



# **Weill Cornell Medicine**

## Engineering & Maintenance

**STANDARD**

## **Design and Project Coordination**

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## **1. GENERAL INFORMATION**

### **PURPOSE**

This document issued by the Weill Cornell Medicine (WCM) Department of Engineering & Maintenance (E&M) identifies Design and Project Guidelines to be incorporated into all new construction or renovation projects at Weill Cornell Medicine. Projects should create design and specification documents that meet or exceed these minimum design standards. Unless otherwise indicated, these standards apply to all WCM sites. Project Managers must ensure that the latest version of this document is made available to the project team at the beginning of each project. Currently, this document is available on the E&M Department website at <https://facilities.weill.cornell.edu>.

This standard will routinely be updated by E&M in order to incorporate industry best practices, technology advancements, and lessons learned from the crew responsible for maintaining WCM spaces.

### **CONTACT INFORMATION**

The E&M main administrative office is located in Olin Hall suite 300. Contact information is as follows:

Senior Director	Michael T. Murphy	<a href="mailto:mtm2004@med.cornell.edu">mtm2004@med.cornell.edu</a>
Director – Engineering	Paul O’Sullivan	<a href="mailto:pao2005@med.cornell.edu">pao2005@med.cornell.edu</a>
Director – Housekeeping	Flore Berger	<a href="mailto:maf2039@med.cornell.edu">maf2039@med.cornell.edu</a>
Director – Operations	George Brendel	<a href="mailto:gjbrend@med.cornell.edu">gjbrend@med.cornell.edu</a>
Energy Manager	Angela Mu	<a href="mailto:anm2140@med.cornell.edu">anm2140@med.cornell.edu</a>
Supervisor – Electrical	Kenneth Leckie	<a href="mailto:khl2002@med.cornell.edu">khl2002@med.cornell.edu</a>
Supervisor – Finishes	Julian Lettsome	<a href="mailto:jel2006@med.cornell.edu">jel2006@med.cornell.edu</a>
Supervisor – Controls	Vincent Romano	<a href="mailto:vir2006@med.cornell.edu">vir2006@med.cornell.edu</a>
Campus Locksmith	Andrew Beekhee	<a href="mailto:abeekhee@med.cornell.edu">abeekhee@med.cornell.edu</a>

The above individuals should be consulted regarding their specific areas of responsibility before any deviation from these minimum Design Standards occurs. Any accepted deviation must be documented in writing.

### **REGULATORY COMPLIANCE**

It is important that all parties involved with the project become familiar with all applicable regulatory requirements on such projects. Final sign-offs, records, permits, certifications, etc. required for future regulatory inspections should be given to E&M for keeping. Examples of this would include air permits, equipment use permits, etc.

## **2. PROJECT COORDINATION**

### **PURPOSE**

This section outlines minimum requirements for each construction project from the initial concept through construction completion.

### **PROJECT SUBMISSIONS, REVIEWS, AND MEETINGS**

The following summarizes various submissions, meetings, reviews, etc. required by E&M for each project:

#### **1. Pre-Design**

- **Pre-Design Meeting**: Discuss the proposed project scope of work and anticipated impact on infrastructure, space, etc. with E&M. (Note: These meetings will help in further defining the infrastructure impact, which will help in project budget development.)
- **Basis of Design**: Submit a 'Basis of Design' document to E&M for review and comment.

#### **2. Design**

- **Initial Design Review Meeting(s)**: Schedule a series of meetings as required to review the following:
  - Review proposed finishes, space requirements, accessories, etc. with the E&M Senior Director and the E&M Director – Housekeeping.
  - Review proposed electrical, plumbing, controls, HVAC+R, etc. with the E&M Senior Director, Director – Engineering, Energy Manager, and Supervisor – Electrical.
  - Review CCTV, Access Control, and Physical security needs with the Director – Operations.
  - Review the proposed hardware, keying, etc. with the Campus Locksmith.
- **Design Document Review**: Provide (3) half size sets of drawings and Specifications for E&M for review and comment.
- **Page Turn Meeting**: Schedule a final review meeting between E&M and the design team to discuss E&M comments on the previous drawing and specification submission.

#### **3. Construction**

- **Access Walkthrough**: Schedule with E&M prior to installing finished ceilings and walls.
- **Final Access Walkthrough**: Schedule with E&M as required demonstrating that access issues identified during the initial walkthrough were addressed.

## PROJECT CLOSE-OUT

The following represents the minimum required information, documentation, training, etc. required for a project prior to E&M accepting the work that was completed.

### 1. Training

E&M requires organized and in-depth training for each of the following systems and equipment:

- Electrical distribution and equipment
- Lighting control system(s)
- HVAC
- Building Management Controls
- Plumbing
- Architectural finishes – maintenance
- Special Carpentry finishes – maintenance & repair

### 2. Closeout Documents

The following is a minimum list of required documents to be provided to E&M prior to a project being closed out. The Project Manager should provide these documents electronically on a hard drive or thumb drive. The Project Manager, Commissioning Agent and Design Team should review the items for completeness prior to submitting them to E&M.

- Drawings – Final Conformance Set
- Drawings – As-Built (all trades)
- Specifications – Final Conformance Set
- All Approved Submittals
- Operation and Maintenance Manuals for all equipment, devices, and systems
- Finish Schedule – all finish types and materials
  - Floors
  - Ceilings
  - Walls
- Signed off E&M punch lists
- Certificate of Completion from the Design Architect(s) and Design Engineer(s)
- Certificate of Completion from the Cx Agent
- Proof of Compliance with Local Law 88 “Upgrade of Lighting Systems”
  - Typically DOB stamped ‘EN’ drawing indicating energy code compliance
  - Drawings, schedule and energy analysis by registered design professional or licensed electrician certifying upgrade is in compliance with technical standards of the NYC electrical and energy codes
- Approved



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- Reports by a NEBB or TABB-certified firm, conducted under the supervision of a Certified Professional
- Warranties / Guarantees
- Regulatory Inspection Reports / Sign-Offs (i.e. elevators, fire safety systems, etc.)
- Controlled Inspection Reports
- Letter from the Expeditor confirming that all Permits and filings are closed
- Keys
- Regulatory Filings: equipment use permits, elevator testing (Cat1& Cat 5), etc.

### 3. Attic Stock

E&M should be provided the attic stock outlined within the project specifications where reasonable. Finding storage for attic stock can often be difficult. At minimum, the following attic stock items should be turned over to E&M neatly organized and adequately labeled.

- Filters – all types
- Ceiling tiles – all types
- Carpeting – all types
- Tiles – all types
- Fuses – all types
- Special items (should be avoided during the initial design)

## DESIGN CONSIDERATIONS

### 1. Equipment Identification

Please refer to the section 'EQUIPMENT IDENTIFICATION AND BMS POINT NAMES' within this Standard for the detailed information on how to correctly represent Equipment Identification within WCM space.

### 2. Controls Point Naming and Identification

Please refer to the section 'EQUIPMENT IDENTIFICATION AND BMS POINT NAMES' within this Standard for the detailed information on how to correctly represent Controls Point Naming and Identification within WCM space.

### 3. Equipment Access

Equipment and systems that require maintenance must be installed in compliance with the manufacturer's minimum recommended clearances for service and maintenance. In the absence of this type information from the manufacturer, equipment shall be installed such that it can be safely accessed when correctly using an 8-foot ladder without having to dismantle or stand on desks, lab benches, etc.

If this type of access cannot be accommodated during the design phase then E&M should be consulted. E&M will try to work with the Project Manager and design team to

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identify how safe access can be accomplished. An example would be a catwalk that may have to be installed in an areaway or MER to safely access equipment at a higher elevation.

When equipment is installed above the ceiling or in an open ceiling configuration in occupied spaces, the centerline of the equipment can be no higher than 11 feet above the finished floor. This is based on the safe and correct use of an 8-foot "A" frame ladder with a 6' person standing no higher than the second step from the top. Equipment needs to be installed in locations where the "A" frame ladder can be set up without dismantling or standing on furniture, lab benches, etc. Light fixtures, piping, supports, other equipment, etc. cannot obstruct access to equipment.

All isolation valves, fire smoke dampers, etc. must be fully accessible working safely off an 8-foot ladder as well.

### 4. Miscellaneous

All projects requiring any modification to wall layouts, space use, etc. must utilize a design engineer to examine impact on HVAC, electrical, plumbing, etc.

## CONSTRUCTION CONSIDERATIONS

### 1. Utility Shutdown Requests

The most current 'Utility Shutdown Request' form is available on the E&M website at <https://facilities.weill.cornell.edu>

Two-week notice is required for all utility shutdown requests.

Project Manager is required to sign off prior to submission

An account number is required to be included on each request.

USR Requests without an account number or Project Manager signature will be rejected.

### 2. Access Walkthroughs

Prior to installing ceiling tiles, etc. the Project Manager must schedule Access Walkthrough(s) with E&M. The goal of these walkthroughs will be to make sure adequate access exists prior to covering equipment. If adequate access does not exist in a specific area, often this same walkthrough can yield an acceptable solution or modification to provide the necessary access. A furniture plan and ladder must be available during the access walkthroughs.

### 3. Project Meetings

The Project Manager should invite E&M to the construction coordination meetings whenever E&M input is required.

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### **COMMISSIONING**

All new and renovated space shall be commissioned through an outside commissioning agent.

### **3. ARCHITECTURAL / GENERAL CONSTRUCTION**

#### **MAINTENANCE SPACE REQUIREMENTS**

When renovating existing WCM space as part of a project there will be no repurposing of any existing E&M space without the written approval from the E&M department Senior Director.

