Appendix III–1A Owner's Project Requirements

Abbreviations and Definitions

A/E	Architect/Engineer Design Team	AHJ	Authority Having Jurisdiction
BAS	Building Automation System	BMS	Building Management System
BOD	Basis of Design	Cx	Commissioning
CxA/CxP	Cx Provider	CC	Controls Contractor
CCS/CxC	Contractor's Commissioning Specialist	CD	Construction Documents
DD	Design Development	DDC	Direct Digital Controls
DOR	Designer of Record	EC	Electrical Contractor
FM	Facility Manager / Director	FPT	Functional Performance Testing
GC	General Contractor	IST	Integrated Systems Testing
MC	Mechanical Contractor	O&M	Operations and Maintenance
OPR	Owner's Project Requirements	QC	Quality Control
PC	Plumbing Contractor	PFC	Pre-Functional Checklist
PDT	Project Design Team	PM	Project Manager
RFI	Request for Information	SD	Schematic Design
SMC	Sheet Metal Contractor	SOO	Sequences of Operation
SOW	Scope / Statement of Work	TAB	Testing, Adjusting, and Balancing

Acceptable Performance

A component or system shall be able to meet specified design parameters and criteria under actual load conditions for a duration of time as indicated within the functional test criteria.

Acceptance

A formal approval of equipment, system, assembly, etc. that each meets requirement defined in the Specifications which allows Cx process activities to proceed. Usually, acceptance is by the Owner or an authorized representative.

Basis of Design (BOD)

The BOD contains design criteria to meet the OPR and the design narrative that satisfies regulatory requirements, standards, and guidelines.

BAS/DDC Controls Integration

A point-to-point outline of the control systems for the purpose of verifying that systems integration meets the OPR and is accessible to O&M personnel for ongoing operation.

Building Envelope Inspection

Verify that the building materials and construction maintain the required thermal and moisture integrity and air tightness of the building system as outlined in Building Envelope Inspection Checklist.

Certificate of Readiness

A letter that indicates all systems have been installed per the Contract Documents, PFCs have been conducted and passed, and all operations have been verified by the associated Contractor.

Commissioning

The process utilized to ensure the operating systems, equipment, controls, and special systems function together properly to meet performance requirements and design intent per the contract documents.

Commissioning Authority

An independent entity contracted by the Owner to lead, plan, coordinate, and implement the Cx process.

Commissioning Meeting

A regular meeting of the Cx team, led by the CxA, with the purpose of facilitating coordination and cooperation to deliver project according to OPR (this document).

Commissioning Plan

An evolving document developed by the CxA that outlines the organization, schedule, resources, coordination, accountability, and documentation requirements for the successful completion of the overall Cx process.

Commissioning Process

The Cx process is focused on validating commissioned systems and equipment information, startups, and performance prior to building occupancy. The process includes incorporating Cx activities into the Design and Construction Phase schedules and identifying and resolving issues that arise.

Commissioning Progress Report

A regular report on any variances in the Cx Specifications or process as approved by the Owner and Cx team. Also provides an update on outstanding and resolved items on the Cx Issues Log as well as any completed tests or checklists.

Commissioning Schedule

The CxA and GC collaborate to incorporate Cx activities into the construction schedule. The schedule will demonstrate enough detail to schedule phases and milestones of the Cx process.

Commissioning Specifications

A contract document that describes the roles and responsibilities of the Cx team, Cx submittal and report requirements, systems to be commissioned, Cx activities, and other related technical specification divisions. Provides organization, documentation requirements, and tools to evaluate and document that the design, construction, and operation of the facility and systems comply with OPR.

Commissioning Summary/Final Report

A document designed to summarize the Cx process for the Owner from the Design Phase through the Occupancy and Operation Phase which includes a final Cx Plan, outstanding issues and recommended solutions, the location of the OPR and BOD, as well as as-built drawings.

Commissioning Team

Individuals responsible for implementing the Cx process. Members must have authority to act on behalf of the entity he or she represents.

Construction Checklists

See Pre-Functional Checklists.

Construction Documents

An assortment of documents that include the project Specifications, plans and drawings, and general terms of the contract that vary from project to project and are used by subcontractors to bid.

Contract Documents

Documents outlining the legally binding agreements of a project such as contracting requirements, specifications, contract drawings, and modifications.

Control System

The system which modulates the building system equipment based on monitored setpoints and control strategies. Control systems are typical on HVAC, security, fire/life safety, and electrical systems.

CxAlloy

A cloud-based software utilized to manage the Cx process by facilitating collaborative issue management, asset tracking, and quality management. All members of the Cx team are invited to the project folder on CxAlloy and others are added by request.

Deficiency

Condition in which the installation or function of a component, piece of equipment, or system is not in compliance with the Cx Specifications, BOD, or OPR.

Design Review Checks (DR Checks)

CxA participates in the review process to check design compliance with BOD, OPR, and Cx Specifications. Discrepancies and deficiencies during DR checks are reported

to the design team and issue resolutions are back-checked for incorporation in the design documents before submittal.

Field Observation / Site Observation

CxA and members of the Cx team complete a site walk through confirming that systems and equipment are installed, integrated, and operating according to BOD and OPR, prior to FPT. CxA shall evaluate construction for proper installation, coordination, testing, and interaction among Cx systems and assemblies. GC and CxA collaborate to incorporate Cx meetings and field observations into the construction schedule on the same date(s).

Field Observation Report

Following field observation visits, the CxA completes a report indicating any deficiencies or issues identified during the walk through as well as the progress made in the Cx process. The report is a summary of the implementation process and an update to the Owner on the status of Cx activities.

Functional Performance Tests

Verification process to ensure that systems and equipment are installed and operating according to OPR and Cx Specifications. Scheduled once all construction checklists are complete and witnessed by all members of the Cx team.

Issues Log

A log of deficiencies and discrepancies identified during reviews, observations, or tests during the Design Phase and the Construction Phase that affect commissioned systems and equipment. Issues are tracked with the software CxAlloy. An entry may be a deficiency, observation, or request for clarification.

Integrated Systems Testing

A simulation of a power failure to test critical equipment before, during, and after the power failure. All Contractors and subcontractors shall provide necessary staff during planning meetings and execution.

Kickoff Meeting

Held at the earliest stages of the Construction Phase, the meeting intent is to discuss and finalize the roles and responsibilities of the Cx team, communication protocols during construction, incorporating Cx process activities into the construction schedule, and review of the OPR, BOD, and the Cx Plan. The CxA will also discuss the checklists and test templates for verifying equipment and systems installs, startups, and operations work according to Specifications.

Lessons Learned Workshop

Held during the Occupancy & Operations Phase, the workshop intent is to discuss the Cx process, activities, or issues that were successful or could use improvement. Any unresolved items from the Issues Log are discussed and resolutions are suggested for the Owner.

