ICC 1000

STANDARD FOR COMMISSIONING

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COMMISSIONING

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The International Code Council (ICC), a membership association dedicated to building safety, fire prevention and energy efficiency, develops the codes and standards used to construct residential and commercial buildings, including homes and schools. The mission of ICC is to provide the highest quality codes, standards, products and services for all concerned with the safety and performance of the built environment. Most United States cities, counties and states choose the International Codes, building safety codes developed by the International Code Council.

The International Codes also serve as the basis for construction of federal properties around the world, and as a reference for many nations outside the United States. The Code Council is also dedicated to innovation and sustainability. ICC Evaluation Service, a subsidiary of ICC, issues Evaluation Reports and Listings for innovative building products as well as environmental documents such as ICC-ES VAR Environmental Reports and ICC-ES Environmental Product Declarations (EPDs).

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General

101.1 Purpose and scope.

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Section 201
Acronyms

201.1 The following acronyms are used throughout the guideline.

BAS Building automation systems
BOD Basis of design
CxA Commissioning agency
EPA Environmental Protection Agency
FPT Functional performance test
HVAC Heating, ventilating and air conditioning
LEED Leadership in Energy and Environmental Design
O&M Operations and maintenance
OPR Owner's project requirements

Section 202
General Definitions

202.1 Acceptance criteria. The conditions that must be met for systems or equipment to meet defined expected outcomes.

202.2 Commissioning (Cx). A process that verifies and documents that the selected building and site systems have been designed, installed and function in accordance with the owner's project requirements and construction documents, and minimum code requirements.

202.3 Commissioning agency (CxA) An established and recognized agent or agency regularly engaged in conducting tests and furnishing commissioning services. The agency may consist of one or multiple individuals having various expertises. The Commissioning Agency can be a third-party commissioning provider or the owner's in-house staff member.

202.4 Commissioning process. The process by which specific documents, components, equipment, assemblies, systems and interfaces among systems are confirmed to comply with the criteria described in the Owner's Project Requirements and other approved project documents.

202.5 Commissioning team. The key members of each party involved with the project designated to provide insight and carry out tasks necessary for a successful commissioning project. Team members may include the commissioning agency, owner or owner's representative, building staff, design professionals, contractors or manufacturer's representatives, and testing specialists.

202.6 Issues log. A formal and ongoing record of problem or concerns — and their resolution — that have been raised by members of the commissioning team during the course of the commissioning process.

202.7 O&M manuals. Documents that provide information necessary for the operation and maintenance of installed equipment and systems.

202.8 Owner. The individual or entity holding title to the property on which the building is constructed.

202.9 Owner's representative. An individual or entity assigned by the owner to act and sign on the owner's behalf.

202.10 Process equipment. Energy-using equipment and components that are not used for HVAC, electrical, plumbing and irrigation operations. Such devices include, but are not limited to, heat transfer, water purifying, air cleaning, air vacuum and air compressing.

202.11 Selecting trained personnel (for commissioning). This guideline follows the *International Green Construction Code*™ (IgCC™) in that "commissioning shall be performed in accordance with

this section by trained personnel with experience on projects of comparable size and complexity." The trained personnel manage and facilitate the commissioning process. The trained personnel develop and implement the commissioning tasks and documentation relating to systems in accordance with Table 903.1 of the IgCC. Trained personnel may include appropriate members of the owner's staff, contractor and design team, as well as independent commissioning professionals.

It is essential that there is a single person designated to lead and manage the commissioning activities. In practice, this individual has been referenced by various identifiers, such as a commissioning authority, agent, provider, coordinator, lead, etc. In this guideline, the term "CxA" is used.

The designated CxA may be an independent third-party commissioning professional, a project design team member (e.g., engineer or architect), an owner's engineer or facility staff, contractor or specialty subcontractor. Methods of evaluating the designated CxA and trained personnel include review of the following:

1. Technical knowledge.
2. Relevant experience.
3. Potential conflict-of-interest concerns.
4. Professional certifications and training.
5. Communication and organizational skills.
6. Reference and sample work products.

202.12 Sequence of operation. A written description of the intended performance and operation of each control element and feature of the equipment and systems.

202.13 Systems manual. The systems manual provides the information needed to understand and properly and optimally operate the building systems and assemblies.

Section 301
Owner's Project Requirements

301.1 Owner's (or owner representative's) project requirements (OPR). The expectations and requirements of the building appropriate to its phase documented before the design phase of the project begins.

301.3 Compliance method. Compliance is demonstrated by the owner or owner's representative developing and/or approving the OPR document, includes requirements identified in the adopted code, standard ???,

301.4 Enforcement. At his or her discretion, the code official shall confirm demonstrated compliance at plan intake by:

1. Receipt of a copy of the OPR document; and
2. Receipt of a form (see the OPR form) signed by the owner or owner's representative attesting that the OPR has been completed and approved by the owner.

Section 302
Basis of Design

302.1 Basis of design (BOD). A written explanation of how the design of the building system meets the OPR shall be completed at the design phase of the building project, and updated as necessary during the design and construction phases. The BOD document shall cover the following areas:

1. Site development and land use.
2. Materials.
3. Energy.
4. Lighting.
5. Water.
6. Indoor environmental quality.
7. Optional systems (not required by the Code).
8. Intent.

302.3 Compliance method. Compliance requires the completion of the BOD and should include the following, where applicable.

1. Site development and land use.
2. Vegetation and soil protection and restoration.
3. Storm water management and erosion control.
4. Land-clearing debris and soil reuse.
5. Site exterior lighting.

302.3.1 Site development and land use. These shall include:

1. Natural resources and base line conditions of building site:
    1.1. Identify invasive vegetation.
    1.2. Determine location of any protection areas and to what extent the native soils and hydrological conditions have been disturbed on site.
    1.3. Applicable codes.
2. Landscape irrigation systems:

2.1. A narrative description of the system shall be provided, including type, performance and water usage.
2.2. The reason for the system selection shall be described, including why the chosen system is better than the alternatives. Issues such as performance, efficiency, reliability, flexibility, expandability, cost, owner preference and simplicity shall be addressed.
2.3. Sequence of operation, including operating schedules and set points shall be listed.
2.4. How the system meets the OPR shall be described.
2.5. Applicable codes shall be listed.

302.3.2 Vegetation and soil protection and restoration. A vegetation and soil protection plan shall be provided in accordance with the following:

1. Existing vegetation location on a building site that is to be preserved and protected.
2. Portions of the building site to be designated vegetation and soil protection areas (VSPAs) during the construction process.
3. Methods to be used to maintain the protection of the designated VSPAs.
4. Temporary locations. Temporary locations for the stockpiling of topsoil that could be potentially damaged by construction activities or equipment shall be identified.
5. Placement of soil. Soil placement or replacement to establish or restore the ability of the soil to support vegetation shall be identified.
6. Topsoils. The design team shall ensure that topsoils or soil blends imported to a building site to serve as topsoil are not mined from greenfield sites or farmlands.
7. Absorption and percolation. A narrative identifying all proposed absorption systems and percolation tests to be performed on the building site shall be provided.
8. Applicable codes. All applicable codes shall be listed on the vegetation and soil protection plan.

302.3.3 Storm water management and erosion control.

1. A narrative description of the system and how the increase in runoff from the resulting development will be addressed shall be provided.
2. The reason for the best management practice (BMPs) selection, including why the chosen BMPs are better than the alternatives; and issues, such as site conditions, performance, efficiency, reliability, flexibility, simplicity, expand- ability, cost and owner preference, shall be described.
3. How the system meets the OPR shall be described.
4. Applicable codes shall be listed for storm water management and erosion control.

302.3.4 Land-clearing debris and soil reuse.

1. A plan that will recycle or salvage 75 percent of the land-clearing debris and excavated soils shall be developed.
2. Materials to be diverted from disposal through recycling or reuse shall be identified.
3. The amount of materials to be diverted (by weight or volume) and the location as to where they will be diverted shall be specified.
4. The removal and disposal of invasive plant species shall be addressed.
5. The method, amount and location of disposal and treatment of contaminated soils shall be provided.
6. Applicable codes shall be listed for land-clearing debris and soil reuse.

302.3.5 Site exterior lighting.

1. A narrative description of the system, including type of fixtures, lamps, ballasts and controls shall be provided.

2. The reason for system selection, including why the chosen system is better than the alternatives; and issues, such as visual comfort, performance, efficiency, reliability, cost, flexibility, owner preference, color rendering, integration with daylighting and ease of control, shall be described.
3. Design criteria for each type of space shall be provided:
3.1. Applicable codes, guidelines, regulations and other references used.
3.2. Illumination design targets [footcandle (lux)] and lighting calculation assumptions.
4. Lighting design targets shall be provided, including uplight rating, glare rating and backlight rating.

302.4 How the system meets the OPR materials.

302.4.1 Building materials criteria. Recognized performance and quality criteria for the selection of building materials shall be described. Criteria might address, for example, durability; water, vapor and air movement control; energy performance; local availability; availability of repair and replacement materials; ease of maintenance.

302.4.2 Applicable codes shall be listed.

302.5 Energy.

302.5.1 Energy metering, monitoring and reporting.
1. All energy-load types to be metered shall be identified.
2. All energy types that are applicable to the building shall be identified.
3. A narrative of the energy data acquisition and management system to be selected shall be provided.
4. Sequence of operation, including operating schedules, set points and stage capacity shall be defined.
5. How the system meets the OPR shall be described.
6. Applicable codes for energy metering, monitoring and reporting shall be listed.

302.5.2 Mechanical systems completion.
1. The means for system balancing, duct testing and O&M systems manual shall be provided.
2. A narrative description of HVAC system, including system type, location, con- trol type, efficiency features, outdoor air ventilation strategy, indoor air quality features, environmental benefits and other special features shall be provided.
3. Reasons for the system selection, including why the chosen system is better than the alternatives; and issues, such as comfort, performance, efficiency, reliability, flexibility, simplicity, cost, owner preference, site constraints, climate, maintenance and acoustics shall be described.
4. Design criteria shall be provided, including the following:
4.1. Load calculation method/software.
4.2. Summer outdoor design conditions (_____°F dry bulb and ____°F wet bulb).
4.3. Winter outdoor design conditions (__°F dry bulb and ____°F wet bulb).
4.4. Indoor design conditions (___°F dry bulb cooling, _____percent RH cooling. _____°F dry bulb heating, _____ percent RH heating).
4.5. Applicable codes, guidelines, regulations and other references used.
4.6. Load calculation assumptions.
5. Sequence of operations, including operating schedules and set points shall be defined. This may refer to plans or specifications if the sequence is indicated within the permit documents.
6. How the system meets the OPR shall be described.

7. Applicable codes regarding mechanical systems completion shall be listed.

302.5.3 Renewable energy systems. A narrative description of the system, including type, performance, control type, energy savings and payback period shall be provided.

1. The reason for the system selection, including why the chosen system is better than the alternatives; and issues, such as performance, efficiency, reliability, flexibility, simplicity, expandability, cost, payback period, utility company incentives, and owner preference, shall be described.
2. Sequence of operation, including operating schedules, set points and energy storage capacity shall be described.
3. How the system meets the OPR shall be described.
4. Applicable codes regarding renewable energy systems shall be listed.

302.6 Lighting. A narrative description of the lighting system, including type of fixtures, lamps, ballasts and controls shall be provided.

302.6.1 System selection. The reason for the system selection, including why the chosen system is better than the alternatives; and issues, such as visual comfort, performance, efficiency, reliability, cost, flexibility, owner preference, color rendering, integration with daylighting and ease of control, shall be described.

302.6.2 Design criteria. Design criteria for each type of space shall be pro- vided, including the following:

1. Applicable codes, guidelines, regulations and other references used.
2. Illumination design targets [footcandle (lux)] and lighting calculation assumptions.

302.6.3 Lighting power testing. Lighting power design targets for each type of space shall be provided.

1. IECC lighting power allowance and lighting power design target (watts/ft^2).

302.6.4 Lighting control strategies. Lighting control strategies for each type of space including sequence of operation, operating schedules and lighting level set-points shall be described. How the system meets the OPR shall be described.

302.7 Water.

302.7.1 Water reuse systems. A narrative description of the system, including type, performance, capacity and reuse purpose shall be provided.

1. The reason for the system selection, including why the chosen system is better than the alternatives; and issues, such as site constraints, climatic conditions, performance, efficiency, reliability, flexibility, expandability, cost, owner preference and simplicity, shall be described.
2. Sequence of operation, including operating schedules and set points shall be defined.
3. How the system meets the OPR shall be described.
4. Applicable codes regarding water reuse systems shall be listed.

302.8 Indoor environmental quality.

302.8.1 Sound reduction barriers. A narrative of proposed sound reduction barriers used to dampen noise from mechanical and emergency generator equipment located outside of buildings shall be provided.