When fitting out new space, adequate consideration and planning must be given to creating adequate storage / space to support the following functions:

- Housekeeping Closets (see section on Housekeeping Closets for design criteria)
- Regulated Medical Waste
- Sharps
- MEP Storage
- Housekeeping supplies storage
- Housekeeping equipment & storage
- Trash storage
- Recycling storage
- Recycling areas (for occupant use)
- Lockers – E&M staff
- Bulk trash (depending on type and size of project)
- Locations of BMS panels, security panels, lighting control panels, etc.

Large-scale projects will require additional space needs such as shops, etc. This will be handled on a project-by-project basis.

#### **ROOFING SYSTEMS**

The preferred roofing system is a Kemper System or equivalent.

When pavers systems are used on a roof, locations above roof drains shall be clearly marked with an easily removable paver or perforated metal panel.

When an exposed membrane system is used, all walking paths to roof mounted equipment and roof access points must be protected with walking pads.

If work is being done on an existing roof, the manufacturer of the roof system being worked on must certify the contractor doing the roof.

#### **KEYING SYSTEMS AND DOOR HARDWARE**

Application of keying systems must be verified with the WCM Campus Locksmith on a per project basis.

The WCM Campus Locksmith must be consulted for direction on the creation of the Keying Schedule.

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Corbin Russwin is the manufacturer for all hardware and lock cylinders.

WCM utilizes a patented system of keyways and cylinders. This may vary at some off-site locations. This must be verified with the WCM Campus Locksmith.

WCM will provide the appropriate Corbin Russwin Key Registry Number for the patented system to the hardware supplier when the keying schedule is created.

Under no circumstances should keys be shipped to the contractor. For all projects, ALL keys and the bitting list must be sent directly to:

Michael T. Murphy  
Weill Cornell Medicine  
445 East 69<sup>th</sup> Street  
Suite 300  
New York, New York 10021

Keys must be delivered as specified a minimum of four (4) full business weeks before the first scheduled occupancy for the space to allow the keys to be logged, tested, assigned and distributed. For all projects, Corbin Russwin is required to provide an updated bitting list electronically for entry into the WCM Key Wizard system at the time of key delivery. Key verification and distribution process cannot begin without this data.

The general requirements for keying and hardware on WCM projects is as follows:

### 1. Cylinders

- a. 93A1, 93A2, 93B1, 93B2 7 pin or F3 6 pin patented keyways
- b. Master ring 7 pin (model #1060-138-A62-7) or 6 pin (model #1060-114-A62-6) cylinders (F3 keyway)
- c. Small format (conventional) 7 pin (model #1000-114-A02-7) or 6 pin (model #1000-114-A02-6) cylinders
- d. Renovations to 1300 York Avenue buildings will use an NYP keyway. Please review these options with the WCM Campus Locksmith once the project begins.

### 4. Hardware (Door Locks)

- a. Corbin Russwin ML2000 series mortise locksets (Prepped for master ring cylinders)
  - Office Entry: ML2051-NSA-MR-626
  - Classroom: ML2055-NSA-MR-626
  - Storage Room: ML2057-NSA-MR-626
  - Privacy: ML2060-NSA -626
  - Passage: ML2010-NSA-626
  - Electrified (**Fail Secure**): ML20905-NSA-MR-626
  - Electrified (**Fail Safe**): ML20903-NSA-MR-626
  - Electrified (**Fail Safe/Secure – Field Adjustable**): ML20906-NSA-626(uses the smaller conventional mortise cylinder)

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- Stand Alone Keypad Access: ACCESS 800-M800 Feature Only (Keypad)
- b. Doors must be prepped to accept master ring cylinders.
- c. Electric Strikes: HES 4500 (**Minimal Use / DO NOT USE** on Corridor or Fire Egress Doors).
- d. Exit Devices: Von Duprin Surface Mounted Only (models 99EO AND 9827)

### 2. Door Closers

- a. LCN (model# 4040XP)

Stand alone card access control of doors are not permitted. All card access control for the college must be via the College's existing card access system that is operated in conjunction with NYPH.

## FINISHES

### 1. Ceilings

Planning needs to be given to post construction access and the type of occupancy when selecting a ceiling system. Research and clinical spaces will typically have more complicated infrastructure systems and hence more components located above the ceiling. These items require access, and they should be accessible by one person while standing safely on an 8-foot ladder. Ceiling tiles measuring more than 2'x4' cannot be managed by a single person and should not be used where access will be required. Use of grid systems smaller than 2'x2' is not appropriate for ceilings where access will be required since the grid needs to be disassembled for access.

Where hard ceilings are provided, access doors must be provided for equipment located above the ceiling. The size of the access doors needs to be appropriate. Access doors in hard ceilings should be no smaller than 12"x12" when only arm access is required (i.e. to operate a valve no more than 18" above the finished ceiling.) Otherwise, access doors are to be a minimum of 24"x24". Access doors shall be hinged and latched with a "D Ring" type latch. Access doors should not be locked.

The use of custom ceiling tiles should be avoided.

Ceiling tiles with a fiberglass, or similar soft backing and a thin skin, should not be used as they damage easily and require edges to be field painted when they are replaced after any cuts.

### 2. Flooring

All flooring materials should be selected in consideration of the lifecycle cost of maintenance. The overall appearance in the end is a function of how well the material selected can be maintained. In general, dull/matte finishes on hard flooring are more difficult to maintain and in the long run will not provide the best overall appearance.

Public areas should utilize materials that will not present a slipping hazard when wet.

Flooring in restrooms, locker rooms, etc. should consider the potential for standing water and should be resistant to slipping.

Stone, tile, grout, etc. should be sealed in accordance with the manufacturer's recommendations.

Seamless flooring should be used only in areas that it is required for infection control or other specific reasons.

Areas that will be subject to standing water and which are above occupied areas shall be waterproofed. This is particularly important in mechanical equipment rooms, sterilizer/glasswasher rooms, water treatment rooms, etc. The method of achieving waterproofing can vary. In some cases, a membrane system is appropriate; in others, epoxy/resin flooring is appropriate.

Cork flooring should not be used.

Prior to turnover, the flooring should be finished (i.e. sealed, waxed, etc.) in accordance with the manufacturer's recommendations.

### 3. Epoxy Paints

When epoxy paints are used, latex epoxy is to be utilized.

### 4. Other Paints

The preferred manufacturer of paints is Benjamin Moore. Custom colors should be avoided, as they cannot be reproduced accurately.

Offices, corridors, labs and similar spaces should be washable eggshell finish. Bathrooms, utility areas and other areas requiring a cleanable surface should be semi-gloss.

## HOUSEKEEPING CLOSETS

In general, one Housekeeping closet is required per floor, per building. Larger floors may require more. The table below lists the minimum requirements for Housekeeping closets:

	RENOVATION	NEW	MANUFACTURER/ MODEL	NOTES
WALLS	Sheetrock/ceramic tile	Sheetrock/ceramic tile		ceramic tiles 4' high in sink area
FLOORS	Stonhard or equiv.	Stonhard or equiv.		
SHELVING	Wall mounted stainless steel 18"x36" (or less to fit)	Wall mounted stainless steel 18"x36"	AMCO: Part# AC1836ZP2 Bracket: Part# AC18ZP	
FAUCETS	Hose connector for dilution system connection	2 handles, short spout with hose connector/hose holder for dilution system	MUSTEE: Part# 63.600A Hose: Part# 65.700	integral backflow protector

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	RENOVATION	NEW	MANUFACTURER/ MODEL	NOTES
SINK	Floor slop sink	Floor type 24"x36"x10" with elevated self-draining shelf	MUSTEE: Model# 65M	
POWER	GFI outlet above the sink	GFI above the sink		
CEILING LIGHT	Covered/switchable	Covered/switchable		
MOP HANGER	Rack organizer - 3 position	Rack organizer - 3 position	MUSTEE: Part# 65.600	mounted 36" above sink
DOOR	Use existing	36"wide, should swing out		
SIZE	Use existing	Min. Room Size: <b>40nsf</b> Must accommodate: Housekeeping cart, size 48"Lx22"W Mop bucket 18"W Laundry bin 19"W		

### RESTROOMS AND RESTROOM ACCESSORIES

Toilet partitions should be stainless or composite material. Painted partitions rust easily and should not be provided. Coat hooks should be provided on the back of the door of each stall.

Walls behind toilets, urinals, sinks, etc. should be tiled to 48" above the finished floor. Floors should be tiled.

All grout and tiles should be sealed per the manufacturer's instructions.

All bathrooms should be provided with a shelf over the sink, coat hook(s), mirror.

Dispensers for toilet seat covers or sanitary napkins are not to be provided.

Hose bibs are not required in bathrooms.

At least one GFI outlet should be provided in the bathroom.

Toilet accessories (toilet paper, soap, paper towels) should be surface mounted. Trash receptacles should be floor standing, not mounted. (specific manufacturer has to be provided in the future)

For Public, Staff, Patient, General Bathrooms and patient care areas accessories shall be:

ITEM	MANUFACTURER	MODEL	SIZE
Toilet Paper Dispenser	San Jamar	R6000TBK 12" JBT Roll	14.9"H x 12.9"W x 5.8"D
Hand Towel Dispenser	San Jamar	Integra Level Roll T850TBK	13.5"H x 11.5"W x 11.25"D
Soap Dispenser (Alternate)	San Jamar	Oceans Soap Dispenser S890TBK	10.5"H x 4.5"W x 4.375"D
Soap Dispenser (Alternate)	Kimberly Clark	In-Sight Smoke/Grey Liquid Soap Dispenser KIM91180	10.375H x 6.125"W x 4.875"D



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ITEM	MANUFACTURER	MODEL	SIZE
Waste Container (Alternate)		Stainless Steel	Bag size 44"H x 33"W. Max. Receptacle Size: 36"H x 66" Top Perimeter
Waste Container (Alternate)	Rubbermaid		Plastic trash can liner 44"H x 33"W. Max. Receptacle Size: 36"H x 66" Top Perimeter

For Executive "High Level Finish" bathrooms ONLY accessories shall be:

ITEM	ACCOMMODATE PRODUCT
Toilet Paper Dispenser	Standard 4.5" diameter roll
Hand Towel Dispenser	Paper Towel Rolls – 8" diameter x 8" wide roll Folded Towels – "C Fold" or Multifold – 10" x 3.5"
Soap Dispenser	800ml Innovak soap cartridge 800ml Kimberly Clark soap cartridge
Waste Container (Public)	Bag size 44"H x 33"W. Max. Receptacle Size: 36"H x 64" Top Perimeter
Waste Container (Private)	Plastic trash can liner – 23"H x 24"W Max. Receptacle Size: 15"H x 48" Top Perimeter Plastic trash can liner 44"H x 33"W Max. Receptacle Size: 36"H x 66" Top Perimeter

## PENETRATIONS AND FIRESTOPPING

All openings in slabs, walls, etc. must be adequately sealed with a fire rated sealant. This sealant must also provide a waterproof seal as well.