Ongoing Commissioning Process

A Cx process with regular intervals of testing and activities to increase systems and equipment function according to changing CFRs.

Operations and Maintenance (O&M) Manual

Contains the information O&M personnel require for the operation and maintenance of equipment, such as manufacturer's instructions, preventive and corrective maintenance procedures and schedules, warranties, and controls.

Owner's Project Requirements (OPR)

A written document developed through collaboration with Owner's groups and design team that details the requirements of a project and the expectation of how the building space will be used and equipment and systems will be operated.

OPR Workshop

Design phase meeting wherein the goal is to review project objectives, schedule, requirements, and directives with the Owner group, DOR, Contractor(s), and members of the Cx team. Ensure all attendees understand and implement project benchmarks for success.

Pre-Functional Checklist

Specific checklists used by the subcontractor to verify building systems, equipment, assemblies, and components are onsite, ready for installation, correctly installed, and operational. QC checklists are primarily static inspections and procedures for preparation of equipment startup/energizing.

Seasonal/Deferred Testing

Conduct FPT in opposite season as initial testing to confirm systems operate as required in OPR, resolve outstanding issues, and confirm O&M personnel are operating facility as designed.

Startup Checklists

A document for the subcontractor to record that equipment has been properly brought online for operation. The subcontractor shall verify that all commissioned equipment functions according to the manufacturer's recommendations and project specifications at initial use and document any deficiencies that may occur. All checklists will be uploaded to CxAlloy for review to ensure systems and equipment meet criteria in the OPR.

Systems Manual

A composite document that contains the technical information required to successfully operate the systems and equipment installed in the building. The document also contains a full commissioning record outlining the Owner, PDT, and Cx team's decision-making process for designing and operating the systems as they are. All user groups should be able to access any information needed to submit warranty claims, program setpoints, or perform interim tests on systems between ongoing Cx visits from CxA.

Testing, Adjusting, and Balancing

The TAB Contractor performs a systematic process to ensure the HVAC and hydronic systems operate according to system design prior to the FPT. Once the system is operating at the desired levels, the TAB Contractor submits report to CxA for review and verification prior to FPT.

Training Plan

Provide O&M Personnel with training to operate and maintain the facility according to OPR and manufacturer's suggestions**.**

1. Overview and Scope

1.1. Purpose and Definition

1.1.1. The Owner's Project Requirements (OPR) document outlines the key requirements and success criteria for the project as determined by the owner. It summarizes the ideas, concepts and criteria deemed to be important and which are to be tracked throughout design, construction, acceptance, and warranty phases.

1.1.2. The OPR serves as a primary reference for the entire project team. The commissioning authority (CxA) will act as an advocate for the owner throughout the project lifecycle and assist in confirming through a sampling approach whether the design, construction and operation of the project meets the goals and requirements put forth by the owner.

1.1.3. The OPR document is derived with input from all project stakeholders each with distinct and possibly conflicting perspectives. Through the process of developing the OPR the intent is to reconcile and clearly document measurable goals.

1.1.4. The OPR will inform the development of the Basis of Design (BOD) document, to be developed by the design team, defining how the OPR is to be achieved in the design documents. The BOD should include narratives and design strategies that respond to each category, goal and requirement specified in the OPR.

1.1.5. The OPR is a living document that will be updated periodically throughout the design and construction phases as needed. The OPR is provided to the building owner, operations and maintenance staff upon completion of the project to serve as a permanent record.

1.2. Scope

1.2.1. The OPR document sets functional goals for the project but is not intended to be a comprehensive list of all goals and requirements and does not replace other important guiding documents such as architectural programming, the request for proposal (RFP), or Contract. The OPR does not contain specific language as to what is to be included in the design or required by code but is the more general feature and categorical performance criteria to be met by the design. Where

practical, the OPR includes measurable indicators used to verify that the performance requirements were met.

1.2.2. The OPR does not include all project requirements and directives but does contain specific expectations that will guide the development of the site and architectural designs, MEP building systems and controls, building envelope and operating plans.

1.2.3. This OPR has been organized in the following format

1.2.3.1. General Owner and User Requirements

1.2.3.2. Environmental and Sustainability Goals

1.2.3.3. Indoor Environmental Quality Requirements

1.2.3.4. Equipment and System Expectations

1.2.3.5. Quality Assurance and Commissioning Activities

1.2.3.6. Building Occupant and O&M Personnel Requirements

1.2.4. Wherever LEED requirements and the OPR are not equivalent, the more stringent requirement shall be adopted

2. General Owner and User Requirements

2.1. Primary Purpose, Program and Use

2.1.1. A new material lab building is proposed for the Illinois Department of Transportation (IDOT) on the Harry Hanley campus located at 2300 South Dirksen Parkway in Springfield, Illinois. The new building will replace and consolidate the existing lab and administration facilities currently occupied by IDOT District 6, Central Bureau of Materials, and Bureau of Research departments. Unification of IDOT departments to a central location is intended to optimize operating processes with a modern facility.

2.1.2. The facility will additionally feature a training center / conference center that provide direct access to daylight and views.

2.1.3. Moreover, the project will support construction of the western spur of the new ring road and should investigate the potential for supporting motor pool improvements, such as provisions for electric vehicle charging infrastructure. Additionally, site and campus improvement should foster a safe, walkable campus environment with easy and pleasant access to buildings throughout the campus. Provisions for pedways / sidewalks, native and inviting landscaping should be made. In

other words, the building should integrated into the campus environment rather than being stand-alone.

2.1.4. The new facility will provide program for a variety of space types grouped under District 6 (D6), Central Bureau of Material (CBM), Bureau of Research (BR), Shared Spaces (including training rooms, receiving/loading/shipping, storage, filing & workrooms) and Building Circulation and Services.

2.1.5. IDOT is responsible for establishing policies and procedures that provide for the quality assurance of materials used in highway projects. To facilitate this IDOT maintains a system of sampling, testing, documentation, and reporting of test results to be accomplished within this new facility.

2.2. Project History

2.2.1. In April 2022, the Capital Development Board (CDB) engaged Tilton, Kelly + Bell to provide bridging documents for the construction and relocation of a consolidated laboratory and office building for the Illinois Department of Transportation on the campus, known as the Hanley Complex, where the agency's headquarters facility presently exists. This project is one of several concurrent projects now underway to consolidate agency activities and provide greater utilization of the IDOT campus. A preliminary study commissioned by the CDB determined the feasibility of constructing a new laboratory and office building to accommodate Materials Testing on the headquarters campus. Prepared by the architectural firm Bailey Edward Design, Inc., the study developed a preliminary space requirements program and conceptual layout.

2.2.2. Draft Bridging Documents were issued September 19, 2022. With Final Bridging Documents provided for review November 21, 2022.