302.8.2 HVAC background noise. A narrative for how HVAC background noise will be addressed shall be provided.

302.8.3 Applicable codes. Applicable codes regarding indoor environmental quality shall be listed

302.9 Optional systems. For each additional system selected:

1. A narrative of system(s) to be commissioned shall be provided.
2. The reason for the system selection, including why the chosen system is better than the alternatives; and issues, such as site constraints, climatic conditions, performance, efficiency, reliability, flexibility, expandability, cost, owner preference and simplicity shall be described.
3. Sequence of operation, including operating schedules and set points shall be defined.
4. How systems meet the OPR shall be defined.
5. Applicable codes regarding optional systems shall be listed.

302.10 Enforcement. At his or her discretion, the code official shall confirm demonstrated compliance at plan intake by:

1. Receipt of a copy of the BOD document; and
2. Receipt of a form (see the BOD form) signed by the architect, engineer or designer of record, attesting that the BOD has been completed and meets the requirements of the OPR.

Section 303
Commissioning Measures Shown in the Construction Documents

303.1 Commissioning requirements. For new buildings, commissioning shall be in- cluded in the design and construction processes. Commissioning requirements shall include requirements identified in the adopted code, standard ???, or the following:

1. OPR.
2. BOD.
3. Commissioning measures shown in the construction documents.
4. Commissioning plan.
5. Design documents review.
6. Submittal review for commissioned systems.
7. Installation verification.
8. Functional performance testing.
9. Documentation.
10. Training.
11. Commissioning report.

303.2 Intent. Commissioning measures or requirements should be clear, detailed and complete to clarify the commissioning process. These include commissioning measures or requirements in the construction documents (plans and specifications) in accordance with IgCC Section 104.1, Information on Construction Documents, and IgCC Table 903.1, Commissioning Plan.

303.3 Compliance method. Compliance is achieved by including commissioning requirements in the project specifications. The commissioning specifications should include the following:

1. Primary (and optionally all) commissioning requirements are included in the general specification division (typically, Division 1), and clear cross references of all commissioning requirements to and from the general division are included to ensure all subcontractors are held to them.

2. A list of the systems and assemblies covered by the commissioning requirements.
3. Roles and responsibilities of all parties including:
    3.1. General contractor and subcontractors, vendors, and construction manager.
    3.2. Commissioning agency.
    3.3. Owner and facility staff.
    3.4. Architect and design engineers.
    3.5. The noncontractor parties in the construction specifications is for informational purposes only to provide the contractor with context for their work.
    3.6. Who writes checklists and tests, who reviews and approves test forms, who directs tests, who executes tests, who documents test results and who approves completed tests. These roles may vary by system or assembly.
4. Meeting requirements.
5. Commissioning schedule management procedures.
6. Issue and remedy procedures.
7. Requirements for execution and documentation of installation, checkout and start up, including controls point-to-point checks and calibrations.
8. Specific testing requirements by system, including:
    8.1. Monitoring and trending.
    8.2. Opposite season or deferred testing requirements, functions and modes to be tested.
    8.3. Conditions of test.
    8.4. Acceptance criteria and any allowed sampling.
    8.5. Details of the format and rigor of the test forms required to document test execution.
    8.6. Example forms are recommended.
9. Submittal review requirements and approval process.
10. Content, authority and approval process of the commissioning plan.
11. Commissioning documentation and reporting requirements.
12. Facility staff training requirements and verification procedures.
13. O&M manual review and approval procedures.
14. System's manual development, and approval requirements and procedures.
15. Definitions section.

303.4 Enforcement. At his discretion, the code official confirms demonstrated compliance at plan intake by:

1. Receipt of a copy of the commissioning specifications; and
2. Receipt of a form (see the Sample Commissioning Measures in Construction Documents form in Chapter 4) signed by the owner or owner's representative, or designer of record, attesting that the owner-approved commissioning specifications are included in the construction documents.

Section 304
Commissioning Plan

304.1 Commissioning plan. Prior to permit issuance, a commissioning plan based on Table 903.1 of the IgCC or adopted code shall be completed to document how the project will be commissioned. The commissioning plan shall include requirements identified in the adopted code or standard ???.

304 2 Intent. The Commissioning plan should be clear, detailed and complete. The commissioning plan establishes the commissioning process guideline for the project and the commissioning team's level of effort by identifying the required commissioning activities to ensure that the OPR and the BOD are met.

304.3 Compliance method. Compliance with code is demonstrated by the preparation of a project-specific commissioning plan that includes the elements listed in the definition at the beginning of this section. The following gives guidance for developing the components of the commissioning plan:

1. General project information—provide project-identifying information, including, but not limited to, the following:
    - 1.1. Project name, owner and location.
    - 1.2. Building type and building area.
    - 1.3. Code information, including type of construction, building areas, occupancy, number of stories, etc.
    - 1.4. Project schedule.
    - 1.5. Contact information of individual/company providing the commissioning services.

2. Commissioning goals—document the commissioning goals, including, but not limited to:
    - 2.1. Meeting locally adopted code requirements for commissioning.
    - 2.2. Meeting the OPR and BOD requirements.
    - 2.3. Carrying out requirements for commissioning activities as specified in the plans and specifications.

3. Systems to be commissioned—see BOD.
    - 3.1. An explanation of the original design intent—document the performance objectives and design intent for each system listed to be commissioned in a written narrative.
        - 3.1.1. Refer to the OPR and BOD documents.
    - 3.2. Equipment and systems to be tested, including the extent of tests.
        - 3.2.1. Provide a list of equipment and systems to be tested.
        - 3.2.2. Describe the range and extent of tests to be performed for each system component, and interface between systems.
    - 3.3. Functions to be tested—provide example functional test procedures to identify the level of testing detail required.
    - 3.4. Conditions under which the test shall be performed—identify the conditions under which the major operational system functions are to be tested, including:
        - 3.4.1. Normal operations and part-load operations.
        - 3.4.2. Seasonal testing requirements.
        - 3.4.3. Restart of equipment and systems after power loss.
        - 3.4.4. System alarm confirmations.
    - 3.5. Measurable criteria for acceptable performance—include measurable criteria for acceptable performance of each system to be tested.

4. Commissioning team information—provide a contact list for all commissioning team members, including, but not limited to:
    - 4.1. Owner and owner's representative.
    - 4.2. Architect and engineers.
    - 4.3. Designated commissioning representative or approved agency.
    - 4.4. General contractor, subcontractors and construction manager.

5. Commissioning process activities, schedules and responsibilities.
    - 5.1. Establish prescribed commissioning process steps and activities to be accomplished by the commissioning team throughout the design to occupancy.
    - 5.2. For each phase of the work, define the roles and responsibilities for each

member of the commissioning team.

5.3. List the required commissioning deliverables, reports, forms and verifica- tions expected at each stage of the commissioning effort.

5.4. Include the confirmation process for the O&M manual, systems manual, and the facility operator and maintenance staff training.

304.4 Enforcement. At his or her discretion, the code official confirms demonstrated compliance at plan intake by:

1. Receipt of a copy of the commissioning plan; and
2. Receipt of a form (see the Commissioning Plan Sample Compliance form) signed by the owner or owner's representative, attesting that the com- missioning plan has been completed.

304.5 Schedule. Where application is made for construction as described in Section 903 of the IgCC or adopted code, the approved agency shall perform commissioning during construction and after occupancy as required by Table 903.1 of the IgCC or adopted code. Where Table 903.1 of the IgCC or adopted code specifies that commissioning is to be performed on a periodic basis, the registered design professional in responsible charge shall provide a schedule of periodic commissioning with the submittal documents that shall be reviewed by the code official.

304.6 Approved agency. The approved agency shall be qualified and shall demonstrate competence to the satisfaction of the code official, for the commissioning of the particular type of construction or operation. The approved agency shall provide written documentation to the code official demonstrating competence and relevant experience or training. Experience or training shall be considered relevant where the documented experience or training is related in complexity to the same type of commissioning activities for projects of similar complexity and material qualities.

An approved agency shall be deemed competent the agency has been trained or certified by an organization accredited by an International Laboratory Accreditation Cooperation signatory or other nationally recognized accrediting agency to IAS AC 476.

Section 305
Functional Performance Testing

305.1 Functional performance testing (FPT). A documented test of the dynamic functioning operation of equipment and systems with the goal of verifying that the project owner's requirements are met. FPT is based on scope of work and contract documents. Test procedures are developed and results documented by the commissioning agency. Functional testing shall include requirements identified in the adopted code, or standard ???.

These components may include, but are not limited to:

1. Central plant. Chillers, cooling towers, chilled and condenser water pumps.
2. Air-handling equipment.
3. Supply and exhaust fans.
4. Variable air volume box (VAV).
5. Refrigeration systems.
6. Humidification and dehumidification.
7. Variable frequency drive (VFD).
8. Heating hot water boilers and circulating pumps.
9. Domestic hot water and circulating pumps.

10. Sewage ejectors.
11. Sump pumps.
12. Storm water pumps.
13. Water pumps.
14. Water fountains/landscape.
15. Interior and exterior lighting controls.
16. Control systems.
17. Emergency power generator system sequence of operations and uninterruptible power systems (UPS).
18. Air compressor, vacuum pumps and process water.

305.2 Prerequisite documentation. Prior to all functional testing, prerequisite/pre- functional verification and startup documentation will be provided in accordance with requirements identified in the adopted code or standard???.

305.3 Compliance method:

305.3.1 Documentation. FPT documentation shall include the requirements identified in the adopted code or standard???.

305.3.2 Reports. FPT reports shall contain information addressing each of the building components tested; testing methods utilized; and include any readings and adjustments made.

The functional testing documentation shall incorporate a signature block information format containing:

1. Date.
2. Responsible party identifier.
3. Required testing instruments.
4. Measurable pass-fail of testing sequence
5. Expected response of operating perimeters.
6. Results of testing that is performed.
7. Operating condition of equipment status upon completion of each test sequence. A deficiencies list shall be incorporated into the functional testing documentation; this list will track and clarify all failed operating sequences and components. The deficiencies list will act as a living document until all components or sequence of operation have been completed. The building department and building owner/owner's representative will require all parties to perform their duties to correct deficient items. The commissioning agent will confirm all corrected issues have been completed and resolved.

304.4 Enforcement. At his or her discretion, the code official confirms demonstrated compliance at plan intake by:

1. Receipt of a copy of the commissioning FPT report; and
2. Receipt of a form (see the FPT Sample Compliance) signed by the owner or owner's representative, attesting that the FPT has been completed.

Section 306
Documentation and Training

306.1 Systems manual. Documentation of the operational aspects of the building needed to understand, operate, and maintain the buildings systems and assemblies shall be completed within the systems manual, which shall be delivered to the building owner or representative and facilities

operator. The systems manual shall include the documentation identified in the adopted code or standard ???.

9. Enforcement. At his or her discretion, the code official confirms demonstrated compliance during on-site enforcement by:

9.1. Receipt of a copy of the written training program and completed attendance forms; and

9.2. Receipt of a form signed by the owner or owner's representative attesting that the training program and delivery of training has been completed (see the sample form).

Section 307
Commissioning Report

307.1 Commissioning report. A complete report of commissioning process activities undertaken through the design, construction and reporting recommendations for the post-construction phases of the building project shall be completed and provided to the owner or owner's representative as required by the adopted code or standard ???.

1. Intent. The commissioning report documents the commissioning process and test results. The report includes confirmation from the commissioning agent verifying that commissioned systems meet the conditions of the OPR, BOD and contract documents. The report should identify and discuss any substitutions, compromises or variances between the final design intent, contract documents and as-built conditions.
2. Compliance method. The components of the commissioning report include requirements identified in the adopted code or standard???.

3. Enforcement. At his or her discretion, the code official confirms demonstrated compliance by:

3.1. Receipt of a copy of the commissioning report; and

3.2. Receipt of a form signed by the owner or owner's representative attesting that the commissioning report has been completed (see the sample form).

Informative Appendix: COMPLIANCE TEMPLATES AND FORMS

Section 401
Owner's Project Requirements

401.1 Template. OPR's are a required step of commissioning. This template is a guide for collecting the information associated with OPR. The information should be developed by the project team in collaboration with the owner.

401.2 Owner and user requirements. These are typically, already covered in the project scope, as described in the building program. They include the primary purpose, program and use of project; and may also describe future expansion needs, flexibility, quality of materials, construction and operation costs.

401.3 Environmental and sustainability goals.

1. Project shall meet the performance requirements required by the owner.
2. Other owner requirements, such as owner priorities among the *International Green Construction Code* or other areas, shall be identified.
3. Site development and land use.
    3.1. Existing vegetation on site is identified and the significance of preserving such vegetation is discussed.
    3.2. Attention to existing land features has been incorporated into the design of the building and site such that any negative impact to the environment is minimized.

