air balancing
  - Commissioning

O&M Tasking

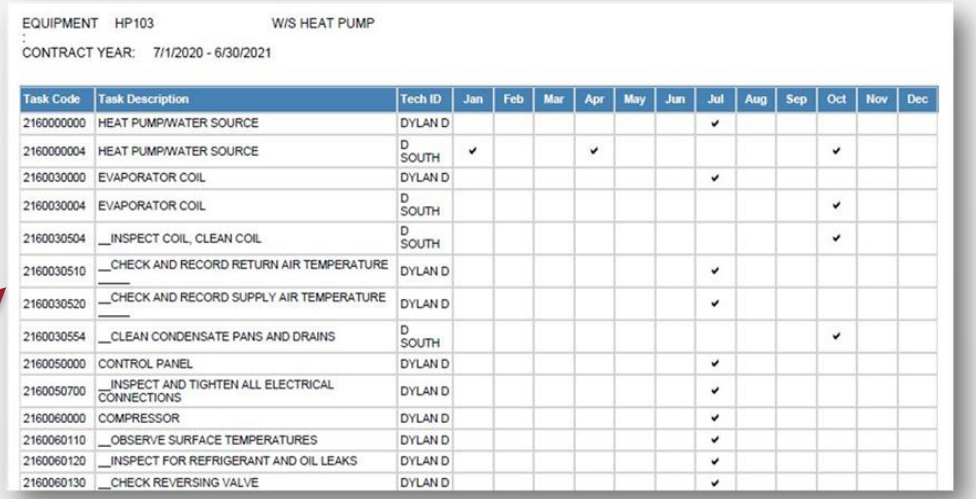
From ASHRAE Standard 100 (section 3):

"Maintain: the process of keeping equipment & components operating or functioning in accordance with manufacturers recommendations & industry standards over their service lives…..

It involves but is not limited to carrying out observation, lubrication, adjustment, calibration, testing, cleaning, replacement, & repair at appropriate intervals as applicable to the specific equipment or component."

O&M Tasking

- See Informative Annex D & ASHRAE 180 for recommended tasking
  - Also: manuf., contractors, consultants
- Include inspection items
  - Including Performance Objectives and Condition Indicators
- Include maintenance items
- Include assignment
  - By skill level or expertise
- Include task frequency
- Include checklists & data



EQUIPMENT HP103 W/S HEAT PUMP
:
CONTRACT YEAR: 7/1/2020 - 6/30/2021

Task Code	Task Description	Tech ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2160000000	HEAT PUMP/WATER SOURCE	DYLAN D							✔					
2160000004	HEAT PUMP/WATER SOURCE	D SOUTH	✔			✔						✔		
2160030000	EVAPORATOR COIL	DYLAN D							✔					
2160030004	EVAPORATOR COIL	D SOUTH										✔		
2160030504	__INSPECT COIL, CLEAN COIL	D SOUTH										✔		
2160030510	__CHECK AND RECORD RETURN AIR TEMPERATURE ____	DYLAN D							✔					
2160030520	__CHECK AND RECORD SUPPLY AIR TEMPERATURE ____	DYLAN D							✔					
2160030554	__CLEAN CONDENSATE PANS AND DRAINS	D SOUTH										✔		
2160050000	CONTROL PANEL	DYLAN D							✔					
2160050700	__INSPECT AND TIGHTEN ALL ELECTRICAL CONNECTIONS	DYLAN D							✔					
2160060000	COMPRESSOR	DYLAN D							✔					
2160060110	__OBSERVE SURFACE TEMPERATURES	DYLAN D							✔					
2160060120	__INSPECT FOR REFRIGERANT AND OIL LEAKS	DYLAN D							✔					
2160060130	__CHECK REVERSING VALVE	DYLAN D							✔					

Does your O&M program include auditing documentation & site work to ensure compliance?