## ROOF STRUCTURES AND DUNNAGE

Rooftop equipment shall be installed so that all required equipment access is available after the installation. All dunnage steel installed will be high enough to provide for reasonable and clear access below equipment. This will also allow for any future roof repair or replacement.

## **4. SECURITY**

### **ELECTRONIC SECURITY SYSTEMS**

#### **1. Access Control System**

All electronic access control devices installed within WCM space should communicate back to WCM's central access control database. This system is the Identocard Premisys Pro platform and utilizes the WCM IT network infrastructure for communication between the central database and the field panels.

Card readers must be compatible with the current WCM ID cards. Card readers should be installed on all IT closets, MERs, electrical closets, main entrances, elevators, and rooms designated by the space occupants.

#### **2. CCTV**

All CCTV design and installations within WCM space require pre-approval from the E&M Director – Operations. At this time specifics with respect the CCTV system design, components and infrastructure will be discussed.

The current CCTV system being used by WCM is the Pelco Digital Sentry platform.

### **PHYSICAL SECURITY**

#### **1. Lobby / Entrances**

All building entrances at WCM locations require some level of physical / electronic security control. These should be consistent with modern day acceptable security measures. Entrance security needs should be discussed in advance with the E&M Director – Operations and NYP Security (if applicable).

Security desks provided within entrances and lobbies at minimum require space for three (3) workstations, one (1) logbook, writing surface, file storage, and one (1) phone.

The need for turnstiles within the building entrance will be reviewed for each project.

## **5. PLUMBING**

### **PIPING**

All new piping shall be insulated. Insulation specification and installation shall be done in accordance with manufacturer recommendations and the current New York City Energy Conservation Code.

All existing piping within the work area shall be insulated if not already.

For all cold systems, the insulation must be applied with a continuous, unbroken vapor seal. Use mastic vapor seal on joints and seams. Hangers, supports, anchors, etc. shall be installed with thermal breaks to avoid condensation.

Valves installed in insulated piping lines shall have removable insulated valve jackets and valve handle extensions that clear the outer insulation surface. Affix labels for valve locations and directional flow.

All piping and pipe insulation shall be labelled and color-coded in accordance with the 'PIPE LABELING AND COLOR CODE REQUIREMENTS' section of this Standard.

### **FIXTURES**

Gas, Air and Vacuum turrets in labs must be lever type handles (not cross handles) to provide positive visual indication of on/off.

#### Fixtures

Item	Notes	Acceptable Manufacturers		
Toilets		Toto	American Standard	Kohler
Faucets – Labs	Manual	Chicago Faucet	Water Saver	T&S Brass
Faucets – Other areas	Manual	Chicago Faucet	American Standard	Kohler
Faucets – Other areas	Sensor - Battery	Sloan	American Standard	Kohler
Flush meters	Manual			
Flush meters	Sensor - Battery	Sloan	Zurin	Kohler

Private bathrooms should utilize manually operated faucets and flushometers. Public bathrooms should utilize battery operated sensor faucets and battery operated sensor flushometers. Sensor faucets/flushometers powered by line or reduced line voltage are not acceptable.

## **6. MECHANICAL**

Pre-construction measurements of water and air systems that will be impacted by the construction project must be made before any changes are made to the systems. At the conclusion of the project, post-construction water and air balancing reports must verify that these existing systems have not been negatively impacted by the construction activities.

Design criteria should take into account guidance from the most recent version of the Climate Resiliency Design Guidelines issued by New York City. According to the March 2019 version, cooling infrastructure shall be designed for 98°F and 2,149 cooling degree days (base 65°F).

### **AIR HANDLING UNITS**

Projects that replace or retrofit AHUs, or retrofits of spaces requiring a total of 5,000 CFMs of ventilation airflow or more, shall incorporate heat recovery, and priority shall be given to the most efficient heat recovery strategy, that incorporates considerations of equipment location and contamination concerns. Heat recovery selection shall be supported by a life cycle cost analysis of the options.

Air side economizer control shall be based on fixed dry bulb high limit of outside air temperature only. This preferred logic is due to low first costs, high energy efficiency, minimal sensor error, and low maintenance costs.

Integral face-and-bypass (IFB) coils are not an acceptable design for air handling units.

Factory built or modular units are to be specified. Field erected units are only permitted when mandated by field conditions or code.

Chilled water coils shall use hot air freeze protection systems. Systems requiring glycol for winterizing are not permitted.

Plug valves shall not be used on air handling unit coil connections.

Balancing valves are acceptable provided a separate isolation valve is also installed.

### **PIPING AND VALVES**

All new piping shall be insulated. Insulation specification and installation shall be done in accordance with manufacturer recommendations and the current New York City Energy Conservation Code.

All existing piping within the work area shall be insulated if not already.

For all cold systems, the insulation must be applied with a continuous, unbroken vapor seal. Use mastic vapor seal on joints and seams. Hangers, supports, anchors, etc. shall be installed with thermal breaks to avoid condensation.

Valves installed in insulated piping lines shall have removable insulated valve jackets and valve handle extensions that clear the outer insulation surface. Affix labels for valve locations and directional flow.

## E&M STANDARD: DESIGN AND PROJECT COORDINATION

All piping and pipe insulation must be labeled and color-coded in accordance with the 'PIPE LABELING AND COLOR CODE REQUIREMENTS' section of this Standard.

All new piping shall be cleaned prior to connecting to existing systems. Cleaning shall be completed to the satisfaction of the current E&M water treatment consultant and vendor.

Three way valves shall not be used under any circumstance.

Separate shut-off valves and strainers shall be provided at each connection for each piece of equipment.

All butterfly valves shall be Jamesbury High Performance type.

### **STEAM DISTRIBUTION**

Steam station insulation shall be calcium silicate. Fiberglass will not be acceptable on steam stations.

Steam stations shall incorporate safety shut-off valves. Pressure relief valves are not acceptable for steam stations.

Plug valves shall not be used on air handler coil connections. Balancing valves are acceptable provided a separate isolation valve is also installed.

Flash tanks will be specified for all high and medium pressure traps and drips. Condensate coolers are not acceptable.

Equipment requiring safety and pressure relief valves will be piped and vented to the exterior. Venting the equipment inside the mechanical equipment room is not acceptable.

### **CONDENSER AND CHILLED WATER DISTRIBUTION**

Condenser water pumps and chilled water pumps shall have variable frequency drives. Pressure reducing valves are not acceptable.

E&M must first approve the new installation of any open loop water filled cooling tower.

### **AIR DISTRIBUTION**

All projects shall have a TAB baseline taken of space prior to design/demo to confirm existing conditions. Testing and balancing contractors shall be NEBB or TABB certified. Non-certified TAB contractors are not allowed.

All pressure sensitive rooms shall have pressure relationships labeled on a separate Pressurization Diagram mechanical drawing. Final pressure relationships between the rooms and adjacent spaces shall be shown on the TAB report.

Laboratories shall be designed to operate at the following default ventilation rates:

1. Occupied Mode: 6 air changes per hour (ACH)

## E&M STANDARD: DESIGN AND PROJECT COORDINATION

### 2. Unoccupied Mode: 4 air changes per hour (ACH)

Higher ventilation rates may be required, and less may be acceptable, when the laboratory process is well defined. Air sampling systems may be used on a case by case basis and should be reviewed with Engineering & Maintenance. If any design standard within this document contradicts codes or regulations, the design engineer shall notify Engineering & Maintenance.

Laboratory occupancy shall be determined by occupancy sensors. Schedules and light switches shall be avoided. Pressurization shall be maintained with reduced airflow.

Consideration for controllability of the air devices at their lower ranges should be made to ensure that the unoccupied flow rate is not below the controllable range of the terminal and accuracy of the flow measuring device. For this reason, the design professional shall include a schedule indicating the airflow setpoints across all expected modes (e.g. maximum cooling mode; occupied sash open position; occupied sash closed position; unoccupied sash closed position; unoccupied sash open position; etc.)

Outlets should provide required NC levels and comfort space conditions without drafts throughout the operating range. After submission of the field verified balancing report, the air balancing company shall return to the job site to perform two (2) occupant comfort balances as directed by the owner or engineer.

Balancing agency shall permanently mark all adjustment devices (valves, dampers, etc.) to enable the setting to be restored.

Upon completion of the installation, the contractor shall rebalance any existing portions of air distribution system and water distribution system affected by the renovation and also balance all new work.

## **VARIABLE FREQUENCY DRIVES (VFD'S)**

Drives shall be provided with a manual bypass. In applications where 100% equipment redundancy is provided, the bypass may not be required if confirmed by E&M.

Acceptable manufactures of variable frequency drives are:

1. ABB
2. Yaskawa

Drives should be specified for use in high ambient temperatures (above 100 degrees F).

Variable Frequency Drives should not be running above 85% prior to turnover.