401.4 Energy-efficiency goals. The project shall comply with the *International Energy Conservation Code* or achieve an increased level of efficiency, as determined by the owner.

1. Lighting systems offering cost-effective, energy-saving potential, and lighting fix- tures and/or controls shall be selected to exceed the *International Energy Con- servation Code*'s minimum efficiency requirements by level, as determined by the owner.
2. High-efficiency HVAC equipment offers cost-effective energy savings, and HVAC equipment shall be selected that meets or exceeds the *International Energy Conservation Code*'s minimum efficiency requirements by level, as determined by the owner.
3. Additional energy-efficiency measures that provide cost-effective energy savings shall be included wherever feasible.
4. Other owner requirements, such as orientation, siting, daylighting, cool roof, natural ventilation or landscaping, shall be identified.

401.5 Indoor environmental quality requirements.

1. Any specific nonstandard indoor lighting requirements, such as pendant-mount- ed lighting, illumination requirements or special applications, shall be listed.
2. Any nonstandard occupant lighting requirements, such as multiple-mode con- trols for assembly spaces, shall be listed.
3. Any nonstandard temperature or humidity requirements used for thermal comfort shall be listed.
4. Any nonstandard ventilation and filtration requirements shall be listed.
5. Any nonstandard occupancy HVAC control requirements, such as integration with existing control systems.
6. Any nonstandard acoustic environment requirements, such as local noise sourc- es requiring mitigation; and spaces, such as classrooms, that require low back- ground noise and short reverberation times, shall be listed.
7. Other owner requirements, e.g., natural ventilation, operable windows, daylight, views.

401.6 Building materials selection. Materials used to keep moisture from accumulat- ing inside the building, such as flashing, waterproofing, subdrains, etc., shall be listed.

401.7 Equipment and systems expectations.

1. Special HVAC equipment requirements, such as equipment type, quality, reli- ability, efficiency, control system type, preferred manufacturers, maintenance re- quirements, etc., shall be listed.
2. Unacceptable HVAC system types or equipment shall be listed.
3. Special lighting equipment requirements, such as list-preferred lamp and ballast types that comply with the owner's standards, shall be listed.
4. Other system requirements:
    4.1. Building occupant and O&M personnel expectations.
    4.2. Day-to-day HVAC operation by occupants and the operating staff.

4.3. Periodic HVAC maintenance performed by building occupants, the operat- ing staff, a service company, the owner's staff or other persons.
4.4. Lighting system maintenance will be performed by building occupants, the operating staff, a service company, the owner's staff or other persons.
4.5. Training required for building occupants, such as demonstrations and in- struction documents.
4.6. Training required for operating and maintenance staff, e.g., demonstrations, classroom training and instruction documents.
4.7. Other owner's requirements, , waste management, elevators and escalators.

OWNER'S PROJECT REQUIREMENTS SAMPLE COMPLIANCE FORM
CF 1

Incorporate This Form into the Plans

Project Address: _____ Permit Number: _____

Item#	OPR ITEMS	PAGE NUMBER IN OPR DOCUMENT
	Project Program	
1	General building information (e.g., size, stories, construction type, occupancy type and number)	
2	Intended uses and schedules	
3	Future expandability and flexibility of spaces	
4	Quality and/or durability of materials and desired building lifespan	
5	Budget or operation constraints	
	Environmental and Sustainability Goals	
6	Level of compliance with the IgCC	
7	Specific environmental or sustainability goals (e.g., water efficiency, water reuse, CO_2 monitoring, xeriscaping, etc.)	
	Energy Efficiency Goals	
8	Overall efficiency of building shall meet the IECC or exceed by ____percent	
9	Lighting system efficiency shall meet the IECC or exceed by ____percent	
10	HVAC equipment efficiency and characteristics	
11	Other measures affecting energy efficiency desired by the owner (e.g., building orientation, shading, daylighting, natural ventilation, renewable power, etc.)	
	Indoor Environmental Quality Requirements	
12	Lighting	
13	Temperature and humidity	
14	Acoustics	
15	Air quality, ventilation and filtration	
16	Desired adjustability of system controls	
17	Accommodations for after-hours use	
18	Other owner requirements (e.g., natural ventilation, daylighting, views, etc.)	
	Equipment and Systems Expectations	
19	Level of quality, reliability, equipment type, flexibility, maintenance and complexity desired	
20	Specific efficiency targets, desired technologies or preferred manufacturers for building systems, acoustics and vibration	
21	Degree of system integration, automation and functionality for controls (e.g., load shedding, demand response, energy management, etc.)	
	Building Occupant and O&M Personnel Expectations	
22	Description of how the building will be operated and by whom	
23	Level of training and orientation required to understand, operate and use the building systems for building operation and maintenance staff, as well as occupants	
24	Building operation and maintenance staff location and capabilities	

(continued)

	Commissioning Agent Information	
25	Name of Commissioning Agency:	
26	Address of Agency:	
27	Contact person(s) Name(s):	

Owner/Owner's Representative Acknowledgement

Owner's project requirements (OPR). The expectations and requirements of the building appropriate to its phase shall be documented before the design phase of the project begins. The OPR includes the elements listed in this form and have been approved by the owner or owner's representative.

Name: _____

☐Owner ☐Owner's Representative

Company Name (if applicable): _____

Signature: _____ Date: _____

Section 102
Basis of Design

402.1 Template. Documentation of the BOD is a required step of the commissioning process. This template is a guide for use by the design team.

402.2 Site development and land use.

1. Natural resources and base line conditions of building site.
2. Landscape irrigation systems.
   2.1. Narrative description of system, including system type(s), location, control type, performance, efficiency and water savings. How the system meets any special requirements listed in the OPR document shall be described.
   2.2. Reasons for system selection shall include the reasons that the selected landscape irrigation systems are a better choice than the alternatives (e.g., performance, efficiency, reliability, flexibility, simplicity, expandability, cost, payback period, utility company incentives, cost, owner preferences, ease of maintenance, etc.).
   2.3. For landscape irrigation system calculations, describe the sizing calculation method, assumptions and results.
3. Vegetation and soil protection and restoration.
4. Storm water management and erosion control.
5. Land debris and soil reuse.
6. Site lighting.

402.3 Materials.

1. A narrative description of foundation drainage and waterproofing materials shall be provided.
2. A narrative description of flashing shall be provided.
3. A narrative description of exterior wall coverings shall be provided.
4. A narrative description of roof coverings shall be provided.

402.4 Energy.

1. Energy monitoring and reporting.

2. Mechanical systems completion. The narrative description of the system shall include: system type(s), location, control type, efficiency features, outdoor air ventilation strategy, indoor air quality features, noise reduction features, environ- mental benefits and other special features. How the system meets any special requirements listed in the OPR document shall be described.

2.1. Reasons for system selection shall include the reasons that the selected system is a better choice than the alternatives (e.g., comfort performance, efficiency, reliability, flexibility, simplicity, cost, owner preferences, site constraints, climate, availability of maintenance, acoustics, etc.).

2.2. Load calculations.

2.2.1. Load calculation method/software: _____.

2.2.2. Summer outdoor design conditions: ___°F dry bulb, ___°F wet bulb.

2.2.3. Winter outdoor design conditions: ___°F dry bulb.

2.2.4. Indoor design conditions: ___°F; ___ percent RH cooling; ___°F heating.

2.2.5. Internal heat gain assumptions:

SPACE	LIGHTING LOAD	PLUG LOAD	OCCUPANT LOAD	INFILTRATION LOAD	OTHER

2.2.6. Calculated cooling loads and system size:

SYSTEM/ AIR HANDLER ID	CALCULATED PEAK COOLING LOAD	SELECTED SYSTEM COOLING CAPACITY	REASONS FOR DIFFERENCE BETWEEN CALCULATED LOAD AND SELECTED SYSTEM CAPACITY

2.3. Sequence of operations. Operating schedules, set points, etc., may refer to plans and/or specifications if the sequence of operations is included there.

3. Renewable energy systems. The narrative description of the system shall include: system type(s), location, inverter type, control type, performance, efficiency, energy savings and payback period. How the system meets any special requirements listed in the OPR document shall be described.

3.1. Reasons for system selection shall include the reasons that the selected renewable energy systems are a better choice than the alternatives (e.g., performance, efficiency, reliability, flexibility, simplicity, expandability, cost, payback period, utility company incentives, space constraints, cost, owner preferences, ease of maintenance, etc.).

3.2. Renewable energy system generation calculations, including a description of the sizing calculation method, assumptions and results.

402.5 Lighting. The narrative description of the system shall include:

1. Fixture type(s).
2. Lamp and ballast type.
3. Control type.

4. Describe how the system meets any special requirements listed in the OPR document.
5. Reasons for system selection shall include the reasons that the selected lighting system is a better choice than the alternatives (e.g., visual comfort performance, efficiency, reliability, flexibility, simplicity, cost, owner preferences, color rendering, integration with daylighting, ease of maintenance, etc.).
6. Lighting design criteria shall include the folowing:

SPACE ID	SPACE TYPE	ILLUMINATION DESIGN TARGET (footcandle)	SOURCE OF TARGET[a]	OTHER LIGHTING DESIGN CRITE-RIA[b]

For SI: 1 footcandle = 10.76 lux.
a. Examples include IES standards and owner's requirements.
b. Additional criteria include CRI and CCT.

7. Lighting power design targets shall include the following:

SPACE TYPE	IECC LIGHTING POWER ALLOWANCE (watts/ft^2)	LIGHTING POWER DESIGN TARGET (watts/ft^2)

For SI: 1 watt/ft^2 = 10.76 Kg/s^3

402.6 Water. Narrative description of system shall include the system type(s), location, control type, efficiency features, environmental benefits and other special features. How the system meets any special requirements listed in the OPR document shall be described.

1. Reasons for system selection shall include the reasons that the selected water heating system is a better choice than the alternatives (e.g., performance, efficiency, reliability, simplicity, space constraints, cost, owner preferences, ease of maintenance, utility company incentives, etc.).
2. Water heating load calculations shall describe the sizing calculation method, as- sumptions and results.
3. Water reuse systems shall include:
   - 3.1. Narrative description of the system, including: system type(s), location, space requirements, equipment requirements, control type, performance, efficiency, potable water savings and payback period. How the system meets any special requirements listed in the OPR document shall be de- scribed.
   - 3.2. Reasons for system selection shall include the reasons that the select- ed water reuse systems are a better choice than the alternatives (e.g., performance, efficiency, reliability, flexibility, simplicity, expandability, cost, payback period, utility company incentives, space constraints, cost, owner preferences, ease of maintenance, etc.).
   - 3.3. Water reuse system calculations shall describe the sizing calculation method, assumptions and results.

402.7 Indoor environmental quality. Features that will dampen mechanical and emergency generator equipment shall be described.

402.8 Other systems (not required by the IgCC). For each system to be commissioned that is not covered by the IgCC, the following shall be included: system information, rationale for selection, description of how the system meets OPR and, if applicable, design criteria. Examples of applicable systems include, but are not limited to, fire suppression systems, FAs, elevators, escalators and demolition/construction waste management.