O&M Task Revisions (L2.2.4)

- Unacceptable indicators (more than two inspections) require investigation and analysis.
- Causes could include:
  - Poor field practices
  - Insufficient time
  - Repairs not made
  - Design issues
  - Obsolete equipment or components
  - Outside (of the system) causes (climate, water leaks, vandalism, etc.)
  - Assessment may indicate need to increase or decrease frequency of tasks (filter changes for example)
- Revisions to O&M Program must be documented

Equipment & Component Replacement

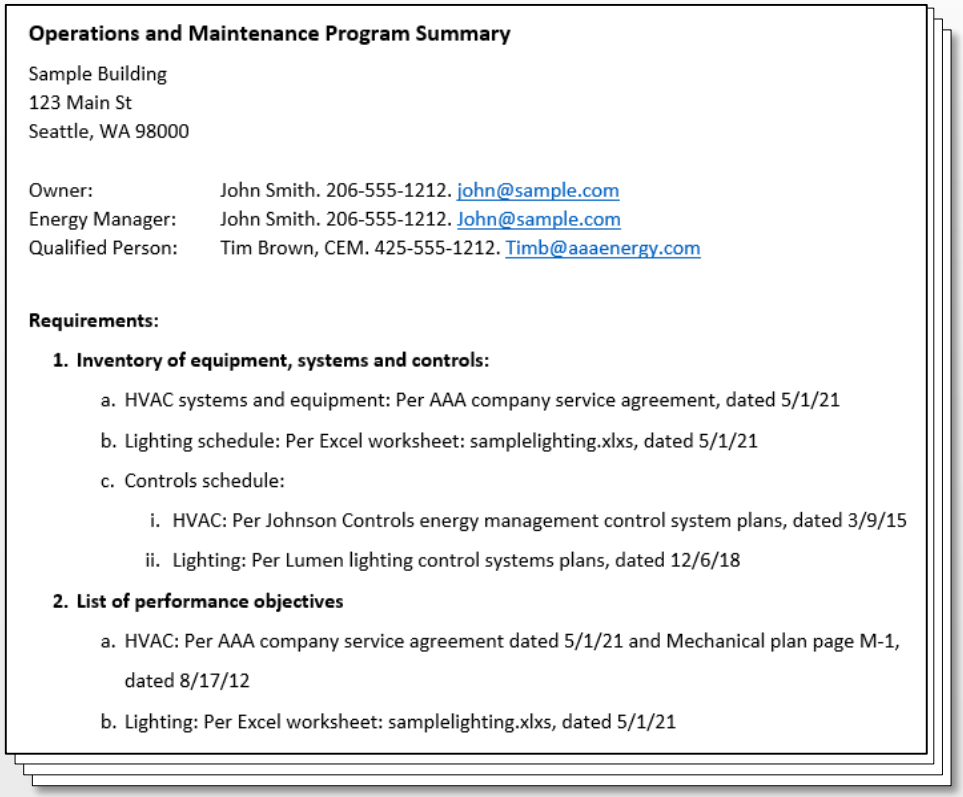
- CBPS has specific requirements around equipment & component replacement
  - HVAC, domestic hot water, refrigeration, and appliances 6.6.1
  - Lighting 6.6.2.1
- Replacements must meet the most stringent requirements of:
  - Federal equipment standards
  - State equipment standards
  - Building Code

O&M Program Deliverables

- Form A (Z6.1) item 8 requires upload of your O&M Program to AHJ
  - Incl. confirmation by Owner, Energy Manager & Qualified Person that O&MP requirements have been met
- There is no O&M Program template or form to follow
  - Owners can use whatever format/system that works best for their operations
- Components of your plan could be in many different locations
  - Written documentation or spreadsheets
  - Vendor agreements
  - Work order software or other tasking software
  - Vendor maintenance tasking software (ask for printed copies of tasking)

O&M Program Deliverables

- Summary document
- Describes how CBPS requirements have been met
- Describes documentation
  - Executive summary or checklist
  - Format is not specified in the Standard
  - Detailed documentation is not required for the upload



Operations and Maintenance Program Summary

Sample Building
123 Main St
Seattle, WA 98000

Owner: John Smith. 206-555-1212. john@sample.com
Energy Manager: John Smith. 206-555-1212. John@sample.com
Qualified Person: Tim Brown, CEM. 425-555-1212. Timb@aaaenergy.com