Drives that are running above 85% during turnover will not be accepted by E&M. This will require further evaluation and input by the design engineer.

## **REFRIGERANTS**

Refrigerants used in compressors must be approved for production at least 15 years beyond the date of equipment purchase. Currently, HFC-134a has no restrictions on its future manufacturing. HCFC-22, HCFC-142b and HCFC-123 are no longer acceptable.

## E&M STANDARD: DESIGN AND PROJECT COORDINATION

Equipment currently using refrigerants that has been or is being phased out should be replaced as part the renovation project.

### **DUCTWORK AND ACCESSORIES**

Fire smoke dampers must be fully accessible.

Duct access doors shall be fully accessible. Access doors should be hinged. Access doors should be a minimum of 18" square when the duct size permits.

Ductwork shall be insulated. Interior insulation lined ductwork is not permitted. When acoustic lining is used, an interior perforated wall must also be utilized.

Terminal boxes (VAV, etc.) shall be easily accessible from an 8-foot ladder.

**7. PIPE LABELING AND COLOR CODE REQUIREMENTS**

All new piping shall be clearly labeled and color-coded based on the following convention:

Type of Service	Markings	Color	Sherwin Williams No.
High Pressure Steam (76+ psig)	HPS	Yellow	Safety Yellow SW4084
Medium Pressure Steam (21 to 75 psig)	MPS	Yellow	Safety Yellow SW4084
Low Pressure Steam (0 to 20 psig)	LPS	Yellow	Safety Yellow SW4084
High Pressure Steam Condensate	HPR	Orange	Safety Orange SW4083
Medium Pressure Steam Condensate	MPR	Orange	Safety Orange SW4083
Low Pressure Steam Condensate	LPR	Orange	Safety Orange SW4083
Chilled Water (Supply and Return)	CHWS CHWR	Dark Blue	Safety Blue SW4086
Condenser Water (Supply and Return)	CWS CWR	Light Green	Circuit Breaker SW4077
Secondary Hot Water	PREHEAT, REHEAT	Tan	Modular Tan SW4002
Energy Recovery (Glycol Mix)	ENERGY RECOVERY	Purple	Plum SW4080
Domestic Cold Water	DCW	Dark Green	Safety Green SW4085
Domestic Hot Water	DHW	Light Blue	Basin SW4054
Natural Gas	GAS	Labels Only	N/A
Safety Valve Vents		N/A	N/A
Cast Iron – Soil Waste and Vents		Labels Only	N/A
Control Compressed Air	AIR	Labels Only	N/A
Laboratory Air	LAB AIR	Labels Only	N/A
Laboratory Vacuum	LAB VAC	Labels Only	N/A
Fire Sprinkler	FS	Red	Safety Red SW4081
Fire Standpipe	FSP	Red	Safety Red SW4081



## **8. WATER TREATMENT SYSTEMS**

WCM's water treatment consultant and vendor is currently:

Industrial Water Technologies (IWT)  
Richard DeMartino  
27 Apple Street  
Tinton Falls, New Jersey 07724  
T: 732-888-1233  
E: [iwtnj@comcast.net](mailto:iwtnj@comcast.net)

This vendor must be consulted during the design. This vendor should be used during construction for all water treatment systems.

## **9. ELECTRICAL**

### **DESIGN ITEMS AND LABELING**

Use of aluminum for any current carrying components is not permitted. All current carrying components must be copper.

All electric panels, boards, switches, etc. must be clearly labeled with the source from which they are fed, including the location and switch designation of the source. Equipment fed from an emergency source shall have white lettering on a red background. All other equipment shall be labeled with black letters on a white background. Refer to the section 'EQUIPMENT IDENTIFICATION AND BMS POINT NAMES' for the acceptable Equipment Naming Convention, which includes electrical equipment.

Main distribution boards, MCC's, etc. shall have each individual switch labeled with the load served.

All panel boards must have a circuit schedule indicating all active, spare and blank positions. The circuit designations must clearly identify the load served. Examples for a circuit designation:

Unacceptable: Recept.  
Unacceptable: Lights  
Acceptable: Recept. A301 Bench 1, 3  
Acceptable: Recept. A301 East & West  
Acceptable: Revco Frz. A303  
Acceptable: Hall Lgts. Cove

All electrical outlets must be labeled with the panel designation and circuit from which they are fed. The use of "P-Touch" type clear labels with black lettering is preferred, as this will not detract from the appearance. Light switches do not need to be labeled, but lighting circuitry must be clearly identified on the panel directory.

Electric panels that are not installed in dedicated and identified electrical closets should be installed where they are clearly visible. In situations where the panels are covered by architectural items, (where permitted by code) the location of the panel must be clearly identified by a sign placed on the point of access to the panel. The sign must read "ELECTRICAL PANEL" in letters that are a minimum of 1" in height and which have a contrasting color to the background of the sign. Architectural coverings placed over electrical panels must not be lockable.

Electrical panels should be lockable with flush mounted lever type latches. All panels on a job should be keyed alike. All electrical shall be keyed to the standard CAT45 key. Panels should latch automatically when closed, but not lock automatically.

## EMERGENCY POWER, DISTRIBUTION AND TRANSFER SWITCHES

All outlets fed from emergency power circuits must have red receptacles and red faceplates. Only in cases where a specific outlet type is not commercially available in red is the use of a red faceplate acceptable as the only means of identification.

When emergency power is available or being provided as part of a project, the following equipment/systems should be connected:

All Life Safety Systems including the following:

- Elevators – meet code minimum and discuss with E&M
- Fire pump and jockey pump
- Egress lighting
- Fire alarm system

The following critical laboratory and research equipment:

- Critical freezers (-80, -120, etc.)
- Incubators
- Environmental Rooms
- Other critical equipment – review with E&M

The following infrastructure, security and ITS systems:

- Building Management Systems and components
- Sewage ejector pumps
- Storm water pumps
- Steam condensate pumps
- 50% of lighting in machine rooms (not 100%)
- 50% of roof lighting (not 100%)
- Cooling tower makeup water pump (only if tower is on emergency)
- Domestic water pumps
- Chilled water pumps as required by chillers on emergency
- Condenser water pumps as required by towers on emergency
- Reheat HW pumps as required by AHU's on emergency
- Security systems and cameras
- Selected outlets within building support services areas, EHS, Security, ITS
- ITS equipment (after review and confirmation with ITS and E&M)
- Main HVAC units (depending on the loads they serve - review with E&M)
- Lab Air systems - review with E&M
- Lab Vacuum systems - review with E&M
- Control Air system (if provided)
- Steam Stations
- Supplemental A/C Units (only if serving critical areas – review with E&M)
- Air handling equipment necessary for smoke purge
- Radiation monitoring systems

In all locations where Emergency Generators, Generator Fuel Pumps, or Automatic Transfer Switches are located, battery backup lighting is to be provided in the immediate vicinity of the equipment. This is intended to provide lighting in the event of a blackout and simultaneous failure of some component on the emergency power system.

## E&M STANDARD: DESIGN AND PROJECT COORDINATION

All Automatic Transfer Switches shall be manufactured by ASCO and come equipped with Bypass-Isolation.

All ATS's shall be provided with in-phase monitoring (synch check). Delayed transfer switch type is not to be permitted.

All ATS's shall be clearly labeled with Normal Source and Location, Emergency Source and Location, Load served. Signs shall be white lettering on red background.

## **10. ENERGY EFFICIENCY LIGHTING STANDARDS**

### **PURPOSE**

The purpose of this lighting standard is to establish guidelines for the purchase, design and installation of WCM interior lighting. This standard is a living document that will routinely be updated by the Department of E&M in order to reflect industry best practices and advances in technology. This guidance, while not comprehensive, aims to deliver more consistency in lighting equipment moving forward and ensure that energy efficiency, life cycle cost, and long-term maintenance requirements are taken into consideration when changes are made.

### **NEW FIXTURE/RETROFIT KIT STANDARDS**

#### **1. Approved Manufacturer(s)**

Approved LED fixture/retrofit kit manufacturers:

- Philips
- General Electric
- Acuity Brands
- LG Lighting
- Remphos

All other manufacturer/models must be formally submitted for approval by Engineering and Maintenance on a per-project basis. Engineers must demonstrate same or better life cycle cost.

#### **2. Product ratings**

- UL-Listed (Underwriters Laboratories)
- DLC (Design Lights Consortium) Qualified Product Listing

#### **3. Specifications**

- L70 LED rated lifetime of 50,000 hours or greater, with 70,000+ hours preferred
- All fixtures/retrofit kits shall be equipped with 0-10 volt dimmable drivers
- Minimum efficacy of 110 LPW (Lumens per watt)
- Minimum CRI (Color Rendering Index) of 80
- Minimum Ambient Temperature Rating to be no less than 40°C (104°F)

#### **2. Warranty**

- Minimum 5-year minimum warranty

### **LED LAMP STANDARDS**

#### **1. Approved Manufacturer(s)**

Approved LED Lamp (Type C) manufacturers:

- Philips
- GE
- LG
- Ledvance (Sylvania)

## E&M STANDARD: DESIGN AND PROJECT COORDINATION

All other manufacturers/models must be formally submitted for approval on a per-project basis

### 2. Product ratings

- UL-Listed (Underwriters Laboratories)
- DLC (Design Lights Consortium) Qualified Products Listing – Required for all TLED “plug & play” lamps (where the lamp category exists within the DLCQP list)
- Energy Star Certified Product Listing – required for all screw-in lamps

### 3. Specifications

- L70 LED rated lifetime of 50,000 hours or greater, with 70,000 hours preferred
- All TLED/PL lamp models should be 0-10v dimmable where possible
- T8/T5 TLED minimum efficacy of 115 LPW (Lumens per watt)
- PL LED Minimum Efficacy of 100 LPW (Lumens per watt)
- Minimum CRI (Color Rendering Index) of 80
- Minimum Ambient Temperature Rating to be no less than 45°C (113°F)