BASIS OF DESIGN SAMPLE COMPLIANCE FORM
CF 2

Incorporate This Form into the Plan

Project Address: _____ Permit Number: _____

ITEM #	BOD ITEMS	PAGE NUMBER IN BOD DOCUMENT
	Site Development and Land Use	
1	An assessment of existing site conditions and narrative relating to the preservation of native soil and hydrological conditions	
2	Narrative description of the landscape irrigation systems, including reason for selection, sequence of operation and relation to the OPR	
3	Narrative description of all proposed absorption systems and percolation tests to be performed; instructions regarding the proper topsoil replacement; and a vegetation and soil protection and restoration plan addressing protected vegetation, location of VSPAs, and temporary locations for the stockpiling of soil	
4	Narrative description of the best management practices to be used on the site for proper storm water management and erosion control, including reasons for selection and relation to the OPR	
5	A listing of all species of invasive plants to be removed; and a waste management plan addressing land-clearing debris removal and recycling and soil reuse	
6	Narrative description for the site lighting system used, including reason for selection, design criteria, design targets and relation to OPR	
	Materials	
7	Narrative description of the foundation drainage and waterproofing materials used	
8	Narrative description of flashing materials used	
9	Narrative description of exterior wall covering materials used	
10	Narrative description of roof-covering materials used	
	Energy	
11	Narrative description of energy data acquisition and management system to be used, including sequence of operation, all energy loads to be metered, energy types applicable to the building and relation to OPR	
12	Narrative description of HVAC system, including means for system balancing, duct testing, O&M manual, reason for system selection, design criteria, sequence of operation and relation to OPR	
13	Narrative description of the renewable energy systems, including reason for system selection, sequence of operation, system generation calculations and relation to OPR	
	Lighting	
14	Narrative description of indoor lighting system, including reason for system selection, sequence of operation and relation to OPR	
	Water	
15	Narrative descriptions of water reuse system, including reason for system selection, sequence of operation, water reuse system calculations and relation to OPR	
	Indoor Environmental Quality	
16	Narrative description of proposed sound reduction barriers used	
17	Narrative description of how HVAC background noise will be addressed	
	Optional Systems (Not Required By the IgCC)	
18	Narrative description of each optional system(s), reason for system(s) selection, sequence of operation(s) and relation to OPR	

(continued)

Architect/Engineer/Designer Acknowledgement I hereby acknowledge the basis of design document has been completed and meets the owner's project requirements.				
	NAME	**LICENSE NUMBER**	**SIGNATURE**	**DATE**
Architect of Record				
HVAC Designer				
Electrical Designer				
Plumbing Designer				
Landscape Architect				
Renewable Energy System Designer				
Other (specify):				

Commissioning Agent Acknowledgement

I have reviewed the basis of design and verified that it meets the owner's project requirements:

Name: _____

Company Name (if applicable):

Agent's Signature: _____ Date: _____

SAMPLE COMMISSIONING MEASURES IN CONSTRUCTION DOCUMENTS
CF3

Project Address: _____ Permit Number: _____

ITEM #	COMMISSIONING MEASURES ITEMS
1	Measures shown in the specifications and cross referenced
2	List of commissioned equipment and systems
3	Cx roles and responsibilities of all parties
4	Meeting requirements
5	Commissioning schedule management procedures
6	Procedures for addressing outstanding issues or noncompliance
7	Requirements for the execution and documentation of installation and equipment start up
8	Specific testing requirements for each system type
9	Submittal review and approval requirements
10	Contents and approval process of the commissioning plan
11	Cx documentation and reporting requirements
12	Facility staff training requirements and verification procedures
13	O&M manual review and approval procedures
14	Systems manual development and approval procedures
15	Definitions

Commissioning Agent Acknowledgment

I have reviewed the construction documents listed in this form and verified their compliance with the owner's project requirements, basis of design and commissioning plan.

Name: _____

Company Name (if applicable): _____

Agent's signature: _____ Date: _____

COMMISSIONING PLAN SAMPLE COMPLIANCE FORM
CF4

ITEM #	COMMISSIONING PLAN ITEMS	PAGE NUMBER IN COMMISSIONING PLAN DOCUMENT
	General Project Information	
1	Project name, owner and location	
2	Building type and building area	
3	Overall project commissioning schedule	
4	Contact information for individual/company providing commissioning services	
	Commissioning Goals	
5	Meeting the IgCC requirements for commissioning	
6	Meeting OPR and BOD requirements	
7	Carrying out requirements for commissioning activities as specified in plans and specifications	
	Systems To Be Commissioned	
8	Explanation of the original design intent (refer to OPR and BOD documents)	
9	Equipment and systems to be tested, functions to be tested, conditions under which the test shall be performed and measurable criteria for acceptable performance	
	Commissioning Team Information	
10	List of all team members and contact information (e.g., owner; owner's representative; architect; engineers; designated commissioning representative; and, if available, general contractor, subcontractors and construction manager)	
	Commissioning Process Activities, Schedules and Responsibilities	
11	Prescribed commissioning process steps and activities to be accomplished by the CxA team throughout the design to occupancy	
12	Roles and responsibilities for each member of the CxA team for each phase of the work	
13	Required Cx deliverables, reports, forms, and verifications expected at each stage of the commissioning effort	
14	Confirmation process for the O&M manual, systems manual and the facility operator and maintenance staff training	

Owner/Owner's Representative Acknowledgement

The commissioning plan includes the items listed in this form and have been approved by the owner or owner's representative.

Name: _____

☐ Owner ☐ Owner's Representative

Company Name (if applicable): _____

Signature: _____ Date: _____

SAMPLE COMPLIANCE FORM FOR FUNCTIONAL TESTING
CF5

This Form is to be Completed at the Time of Inspection

Project Address: _____ Permit Number: _____

List the functional test reports in this form for all systems to be tested

REPORT#[a]	SYSTEM/EQUIPMENT FUNCTIONAL TESTING REPORT	PAGE/TAB NUMBER IN COMMISSIONING REPORT

a. For example, FPT-003.

Commissioning Agent Acknowledgment

I have reviewed the test reports listed in this form and verified that they are complete; these tests have been executed with deficiencies corrected.

Name: _____

Company Name (if applicable):

Agent's signature: _____ Date: _____

MINIMUM REQUIREMENTS FOR FUNCTIONAL TESTING REPORT

Functional performance tests shall demonstrate the correct installation and operation of each component, system and system-to-system interface in accordance with the approved plans and specifications. Functional performance testing reports shall contain information addressing each of the building components tested, the testing methods utilized, and include any readings and adjustments made. Test forms have been developed for each piece of commissioned equipment and system, and include the checked elements listed below. These tests have been executed with deficiencies corrected.

	FUNCTIONAL TEST ELEMENTS	INCLUDED
1	Date and responsible party	☐
2	Signature block—confirming test results are complete and accurate	☐
3	Prerequisites	☐
4	Precautions	☐
5	Instrumentation	☐
6	Reference to the operating source being confirmed	☐
7	Test instructions	☐
8	Acceptance criteria	☐
9	Results	☐
10	Return-to-normal sequence of operations	☐
11	Deficiency list	☐

CxA Signature_____ Date_____

DOCUMENTATION AND TRAINING SAMPLE COMPLIANCE FORM
CF6

This Form is to be Completed at the Time of Inspection

Project Address: _____ Permit Number: _____

Part 1: Documentation

ITEM #	SYSTEM MANUAL ELEMENTS	PAGE NUMBER IN TRAINING MANUAL DOCUMENTS
	Site Information	
1	General (e.g., address, acreage, local utility information, other)	
2	Facility description [e.g., use/function; square footage (m^2); occupancy type; construction type; BOD; location of major systems and equipment]	
3	Project history (e.g., project requirements (BOD/OPR); project's undocumented events; record drawings and documents; final control drawings and schematics; final control sequences; construction documents)	
4	Current requirements [e.g., building operating schedules; space temperature; humidity; pressure; CO_2 set points; summer and winter setback schedules; chilled and hot water temperatures; as-built control set points and parameters]	
	Site Contact Information	
5	Owner	
6	Emergency contacts	
7	Design team (e.g., architect, professional engineer, electrical engineer, other)	
8	Prime contractor	
9	Subcontractor	
10	Equipment supplier	
	Basic O&M	
11	Basic operation (e.g., narratives of basic equipment operation; interfaces, interlocks and interaction with other equipment and systems; initial maintenance provided by the contractor)	
12	General site operating schedules (e.g., instructions for changes in major system operating schedules; instructions for changes in major system holiday and weekend schedules)	
13	Basic troubleshooting (e.g., cite-recommended troubleshooting procedures specific to major systems and equipment; manual operation procedures; standby/backup/bypass operation procedures; major system power fail resets and restarts; trend log listing)	
14	Recommended maintenance events log (e.g., HVAC air filter replacement schedule and log; building control system sensor calibration schedule and log)	
15	O&M manuals (location or delivery information)	
	Major Systems	
16	HVAC systems and controls (e.g., air-conditioning equipment, heating equipment, air distribution equipment, ventilation equipment, building automation system)	
17	Indoor lighting systems and controls (e.g., lighting control panels, occupancy sensors, daylight harvesting systems)	
18	Renewable energy systems (e.g., photovoltaic panels and inverters; wind-powered electrical generators and inverters)	
19	Landscape irrigation systems (e.g., water distribution diagrams and control system)	
20	Water reuse systems (e.g., reclaimed water system for indoor use, reclaimed water for irrigation use)	

(continued)

	Site Equipment Inventory and Maintenance Notes	
21	Spare parts inventory	
22	Frequently required parts and supplies	
23	Special equipment required to operate or maintain systems	
24	Special tools required to operate or maintain systems	
	Special Inspections	
25	Copies of any special inspection verifications	
	Other	
26	Other resources and documentation	

Part 2: Training

ITEM #	TRAINING PROGRAM ELEMENTS	PAGE NUMBER IN TRAINING DOCUMENT
1	System/equipment overview (e.g., what it is; what it does; and with what other systems and/or equipment it interfaces)	
2	Review and demonstration of servicing and preventative maintenance	
3	Review of the information in the systems manual	
4	Review of the record drawings on the system/equipment	

Owner/Owner's Representative Acknowledgement

☐ ☐ Documentation of the operation aspects of the building shall be completed within the systems manual and delivered to the building owner or representative and the facilities operator. The systems manual includes the elements listed in Part 1 of this form.

☐ ☐ When the appropriate maintenance staff is made available prior to the certificate of occupancy, the written training program will be executed to these staff. The written training program includes the elements listed in Part 2 of this form.

Name: _____

☐ Owner ☐ Owner's Representative

Company Name (if applicable): _____

Signature: _____ Date: _____

COMMISSIONING REPORT SAMPLE COMPLIANCE FORM
CF7

This Form is to be Completed at the Time of Inspection

Project Address: _____ Permit Number: _____

A complete report of commissioning process activities undertaken through the design, construction and reporting recommendations for the post-construction phases of the building project shall be completed and provided to the owner or owner's representative. The commissioning report includes the checked elements listed below and has been approved by the owner or owner's representative.

	COMMISSIONING REPORT ELEMENTS	INCLUDED
1	Executive summary with conclusions and outstanding issues	☐
2	History of system deficiencies and resolution	☐
3	Summary of system functional test results	☐
4	Summary of training completion	☐
5	Comparison of metered energy usage (if available) to energy efficiency goals in BOD	☐
6	Attachments of commissioning plan, OPR, BOD, executed (filled in) installation checklists, executed functional tests, and recommendations for end-of-warranty review	☐

Owner and Commissioning Agent Acknowledgment

The commissioning report includes the items listed in this form and is approved by the owner/owner's representative and commissioning agent.

1. Owner/Owner's Representative
The commissioning report includes the items listed in this form and has been approved by the owner or owner's representative.

Name: _____

☐ Owner ☐ Owner's Representative

Company Name (if applicable): _____

Signature: _____ Date: _____

2. Commissioning Agent

Name: _____

Company Name (if applicable): _____

Signature: _____ Date: _____

CHAPTER 5: REQUIRED SKILLS AND MINIMUM QUALIFICATIONS

Section 501
Site Development and Land Use

501.1 Landscape irrigation systems. Landscaping irrigation systems require the knowledge of:

1. Local (municipal) regulations pertaining to landscape irrigation.
2. Landscape irrigation design principles.
3. Landscape irrigation components.
4. Regional vegetation pertaining to minimal water requirements for sustainable growth.
5. Both potable and nonpotable water sources.
6. Basic plumbing systems.
7. Landscape design and systems.

501.2 Outdoor fountains and water features. Outdoor fountains and water features require the knowledge of:

1. Local (municipal) regulations pertaining to outdoor fountains and water features.
2. Fountain and water feature design principles.
3. Fountain and water feature components.
4. Fountain and water feature materials.
5. Nonpotable water sources.
6. Codes and standards pertaining to erosion control.
7. Principles and practice of controlling sediment, erosion and other storm water pollutants.
8. Hydrology, water quality, air quality, habitat conservation and site grading.

501.3 Movement of water. Any movement of water requires the knowledge of:

1. On-site rainfall management as it pertains to volume, duration and discharge.
2. Hydrologic soil groups.
3. Pollutants, including, but not limited to, sediments, organic compounds, nutrients, metals, bacteria, viruses, oils and grease.
4. Ground water contamination.
5. Drainage system elements, including, but not limited to, infiltration, retention and detention basins, and biofilters.
6. Drainage system design techniques, including, but not limited to, two-stage design, basin-side slopes, forebay, low-flow channels, vegetation, maintenance access, multiple use and aesthetics.

501.4 Topography and site grading. In determining topography and site grading, knowledge of the following is necessary:

1. Principles and practice of site grading; and cut and fill regulations and calculation.
2. Hydrology, water quality, air quality, habitat conservation and site grading.
3. Flood plain development.

4. Principles of soil mechanics in the investigation, evaluation and design of civil works involving the use of earth materials.

501.5 Construction waste management. Construction waste management requires knowledge of:

1. Local or regional regulations pertaining to construction waste management.
2. Recycling and salvaging construction materials.
3. Materials cost pertaining to their adaptive reuse.
4. Hazardous construction and demolition wastes.