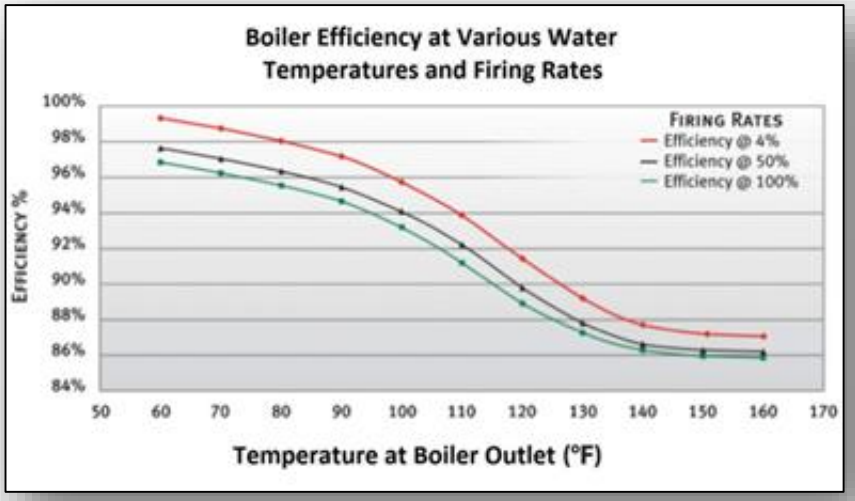
Requirements:

1. **Inventory of equipment, systems and controls:**
   a. HVAC systems and equipment: Per AAA company service agreement, dated 5/1/21
   b. Lighting schedule: Per Excel worksheet: samplelighting.xlxs, dated 5/1/21
   c. Controls schedule:
      i. HVAC: Per Johnson Controls energy management control system plans, dated 3/9/15
      ii. Lighting: Per Lumen lighting control systems plans, dated 12/6/18
2. **List of performance objectives**
   a. HVAC: Per AAA company service agreement dated 5/1/21 and Mechanical plan page M-1, dated 8/17/12
   b. Lighting: Per Excel worksheet: samplelighting.xlxs, dated 5/1/21

HVAC Operational Energy Conservation Measures

- Reset schedules for HVAC equipment
  - Key concept: match equipment capacity to load

- Examples:
  - VAV system supply air temperature reset
  - VAV system supply air pressure reset
  - Chilled water supply temperature reset
  - Boiler supply water temperature reset



HVAC Operational Energy Conservation Measures

- Review/revise control system sequence of operation
  - Changes to the building or building operations
  - Review for energy efficient operations
  - Remove overrides or temporary programming

- Look for and lock out, or correct rogue zones:
  - System operation many be negatively impacted by a zone not maintaining set point
  - Examples include:
    - South or west exterior offices
    - Computer rooms
    - Undersized terminal units

HVAC Operational Energy Conservation Measures

- Inadvertent simultaneous heating and cooling
  - Overlapping control loops
  - Leaking valves on heating or cooling coils
  - Dirty air velocity sensors on VAV systems

- Air balance corrections
  - Over or under supplied zones
  - Over or under exhausted restrooms, kitchens, industrial applications
  - Incorrect make up air volumes and balance
  - Incorrect outside air intake minimum
  - VAV box minimum ventilation airflow

HVAC Operational Energy Conservation Measures

- Eliminate HVAC in vestibules and unoccupied areas
- Use outside air to flush and pre-cool the building
- Revise space layout, zoning and air distribution to:
  - Reduce the impact of doors and windows on occupants
  - Reduce the impact of drafts
  - Minimize impact of after-hours operation or partial occupancy

Review

- Get started revising and implementing O&M Program as soon as possible
- Ensure all equipment & systems required by the CBPS are included
- Include performance objectives and program goals
- Include a formal tenant improvement process in your O&M Program
- Make sure your written maintenance tasking includes who and when

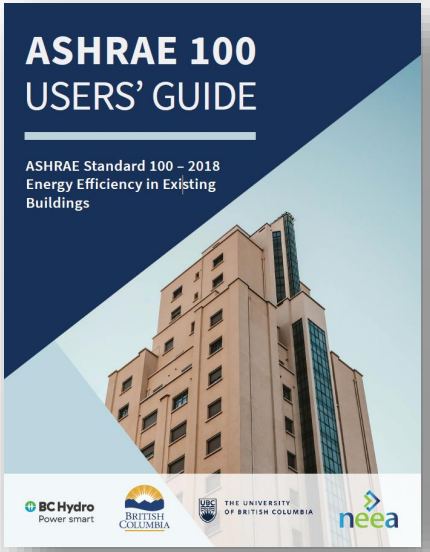
Review (continued)