2.3. Broad Goals

2.3.1. The new lab facility is intended to position IDOT to continue its mission well into the future with flexibility to adjust to seasonal operational demands, new procedural, and equipment requirements, and to provide a more efficient and effective environment in which to conduct their work.

2.4. Building Lifecycle, Adaptability and Future Expansion

2.4.1. The proposed facility's life expectancy should be at least 60 years. As this exceeds the typical expectancy of mechanical equipment (15-20 years) accommodation should be made for its ultimate replacement and renewal.

2.4.2. Freeway technology has advanced significantly over the past 60 years and will continue to do so over the next requiring novel testing equipment and methods. The facility should be designed to allow for equipment to be replaced and new equipment to be added. While there is no present growth in personnel anticipated, presumably new equipment will require additional space. Therefore, if viable, future expansion should be considered in the design of the new facility. Things to be considered include:

2.4.2.1. Building layout

2.4.2.2. Electrical and Telecom capacity

2.4.2.3. Mechanical system capacity or expandability

2.4.2.3.1. Provide using agency and CDB cost estimate for 10-20% increased capacity.

3. Environmental and Sustainability Goals

3.1. General

3.1.1. The project shall achieve LEED v4 Silver Certification through building and site design, without reliance on owner policy or purchases. A LEED strategy shall be developed with an adequate buffer, 5-point minimum, over the LEED Silver 50-point threshold. The design-build team shall be required to provide all LEED submittals, calculations and supporting documentation to obtain LEED Silver Certification.

3.2. Energy Efficiency Goals

3.2.1. At a minimum the project must demonstrate an improvement of 16% in the proposed building performance rating as compared with the baseline building performance rating. Calculation shall be in accordance with ASHRAE 90.1-2010 Appendix G, using a whole building simulation model.

3.2.2. The design should anticipate the requirement to be fully electric, no on-site fossil fuel consumption, within 25 years in support of the state's

goal to move toward 100% clean energy by 2050. In keeping with this objective, the design-build team should provide a comparison of at least (2) HVAC systems considering first cost and operational cost accounting for state and federal incentives for systems such as geothermal heat pumps.

3.2.3. The design shall prioritize passive energy reduction through building massing, envelope, and fenestration to reduce equipment capital cost and spatial requirements.

3.2.4. The design shall incorporate energy recovery as to further reduce energy demand and consumption. Heat Recovery Wheels and Fixed-plate Membranes that allow for both sensible and latent heat transfer should be prioritized.

3.2.5. Measurement devices shall be provided to collect energy consumption data for each supply source to the building (including gas, electricity and on-site renewables).

3.2.6. The design-build team shall adhere to all Capital Development Board design-build requirements.

3.2.7. The design-build team shall provide a cost estimate for electrical vehicle charging infrastructure at the site.

3.3. Sustainability Goals

3.3.1. LEED Silver v4 certification under LEED BD+C New Construction is the primary sustainability goal for the project.

3.3.2. Emphasize water as a resource by reducing potable water demand by 30% for indoor use and eliminating its use for landscaping.

3.3.3. Water-bottle filling stations shall be included with at least 50% of all drinking fountains installed indoors on the premises.

3.3.4. Deionized water shall be available to labs as specified in the room data sheets and is preferred to be centrally produced and distributed

3.4. Siting

3.4.1. The proposed Hanley site is dominated by a heavily wooded area with two (2) existing warehouses to be demolished. The site has steep elevation changes with a ravine in the northwest corner and a severe drop off at the southern edge of the site. East-West exposures should be

minimized as to prevent glare conditions and promote natural daylight harvesting opportunities from the South. Care should be considered when siting and designing parking lots as to achieve two (2) LEED credits for heat island reduction.

3.4.2. More than 20% existing native or adapted plants shall be retained on the site. Additional site development may include bioretention facilities, constructed wetlands, planters, and open space with planting.

3.4.3. The design-build team shall review State Historic Preservation office (SHPO) requirements for the site and comply if necessary.

3.5. Building Envelope

3.5.1. Resilient materials shall be incorporated in keeping with the 60-year life expectancy of the facility with an emphasis on maximizing recycled content with a goal of 30% based on cost.

3.5.2. The design should seek to maximize visible light transmittance (VT%) while minimizing solar heat gain coefficient (SHGC) in glazing. An SHGC of less than 0.30 should be targeted with a VT greater than 60% utilizing a Low-E coating for East, West and Southern exposures.

3.5.3. While most spaces could benefit from direct access to views and daylight, Private Offices & Conference Rooms, and Training Rooms are required. Special care should be placed to coordinate with IDOT as individual labs may have specific light sensitivity criteria.

3.5.4. Consideration should be given to balancing the window-to-wall ratio (WWR) across the building as to prevent overheating in summer and unnecessary heating requirements in winter.

3.5.5. Opaque exterior walls shall include continuous insulation and a simple capital and operational cost study provided to determine an optimal R-Value which may exceed code.. Thermal mass walls are generally preferred to light-weight steel construction as to reduce diurnal variations in temperature and limit heating/cooling requirements in off-hours.

3.5.6. A high-albedo cool roof shall be utilized to limit the increase in surface temperature of the roof in summer months as to reduce cooling demands over conventional roofing materials and/or a green roof.

3.6. LEED BECx Requirements

3.6.1. In fulfillment of LEED BECx requirements, the CxA will complete activities in accordance with ASHRAE Guideline 0-2005 and the National Institute of Building Science (NIBS) Guideline 3-2012. The design-build team shall provide enclosure testing for the following (see table for further details):

3.6.1.1. ASTM C 1715 – Standard Test Method for Evaluation of Water Leakage Performance of Masonry Wall Drainage Systems

3.6.1.2. ASTM E1186 Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems

3.6.1.3. ASTM D4541 Test Method for Pull-off Strength for Coatings Using Portable Adhesion Testers

3.6.1.4. ASTM C1193 Standard Guide for Use of Joint Sealants, Appendix X1-Method A, Field Applied Sealant Joint Hand Pull Tab

3.6.1.5. ASTM D7877: Standard Guide for Electronic Methods for Detecting and Locating Leaks in Waterproof Membrane

3.6.1.6. ASTM E783 Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors

3.6.1.7. ASTM E1105: Water Penetration of Installed exterior Windows, Skylights, Doors and Curtain Walls

3.6.1.8. AAMA 501.2: Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems

3.6.1.9. ASTM E779 - Test Method for Determining Air Leakage Rate by Fan Pressurization / ASTM E1827 - Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door

3.6.2. Design Build firm to provide a detailed analysis showing the location of the dew point for each unique wall type in the Basis of Design.

3.6.3. 100% continuous insulation shall be on the outside of the building. The dewpoint modeling must show the dew point to be in the middle of the continuous insulation.