### 4. Warranty

- 5-year minimum warranty on linear & PL lamps
- 3-year minimum warranty on screw-in lamps

## BALLAST / DRIVER STANDARDS

### 1. Approved Manufacturer(s)

Utilize drivers over ballasts where possible

Approved non-dimmable ballast/driver manufacturers:

- Philips Advance
- GE
- LG
- Ledvance (Sylvania)

All other manufacturers/models must be formally submitted for approval on a per project basis

Approved dimmable ballast/driver manufacturers:

- Lutron
- Philips Advance
- GE
- LG
- Ledvance Sylvania

All other makes/models must be formally submitted for approval on a per-project basis

### 2. Product ratings

- Underwriters Laboratories (UL) listed

### 3. Specifications

## E&M STANDARD: DESIGN AND PROJECT COORDINATION

- Minimum Start Temperature: 0°F (-18°C)
- Minimum Ambient Temperature Rating: 45°C (113°F)
- Ballast shall have a minimum ballast factor for primary lamp application as follows: 0.75 for Low Watt, 0.85 for Normal Light Output and 1.20 for High Light.
- Minimum Power Factor Rating: 0.98
- THD (Total Harmonic Distortion) ≤ 10 %

### 4. Warranty

- 5-year minimum warranty

## INSTALLATION BEST PRACTICES

New lighting systems must meet the current NYC Energy Conservation Code, with associated documentation for NYC Local Law 88 compliance in 2025.

All lighting projects with electrical work required must include the Weill Cornell Medicine standards on “lockout/tagout” procedures.

Functionally test emergency egress lighting systems for proper operation and light levels.

When retrofitting LEDs within T8/T5 type lamps, employ direct-fit/UL-Type C retrofits (“Relamp/Reballast” option), utilizing LED tubes with compatible drivers. Direct-voltage/UL Type B retrofits are not allowed.

Where possible, maintain consistency of lighting within similar space types across campus.

Vendors must ensure that light levels are commissioned/tuned after installation.

## EQUIPMENT SPECIFICATIONS

### 1. Fixture Type: Standard Recessed Troffers

Typical Space Types: Common, Office, Restroom, Storage, Lab

- a. LG Recessed Troffer 1x4: Model F4035TB1131, 3500K
  - Rating(s): UL-Listed, DLC-Listed
  - Warranty: 5 years
  - L80 Life Rating: 50,000 Hours
  - Dimmability: Yes, 0-10v
  - Efficacy (Lumens/watt): 100
  - CRI: 82 CRI
  - Minimum Ambient Temperature Rating: -4°F
  - Maximum Ambient Temperature Rating: 104°F
  - 2x2 Lumen Packages: 3200L
  - 1x4 Lumen packages: 4000L
  - 2x4 Lumen Packages: 4000L
- b. Philips “EvoGrid”
  - Rating(s): UL-Listed, DLC-Listed

## E&M STANDARD: DESIGN AND PROJECT COORDINATION

- Warranty: 5 years
  - L70 Life Rating: 80,000 Hours
  - Dimmability: Yes, 0-10v
  - Efficacy (Lumens/watt): 115
  - CRI: 80 CRI
  - Minimum Ambient Temperature Rating: N/A
  - Maximum Ambient Temperature Rating: 104°F
  - 2x2 Lumen Packages: 3000L, 3800L, 4500L
  - 1x4 Lumen packages: 3000L, 3800L, 4500L
  - 2x4 Lumen Packages: 3800L, 4300L, 4800L, 5400L, 7400L
- c. Lithonia “FSL”
- Rating(s): UL-Listed, DLC-Listed
  - Warranty: 5 years
  - L80 Life Rating: 60,000 Hours
  - Dimmability: Yes, 0-10v
  - Efficacy (Lumens/watt): 120
  - CRI: 82 CRI
  - Minimum Ambient Temperature Rating: N/A
  - Maximum Ambient Temperature Rating: N/A
  - 2x2 Lumen Packages: 2000L, 3300L, 4000L, 4800L, 6000L
  - 1x4 Lumen packages: N/A
  - 2x4 Lumen Packages: 3000L, 4000L, 4800L, 6000L, 7200L, 8500L, 10000L, 12000L

## 2. Fixture Type: Recessed Troffers, Limited Space Above Fixture (<2.5”)

Typical Space Types: Common, Office, Restroom, Storage, Lab

- a. MaxLite “MLFP” Flat Panel
- Fixture Depth: 2.2”
  - Dimension Options: 1x4, 2x2, 2x4
  - Rating(s): UL-Listed, DLC-Listed
  - Warranty: 10 years
  - L70 Life Rating: 50,000 Hours
  - Dimmability: Yes, 0-10v
  - Efficacy (Lumens/watt): 115
  - CRI: 80 CRI
  - Minimum Ambient Temperature Rating: -4°F
  - Maximum Ambient Temperature Rating: 104°F
  - 2x2 Lumen Packages: 2400L, 3400L, 4600L 1x4 Lumen packages: 2400L, 3300L, 4800L
  - 2x4 Lumen Packages: 3500L, 4300L, 5800L
- b. Philips “FluxPanel” Flat Panel
- Fixture Depth: 1.9”
  - Dimension Options: 1x4, 2x2, 2x4
  - Rating(s): UL-Listed, DLC-Listed



## E&M STANDARD: DESIGN AND PROJECT COORDINATION

- Warranty: 5 years
  - L70 Life Rating: 81,000 Hours
  - Dimmability: Yes, 0-10v
  - Efficacy (Lumens/watt): 112
  - CRI: 80 CRI
  - Minimum Ambient Temperature Rating: -4°F
  - Maximum Ambient Temperature Rating: 104°F
  - 2x2 Lumen Packages: 3000L, 3800L, 4500L
  - 1x4 Lumen packages: 3000L, 3800L, 4500L
  - 2x4 Lumen Packages: 3800L, 4300L, 4800L, 5400L, 6000L
- c. Sylvania "PANELF" Flat Panel
- Fixture Depth: 2.2"
  - Dimension Options: 1x4, 2x2, 2x4
  - Rating(s): DLC-Listed
  - Warranty: 5 years
  - L70 Life Rating: 50,000 Hours
  - Dimmability: Yes, 0-10v
  - Efficacy (Lumens/watt): 114
  - CRI: 80 CRI
  - Minimum Ambient Temperature Rating: -4°F
  - Maximum Ambient Temperature Rating: 104°F
  - 2x2 Lumen Packages: 3500L
  - 1x4 Lumen packages: 3200L, 3300L, 3500L
  - 2x4 Lumen Packages: 3300L, 3500L, 4200L, 4300L

### 3. Fixture Type: Linear Pendant Fixtures

Typical Space Types: Common, Office, Lab

- a. Philips "BoldPlay"
- Linear Length Options: 1x4
  - Rating(s): UL-Listed, DLC-Listed
  - Warranty: 5 years
  - LM80: 72,000 Hours
  - Dimmability: 0-10v
  - Efficacy (Lumens/watt): 110
  - CRI: 80 CRI
  - Minimum Ambient Temperature Rating: 32 Degrees Fahrenheit
  - Maximum Ambient Temperature Rating: 104 Degrees Fahrenheit
  - Lumen Packages (per 4' Length): 3400L, 4600L, 6500L
- b. Philips "FloatPlane"
- Linear Length Options: 1x4
  - Rating(s): UL-Listed, DLC-Listed
  - Warranty: 5 years
  - LM80: 116,000 Hours
  - Efficacy (Lumens/watt): 125

## E&M STANDARD: DESIGN AND PROJECT COORDINATION

- CRI: 80 CRI
  - Minimum Ambient Temperature Rating: 32 Degrees Fahrenheit
  - Maximum Ambient Temperature Rating: 104 Degrees Fahrenheit
  - Lumen Packages (per 4' Length): 3200L, 4500L, 6000L
- c. Acuity “Bruno LED Softshine”
- Linear Length Options: 1x4, 1x8, 1x12
  - Rating(s): CSA/CUS Listed
  - Warranty: 5 years
  - LM80: 60,000 Hours
  - Efficacy (Lumens/watt): 140
  - CRI: 80 CRI
  - Minimum Ambient Temperature Rating: N/A
  - Lumen Packages (per 4' Length): 3200L, 4000L, 5200L, 6000L

### 4. Fixture Type: Linear Stairwell Fixtures

(must include Bi-Level Dimming; horizontal installations preferred)

Typical Space Types: Stairwells, “Back of House” Corridors

- a. Lutron “FXS” Linear Fixture (2' & 4')
- Rating(s): UL-Listed, DLC-Listed
  - Compatible External Sensor Required (Lutron “LRF2” line)
  - Warranty: 10 years
  - LM70 Life Rating: 50,000 Hours
  - Dimmability: 0-10v
  - Efficacy (Lumens/watt): 100
  - CRI: 80 CRI
  - Minimum Ambient Temperature Rating: 32°F
  - Maximum Ambient Temperature Rating: 104°F
  - 2' Lumen Packages: 1900L, 3500L
  - 4' Lumen Packages: 2800L, 5100L
- b. Philips “FluxStream”
- Rating(s): UL-Listed, DLC-Listed
  - Integrated Dimmable Occupancy sensor (“DAYOCC” to be added to model #)
  - Warranty: 5 years
  - L70 Life Rating: 100,000 Hours
  - Dimmability: Yes, 0-10v
  - Efficacy (Lumens/watt): 120
  - CRI: 80 CRI
  - Minimum Ambient Temperature Rating: -20°C to 25°C
  - 2' Lumen Packages: 2000L, 3000L
  - 3' Lumen Packages: 3000L
  - 4' Lumen Packages: 3000L, 4000L, 5500L, 7000L