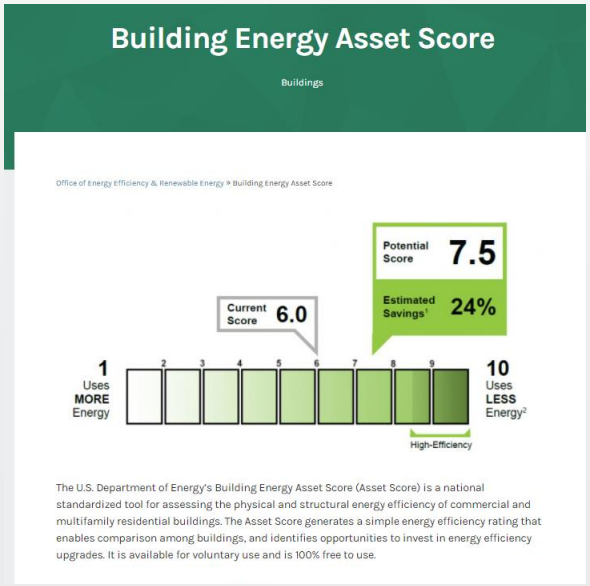
- O&M Program objectives, methods and systems are at the owner's discretion
- The O&M Program is a living document that is updated frequently
- Create a summary document describing your O&M Program for reporting
- Look for energy savings in HVAC operations…lots of opportunity at great ROI

Resources Reminder

Available to download at NEEA website:

- https://neea.org/resources/ashrae-100-users-guide

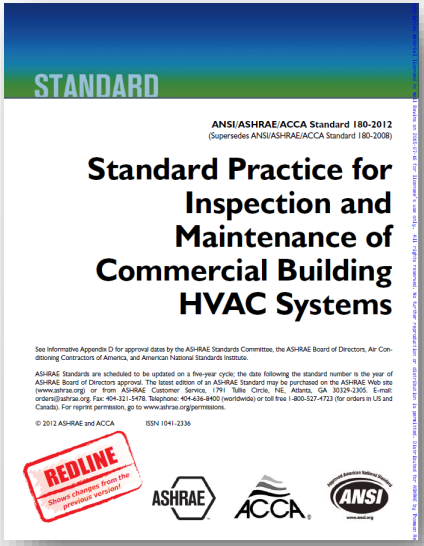




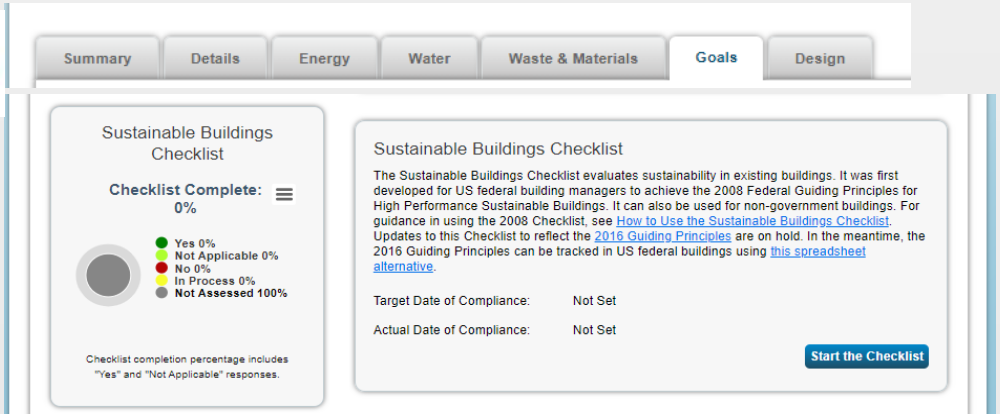
Building Energy Asset Score
https://buildingenergyscore.energy.gov
Look for the Data Collection Form – Long

Resources Reminder

- *ASHRAE Standard 180-2012 Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems*
- Other Resources:
  - Federal Energy Mgmt. Program (FEMP) https://www.energy.gov/eere/femp/federal-energy-management-program
  - GSA Sustainable Facilities Tool – Resources in Portfolio Manager



ENERGY STAR® PortfolioManager®



30 minute Q&A starting now

Please submit your questions to the question box

Thank you to Neil Bavins for helping develop the webinar series

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