	Test	System	Test Required by ASTM 2813	Specification Section	Lab System Testing	Field Mockup Testing	In-Situ Field Testing	Recommended Sampling Rate		Notes
								Location	Quantity	
1	ASTM C 1715 – "Standard Test Method for Evaluation of Water Leakage Performance of Masonry Wall Drainage Systems"	Unit Masonary	No			Yes	Yes	TBD	1/600SF	If Masonry included in final design. Alternative option - functional performance testing weeps after veneer construction installed to 3 courses above cavity drainage material. Can be completed by contractor with documentation
2	ASTM E1186 Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems	Fluid Applied Membrane Air Barriers	Yes			Yes	Yes	TBD	1/600SF	
3	ASTM D4541 Test Method for Pull-off Strength for Coatings Us-ing PortableAdhesion Testers	Modified Bituminous Sheet Air/Weather Barriers	Yes			Yes	No	TBD	1/600SF	
5	ASTM C1193 Standard Guide for Use of Joint Sealants, Appendix X1-Method A, Field Applied Sealant Joint Hand Pull Tab	Joint Sealants	Yes			No	Yes	TBD	1/500 LF, per different joint type	
4	ASTM D7877: Standard Guide for Electronic Methods for Detecting and Locating Leaks in Waterproof Membranes	Waterproofing and Roofing	No			No	Yes	TBD	Final by phase	
6	ASTM E783 Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors	Glazed Aluminum Curtain Wall and Glazed Aluminum Curtain Walls	Yes			No	Yes	TBD	2 samples per system per installation condition	
7	ASTM E1105: Water Penetration of Installed exterior Windows, Skylights, Doors and Curtian Walls	Glazed Aluminum Curtain Wall and Glazed Aluminum Curtain Walls	Yes			No	Yes	TBD	2 samples per system per installation condition	
8	AAMA 501.2: Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems	Glazed Aluminum Curtain Wall and Glazed Aluminum Curtain Walls	Yes			No	Yes	TBD	2 samples per system per installation condition	
9	ASTM E779 - Test Method for Determining Air Leakage Rate by Fan Pressurization / ASTM E1827 - Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door	Whole building pressuization test							Whole building - by phase (at least 2 tests)	

4. Indoor Environmental Quality Requirements

4.1. Intended Use

4.1.1. Most of the program, approximately 50% is lab space with specific requirements as outlined in the room data sheets. The remainder consists of the training center, offices, shared spaces, a library, and circulation that will necessarily be isolated (w/r to airflow and acoustics) from the lab space.

4.1.2. This facility will process a large volume of bulk samples of concrete, stone fill, aggregate, cement, and asphalt materials. These materials will necessarily be transported to their respective lab areas for testing purposes. Both in transport and in testing indoor environmental quality can be impacted from acoustics (decibels dB) to indoor air quality (PM10 / PM2.5). Lab space HVAC systems should be separate from office space and training facilities.

4.2. Occupancy Schedule

4.2.1. Monday-Friday: 6am – 6pm

4.2.2. Saturday: Closed

4.2.3. Sunday: Closed

4.2.4. Holidays: Closed

4.2.5. Training center may be used during off hours and will require accommodation.

4.3. Accommodations for After-Hours Use

4.3.1. The building shall allow for the override of lighting and HVAC systems, by zone, for a 2-hour (adj.) period to accommodate potential after-hours use. Proper zoning should be incorporated as to minimize energy consumption during off-hours use.

4.3.1.1. Rooms requiring 24/7 temperature control without setback served by same unit

4.3.1.2. Rooms requiring tight humidity control ideally served by same unit

4.4. Temperature, Humidity, Air Quality

4.4.1. Indoor conditions shall follow current ASHRAE Standard 55 guidelines or room data sheet requirements, whichever is more stringent.

4.4.2. Design-build team shall develop and implement an IAQ construction management plan including post-construction flush-out.

4.4.3. The VOC content of architectural coatings and paints shall comply with limits of the California Air Resources Board (CARB) Suggested Control Measures (SCM).

4.4.4. Office furniture systems and seating shall comply with ANSI/BIFMA M7.1 for VOC emissions.

4.4.5. HVAC systems serving Analytical Chemistry shall be able to maintain 45% Relative Humidity +/-5%. Contractor shall provide dewpoint analysis of enclosing walls/glazing to verify no potential for condensation.

4.5. Ventilation

4.5.1. Minimum ventilation rates shall follow current ASHRAE 62.1 Standards or room data sheet requirements, whichever is more stringent.

4.5.2. Demand-control ventilation shall be incorporated as to reduce energy consumption by reducing airflow to vacant spaces during occupied hours. This will require the use of CO2 sensors in all densely occupied multi-occupant spaces such as breakrooms and conference rooms, open office seating areas, training spaces, auditoriums, and workrooms. Installed devices must be capable of providing occupant alert with either audible or visual alarm based on measured space levels.

4.5.3. The building overall shall be designed to be slightly positively pressurized during all non-emergency modes of operation.

4.5.4. Specific lab spaces shall be kept under a negative pressure as documented in the room data sheets. Both building pressure and individual lab space pressures shall be monitored.

4.5.5. MERV 13 or greater air filters shall be used in supply air systems during construction, flush out and through occupancy.

4.6. Specialized Services (Filtration, Fume Hoods & Freeze/Thaw Unit, Testing Equipment)

4.6.1. Various lab spaces have dust collection requirements, and it is preferred to have a centralized collection system at grade level for ease of operations and maintenance.

4.6.2. Various lab spaces have fume hood requirements and shall use sash sensors for control.

4.6.3. Fume hoods shall have an airflow monitor detecting if the face velocity drops below setpoint with a corresponding audible alarm. Similarly, if low static pressure is detected an alarm will be annunciated.

4.6.4. A large bespoke freeze-thaw unit to be used for lab testing shall be constructed with the building constructed around. All supporting infrastructure will need to be in place and ready (commissioned) to support testing and commissioning which shall occur immediately after installation and startup. Commissioning of the freeze-thaw system is the responsibility of the seller and shall be coordinated with the using agency, contractor and building commissioning agent.

4.6.5. The design-build contractor shall be responsible for coordinating with the using agency on the schedule for moving equipment into the new facility and with the commissioning authority for associated testing. Supporting infrastructure must be complete and verified fully functional, including any associated commissioning activities, prior to relocation. At a minimum, equipment coordination meetings should occur 2 months prior to relocating any major piece of equipment or equipment grouping.

4.7. Lighting

4.7.1. All lighting shall be LED type with occupancy/vacancy control where required by International Energy Conservation Code (IECC)

4.7.2. Lighting control system shall interface with the Building Automation System (BAS)

4.7.3. Light levels shall be in accordance with Illuminating Engineering Society (IES) guidelines

4.7.4. Light levels in labs shall average 75 fc at 36”

4.7.5. The design-build team should consider daylight modeling to be used for determining an appropriate WWR per orientation and location.