501.6 Heat island mitigation. Heat island mitigation requires the knowledge of:

1. Local, regional and municipal codes and standards pertaining to heat island mitigation.
2. Energy consumption trends, air pollutant emissions, greenhouse gases, water quality and human health and comfort.
3. Use of trees and vegetation as they pertain to heat island mitigation.
4. Practices and principles involved in green roof and cool roof design and construction.
5. Practices and principles involved in pervious and cool pavement design and construction.

501.7 Outdoor and site lighting. Knowledge of the following is required for outdoor and site lighting:

1. Local, regional and municipal codes and standards pertaining to outdoor and site lighting.
2. White light sources and the benefits thereof.
3. Photometrics.
4. Principles and practices of site lighting, up lighting, lighting trespass, glare and dark-sky friendliness.

501.8 EPA's 1995 Brownfield Program. Established to limit the liability to potential developers; knowledge of the following is necessary:

1. Expansion or redevelopment of sites, which have been abandoned, idled or underused, that have been complicated by real or perceived environmental contamination, structure obsolescence, lack of access to capital and overall neighborhood opposition to the redevelopment of the site.
2. Local zoning ordinances.
3. Soil science.

501.9 Evaluating the CxA. The following is a list of qualifications that the code official may use in evaluating the CxA. The code official may consider one or more of the qualifications in this list:

1. Third-party certification acceptable to the AHJ.
2. State licensure or reciprocity may not be a manufacturer of components; and it may not be the installer.
3. Prior experience within the landscape irrigation industry.
4. Water feature engineer.

5. Civil engineer.
6. National Pollutant Discharge Elimination System Level 1A Certification.
7. Civil engineer experienced and knowledgeable in the practice of soil engineering (soils engineer).
8. Professional Certification: International Waste Manager – Technical status or equal.
9. Building Commissioning Certifications with experience requirements.

Section 502
Materials (Architectural Building Assembly)

502.1 Materials (architecural building assembly). A knowledge of the following is necessary:

1. IgCC 105.4.
2. The *International Building Code*® (IBC®).
3. Building assemblies, architectural detailing and structural system calculations.
4. Energy codes, ASHRAE 90.1.
5. Material safety data sheets (MSDS) and other product verification.
6. Egress requirements.

502.2 Qualifications. The following is a list of qualifications that the code official may use when evaluating the CxA. The code official may consider one or more of the qualifications in this list:

1. Licensed architect.
2. Professional engineer.
3. ICC certified inspector.
4. ICC certified CALGreen inspector.
5. Licensed contractor (third party).

Section 503
Energy

503.1 Management and monitoring systems. In the approval and enforcement of management and monitoring systems, knowledge of the following is required:

1. Energy policy.
2. Assessing the potential value of improved energy management.
3. Securing sufficient resources to implement strategic energy management.
4. Assuring accountability and commitment from core parts of the organization.
5. Identifying opportunities for improvement and ensuing implementation (including staff training).
6. Measuring, tracking, evaluating and communicating results.
7. Technical standards.
8. Indoor air quality.
9. Energy audits.

9.1. Inspection, survey and analysis of energy flows for energy conservation.

9.2. Types of energy audits.

9.2.1. Benchmarking.

9.2.2. Walk-through or preliminary audit.

9.2.3. General audit.

9.2.4. Investment-grade audit.

10. Procurement.
11. Financing.
12. Codes and standards.
13. Energy accounting and economics.
14. Instrumentation.
15. Alternative finance.
16. Building automation and control systems.
17. Electrical systems.
18. Energy procurement.
19. Green buildings, LEED and Energy Star.
20. Lighting systems.

503.2 Qualifications. The following is a list of qualifications that the code official may use in evaluating the CxA. The code official may consider one or more of the qualifications in this list:

1. Professional engineer.
2. An independent third-party commissioning certification program.

Section 504
HVAC Systems

504.1 HVAC systems. Knowledge and consideration of the following are required when evaluating HVAC systems:

1. Design and construction phase commissioning process.
2. Construction communication protocol.
3. Facility requirements.
4. Sustainability and energy requirements.
5. Facility design and construction requirements.
6. Design conditions (climatic conditions, room conditions, temperature humidity levels, and pressure requirements, etc.).
7. Design methods, techniques and software applications.
8. National, state and local building codes, standards and guidelines.
9. Schematic, design development, construction phase documents.
10. Design of mechanical, electrical and plumbing systems.
11. Electrical—Power distribution, motor control centers, power monitoring, etc.
12. Building automation systems, diagrams, points and sequences.
13. Specification formats.

14. Construction phase commissioning processes.

15. Commissioned systems and equipment.

16. Construction submittals.

17. Installation requirements of mechanical, electrical and plumbing (MEP) equipment and systems.

18. O&M requirements.

19. Equipment manufacturer's start-up procedures.

20. Mechanical/electrical equipment and system operation.

21. BAS control diagrams, points, sequences and configuration.

22. TAB process and procedures.

23. O&M documentation.

24. System manual components.

25. Delivery of training.

25.1. Record test data and results.

25.2. Develop trending and analyze trend reports.

25.3. Facilitate the FPT process.

504.2 Qualifications. The following is a list of qualifications that the code official may use in evaluating the CxA. The code official may consider one or more of the qualifica- tions in this list:

1. Professional engineer.

2. An independent third-party commissioning certification program.

Section 505
Lighting

505.1 Lighting systems. Knowledge of the following is required for the evaluation oflighting systems:

1. Skills and abilities to verify that the systems listed are designed, installed and operate as intended.

2. IEEE standards.

3. NFPA 70.

4. Arc flash safety requirements.

5. Lockout tag-out procedures and medium-voltage power distribution equipment and controls.

6. Motors, starters and VFDs.

7. Generator systems and their associated subsystems [battery charging and starting; lubrication; fuel; ignition; cooling; prime-mover engine (Diesel/turbine); reduction gear; exciter; and generator] of UPS systems and their associated subsystems (backup generator; input/output switch gear; battery and charging).

8. Underwriters Laboratories (UL) standards for lightning protection.

505.2 Qualifications. The following is a list of qualifications that the code official may use in evaluating the CxA. The code official may consider one or more of the qualifications in this list:

1. Professional engineer.
2. Third-party certification acceptable to the AHJ.

Section 506
Water

506.1 Water systems. Knowledge, skills and abilities to verify that the systems listed are designed, installed and operate as intended is required.

506.2 Qualifications. The following is a list of qualifications that the code official may use when evaluating the CxA. The code official may consider one or more of the qualifications in this list:

1. Professional engineer.
2. Third-party certification acceptable to the AHJ.

Section 507
Indoor Environmental Quality

507.1 Indoor environmental quality. Information regarding environmental quality can be found in Section 502, Materials (Architectural Building Assembly), Section 504, HVAC Systems, and Section 505, Lighting.

Section 510
Vertical Conveyance Systems

510.1 Elevators. Knowledge of the following is required for the approval of elevators:

1. ASME A17.1.
2. ASME A17.2.
3. ASME A17.3.

510.2 Qualifications. The following is a list of qualifications that the code official may use when evaluating the CxA:

1. Qualified Elevator Inspector (QEI) certification.
2. Third-party license.

510.3 Escalators. Knowledge of the following is required for the approval of escalators:

1. ASME A17.1.
2. ASME A17.2.
3. ASME A17.3.
4. Speed measurements as related to escalators.

510.4 Qualifications. The following is a list of qualifications that the code official may use when evaluating the CxA. The code official may consider one or more of the qualifications in this list:

1. QEI certification.
2. State licensing, if applicable.

Section 511
Construction and Demolition Waste Management

511.1 Construction and demolition waste management. Knowledge of the follow- ing is required for the evaluation of construction and demolition waste management systems:

1. Federal, state and local regulatory requirements for construction and demolition waste management (C&D WM).
2. Federal, state and local regulatory requirements for C&D hazardous materials WM.
3. Material recycling and salvaging process.
4. Materials cost pertaining to their adaptive use.
5. Federal, state and local requirements for health and safety awareness for C&D material handling and management jobsite process.
6. Project documents and scope of work associated with all materials cited for C&D WM.
7. Methods appropriate for project C&D WM bulk commingling, and diversion or source-site separation and diversion.
8. Project schedule and critical path of C&D WM within all scopes of project work.
9. Communication skills and knowledge of information management for project.

511.2 Qualifications. The following is a list of qualifications that the code official may use when evaluating the CxA. The code official may consider one or more of the qualifications in this list:

1. Approved and recognized training programs for Federal and State Occupational Health and Safety Administration (OSHA) Asbestos Abatement certifications and compliance.
2. Approved and recognized training programs for Federal and State OSHA Lead Abatement certifications and compliance.
3. Approved and recognized training programs for Federal and State OSHA 10 and OSHA 30 certifications.
4. Approved respiratory awareness compliant with OSHA 29 CFR, Part 1910.134.
5. Approved and recognized green construction training programs for construction and demolition waste management.

Section 601
Systems Verification

601.1 Systems verification. The tables in Chapter 6 provide a visual list of equipment/ items/components that need to be tested/verified when installed or where applicable.

Table 601
Site Development and Land Use

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
Landscape Irrigation: • Landscape irrigation design • Static pressure verification • Point of connection • Backflow prevention • Flow meter • O&M manual	• Verify the availability of required static pressure. • Backflow. • O&M manual.
Irrigation Design and Systems: • Irrigation controllers with weather or moisture-based capabilities • Irrigation design • Sprinkler head layout at perimeter of building	• Check irrigation controllers for compliance with the plans and specifications. • Check for proper irrigation, proper water spray coverage, and appropriate overlap and spacing in accordance with the plans. • Check for correct sprinkler head emitters with appropriate head rotation to prevent over spraying onto building walls. • Verify sprinkler head per approved plans.
Outdoor Ornamental Fountains and Water Features: • System calibration • System performance • Testing of system or related components in-pool items • Testing of mechanical room • Erosion control systems	• For outdoor ornamental fountains and water features, verify the following per plans: □ Design of water feature or fountain. □ Available water source. □ Available electrical voltage. □ Electrical components. □ Mechanical components. □ Plumbing components. • Verify calibration of all components, including, but not limited to, pumps, filters, chemical controllers, motors, electrical panels, pipe installation, geo-membranes, surface materials. • Verify performance of leakage tests. • Verify performance of the system as a unit. • Verify performance of all modes of operation. • Verify test of in-pool items, including, but not limited to, nozzles, suction and inlet fittings, overflows and weirs, control valves, lights, junction boxes, cord seals, and level sensors. • Verify test of mechanical room, including, but not limited to, control panel terminations, lighting panel, disconnects and ground-fault device wiring to all equipment, valve tags and flow directional arrows, piping and pressure gauges.

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS

Site drainage:	• Verify storm water pollution prevention plan (SWPPP), when required, is on site.
	• Verify drainage system is installed in accordance with site drainage plan.
	• Check, when required by the plans:
	  □ Silt fencing.
	  □ Construction drive.
	  □ Erosion control blankets.
	  □ Erosion control straw logs.
	• Observation and documentation that all BMP pertaining to erosion control were successfully utilized.
	• Observation and documentation during construction that all elements of the erosion control plan are in place such that the soil on the site is contained with no chance of run-off.
	• Verification that collected water after a rain event will move through the site in accordance with the site drainage plan.
	• Verification and documentation that the drainage system components meet or exceed those specified in the site drainage plan.
	• Verification and observation that the O&M and systems manual, as submitted, meet the criteria and needs of the end user.

Topography and Grading (cut/fill): • Grading plan • Soil analysis/compaction plan • Site safety plan • Tree removal/mitigation plan • Soil stabilization and erosion • Control plan • Re-vegetation plan, slope-control planting • Equipment utilization plan • Ground water and infiltration	• Verify that soils reports are complete and in accordance with local rules and regulations. • Verify site waste reduction plan is consistent with IgCC and/or local ordinance, including tree removal. • Verify vegetation meets the re-vegetation plan. • Ensure air quality plan is part of SWPPP or soil erosion control plan. • Check to ensure site safety plan is in place. • Verify that earth-moving equipment has been maintained and repaired in accordance with the O&M manual pertaining to each piece of equipment. • Verify that all elements of site erosion control are monitored daily for deficiencies or necessary repairs. • Verify that areas of fill are compacted to a level that meets or exceeds the soil compaction plan. • Verify that sufficient soil samples representing a true cross section of the cut and fill areas, and of the material to be used as fill, have been taken and tested under the supervision of a certified soils engineer. • Verification of all field and laboratory tests of the land to be covered with fill to confirm that the characteristics of the soil, including its expansive qualities, and bearing value of the land, consolidation potential, can support the proposed fill and structures. • Verify that laboratory analysis and related data support the proposals to replace, rework or blend, or to stabilize or modify with additives. • Periodic site inspections to verify that the previously disturbed areas are maintaining their slopes and compaction rates.
Land-clearing Debris and Soil Reuse: • Waste management communication plan • Waste inventory • Salvage • Disposal • Source-separated construction, demolition and land-clearing recycling • Waste management report	• Verify that the materials on the site are handled as outlined in the waste management plan. • Verify that the recyclables and salvage items are packaged for removal and transported as outlined in the waste management plan. • Verify that hazardous construction materials are handled as outlined in the construction waste management plan. • Verify that the waste management goals and the waste prevention goals met the requirements of the waste management plan. • Verify that the waste inventory reconciles with all disposal manifests or weight tickets. • Verification and documentation that the waste management report correctly reflects the outcome of the waste management plan.