### 5. Fixture Type: Linear Strip Fixtures

## E&M STANDARD: DESIGN AND PROJECT COORDINATION

(horizontal installations preferred)

Typical Space Types: “Back of House” Corridors, Mechanical/Equipment Rooms, Storage

- a. Philips “FluxStream”
  - Rating(s): UL-Listed, DLC-Listed
  - Warranty: 5 years
  - L70 Life Rating: 100,000 Hours
  - Dimmability: Yes, 0-10v
  - Efficacy (Lumens/watt): 120
  - CRI: 80 CRI
  - Minimum Ambient Temperature Rating: -20°C to 25°C
  - 2’ Lumen Packages: 2000L, 3000L
  - 3’ Lumen Packages: 3000L
  - 4’ Lumen Packages: 3000L, 4000L, 5500L, 7000L
  
- b. GE “Albeo ALV1”
  - Rating(s): UL-Listed, DLC-Listed
  - Warranty: 5 years
  - L70 Life Rating: 100,000 Hours
  - Dimmability: 0-10v
  - Efficacy (Lumens/watt): 140
  - CRI: 70 CRI
  - Minimum Ambient Temperature Rating: -22 Degrees Fahrenheit
  - Maximum Ambient Temperature Rating: 113 Degrees Fahrenheit
  - 4’ Lumen Packages: 3350L, 5350L, 7350L
  - 8’ Lumen Packages: 6300L, 10700L, 14800L
  
- c. Acuity Holophane “HZL1D”
  - Rating(s): UL-Listed, DLC-Listed
  - Warranty: 5 years
  - L70 Life Rating: 50,000 Hours
  - Dimmability: 0-10v
  - Efficacy (Lumens/watt): 130
  - CRI: 83 CRI
  - Minimum Ambient Temperature Rating: -20°C to 30°C
  - 2’ Lumen Packages: 1500L, 2500L, 3500L
  - 3’ Lumen Packages: N/A
  - 4’ Lumen Packages: 3000L, 5000L, 7000L
  - 8’ Lumen Packages: 6000L, 10000L, 14000L

### **6. Fixture Type: Standard Recessed Downlight, (4” & 6”)**

Typical Space Types: Common, Office, Restroom, Lab

- a. Philips “Calculite”
  - Rating(s): UL-Listed, Energy Star
  - Warranty: 5 years

## E&M STANDARD: DESIGN AND PROJECT COORDINATION

- LM70: 60,000 Hours
  - Efficacy (Lumens/watt): 108
  - 4" Lumen Packages: 500L, 1000L, 1500L, 2000L, 2500L, 3000L
  - 6" Lumen Packages: 1000L, 1500L, 2000L, 2500L, 3500L, 4800L, 6000L
- b. GE "LDX"
- Housing: LDX6RAxxx8xxVQ
  - Reflector: RDI6RWDFWTMR
  - Hanger Bars: BH3
    - Rating(s): UL-Listed
    - Warranty: 5 years
    - LM85: 50,000 Lumens
    - Efficacy (Lumens/watt): 103
    - 4" Lumen Packages: 1000L, 1500L, 2000L, 3000L, 4000L, 5000L, 6000L
    - 6" Lumen Packages: 1000L, 1500L, 2000L, 3000L, 4000L, 5000L, 6000L

### 7. Retrofit Type: Standard Recessed Downlight, Retrofit Kit (4" & 6")

Typical Space Types: Common, Office, Restroom, Storage, Lab

- a. GE "LRX"
- Rating(s): UL-Listed, Energy Star
  - Warranty: 5 years
  - LM85: 50,000 Hours
  - Efficacy (Lumens/watt): 92
  - Task Tuning/Lumen Management Option: Selectable Driver Package which allows switching from full power to a low power mode
  - 4" Lumen Packages: 650L, 1000L
  - 6" Lumen Packages: 650L, 1000L, 1800L
- b. Philips "Lightolier"
- Rating(s): UL-Listed, Energy Star
  - Warranty: 5 years
  - LM70: 42,000 Hours
  - Efficacy (Lumens/watt): 77
  - 4" Lumen Packages: 900L
  - 6" Lumen Packages: 1400L

### 8. Lamp Type: Linear T8/T5 LED Lamps

Typical Space Types: "Back of House" Corridors, Mechanical/Equipment, Vivarium, Storage

- a. Philips T8 LED Lamps
- Recommended 4' Model: 13T8/48 (Dimmable)
  - Recommended Standard 3': 8.5T8 LED/36 (Non-Dimmable)
  - Recommended Standard 2': 7T8 LED/24 (Non-Dimmable)

## E&M STANDARD: DESIGN AND PROJECT COORDINATION

- LM70: 70,000 Hours
  - Efficacy (Lumens/watt): 131
- b. LG T8 LED Lamps
- Recommended 4' Model: 15T8/48 (0-10V Dimming Option)
  - LM70: 50,000 Hours (4')
  - Efficacy (Lumens/watt): 127
- c. GE T8 LED Lamps
- Recommended 4' Model: LED15T8/G4 (Limited Dimming)
  - Recommended Standard 3': LED12T8/G4
  - Recommended Standard 2': LED8T8/G2 (Limited Dimming)
  - LM70: 50,000 hours (2' & 3'); 50,000 Hours (4')
  - Efficacy (Lumens/watt): 136
- d. Philips High Output LED Lamps
- Recommended High Output 4': 24T5 LED/HO/48
  - LM70: 50,000 Hours
  - Efficacy (Lumens/watt): 135
- e. Philips T5 LED Lamps
- Recommended 4' Model: 14T5/HE/48 (Dimmable)
  - LM70: 50,000 Hours
  - Efficacy (Lumens/watt): 131

### 9. Linear T8/T5 Electronic Drivers/Ballast

Typical Space Types: "Back of House" Corridors, Mechanical/Equipment, Storage

- a. T8 Drivers
- 1 or 2-Lamp Fixtures: Philips ICN-2P16-TLED
  - 2 or 3-Lamp Fixture: Philips ICN-3P16-TLED
  - 3 or 4-Lamp Fixture: Philips ICN-4P16-TLED
- b. T5HO Ballasts
- 1 or 2-Lamp Fixtures: Philips ICN2S24TLED90CN35M
  - 3 or 4-Lamp Fixture: Philips ICN4S24TLED90C2LSG
- c. T5HE Ballasts
- 1 or 2-Lamp Fixtures: Philips ICN-2S28

### 10. Lamp/Ballast Type: Plug in G24Q

Typical Space Types: "Back of House" Corridors, Mechanical/Equipment, Storage

- a. Philips G24Q LED Plug-In Lamps
- Recommended Vertical LED Lamp: 10.5PL-C/T LED/26V
  - Recommended Horizontal LED Lamp: 8.5PL-C/T LED/26H
  - Rating(s): UL-Listed, Energy Star

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- Warranty: 5 years
  - LM70: 50,000 Hours
  - Efficacy (Lumens/watt): 90
- b. GE G24Q LED Plug-In Lamps
- Recommended Vertical LED Lamp: LED9G24Q-V
  - Recommended Horizontal LED Lamp: LED9G24Q-H
  - Rating(s): UL-Listed, DLC
  - Warranty: 5 years
  - LM70: 50,000 Hours
  - Efficacy (Lumens/watt): 100

### 11. Hazardous Area Fixtures

Typical Space Types: Hazardous Area “Class 1, Division 1” (Groups A, B, C, D), Hazardous Area “Class 2, Division 1 & 2” (Groups E, F, G)

- a. Holophane “HPLD”
- Rating(s): UL-Listed, DLC-Listed
  - Warranty: 5 years
  - L80 Life Rating: 60,000 Hours
  - Dimmability: Yes, 0-10v
  - Efficacy (Lumens/watt): 115
  - CRI: 80 CRI
  - Minimum Ambient Temperature Rating: -40°F
  - Maximum Ambient Temperature Rating: 104°F
  - Lumen Packages: 3800L, 5400L, 6900L, 9100L, 11200L, 13400L
- b. Holophane “HXPL”
- Rating(s): UL-Listed, DLC-Listed
  - Warranty: 5 years
  - L80 Life Rating: 60,000 Hours
  - Dimmability: Yes, 0-10v
  - Efficacy (Lumens/watt): 116
  - CRI: 80 CRI
  - Minimum Ambient Temperature Rating: -4°F
  - Maximum Ambient Temperature Rating: 131°F
  - 2’ and 4’ Lumen Packages: 3000L, 4000L, 5000L, 8000L, 10000L

## ILLUMINANCE RECOMMENDATIONS

The following are illuminance recommendations for various areas and task types. The information provided represents the Average Horizontal Illuminance Target with Specific Height Illuminance Targets. The ratio represents the Horizontal Uniformity Target (AVG: MIN).