4.7.6. The design should consider a clerestory, daylight shelf and/or skylights to drive daylight deeper within the building.

4.7.7. Outdoor luminaires serving uncovered parking and open areas shall be controlled to be off during daylight hours. Light areas only as required for safety and comfort.

4.7.8. The training center and other areas defined by the using agency shall utilize lighting scene control.

4.8. Acoustics

4.8.1. The design-build team should meet the acoustical control requirements of ASHRAE Standard 189.1 section 8.3.3 or room data sheet requirements, whichever is more stringent. This section pertains to the building envelope, the interior spaces, and the related mechanical equipment and systems. Acoustical treatment and barriers between training center, office and lab spaces should be considered. Certain lab spaces have vibration requirements (see room data sheets) and should be designed accordingly.

4.9. Individual Controllability

4.9.1. Users should have +/- 2°F control via zone thermostats.

4.9.2. Users should have individual control of private office lighting, including on/off and dimming.

4.9.3. Users should have individual control of training room lighting, including on/off, scene control and dimming.

4.10. Special Considerations

4.10.1. Some laboratory spaces will require electrostatic discharge flooring, consult room data sheets and user agency.

5. Equipment and System Expectations

5.1. HVAC Equipment

5.1.1. Redundancy shall be considered for by providing multiple pumps, boilers, cooling towers, domestic hot water heaters that will allow for partial capacity in the event of a failure.

5.1.2. Diversity assumed in sizing equipment shall be disclosed for review by owner team. This number should not exceed 85%.

5.1.3. Cooling towers, if applicable, shall be equipped with makeup water meters, conductivity controllers and overflow alarms.

5.1.4. Condensate reclamation from air-conditioning units with a capacity greater than 5 refrigeration tons shall be evaluated.

5.1.5. HVAC compressors shall not be fixed speed and instead should be variable speed or digital scroll allowing for modulation down to 10% capacity

5.1.6. Air handling units should utilize fan wall technology with ECM motors for redundancy

5.1.7. Boiler turndown should meet or exceed 10:1

5.1.8. Coils and other heat exchangers shall be selected so that the hot water return temperature is 120°F or less

5.1.9. Water-Source Heat Pumps and Geothermal should be investigated with financial analysis provided to using agency and CDB.

5.2. HVAC Controls

5.2.1. Building automation system shall be microprocessor based with distributed direct digital control (DDC). Incorporate the use of direct digital electronic controls for all central mechanical equipment. It shall be completely stand-alone as a system and remotely monitorable. DDC shall require BACNet compatibility and open operability.

5.2.2. Control set-points and operation schedules shall be adjustable by building maintenance engineers. Trending of all points, equipment operation, and alarms shall be readily available and stored locally for 36 months.

5.2.3. Operator terminal shall be provided for use by the building maintenance engineers with remote access capability.

5.2.4. Packaged controls shall not be utilized on major equipment such as Air Handling Units and instead equipment DDC ready with control to be provided by Temperature Controls contractor.

5.2.4.1. The BAS should monitor minor equipment (eg CRAC units) and space conditions

5.2.5. Where used to control both heating and cooling, zone thermostatic controls shall be configured with at least a 5°F deadband.

5.2.6. Zones with reheat shall not supply heating air more the 20°F above space temperature set point

5.2.7. Upon control system network failure all equipment should remain operational through their local controller or to the last known value

5.2.8. The system shall be capable of monitoring energy consumption broadly (electric meter, gas meter) and that information data should be easily exposed to remote queries. Such provision would be necessary if they state were to begin monitoring energy consumption of buildings and for aggregating and sharing information with LEED. This further supports having a non-proprietary open platform.

5.2.9. In addition to a dedicated operator workstation, provisions should be made for untethered access through an iPad to help facilitate building engineering work. Also, remote access should be made available.

5.3. Domestic Hot Water

5.3.1. Design should provide comparison of tank and tankless water heaters, possibly distributed.

5.3.2. Piping distribution should aim to minimize distance between source of hot water and demand.

5.4. Daylight and Controls

5.4.1. The design should strive to achieve 50% daylit floor area overall using primary side-lighted area and skylights provided this does not interfere with lab requirements.

5.4.2. Automatic blinds shall be considered and/or exterior shading designed for seasonal variation in sun altitude.

5.4.3. Dimmable ballasts should be capable of operating at 15% or less of rated power at maximum light output

5.5. Emergency Power

5.5.1. A central building UPS system shall be provided to support critical lab function in the event of power disruption, see room data sheets.

5.5.2. An emergency generator shall be provided for back-up power to life-safety loads and equipment requested by IDOT.

5.5.3. Critical lab HVAC equipment shall be on emergency power.

5.6. Plug Loads and Specialized Equipment

5.6.1. Appliances such has refrigerators and dishwashers shall comply with EnergyStar requirements

5.6.2. Reverse osmosis systems shall be equipped with an automatic shutoff valve to prevent production of reject water when there is no demand for treated water.

5.6.3. Power receptacle control should be reviewed with owner for office spaces. Receptacles may be controlled on scheduled basis using a time-switch control, via an occupancy sensor or via another control signal.

5.6.4. Freeze/Thaw tanks shall be designed, constructed and commissioned to using agency requirements.

5.7. Security Systems

5.7.1. Access control and alarm

5.7.1.1. The building will have a complete access control system which will monitor, and alarm programmed events as well as control access to doors throughout the facility.

5.7.2. Video surveillance system

5.7.2.1. The building will have a complete video surveillance system which will monitor and record activity throughout the interior and exterior of the building.

5.7.3. Video intercom doorbell system

5.7.3.1. A stand-alone video intercom system shall be provided to allow for clear two-way intercommunications between the D6 entry door and D6 lab staff area.

6. Quality Assurance and Commissioning Activities

6.1. The design-build team will be required to provide a quality assurance plan for review and acceptance by all stakeholders including the CxA. The plan should outline specific metrics and activities beyond those required by LEED that will be used throughout the duration of the project to assure quality. The CDB, IDOT and the CxA will have the authority to amend this plan at their discretion throughout the project and it will be the responsibility of the Design-Build firm to incorporate and report on all agreed upon metrics at scheduled milestones.