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
Heat Island Mitigation: • Energy consumption • Air pollutant emissions • Greenhouse gases • Trees and vegetation	• Verify cool roof complies with thermal emittance, solar reflectance, or SRI values per the code. • Verify structural and vegetative elements of the green roof. • Verification of the water quality as it pertains to the mitigation techniques utilized in the original construction of the site. • Verify that the O&M manual meets the needs of the property owner. • Check and document the energy consumption savings as they pertain to the mitigation techniques used in the construction of the site. • Check and document the decreased air pollutant emissions and greenhouse gases produced and released as they pertain to the mitigation techniques utilized in the original construction of the site. • Verification and documentation of the water quality as it pertains to the mitigation techniques utilized in the original construction of the site.
Lighting: • Site lighting • Security lighting • Area lighting • Landscape lighting • Sports lighting	• Verify exterior lighting meets light pollution plan. • Check and document that all fixtures are in compliance with the definitions as defined by the IESNA. • Check peripheral vision enhancement. • Check and document that the smallest wattage lamp source available is used to meet the desired lighting levels. • Check and document that the ratios of illuminance and luminance values are in compliance with the IESNA's *9th Edition Handbook Recommended Standards*. • Verify that all fixtures installed have been either selected from the specified product group or submitted as approved alternatives, as approved by the governing body of the local area. • Check and document that primary entry lighting, exterior emergency egress lighting, service area lighting, surface parking, parking garage and roadways are in compliance with the final lighting commissioning plan. • Verification and documentation that the O&M manual meets the goals of the owner.
Brownfield Mitigation: • Baseline risk assessment • Corrective action plan • Remedial action plan • Remedial investigation/ feasibility study	• Verification and documentation that the baseline risk assessment clearly and correctly identified and evaluated the threat to human health and the environment. • Verification and documentation that the recommended cleanup criteria and alternatives for remediation are aligned with the extent of contamination on the site. • Observation, verification and documentation that the cleanup of the site is at a level determined to be health protective for its intended use.

Table 602
Materials (Architectural Building Assembly)

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
• Foundations subsoil drainage system	• Verify compliance with approved plans, specifications and construction documents.
• Foundation dampproofing and waterproofing	
• Flashing at: exterior doors, skylights, wall flashing and drainage systems	
• Exterior wall coverings	
Optional systems (not in the IgCC):	
• Moisture envelopes	• Meet OPR, BOD, Cx specifications.
• Exterior below-grade walls	• Check for proper drainage system at exterior wall perimeter to keep water from entering the building.

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
• External floor and soffits, slab-on-grade	• Check for thermal resistance or insulation when required. • Check the IECC, when applicable. • Slabs: Check drainage for moisture penetration.
• Exterior walls	• Check drawings for wall assembly requirements and any sound transmission class (STC) requirements in accordance with ASTM E 90 and ASTM E 413. • Check for compliance with Section 1403.2 of the 2009 *International Building Code* (IBC).
• Exterior glazed window fenestration: windows, glazed doors and skylights	Drawing reviews and contractor submittal reviews: • Check that fenestration products are labeled with a *U*-factor (see NFRC 100) and a solar heat gain coefficient (SHGC) (see NFRC 200), and certification for the air infiltration requirement of 0.3 cfm/ft^2 of the 2010 *California Energy Code* (CEC) or other approved standards. • Check for proper flashing and caulking at walls and roof assemblies. Glazed doors: • Check for proper flashing, and seals and gaskets; and proper pull force, if provided with a closer. • Check for proper door swing. • Check for STC requirements, if applicable.
• Site-built fenestration: curtain walls and store-front systems, and atrium roof systems	• Check for a label certificate issued by the National Fenestration Rating Council (NFRC) or a label certificate issued by the glazing fabricator that meets the default *U*-factor of the 2008 CEC and SHGC; or an NFRC component modeling approach (CMA) label certificate or another approved standard. • Check for proper door swing. • Check for STC requirements, if applicable.
• Field-fabricated fenestrations: fenestration made at the site, not preformed or cut	• Check for compliance with the default *U*-factor and the default SHGC in accordance with the tables of the 2008 CEC or another approved standard.
• Exterior doors	• Check for proper flashing installation at header, walls and floor. • Check for *U*-factor requirements for swinging and nonswinging doors. • Check for appropriate manufacturer's referenced standard [American Architectural Manufacturer's Association (AAMA); Canadian Standards Association (CSA); and Window and Door Manufacturer's Association (WDMA) or other approved standard] product data sheets.
• Sealants, control joints and flashing (stationary and moveable)	• Check for proper installation in accordance with the manufacturer's written instructions. • Check for proper flashing installation.
• Shading devices (stationary and moveable)	• Check for proper anchoring to building with proper flashing at wall connections. • At mechanical devices: check for proper installation and controls.
• Structural systems	• Check for proper anchoring in accordance with construction documents, including metal connectors and beam supports.
• Materials and finishes	• Check for compliance with allowed volatile organic compound limits and proper manufacturer's installation application. • Review product data sheets.

For SI: 1 cubic foot per minute per square foot = 0.00508 m^3/(s · m^2).

Other Project Requirements (not required by the IgCC)

• Structural systems	• Check for proper anchoring in accordance with the construction documents, including metal connectors and beam supports.
• Structural requirements for mechanical systems and renewable energy systems	• Prefunctional checklists, site observations and construction testing.

Table 603
Energy

Management and Monitoring Systems

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
• Workstation graphic displays	Verify the following is consistent with the commissioning plan: • Systems design. • System specifications. • System submittals. • System installations. • System prestartup inspection checklist. • System functional performance testing. • Systems training. ☐ Device Point to Point checkout (Static Testing). ☐ Device Point to Point checkout (Dynamic Testing). ☐ Sensor calibration. ☐ Valve and damper stroke setup and check. ☐ Coil valve leak check. ☐ Isolation valve or system valve leak check.
• Public display systems	
• Central processing/monitoring hardware and software	
• Network communications/alarm functions	
• User interface with emergency medical services	
• Monitoring functions required for facility operations	
• Local control panels and individual monitoring points	
Integrated Automation Instrumentation for HVAC Systems: • Actuators and operators • Sensors and transmitters • Control valves • Control dampers • Flow meters	
Integrated Automation Instrumentation for Plumbing Systems: • Domestic water metering • Grey water metering • Fuel system (gas, oil) metering	
Integrated Automation Instrumentation and Terminal Devices for Electrical Systems: • Power meters • Kilowatt (kW) transducers • Current sensors • Battery monitors • Lighting relays • UPS monitors	
Integrated Automation of Renewable Energy Systems: • Solar photovoltaic • Wind generation • Geothermal	
• Building management systems	• Confirm installation complies with the contract documents
• Electrical systems	
• Lighting systems	
• Alternative power systems	
• On-site renewable energy	
• Whole-building energy analysis	• Confirm installation complies with the contract documents
• Controllability of lighting systems	
• Controllability of thermal systems	

Table 604
HVAC Systems

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
Instrumentation and Control for HVAC: • Actuators and operators • Sensors and transmitters • Control valves • Control dampers • Direct-digital control system	(tasks included on previous page)
Unitary HVAC Equipment: • Packaged terminal air conditioners • Room air conditioners • Self-contained air conditioners • Computer room air conditioners • Split-system air conditioners • Air-source unitary heat pumps • Water-source unitary heat pumps	• Verify air system balancing. • Verify hydronic system balancing. • Verify duct system testing. • Verify that mechanical system manuals and construction documents required by the O&M manual are submitted. • Verify functional performance testing of HVAC equipment and associated controls and control systems. • Verify acceptance of HVAC systems and equipment/system verification report. • Verify that preparation and distribution of final HVAC system is complete and in accordance with the contract documents. • Confirm construction documents, required drawings, manuals, balancing reports and commissioning report are provided. □ Confirm they are provided to the owner. • Verify air-handling system access. • Verify air-handling system filters. • Verify temperature and humidity in occupied spaces. • Verify specific indoor air quality and pollutant control measures. • Verify listing, installation and venting of fireplaces and combustion appliances. • Verify that mechanical and emergency generator equipment is located outside building or located where exposed to the exterior environment.
Humidity Control Equipment: • Humidifiers • Heated-pan humidifiers • Wetted-element humidifiers • Atomizing humidifiers • Direct-steam-injection humidifiers • Jacketed, steam humidifiers • Self-contained steam humidifiers • Portable humidifiers, mechanical dehumidification units • Outdoor, mechanical dehumidification units • Indoor, mechanical dehumidification units • Portable dehumidifiers • Desiccant dehumidification units	

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
Convection Heating and Cooling Units: • Chilled beams • Air coils • Fan coil units • Unit ventilators • Induction units • Radiators convectors • Finned-tube radiation heaters • Unit heaters • Cabinet unit heaters • Propeller unit heaters • Wall and ceiling unit heaters • Water-to-water heat pumps	• Verify air system balancing. • Verify hydronic system balancing. • Verify mechanical system manuals construction documents required by the O&M and systems manual are submitted. • Verify functional performance testing of HVAC equipment and associated controls and control systems. • Verify acceptance of HVAC systems and equipment/system verification report. • Verify that preparation and distribution of final HVAC system is complete and in accordance with the contract documents. • Confirm construction documents, required drawings, manuals, balancing reports and commissioning report are provided. Confirm they are provided to the owner. • Verify air-handling system access. • Verify air-handling system filters. • Verify temperature and humidity in occupied spaces. • Verify specific indoor air quality and pollutant control measures. • Verify listing, installation and venting of fireplaces and combustion appliances. • Verify that mechanical and emergency generator equipment is located outside of the building or located where exposed to the exterior environment.
Humidity Control Equipment: • Humidifiers • Heated-pan humidifiers • Wetted-element humidifiers • Atomizing humidifiers • Direct-steam-injection humidifiers • Jacketed, steam humidifiers • Self-contained steam humidifiers • Portable humidifiers • Mechanical dehumidification units • Outdoor, mechanical dehumidification units • Indoor, mechanical dehumidification units • Portable dehumidifiers • Desiccant dehumidification units	
Radiant Heating Units: • Radiant-heating electric cables • Radiant-heating electric mats • Radiant-heating hydronic piping • Radiant-heating electric panels • Gas-fired radiant heaters • Electric radiant heaters	

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
Central Heating Equipment—Breechings, Chimneys and Stacks: • Draft control devices • Draft-induction fans • Vent dampers • Barometric dampers • Fabricated breechings and accessories • Fabricated stacks • Gas vents • Insulated sectional chimneys • Flue-gas filtration equipment • Gaseous filtration • Particulate filtration	• Verify air system balancing and a means for providing the system balancing. • Verify hydronic system balancing and a means for providing the system balancing. • Verify duct system testing. • Verify that mechanical system manuals and construction documents required by the O&M manual are submitted. • Verify functional performance testing of HVAC equipment and associated controls and control systems. • Verify acceptance of HVAC systems and equipment/system verification report. • Verify that preparation and distribution of final HVAC system is complete and in accordance with the contract documents. • Confirm construction documents, required drawings, manuals, balancing reports and commissioning report are provided. □ Confirm they are provided to the owner. • Verify air-handling system access. • Verify air-handling system filters. • Verify temperature and humidity in occupied spaces. • Verify specific indoor air quality and pollutant control measures. • Verify listing, installation and venting of fireplaces and combustion appliances. • Verify that mechanical and emergency generator equipment is located outside of the building or located where exposed to the exterior environment.