### 1. Classrooms / Training Spaces

- |                         |                   |     |
|-------------------------|-------------------|-----|
| • AV                    | 10 FC @ 2' 6" AFF | 2:1 |
| • Dedicated VDT screens | 15 FC @ 2' 6" AFF | 2:1 |

## E&M STANDARD: DESIGN AND PROJECT COORDINATION

- Hardcopy / Writing 40-80 FC @ 2' 6" AFF 2:1
- 2. Conference Rooms**
  - General 30 FC @ 2' 6" AFF 3:1
  - Projection 3 FC @ 2' 6" AFF 3:1
  - Video Conferencing
    - Surface to be read by Document Camera 30 FC @ SURFACE 2:1
- 3. Corridors**
  - Laboratories 10-20 FC @ Floor 2:1
  - General Corridors
    - Back-of-House (Service and Utility) 5-10 FC @ FLOOR 2:1
    - Public / Administration 10-15 FC @ FLOOR 2:1
- 4. Laboratories**
  - Benches 100 FC @ 3' AFF 2:1
  - General 30 FC @ 3' AFF 4:1
- 5. Lobbies**
  - At Building Entry – General Lighting
    - Day 10 FC @ FLOOR 4:1
    - Night 5 FC @ FLOOR 4:1
  - Reading / Work Areas 15-30 FC @ 3' AFF 2:1
  - Reception Desks 15-30 FC @ DESKTOP 2:1
- 6. Vivariums**
  - Animal Care 30 FC @ FLOOR 2:1
- 7. Restrooms / Toilets**
  - Public Restroom 5-10 FC @ FLOOR 2:1

## **11. ENERGY EFFICIENCY LIGHTING CONTROLS**

### **PURPOSE**

The purpose of this lighting controls standard is to establish guidelines for the specification, design and installation of WCM space interior lighting. This standard is a living document that will be updated by E&M in order to reflect industry best practices and advances in technology. This guidance, while not comprehensive, aims to deliver more consistency in lighting control systems moving forward and ensure that energy efficiency, life cycle cost, and long-term maintenance requirements are taken into consideration when changes are made.

### **APPROVED MANUFACTURER**

#### **1. Approved Manufacturer(s)**

Lutron Electronics Co., Inc.

- a. Lutron Vive
- b. Lutron Quantum™ (requires E&M pre-approval)

### **INSTALLATION BEST PRACTICES**

New lighting systems must meet the current NYC Energy Conservation Code, with associated documentation for NYC Local Law 88 compliance by 2025.

Maintain consistency of lighting and lighting controls within similar space types across campus. Vendors must ensure that lighting control systems are properly commissioned after installation.

Occupancy sensors used for lighting controls should also communicate with the HVAC controls. The HVAC controls will respond to space occupancy in addition to the lighting system.

### **NETWORK LIGHTING CONTROL SYSTEM BASIS OF DESIGN – QUANTUM™**

Quantum™ includes computer-based software that provides control, configuration, monitoring and reports.

#### **1. Front End Equipment, Software, and Licenses**

- a. Lighting Management Processor Panel – Operates system controls, time clocks, features listed below, and stores information on the Q-Manager server.
- b. Quantum™ Q-Manager – Lighting control management server for data logging, monitoring, and control.
- c. Quantum™ Vue – Lighting control management dashboard and control software.
- d. BACnet – Integration with Building Management System (BMS)
- e. GreenGlance – Energy savings display software



## E&M STANDARD: DESIGN AND PROJECT COORDINATION

- f. Occupancy Monitoring – Reports occupancy for each area.
- g. FOFP – View status and control individual fixtures
- h. Hyperion™ Solar Adaptive Shade Control Algorithm Software for QS Window Treatments

### 2. Load Controllers

- a. Energi Savr Node (ESN) – Modular Lighting Control Panels – Corridors, Offices, Common areas
  - QSN-2ECO-S – Ecosystem addressable fixture lighting controller. x2 links of 64 addresses each.
    - Ecosystem LED Drivers
  - QSN-4T16-S – 0-10V dimming controller
  - QSN-4S16-S – 16A relay controller
- b. Grafik Eye QS – In-wall load control and scene selection interface – Conference Rooms, Lounges, VIP Offices
  - Installs in 4-gang wall box
  - Can control up to 6 phase adaptive zones, or up to 64 Ecosystem ballasts/drivers in 16 zones, and zone map from other load controllers.
  - 5 button scene button station
  - Optional 2 shade column button stations

### 3. Wall Stations

- a. SeeTouch Keypads - Low voltage control stations connected to the processor link.
  - Configurable button layout (2-5 buttons and raise/lower)
- b. Wired PX Pico wall stations
  - Wires directly to ESN panels or QSM module

### 4. Sensors – Manual on or Auto on

- a. LOS-CXX – Wired Ceiling Occupancy Sensor – Wires to ESN panel or QSM Module
  - Rated for 500ft at 180°, 1000ft at 180°, or 2000ft at 360°
  - Technology: PIR, Ultra Sonic, or Dual Technology
- b. LOS-WDT-WH – Wired Wall Sensor - Wires to ESN panel or QSM Module
  - Rated for 1,600ft at 110°
  - Dual Technology
- c. EC-DIR-WH – Wired Daylight Sensor - Wires to ESN panel or QSM Module

### 5. UL-924 Emergency & Fire Alarm Interface

- a. LUT-ELI-3PH – Connects to load control panels, normal, and EM power

## **WARRANTY - LSC-B2 – LUTRON BASE WARRANTY**

### **1. Minimum Warranty**

- a. 2-years of parts and labor coverage with 24/7 tech support
  - 100% replacement of parts and diagnostic labor for years 1-2
- b. 5-year warranty on all Ballasts/Driver
  - 100% parts coverage for Ballasts/Drivers purchased with on-site start-up. Three Years, 100% parts coverage for Ballasts/Drivers not purchased with start-up.

## **NETWORK LIGHTING CONTROL SYSTEM BASIS OF DESIGN – VIVE™ (REQUIRES E&M PRE-APPROVAL)**

Vive™ is a wireless system that includes browser or app-based software providing control, time clock events, configuration, and energy dashboards.

### **1. Front End Equipment**

- a. Vive Hub – 71 ft<sup>2</sup>
  - HJS-0 – 75 Devices
  - HJS-1 – 700 Devices
  - HJS-2 – BACnet integration and 700 Devices

### **2. Load Controllers**

- a. Fixture Controllers – Can control up to three drivers/ballasts. Integral Occupancy/Daylight sensor available (see Sensors section).
  - FCJS-010 – 0-10V PowPak
  - FCJS-ECO – Ecosystem PowPak
    - Ecosystem LED Drivers
- b. Zone Controllers
  - RMJS-5R or RMJS-16R – 5A or 16A relay PowPak
  - RMJS-8T – 8A 0-10V zone PowPak
- c. In-Wall Controls
  - MRF2S Dimmers and Switches – Relay and phase adaptive applications. Can also be mounted in ceiling.

### **3. Wall Stations**

- a. PJ2 Pico Wall stations - Wireless control stations.
  - Configurable button layout (2-4 buttons with raise/lower)

### **4. Sensors - Manual on or Auto on**

- a. LRF2-OCR2B-P-WH - Wireless Ceiling Occupancy Sensor
  - Passive Infra-Red (PIR)
  - 324 ft<sup>2</sup> at 8ft AFF, 676 ft<sup>2</sup> at 12ft AFF

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- b. LRF2-OWLB-P-WH - Wireless Wall Mount Occupancy Sensor
  - Passive Infra-Red (PIR)
  - 1500 ft<sup>2</sup> - 3000 ft<sup>2</sup> mounted between 6-8 ft. AFF
- c. FC-SENSOR – 2-Wire connection to fixture PowPacks
  - 150 ft<sup>2</sup> at 9ft AFF
- d. LRF2-DCRB-WH – Wireless Daylight Sensor

## **12. UTILITY METERING**

The purpose of this metering standard is to establish guidelines for the specification, design, purchase, installation of metering and sub-metering at WCM. This applies to meters owned and maintained by WCM.

### **ELECTRIC METERS**

#### **1. Approved Manufacturer(s)**

- a. Billing/reporting meters – Dent PowerScout 3037
- b. Non-billing/non-critical meters – Dent PowerScout 3037, Square D ION 7330, 7600, and 8600 line meters are acceptable

Other metering products may be acceptable if they do not support billing functions. Proposed products should be submitted to E&M for review beforehand

#### **2. Communication**

- a. All meters must come with Modbus communication options cards
- b. Must be capable of being tied into the campus energy management information system (eSight). RS-485 wire from the meter must be installed in an accessible location, with a CAT-6 data jack nearby. E&M will be responsible for completing the connection to the campus EMIS.

### **STEAM METERS**

#### **1. Approved Manufacturer(s)**

- a. Sierra vortex meters – InnovaMass 241i (Note: 240/241 models are no longer acceptable)

#### **2. Communication**

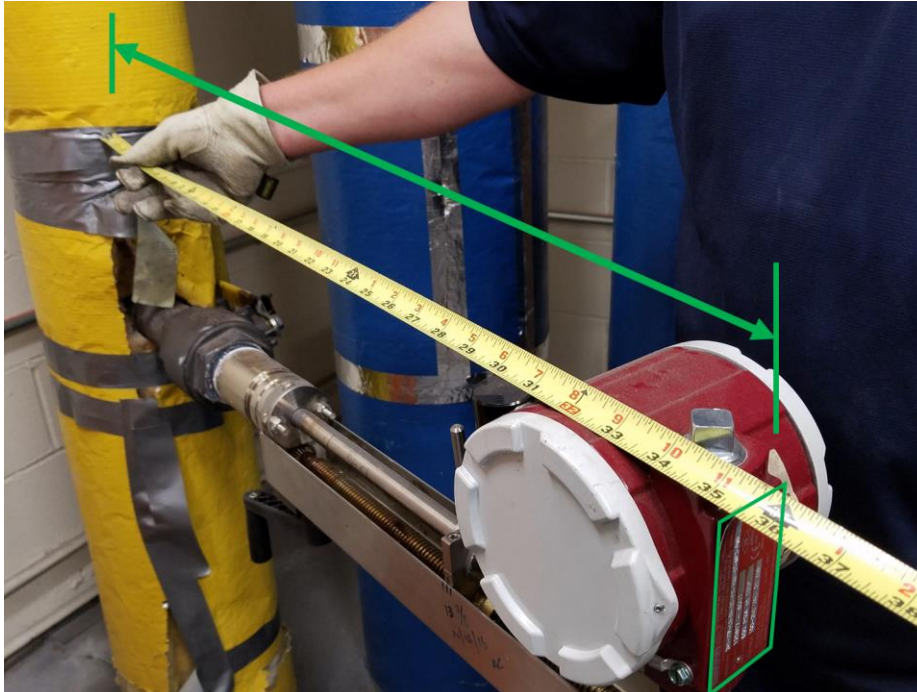
- a. Must be capable of communicating with the energy management information system (eSight) via Modbus communications

#### **3. Installation**

- a. Meters must be sized correctly for the steam load profile and pipe diameter, and they must be properly commissioned.
- b. When installed properly, the sensor head should be located 5” inside the pipe for pipe diameters > 10”. For pipe diameters 10” or smaller, the sensor head should be in the center of the pipe.
- c. Technicians from the manufacturer, Sierra Instruments, or the manufacturer’s representative, North East Technical Sales, are preapproved for calibration and commissioning of steam meters.