6.2. The CxA will complete the following as required for LEED Fundamental Commissioning

6.2.1. Assist with developing the OPR and review the OPR, Bridging-Documents, BOD, and design documentation

6.2.2. Cx to participate in LEED charette

6.2.3. Develop and implement a Cx Plan

6.2.4. Confirm incorporation of Cx requirements into the construction documents

6.2.5. Develop construction checklists

6.2.6. Cx to perform TAB verification

6.2.7. Develop functional performance test procedures

6.2.8. Direct and verify system test execution

6.2.9. Maintain issues log throughout the Cx process

6.2.10. Prepare final Cx process report

6.2.11. Document and report finding directly to the CDB and owner throughout the process

6.3. The CxA will complete the following as required for LEED Enhanced Commissioning

6.3.1. Review contractor submittals

6.3.2. Verify inclusion of systems manual requirements in construction documents

6.3.3. Verify inclusion of operator and occupant training requirements in construction documents

6.3.4. Verify systems manual delivery

6.3.5. Verify operator and occupant training delivery and effectiveness

6.3.6. Review building operations in warranty period at 10 months after substantial completion

6.3.7. Develop an on-going commissioning plan

7. Building Occupant and O&M Personnel Requirements

7.1. Facility Operation & Management

7.1.1. A third-party contractor will operate and maintain the building on a day-to-day basis.

7.1.2. Facilities maintenance staff will develop a plan to enter building parameters and energy consumption data into the EnergyStar Portfolio Manager to track building performance.

7.1.3. Design-builder shall provide asset data for inclusion into a computer maintenance management system (CMMS):

7.1.3.1. Manufacturer

7.1.3.2. Model

7.1.3.3. Serial

7.1.3.4. Components (Filter size/type, motor size, belts etc.)

7.1.3.5. Checking requirements

7.1.3.6. Maintenance requirements

7.1.3.7. Troubleshooting items

7.1.4. Adequate clearance shall be provided around equipment and systems requiring maintenance or replacement. The design shall incorporate and

specify access panels, walkways, stairs, and ample space to remove components requiring basic and extensive maintenance.

7.1.5. The design-build contractor shall provide diagrams demonstrating adequate clearances for equipment are maintained with every submission, including in the initial competition phase.

7.1.6. Placement of equipment shall be centralized within dedicated mechanical rooms and accessible such that maintenance work will not disrupt facility operations

7.1.7. Electrical panels should be in dedicated electrical rooms accessible from public spaces

7.1.8. Removal and future replacement of equipment must be possible with minimal effort. Minimal effort is defined by use of existing owner equipment. The exception being large equipment such rooftop units, chillers/heat pumps cooling towers.

7.1.9. All equipment that will eventually need to be replaced must have a location specified in the drawings, along with provisions (i.e. access doors) for ease of replacement. This includes equipment such as valves, water hammer arresters, transformers for automatic flush/ sink valves, etc.

7.1.10. Some laboratories will require overhead cranes, coordinate with using agency.

7.1.11. The Basis of Design shall detail maintenance scenarios, including pathways and clearances. At a minimum it shall address the following: re-fueling generator, replacing HVAC filters, recharging water softeners, pulling chiller tubes, cleaning condenser coils, replacing exterior and interior lighting, accessing plumbing clean-outs, replacing AHU coils, replacing fan and pump motors.

7.1.12. Provide double doors for exterior mechanical access where possible.

7.1.13. Roof mounted equipment must be accessible via stairway and include safety railing/guard. Installation of equipment on grade or inside is preferred.

7.1.14. Systems should be designed as to minimize the number of materials and spare parts that the owner is required to keep in inventory.

7.1.15. Provision for recycling storage and collection shall meet LEED minimum prerequisites. Recyclable materials must include mixed paper, corrugated cardboard, glass, plastics, and metals. Take appropriate measures for the safe collection, storage, and disposal of two of the following: batteries, mercury-containing lamps, and electronic waste.

7.2. O&M Training

7.2.1. Adequate training of O&M staff shall include, at a minimum, basic operating principles, preventative maintenance program, steps to ensuring sustained system performance, and minimization of emergency repair and replacement costs.

7.2.2. Training sessions shall take place in a classroom or virtually and shall be recorded.

7.2.3. Design engineer, contractor and building staff shall be present for training.

7.2.4. Training program shall be functionality-based rather than hours-based with training topics provided to the owner in an agenda in advance of training.

7.2.5. Training shall occur in conjunction with each phase of construction to ensure staff understand equipment operation prior to occupancy.

7.2.6. Training videos shall be made of major training activities. Videos shall be organized and archived as part of the construction scope of work.

7.2.7. Operation and maintenance manuals are to be provided for review 90 days prior to training.

7.2.8. A systems manual shall be provided to the owner as developed by the CxA. The systems manual is a composite document that will include final project documentation, including: OPR, BOD, Cx Plan, Cx Progress Reports, Submittals, Installation manuals, O&M manuals, Schematics and BAS GUI overview, Functional Performance Test Scripts, Record Drawings and other relevant materials.

7.3. Occupant Orientation

7.3.1. The building owner shall receive a high-level overview of all building equipment and systems including the purpose or function of equipment and their expected sequence of operation.

Appendix III–1B LEED Requirements

LEED Certification – The design-build team is required to achieve the project LEED Silver certification target in accordance with the requirements established in the LEED Rating System for LEED v.4. The goal in achieving LEED Silver certification is to deliver a facility that provides an excellent work and testing environment for employees and staff, and also delivers long-term energy and water resource savings.

It is anticipated that the design-build team will utilize an integrative design process and sustainability best practices to develop a facility that achieves the Owner's project LEED goals. This will require early and collaborative goal setting, early energy modeling and water budgeting, and using updates to this modeling and other technical analyses throughout design, as well as an integrative analysis and process, to guide design decisions.

Specific Design-Builder responsibilities shall include:

- Provide a qualified LEED Coordinator during design and construction.
- Develop LEEDv4 scorecard that complies with Owners Project Requirements (OPR) document. Scorecard is to be developed as outcome of Goal Setting meeting. Scorecard is not accepted until reviewed and approved by Owner.
- Provide Plans, procedures and calculations, procure materials, and provide documentation necessary to develop the design to meet Owner Sustainability and LEED goals, and to obtain Prerequisites and credits required for LEED certification.
- Respond to questions and requests for additional information from Owner and project LEED Administrator, and the USGBC, regarding LEED Prerequisites and credits until the USGBC has made its determination on the project's LEED certification application. Respond in format acceptable to Owner, project LEED Administrator and USGBC.
- LEED Online Submittals: Upload project LEED documentation submittal data directly to USGBC "LEED Online" website.
- Completed LEED certification process. Work is not complete until Owner has accepted USGBC's final review of LEED certification, and LEED plaque is procured and installed.

- Include all costs associated with LEED review, and with purchase and installation of plaque upon project certification. Include Appeals should they be required to earn the LEED prerequisites and necessary credits.