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
Fuel-fired Heaters: • Fuel-fired duct heaters • Oil-fired duct heaters • Gas-fired duct heaters • Gas-fired radiant heaters • Fuel-fired unit heaters • Oil-fired unit heaters • Gas-fired unit heaters	
Furnaces: • Electric-resistance furnaces • Fuel-fired furnaces • Gas-fired furnaces • Oil-fired furnaces	
Heat Exchangers for HVAC: • Steam-to-steam heat exchangers, steam-to-water heat exchangers • Liquid-to-liquid heat exchangers • Plate-type, liquid-to-liquid heat exchangers • Shell-type, liquid-to-liquid heat exchangers • Direct-geoexchange heat exchangers	• Verify air system balancing and a means for providing the system balancing. • Verify hydronic system balancing and a means for providing the system balancing. • Verify duct system testing. • Verify that mechanical system manuals and construction documents required by the O&M manual are submitted. • Verify functional performance testing of HVAC equipment and associated controls and control systems. • Verify acceptance of HVAC systems and equipment/system verification report. • Verify that preparation and distribution of final HVAC system is complete and in accordance with the contract documents. • Confirm construction documents, required drawings, manuals, balancing reports and commissioning report are provided. □ Confirm they are provided to the owner. • Verify air-handling system access. • Verify air-handling system filters. • Verify temperature and humidity in occupied spaces. • Verify specific indoor air quality and pollutant control measures. • Verify listing, installation and venting of fireplaces and combustion appliances. • Verify that mechanical and emergency generator equipment is located outside of the building or located where exposed to the exterior environment.
Heating Boiler Feedwater Equipment: • Boiler feedwater pumps • De-aerators	
Heating Boilers: • Electric boilers • Condensing boilers • Stainless-steel condensing boilers • Aluminum condensing boilers • Low-mass boilers • Pulse combustion boilers • Cast-iron boilers • Water-tube boilers • Finned water-tube boilers • Steel water-tube boilers • Copper water-tube boilers • Fire-tube boilers • Scotch marine boilers • Steel fire-tube boilers • Boiler blowdown systems	
Solar Energy Heating Equipment: • Heating solar collectors • Heating solar flat-plate collectors • Heating solar concentrating collectors • Heating solar vacuum-tube collectors • Packaged solar heating equipment	

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
Central Cooling Equipment: • Refrigerant compressors • Centrifugal refrigerant compressors • Noncondensable, gas-purge equipment • Reciprocating refrigerant compressors • Scroll refrigerant compressors • Rotary-screw refrigerant compressors • Compressor and condenser units, packaged air/water-cooled refrigerant compressor and condenser units	• Verify air system balancing and a means for providing the system balancing. • Verify hydronic system balancing and a means for providing the system balancing. • Verify duct system testing. • Verify that mechanical system manuals and construction documents required by the O&M manual are submitted. • Verify functional performance testing of HVAC equipment and associated controls and control systems. • Verify acceptance of HVAC systems and equipment/system verification report. • Verify that preparation and distribution of final HVAC system is complete and in accordance with the contract documents. • Confirm construction documents, required drawings, manuals, balancing reports and commissioning report are provided. □ Confirm they are provided to the owner. • Verify air-handling system access. • Verify air-handling system filters. • Verify temperature and humidity in occupied spaces. • Verify specific indoor air quality and pollutant control measures. • Verify listing, installation and venting of fireplaces and combustion appliances. • Verify that mechanical and emergency generator equipment is located outside of the building or located where exposed to the exterior environment.
Cooling Towers: • Forced-draft cooling towers • Open-circuit, forced-draft cooling towers • Closed-circuit, forced-draft cooling towers • Natural-draft cooling towers • Liquid coolers	
Packaged Water Chillers: • Absorption water chillers • Direct-fired absorption water chillers • Indirect-fired absorption water chillers • Centrifugal water chillers • Air-cooled centrifugal water chillers • Water-cooled centrifugal water chillers reciprocating water chillers • Scroll water chillers • Rotary-screw water chillers	
Thermal Storage: • Chilled-water thermal storage • Ice thermal storage • Ice-slurry thermal storage	• Verify air system balancing and a means for providing the system balancing. • Verify hydronic system balancing and a means for providing the system balancing. • Verify duct system testing. • Verify that mechanical system manuals and construction documents required by the O&M manual are submitted. • Verify functional performance testing of HVAC equipment and associated controls and control systems. • Verify acceptance of HVAC systems and equipment/system verification report. • Verify that preparation and distribution of final HVAC system is complete and in accordance with the contract documents. • Confirm construction documents, required drawings, manuals, balancing reports and commissioning report are provided. □ Confirm they are provided to the owner. • Verify air-handling system access. • Verify air-handling system filters. • Verify temperature and humidity in occupied spaces. • Verify specific indoor air quality and pollutant control measures. • Verify listing, installation and venting of fireplaces and combustion appliances. • Verify that mechanical and emergency generator equipment is located outside of the building or located where exposed to the exterior environment.

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
Air Outlets and Inlets: • Diffusers, registers and grilles • HVAC gravity ventilators • HVAC gravity dome ventilators • HVAC gravity-louvered penthouse ventilators • HVAC gravity upblast ventilators	• Verify air system balancing. • Verify hydronic system balancing. • Verify duct system testing. • Verify that mechanical system manuals and construction documents required by the O&M manual are submitted. • Verify functional performance testing of HVAC equipment and associated controls and control systems. • Verify acceptance of HVAC systems and equipment/system verification report. • Verify that preparation and distribution of final HVAC system is complete and in accordance with the contract documents. • Confirm construction documents, required drawings, manuals, balancing reports and commissioning report are provided. □ Confirm they are provided to the owner. • Verify air-handling system access. • Verify air-handling system filters. • Verify temperature and humidity in occupied spaces. • Verify specific indoor air quality and pollutant control measures. • Verify listing, installation and venting of fireplaces and combustion appliances. • Verify that mechanical and emergency generator equipment is located outside of the building or located where exposed to the exterior environment.
Air Terminal Units: • Constant-air-volume units • VAV units	
Electronic Air Cleaners: • Washable electronic air cleaners • Self-contained electronic air cleaners	
Gas-phase Air Filtration: • Activated-carbon air filtration • Chemically impregnated adsorption air filtration • Catalytic-adsorption air filtration	
HVAC Air Cleaning Devices—Particulate Air Filtration: • Panel air filters • Renewable-media air filters • Washable air filters • Extended surface filters • High-efficiency particulate filtration	
HVAC Air Distribution: • Dampers • Volume-control dampers • Fire dampers • Smoke-control dampers • Backdraft dampers • Duct silencers • Turning vanes • Duct- access doors • HVAC fans • Axial HVAC fans • Centrifugal HVAC fans. • HVAC power ventilators • Air curtains	
Special Exhaust Systems: • Dust-collection systems • Sawdust collection systems • Engine exhaust systems • Positive-pressure engine exhaust systems • Mechanical engine exhaust systems	(Included in above tasks/comments) • Verify compliance with local codes
Ventilation Hoods: • Commercial kitchen hoods • Listed commercial kitchen hoods • Standard commercial kitchen hoods • Fume hoods	

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
HVAC Piping and Pumps; **Hydronic Piping and Pumps:** • Hydronic piping • Underground hydronic piping • Above-ground hydronic piping • Ground-loop heat-pump piping • Hydronic piping specialties • Hydronic pumps • In-line centrifugal hydronic pumps • Base-mounted, centrifugal hydronic pumps • Vertical-mounted, double-suction centrifugal hydronic pumps • Vertical-turbine hydronic pump, automatic	• Installed in compliance with contract documents. • Flushing and cleaning plan submitted and approved. • System properly flushed and cleaned and temporary piping removed. • Piping pressure tested according to contract document. • Isolation valves provided at all branches and main takeoffs as required by the contract documents. • Valves installed in the proper direction. • Valves that require a positive shutoff are verified to not leak when closed at normal operating pressure. • Valves tagged and valve schedule submitted and displayed per contract documents. • Temperature, pressure and flow gages and sensors installed. • Piping gages, BAS and associated panel temperature and pressure readouts match.
HVAC Water Treatment: • Water treatment for closed-loop hydronic systems • Water treatment for open hydronic systems • Water treatment for steam system feedwater	
Internal-combustion Engine Piping: • Internal-combustion engine remote-radiator coolant piping • Internal-combustion engine exhaust piping	
Refrigerant Piping: • Refrigerant piping valves • Refrigerant piping specialties • Refrigerant safety relief valve discharge piping • Refrigerants	
Steam and Condensate Piping and Pumps: • Steam and condensate pump units • Steam and condensate heating piping • Steam and condensate heating piping specialties • Steam condensate pumps • Electric-driven steam condensate pumps • Pressure-powered steam condensate pumps	

Table 605
Lighting and Electrical

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
Lighting and Electrical: • Automatic demand-reduction control system functionality • Plug load controls • Connection of appliances to switched receptacles • Verification of transformer nameplate efficiency • Lamps (lighting installations) • Ballasts (lighting installations)	• Devices installed per manufacturer's instructions and specifications.
• Lighting control systems (low voltage)	• Verify a representative sample of zones for sweep warning effectiveness, override capability and zone size. • Test accuracy of schedule, sweep warning system and sweep override switches.
• Automatic daylight harvesting	• Verify photosensors are properly placed and aimed. • Verify daylight control zones correspond to available daylight. • Calibrate dimming set points without the presence of daylighting. • Calibrate dimming gain in presence of daylighting. • Calibrate switching deadbands and set points. • Performance test a representative sample of daylight zones.
• Occupancy and vacancy sensors	• Calibrate sensitivity sensor and time delay adjustment. • Performance test a representative sample of control zones, including entry tests, hand-motion tests and perimeter tests.

Optional Items

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
Medium-voltage: • Substations • Switches • Circuit breakers • Switchgear • Switchboards • Panel boards • Emergency systems	• Verify coordination study is complete, and that breaker and relay settings are set in accordance with the study. • Witnessing of factory tests, as appropriate. • Ensure all necessary representatives are present (e.g., installer, factory representative, etc.). • Review start-up checklist. • Test transformers. • Test protective devices. • Test control circuits, e.g., potential transformers and current transformers. • Test switchgear, e.g., electrical and mechanical operations. • Test circuit breakers. • Local operational tests. • Remote operational tests, if applicable. • Verify training of operating personnel for O&M of equipment.

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
Low-voltage: • Substations • Disconnects • Circuit breakers • Motor control centers • Panel boards • Emergency systems	• Verify coordination study is complete, and that breaker and relay settings are set in accordance with the study. • Witnessing of factory tests, as appropriate. • Ensure all necessary representatives are present (e.g., installer, factory representative, etc.). • Review start-up checklist. • Test transformers. • Test protective devices, e.g., potential transformers and current transformers. • Test control circuits. • Test switchgear, e.g., electrical and mechanical operations. • Test circuit breakers. • Local operational tests. • Remote operational tests, if applicable. • Verify training of operating personnel for O&M of equipment.
• Motors, motor starters and drives (VFD)	• Witnessing of factory tests, as appropriate. • Ensure all necessary representatives are present (e.g., installer, factory representative, etc.). • Review start-up checklist. • Verify motor and starter data match specification and each other. • Inspect the installation. • Take voltage and current reading; compare with nameplate and manufacturer's specifications. • Test for proper motor rotation; if VFD, verify proper motor rotation when in VFD bypass mode. • Local operational tests. • Remote operational tests, if applicable. • Verify training of operating personnel for O&M of equipment. • Monitor operations.
• Emergency generators and distribution systems	• Verify coordination study is complete, and that breaker and relay settings are set in accordance with the study. • Witnessing of factory tests, as appropriate. • Ensure all necessary representatives are present (e.g., installer, factory representative, etc.). • Review start-up checklist and factory commissioning plan. • Inspect the installation. • Follow factory commissioning plan. • Local operational tests. • Remote operational tests, if applicable. • Load and duration tests (increasing loads over increasing durations). • Verify training of operating personnel for O&M of equipment. • Monitor operation.
• UPS	• Witnessing of factory tests, as appropriate. • Ensure all necessary representatives are present (e.g., installer, factory representative, etc.). • Review start-up checklist and factory commissioning plan. • Inspect the installation. • Follow factory commissioning plans (transfer testing, to generator, to bypass, to maintenance bypass, etc.). • Verify training of operating personnel for O&M of equipment. • Monitor operation.

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
• Grounding equipment and building grounding systems	• See IEEE 81. • Ensure all necessary representatives are present (e.g., installer, factory representative, etc.). • Inspect the installation. • Verify training of operating personnel for O&M of equipment.
• Lightning protection equipment and systems	• Ensure all necessary representatives are present (e.g., installer, factory representative, etc.). • Inspect the installation. • Ensure installer is listed by UL, and that a master label application is submitted to UL for the installation. • Ensure owner signs the master label application. • Ensure receipt of master label from the installer. • Place master label on the protected structure, as requested. • Take voltage and current reading; compare with nameplate and manufacturer's specifications. • Test for proper motor rotation; if VFD, verify proper motor rotation when in VFD bypass mode. • Verify training of operating personnel for O&M of equipment. • Monitor operation.

Other Electrical Systems (Communications—Including Telecom, Intercom, Public Address, Television, Video, etc.)