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Commissioning documentation is to be submitted to E&M. A photo showing a tape measure measuring from the flat head of the probe display to the edge of the pipe (or to the edge of insulation) is to be submitted to the Energy Manager to demonstrate proper insertion depth. Pipe diameter information and insulation thickness should be provided. From the flat head of the display to the sensor head inside the pipe is 41.5 inches.



## CHILLED WATER / HOT WATER METERS

### 1. Approved Manufacturer(s)

- a. Flexim Fluxus ultrasonic flowmeter

Note: Must be installed by Flexim, not a third party

### 2. Communication

- a. Must be capable of communicating with the energy management information system (eSight) via Modbus communications

### 3. Miscellaneous

- a. Other water meters may be acceptable if they do not support billing functions

## DOMESTIC WATER METERS

### 1. Communication

- a. Must be capable of communicating via pulse output to the energy management information system. If it is a DEP-billing meter, must have a DEP-approved dual output register

## E&M STANDARD: DESIGN AND PROJECT COORDINATION

### **METER MAINTENANCE**

Steam and chilled water meters that support billing functions are to be calibrated annually by Engineering & Maintenance.

The Energy Manager maintains a list of all existing meters.

Totalizer functions must be enabled on all meters

### **13. EQUIPMENT IDENTIFICATION AND BMS POINT NAMES**

The following system is to be utilized for identifying all equipment, meters, etc. on the design, construction and as-built drawings. This system is also used within the WCM computerized maintenance management system for service calls and the Preventive Maintenance Program.

#### **EQUIPMENT DESIGNATION**

The following format must be used for all equipment designation:

Equipment Designation: **EEEE-BB-FF-NNAA**

where:

**EEEE** is the Equipment Type Codes as identified under the EQUIPMENT TYPE CODES section below.

**BB** is the Building Code as determined by Capital Planning Space Management.

**FF** is the Floor that the equipment is physically located on.

Floor Examples:

SSB	Sub-Sub-Basement
SB	Sub-Basement
B	Basement
01-17	Floors 1 through 17
R06	Roof at 6 <sup>th</sup> floor elevation (typical)

**NN** is the sequential number for each of that specific equipment type physically located on that floor in that building.

**AA** (if needed) is an alphabetical code that is applied to separate two or more pieces of equipment that may be part of the same overall equipment type (i.e. Compressor A and Compressor B in a two-compressor set)

Examples:

**ACCH-S-R12-1** is an **Air Cooled Chiller** located in the **S** building on the **12<sup>th</sup>** floor roof (Floor **R12**) and it is the **1st** piece of this equipment type on the level in this building

**HWCP-S-11-3A** is a **Hot Water Circulating Pump** in the **S** building **11<sup>th</sup>** floor and it is the **3<sup>rd</sup>** of that type of equipment type located on that floor, and it is pump **A** of a set of two or more (i.e. a skid mounted system or similar)

#### **BMS POINT IDENTIFICATION**

The following system is to be utilized for identifying items that are connected in some way to one of the WCM Building Management Systems.

## E&M STANDARD: DESIGN AND PROJECT COORDINATION

Please note that the position of the 'BUILDING CODE' and the 'EQUIPMENT TYPE CODE' are intentionally reversed for the 'BMS POINT IDENTIFICATION' as compared to the 'EQUIPMENT DESIGNATION'.

Additionally, for 'BMS POINT IDENTIFICATION', "periods" are used as separators in place of "dashes".

BMS Point Name: **BB.EEEE.FF.NNAA.DDDD.DDDD**

where:

**BB** is the Building Code as determined by Capital Planning Space Management.

**EEEE** is the Equipment Type Codes as identified under the EQUIPMENT TYPE CODES section below.

**FF** is the Floor that the equipment is physically located on.

Floor Examples:

SSB	Sub-Sub-Basement
SB	Sub-Basement
B	Basement
01-17	Floors 1 through 17
R06	Roof at 6 <sup>th</sup> floor elevation (typical)

**NN** is the sequential number for each of that specific equipment type physically located on that floor in that building.

**AA** (if needed) is an alphabetical code that is applied to separate two or more pieces of equipment that may be part of the same overall equipment type (i.e. Compressor A and Compressor B in a two-compressor set)

**DDDD** is the further equipment/system/point descriptor from the Building Automation System Point Glossary (see the separate WCM BMS Standards). Multiple point descriptors may be required.

Example:

**S.AHU.11.5.SF.LTD** is in **S** building, **Air Handler Unit**, **11<sup>th</sup>** Floor, **Unit #5** on that floor, the **Supply Fan** section, **Low Temperature Detector**

## EQUIPMENT TYPE CODES

The following is a current list of Equipment Type Codes currently used by Engineering & Maintenance. These codes are consistent with the WCM computerized maintenance management system. These codes should be used as specified in sections 'EQUIPMENT DESIGNATION' and 'BMS POINT IDENTIFICATION' above.



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<u>Equip. Type Code</u>	<u>Equipment</u>
ABS	ABSORBER
ACCH	AIR COOLED CHILLER
ACU	PACKAGED A/C UNIT
AHU	AIR HANDLER UNIT
AP	AIR PURIFIER
APRS	AIR PRESSURE REDUCING STATION
ATS	AUTOMATIC TRANSFER SWITCH
AWT	ACID WASTE TANK
B	BOILER
BAT	BATTERIES/CHARGERS
CAC	CONTROL AIR COMPRESSOR
CAD	CONTROL AIR DRYER
CDM	CLOTHES DRYER MACHINE
CHWP	CHILLED WATER PUMP
CP	CONDENSATE PUMP
CR	COLD ROOM
CT	COOLING TOWER
CURT	CURTAINS
CWM	CLOTHES WASHER MACHINE
CWP	CONDENSER WATER PUMP
D	DOOR
DC	DRY COOLER
DH	DEHUMIDIFIER
DHWH	DOMESTIC HW HEATER
DHWP	DOMESTIC HW CIRC PUMP
DHWT	DOMESTIC HW STOR TANK
DPE	DIST. PANEL EMERGENCY
DPN	DIST. PANEL NORMAL
DR	DRAIN
DS	DISCONNECT SWITCH
DWP	DOMESTIC WATER PUMP
DWT	DOMESTIC WATER TANK
E	ELEVATOR
EF	EXHAUST FAN
EMP	EMPLOYEE
ERU	ENERGY RECOVERY UNIT
ESC	ESCALATOR
ET	EXPANSION TANK
FBRC	FILTER BANK. RAD. CARB.
FCU	FAN COIL UNIT
FDR	FIRE DOOR
FK	FLOOD KIT
FL	FREEZER LABORATORY
FOP	FUEL OIL PUMP
FOT	FUEL OIL TANK
FP	FIRE PUMP

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FPB	FAN POWERED BOX
GEN	GENERATOR
GP	GLYCOL PUMP
GT	GREASE TRAP
H	HUMIDIFIER
HAF	HOT AIR FURNACE
HWCP	HW CIRCULATING PUMP
HX	HEAT EXCHANGER
IM	ICE MACHINE
IR	INCUBATOR ROOM
IS	IRRIGATION SYSTEM
JP	JOCKEY PUMP
K	KITCHEN
LAC	LAB AIR COMPRESSOR
LAD	LAB AIR DRYER
LGS	LAB GAS/AIR SHUTOFFS
LPE	LIGHTING PANEL EMERGENCY
LPN	LIGHTING PANEL NORMAL
LVP	LAB VACUUM PUMP
MCCE	MCC EMERG.
MCCN	MCC NORMAL
MDCW	METER DOMESTIC WATER
MEE	MISC.ELECTRICAL EQUIP
MELE	METER ELECTRIC
MSTM	METER STEAM
MWP	MAKEUP WATER PUMP
PC	POWER CONDITIONER
PPE	POWER PANEL EMERG.
PPN	POWER PANEL NORMAL
RF	RETURN FAN
RHCW	REHEAT COIL-WATER
RL	REFRIGERATOR-LABORATOR
ROOM	ROOM
RRS	REFRIGERANT RECOVERY
SAFE	SAFE
SEC	SECURITY SYSTEM
SEP	SEWAGE EJECTOR PUMP
SP	SUMP PUMP
SPR	FIRE SPRINKLER SYSTEM
SPRV	STEAM PRV STATION
SSF	SIDE STREAM FILTER
SWG	SWITCHGEAR
TXE	TRANSFORMER EMERGENCY
TXN	TRANSFORMER NORMAL
UHE	UNIT HEATER-ELECTRIC
UHG	UNIT HEATER-GAS
UHHW	UNIT HEATER-HOT WATR
UHS	UNIT HEATER-STEAM
VAV	VARIABLE AIR VOL BOX
VFD	VARIABLE FREQ. DRIVE

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WAC  
WCCH  
WS  
WT  
WTS

WINDOW AIR CONDITIONING  
WATER COOLED CHILLER  
WATER SOFTENER  
WATER TANK  
WATER TREATMENT SYSTEM

## **14. BUILDING AUTOMATION AND CONTROLS**

Refer to existing document 'STANDARD: BUILDING MANAGEMENT SYSTEMS' which is also available on the E&M website.