Meetings:

- LEED Goal Setting meeting: Coordinate with Owner, LEED AP and CxA and Stakeholders as identified by Owner, to schedule, participate in, and document a LEED Goal Setting meeting within 14 days of award, and prior to further commitment of design direction, to set direction for design and ensure Owner goals are met.
    - A LEED Scorecard with targeted credits to achieve project LEED goals will be produced from this meeting.
    - Develop a LEED Action Plan to support the Scorecard that describes how each targeted credit will be achieved by the project's design and construction.
- LEED Progress meetings: Facilitate and document monthly LEED progress meetings, which will be conducted throughout design and construction to ensure progress in meeting LEED goals. For each meeting, provide updates to design and calculations, and documentation and reporting as appropriate by project phase. LEED Action Plan updates may be used to provide design phase updates.
- LEED Construction Kick-off meeting: Coordinate with Owner and LEED AP to schedule and conduct and document meeting prior to mobilization to the site. Review LEED requirements as outlined in the LEED scorecard and Action Plan. Review construction phase LEED Plans for compliance with LEED requirements.
- Attendees: Authorized representatives of Owner, LEED Administrator, Commissioning Authority, A&E, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend meetings. Participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.

Submittals:

- Basis of Design (BOD): Provide a BOD for review by the LEED consultant and Commissioning Authority that shows in detail how the requirements of the OPR are met in the design. The BOD content and format should follow requirements in the LEED Fundamental Commissioning at a minimum.

- Energy modeling iterations, site assessment, and water budgeting calculations.

    - Initial modeling and calculations must be undertaken as soon as possible and before commitment to design direction, to inform design decision-making and to provide evidence of compliance with the Integrative Design process. In this way, they will provide value in informing decision-making in the design process.

    - Provide iterations of modeling and calculations to support LEED Action Plan updates at each design milestone.

- Commissioning and LEED review of plans and specifications shall be undertaken in conjunction with the Owner project milestone reviews. Per LEED requirements, Cx reviews must be undertaken no less than the equivalent of mid-construction documents and in a back-check set with review comments addressed / incorporated. Provide complete drawings and specifications for these reviews.

- LEED Action Plan: Provide initial Plan for review as a product of the LEED Goal Setting Meeting. Refine and provide with each milestone design submittal. Updates to Plan shall be provided monthly for the duration of the project.

    - Plan shall be electronic and accessible at all times for review of progress.

    - LEED Action Plan shall indicate how each targeted LEED credit and prerequisite will be met, including a listing of all required submittals and calculations, percentage complete, progress update notes, applicable product data for material selection, certifications for construction practices, procurement data, cumulative calculations, final calculations, information needed from Owner, and action items with name of individuals responsible.

    - Construction phase LEED Plans will be required for specific LEED Prerequisites and credits. These Plans must be provided as project submittals.

- LEED Progress Reports: Throughout project duration, concurrent with each Application or Payment, or as directed by Owner, submit monthly reports in format as directed by Owner and project LEED Administrator, documenting compliance with approved LEED Action Plan, and comparing actual design and construction and procurement activities with LEED Action Plans, and to track progress across all targeted LEED Prerequisites and credits.

- Construction phase LEED product or material submittals are in addition to other technical submittals. If submitted item is identical to that submitted to

comply with other requirements, submit duplicate copies as separate submittals to verify compliance with indicated LEED requirements.

Appendix III–1C Draft Commissioning Specification

SECTION 01 9113 – GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Submittals, Demonstration and Training, and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Contractor's Cx Submittal Requirements
2. Contractor's Cx Responsibilities
3. Commissioning Team
4. Commissioning Meetings
5. Commissioning Plan
6. Documentation
7. Notifications
8. Submittal Reviews
9. Construction Checklist Overview
10. Field Observation and Issues Log
11. Start-Up
12. O&M Manuals
13. Training
14. Control System Verification
15. Test, Adjust, and Balance Review
16. Functional Performance Testing
17. Seasonal Testing
18. Warranty Review
19. Record Drawings

B. Related Sections

1. Division 01, Closeout Procedures
2. Division 01, Indoor Air Quality During Construction
3. Division 01, 21, 22, 23, 25, 26 and 27 specifications as determined by the "Included Systems" section of this specification.
4. Section 23 0593, Testing, Adjusting, and Balancing For HVAC

1.3 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Construction IAQ Plan

C. TAB Plan, Initial TAB report (prior to TAB verification), Final TAB report. As indicated in section 3, "Test, Adjust, and Balance Verification" of this specification.

D. Systems and Equipment Submittals: as identified in section 1, "Included Systems" of this specification.

E. Contractor's Construction Progress Schedule: Submit to team with regular updates, incorporating Cx procedures as indicated in section 1, "Schedule" of this specification.

F. Contractor must complete and submit the Construction Checklists to the CxA for backcheck. Submittal and Review required prior to initiation of FPT's. See section 3, "Construction Checklist Overview" of this specification.

G. Submit response to CxA's issues log within 7 days of receipt (occurs concurrent with CxA's field observations through-out Construction and Acceptance phase). See section 3, "Field Observation and Issues Log" of this specification.

H. Manufacturer's start-up reports: Submit as required by the respective equipment specifications. See section 3, "Start-Up" of this specification

I. O&M Manuals: Contractor shall submit an O&M Manual outline at 50% construction and must have this outline approved by the A/E, Owner, and CxA. O&M Manual shall be submitted a minimum of 90 days prior to scheduled Owner Training to allow for review and correction prior to Owner training. O&M manual shall include all requirements from equipment and division 01 specifications plus the items identified herein section 3, "O&M Manuals" of this specification.

J. Owner Training: Submit training agendas as outlined in section 3, "Training" of this specification.

K. Control System Verification: Submit contractor's verification that controls work is complete, include point to point verification, calibration report, and valve and damper stroke report as indicated in section 3, "System Control Verification" of this specification.

L. Emergency Power System Verification: Submit contractor's verification that generators, automatic transfer switches and controls have tested individually and as a system to meet the requirements of the specifications. Verification to include settings of generator and automatic transfer switch control and alarm devices.

M. Record Drawings: In accordance with Division 01, 22, 23, 25, and 26 specifications.

1.4 DEFINITIONS

A. BoD: Basis of Design. A document, prepared by the Design Professional and Engineers, that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

B. Commissioning Plan: A document, prepared by CxA, that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

C. CxA: Commissioning Authority. Owner will contract with CxA directly.

D. OPR: Owner's Project Requirements. A document, prepared by CxA that details the functional requirements of a Project and expectations of how it will be used and operated. This document includes Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

E. Systems, Assemblies, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, equipment, and components.

F. TAB: Testing, Adjusting, and Balancing.

1.5 DESCRIPTION

A. Owner has elected to use the Commissioning Process as part of their quality assurance process to design, construct, and operate this building. As with any quality process, Commissioning provides tools to enable everyone involved in the construction of a building to ensure the final building meets the original intent of the Owner. A primary tool used is the completion of pre-functional checklists by individual workers. The checklists will be provided by the sub-contractors with CxA approval. The checklists can

easily track the current state of work by providing the key criteria in the specifications the Owner has defined as important for the successful installation and long-term operation of systems and equipment.