Optional items

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
Medium-voltage: • Transformers • Substations • Switches • Circuit breakers • Switchgear • Switchboards • Panel boards • Emergency systems	• Verify coordination study is complete, and that breaker, fuse and relay settings are set in accordance with the study. • Witnessing of factory tests, as appropriate. • Ensure all necessary representatives are present (e.g., installer, factory representative, etc.). • Review start-up checklist. • Test transformers. • Test protective devices. • Test control circuits, e.g., potential transformers and current transformers. • Test switchgear, e.g., electrical and mechanical operation. • Test circuit breakers. • Local operational tests. • Remote operational tests, if applicable. • Test all mechanical connections using an infrared camera after initial energizing and after the system is loaded. • Verify training of operating personnel for O&M of equipment.

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
Low-voltage: • Transformers • Substations • Disconnects • Bus duct • Circuit breakers (air circuit breakers not molded case circuit breakers) • Motor control centers • Panel boards • Emergency systems	• Verify coordination study is complete, and that breaker, fuse and relay settings are set in accordance with the study. • Witnessing of factory tests, as appropriate. • Ensure all necessary representatives are present (e.g., installer, factory representative, etc.). • Review start-up checklist. • Test transformers. • Test protective devices, e.g., potential transformers and current transformers. • Test control circuits. • Test switchgear, e.g., electrical and mechanical operation. • Test circuit breakers. • Local operational tests. • Remote operational tests, if applicable. • Test all mechanical connections using an infrared camera after initial energizing and after the system is loaded. • Verify training of operating personnel for O&M of equipment.
• Motors, motor starters and drives (VFD)	• Witnessing of factory tests, as appropriate. • Ensure all necessary representatives are present, e.g., installer, factory representative, etc. • Review start-up checklist. • Verify motor and starter data match specification and each other. • Inspect the installation. • Take voltage and current reading, compare with nameplate and manufacturer's specifications. • Test for proper motor rotation; if VFD, verify proper motor rotation when in VFD bypass mode. • Local operational tests. • Remote operational tests, if applicable. • Verify training of operating personnel for O&M of equipment. • Monitor operation.
• Emergency generators and distribution systems	• Verify coordination study is complete, and that breaker, fuse and relay settings are set in accordance with the study. • Witnessing of factory tests, as appropriate. • Ensure all necessary representatives are present (e.g., installer, factory representative, etc.). • Review start-up checklist and factory commissioning plan. • Inspect the installation. • Follow factory commissioning plan. • Local operational tests. • Remote operational tests, if applicable. • Test all mechanical connections using an infrared camera after initial energizing and after the system is loaded. • Load and duration tests (increasing loads over increasing durations). • Verify training of operating personnel for O&M of equipment. • Monitor operation.
• UPS	• Witnessing of factory tests, as appropriate. • Ensure all necessary representatives are present (e.g., installer, factory representative, etc.). • Review start-up checklist and factory commissioning plan. • Inspect the installation. • Follow factory commissioning plans (transfer testing to generator, to bypass, to maintenance bypass, etc.). • Test all mechanical connections using an infrared camera after initial energizing and after the system is loaded. • Verify training of operating personnel for O&M of equipment. • Monitor operation.

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
• Grounding equipment and building grounding systems	• Ensure all necessary representatives are present (e.g., installer, factory representative, etc.). • Inspect the installation. • Verify training of operating personnel for O&M of equipment.
• Lightning protection equipment and systems	• Ensure all necessary representatives are present (e.g., installer, factory representative, etc.). • Inspect the installation. • Ensure installer is listed by UL and that a master label application is submitted to UL for the installation. • Ensure building owner signs the master label application. • Ensure receipt of master label from the installer. • Place master label on the protected structure, as requested. • Take voltage and current reading, compare with nameplate and manufacturer's specifications. • Test for proper motor rotation; if VFD, verify proper motor rotation when in VFD bypass mode. • Verify training of operating personnel for O&M of equipment. • Monitor operation.

Table 606
Water

Plumbing Systems (Water Distribution, Sanitary/Storm Water, Rainwater, Gray Water, etc.)

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
Facility Water Distribution Piping: • Domestic water piping • Domestic water piping specialties • Domestic water pumps • Domestic water-packaged booster pumps	• Installed in compliance with contract document. • Flushing and cleaning plan submitted and approved. • Piping pressure tested according to contract document.
Facility potable-water-storage tanks	• Installed in compliance with contract document.
Facility Sanitary Sewerage: • Sanitary waste piping specialties • Sanitary drains • Fats, oils and grease disposal systems • Grease removal devices • Backwater valves • Air admittance valves • Sanitary waste interceptors and separators • Sanitary sewerage pumps • Wet pit-mounted, vertical sewerage pumps • Submersible sewerage pumps • Sewerage pump basins and pits • Facility septic tanks • Facility gray water tanks	• Installed in compliance with contract document. • Flushing and cleaning plan submitted and approved. • System properly flushed and cleaned and temporary piping removed. • Piping pressure tested according to contract document. • Valves installed in the proper direction. • Valves that require a positive shutoff are verified to not leak when closed at normal operating pressure. • Valves tagged and valve schedule submitted and displayed per contract documents.

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
Facility Storm Drainage: • Facility storm drainage piping • Sump pump discharge piping • Sump pumps • Submersible sump pumps • Sump-pump basins and pits • Packaged, pedestal drainage pump units • Packaged, submersible, drainage pump units • Rainwater storage tanks	• Installed in compliance with contract documents. • Flushing and cleaning plan submitted and approved. • System properly flushed and cleaned and temporary piping removed. • Piping pressure tested according to contract documents. • Valves installed in the proper direction. • Valves that require a positive shutoff are verified to not leak when closed at normal operating pressure. • Valves tagged and valve schedule submitted and displayed per contract documents. • Check electrical connections.
General service compressed-air systems	• Verify installation in compliance with contract document
Domestic Water Heat Exchangers: • Instantaneous domestic water heat exchangers • Heating fluid-in-coil, instantaneous domestic water heat exchangers • Domestic water-in-coil, instantaneous domestic water heat exchangers • Heating fluid, instantaneous domestic water heat exchangers • Circulating, domestic water heat exchangers • Circulating, compact domestic water heat exchangers • Circulating, storage domestic water heat exchangers • Noncirculating, domestic water heat exchangers • Noncirculating, storage domestic water heat exchangers • Domestic water brazed-plate heat exchangers • Domestic water frame-and-plate heat exchangers • Domestic water heat reclaimers	• Comply with manufacturer's recommended checkout and startup procedures. • Manufacturer's recommended spare parts are provided. • Equipment label permanently affixed. • Pumps in place and properly supported. • Pressure/temperature relief valves installed per contract documents. • Shaft seal is leak free. • Insulation installed per contract documents. • All electrical connections are tight. • Grounding installed and operational. • Safeties installed and operational. • Control system interlocks connected and functional. • Pump rotates in correct direction. • Temperature and pressure gages and sensors installed per contract documents.
Domestic Water Softeners; **Domestic Water Filtration Equipment;** **Electric Domestic Water Heaters:** • Instantaneous electric domestic water heaters • Flow-control, instantaneous electric domestic water heaters • Thermostat-control, instantaneous electric domestic water heaters • Electric domestic water heaters • Small-capacity electric domestic water heaters. • Residential, storage electric domestic water heaters • Collector-to-tank, solar-electric domestic water heaters • Collector-to-tank, heat-exchanger-coil, solar-electric domestic water heaters • Light-commercial electric domestic water heaters • Commercial domestic water electric booster heaters • Commercial domestic water electric booster heaters • Commercial storage electric domestic water heaters	• Comply with manufacturer's recommended checkout and startup procedures. • Manufacturer's recommended spare parts are provided. • Equipment label permanently affixed. • Pumps in place and properly supported. • Pressure/temperature relief valves installed per contract documents. • Shaft seal is leak free. • Insulation installed per contract documents. • All electrical connections are tight. • Grounding installed and operational. • Safeties installed and operational. • Control system interlocks connected and functional. • Pump rotates in correct direction. • Temperature and pressure gages and sensors installed per contract documents.

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
Fuel-fired Domestic Water Heaters: • Instantaneous, tankless, gas domestic water heaters • Residential gas domestic water heaters • Residential, atmospheric, gas domestic water heaters • Residential, direct-vent, gas domestic water heaters • Residential, power-vent, gas domestic water heaters • Commercial gas domestic water heaters • Commercial, atmospheric, gas domestic water heaters • Commercial, power-burner, gas domestic water heaters • Commercial, power-vent, gas domestic water heaters • Commercial, high-efficiency, gas domestic water heaters • Commercial, coil-type, finned-tube, gas domestic water heaters • Commercial, grid-type, finned-tube, gas domestic water heaters • Oil-fired domestic water heaters • Large-capacity, oil-fired domestic water heaters • Dual fuel-fired domestic water heaters	• Comply with manufacturer's recommended checkout and startup procedures. • Manufacturer's recommended spare parts are provided. • Equipment label permanently affixed. • Pumps in place and properly supported. • Pressure/temperature relief valves installed per contract documents. • Shaft seal is leak free • Insulation installed per contract documents. • All electrical and fuel connections are tight. • Grounding installed and operational. • Safeties installed and operational. • Control system interlocks connected and functional. • Pump rotates in correct direction. • Temperature and pressure gages and sensors installed per contract documents.
Commercial Plumbing Fixtures: • Commercial water closets, urinals and bidets • Commercial water closets • Commercial urinals • Commercial lavatories and sinks • Commercial lavatories • Commercial sinks • Commercial bathtubs • Commercial showers • Commercial disposers • Wash fountains • Commercial faucets, supplies and trim • Flushometers	• Installation is per manufacturer's instructions. • Pipe fittings complete and properly supported. • Faucet/flush handles secure and properly aligned. • Associated trim and accessories consistent with contract documents. • Joints between fixtures, walls and floors and counters sealed. • Insulation installed per contract documents. • Fixtures consistent with ADA. • Water pressure meets contract documents. • Hot water temperature meets contract documents. • Automatic flush valves and sensors verified for proper operation and sensitivity adjustment.
Emergency Plumbing Fixtures: • Emergency showers • Eyewash equipment • Self-contained eyewash equipment	• Installation is per manufacturer's instructions. • Water pressure meets contract documents. • Hot water temperature meets contract documents.
Drinking Fountains and Water Coolers: • Drinking fountains • Pressure water coolers • Water-station water coolers • Remote water coolers	• Installation is per manufacturer's instructions. • Water pressure meets contract documents. • Water temperature meets contract documents.

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
Fountain Plumbing Systems: • Fountain piping • Fountain pumps • Fountain water treatment equipment • Fountain equipment controls	• Comply with manufacturer's recommended checkout and startup procedures. • Manufacturer's recommended spare parts are provided. • Equipment label permanently affixed. • Pumps in place and properly supported. • Pressure / temperature relief valves installed per contract documents. • Shaft seal is leak free. • Insulation installed per contract documents. • All electrical connections are tight. • Grounding installed and operational. • Safeties installed and operational. • Control system interlocks connected and functional. • Pump rotates in correct direction.
Swimming Pool Plumbing Systems: • Swimming pool pumps • Swimming pool water treatment equipment • Swimming pool equipment controls	

Table 607
Indoor Environmental Quality

IEQ Requires	TASKS/COMMENTS
• For IEQ requirements for individual systems see the following sections: □ See Table 603, Energy, and Table 604, HVAC Systems.	—
• Optional systems (not required by the IgCC). □ See Table 602, Materials (Architectural Building Assembly).	—

Table 612
Construction and Demolition Waste Management

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
• C&D waste diversion goals • Integrated waste management plan within all scopes of project work • C&D WM project team coordinator • C&D WM field worker requirements • Project staging and coordination issues • Establish types of materials to be diverted, salvaged and or recycled • Identify known and potential hazardous materials on project • Material consumption during project development and design • Material consumption and waste during all project phases and scopes of work • Desired method of C&D WM • Verification documents and information management process reporting • C&D WM schedule of events within project critical path	• External verification documentation and reporting. • Internal information management process reporting and records. • Monitor and evaluate progress and coordinate adjustments, as necessary. • Coordinate progress and events; and communicate through proper documentation, meetings and other communications. • Verification that the integrated waste management plan on site is communicated and documented to a qualified and approved waste hauler. • Verification for the proper handling of hazardous C&D materials on site, and that they are transferred to an approved waste hauler for hazardous C&D materials removed from the project site. • Verification that project material consumption goals are being met. • Verification that recycled and salvaged material intended for project reuse, meets all material design requirements, codes, standards and project documents. • Verification of material cost savings and diversion goals, as they relate to recycled and salvaged materials. • Verification and amount of source site separation and diversion, for each material identified. • Verification and amount of bulk commingling and diversion, for all materials with an estimate for each type of material used on project. • Verification that workers are approved and meet all necessary federal, state and local regulatory requirements for handling hazardous materials. • Verification of project closeout; all documentation required for the project is complete, up-to-date, and reported as required by the AHJ and contract documents.