B. The Commissioning Process and procedures shall meet current LEED requirements for:

1. Fundamental Commissioning
2. Enhanced Commissioning
3. Measurement and Verification
4. Building Envelope Commissioning

C. A key component of Commissioning is the verification of the operation of heating and cooling systems in all modes of operation to ensure the building is ready for year-round occupancy.

D. A key component of Commissioning is the verification of the operation of the emergency power system in all modes of operation and the integration with other building systems to ensure the emergency power system is ready for occupancy.

E. Commissioning provides verification of training of operation and maintenance personnel by ensuring that detailed training agendas are utilized and requiring detailed submittal requirements from Contractors prior to accomplishing any training.

F. The commissioning scope of work shall encompass building, fire suppression, mechanical, electrical, plumbing, communication and security systems indicated in "Included Systems".

1.6 INCLUDED SYSTEMS

A. The following systems and their components are the focus of the Commissioning Process due to their complexity and the need to have coordination among the various subcontractors:

1. Divisions 3-8 – Building Envelope
    a. Slab on Grade Concrete
    b. Unit Masonry
    c. Thermal Barrier
    d. Air Barrier
    e. Moisture Barrier
    f. Metal Wall Panels
    g. Standing Seam Metal Roofing
    h. SBS Modified Bituminous Membrane Roofing

i. Exterior Joints and Sealants
j. Exterior Hollow Metal Door Frames
k. Aluminum Entrance Doors
l. Aluminum Storefront Framing
m. Aluminum Curtain Walls
n. Windows
o. Skylights
p. Roofing
q. Security / Electronic Hardware

2. Division 21 and 28 – Fire Protection and Fire Alarm
   a. Fire Alarm
   b. Sprinkler and Standpipes
   c. Fire Pumps
   d. Atrium Smoke Control
   e. Smoke Evacuation / Purge
3. Division 22 - Plumbing
   a. Domestic Hot Water System and Controls
   b. Circulation Pumps
   c. Booster Pump
   d. Temperature Mixing Valves
   e. Water Softener
   f. Elevator Pit Sump Pumps
   g. Irrigation
   h. Sanitary and Storm Water Systems
   i. Specialty Gases
4. Division 23 – Heating, Ventilating and Air Conditioning
   a. Heating Hot Water System
   b. Chilled Water System
   c. Solar Hot Water System
   d. Hot Water Circulator Pumps
   e. Steam Boilers
   f. Steam Boiler Water Feed Pumps

g. Air Cooled Chillers
h. Cooling Towers
i. Dry Cooler
j. CHW Variable Primary Pumps
k. High Temp. CHW Supply Pumps
l. Process CHW Pumps
m. Air Handling Units
n. Variable Volume Boxes
o. Fan Powered Terminal Units
p. Fan Coil Units
q. Unit Heaters / Cabinet Unit Heaters
r. Dedicated Outdoor Air Units
s. Variable Frequency Drives
t. Expansion and Buffer Tanks, Air Separators
u. Water Treatment
v. Piping and Insulation
w. Ductwork and Sound Attenuation
x. Dedicated Cooling / Computer Room AC
y. Refrigeration Systems
z. General Exhaust Fans
aa. Kitchen Exhaust Fans
bb. Specialty Exhaust
cc. Make Up Fume Hood
dd. Air Compressor
ee. Ductless Split Systems
ff. Heat Exchangers
gg. Snowmelt System
hh. Integrated Automated Facility Controls

5. Division 26 - Electrical
   a. Interior Lighting and Controls
   b. Exterior Lighting and Controls
   c. Egress and Emergency Lighting

d. Power Systems and Distribution

e. Generators

f. ATS (Automatic Transfer Switch)

g. UPS (Uninterruptable Power Supply)

h. Grounding

6. Division 27 – Communications

7. Division 28 – Electronic Safety and Security

1.7 SCHEDULE

A. The Contractor shall provide the Commissioning Authority (CxA) with a detailed Construction Progress Schedule within 30 days of the commencement of work. The Contractor shall also provide the Commissioning Authority (CxA) with Construction Progress Schedule updates throughout the construction period. Schedules shall include all submittals; equipment start-up activities; ductwork testing; pipe flushing; Test, Adjust, and Balance; and Owner training. The CxA will provide the Contractor with commissioning activities into the overall project schedule.

B. Contractor shall notify CxA 14-days minimum prior to equipment startup, ductwork testing, pipe testing and flushing, water treatment certification, and AHJ inspections. All documentation shall be sent to CxA for record.

C. Contractor shall complete pre-functional checklists and installation checklists daily.

D. Contractor shall submit proposed startup procedures for review 14-days minimum prior to startup.

E. Contractor shall submit Certificate of Readiness Forms to CxA prior to scheduling functional testing.

F. Controls contractor shall submit trending for review to CxA 14-days minimum prior to functional performance testing. Trending duration shall be for 7-days on 30-minute intervals and shall include all points as requested by CxA. Functional testing will not be scheduled prior to CxA and Owner approving trends.

G. TAB contractor shall be responsible for 10% TAB Verification with CxA and Cx Team. TAB contractor shall provide final report for review to CxA prior TAB Verification.

H. FPT (Functional Performance Test) procedures will be developed by the CxA (see item 3.13). The contractor shall return consolidated comments from all subcontractors within 14 days of receipt from the CxA.

I. Contractor shall be responsible for participating in and performing functional performance testing at end of construction, and as necessary for seasonal testing, and at 10-month warranty review.

J. Contractor shall submit O&M Manuals and warranties within 30 days of receiving approved product submittals and shop drawings. O&M Manuals to be submitted to CxA a minimum of 90 days prior to training.

K. The Contractor shall submit Training Materials and Agendas 30 days prior to scheduled training.

L. Seasonal testing will be performed during the opposite season of the original Functional Testing.

M. Warranty Review will be conducted 10-months after ~~substantial~~ Material Completion.

PART 2 - PRODUCTS

2.1 Not used

PART 3 - EXECUTION

3.1 COMMISSIONING TEAM

A. The Construction Professional and each subcontractor shall designate a single individual to be responsible for coordinating CX activities with Owner and CxA.

B. The members of the commissioning team consist of Owner, Owner O&M personnel, Construction Professional (GC), Mechanical Contractor (MC), Electrical Subcontractor(s) (ES), Testing Adjusting and Balancing (TAB) subcontractor, Controls Subcontractor (CS), and Commissioning Authority (CxA).

3.2 COMMISSIONING MEETINGS

A. All commissioning team members shall attend preconstruction Cx meeting. The meeting will be to discuss the Cx process, scheduled activities, and Cx team responsibilities.

B. Commissioning meetings/discussions will be held throughout the duration of construction and will typically be part of or follow a scheduled project coordination meeting. Commissioning meetings may be separate from other meetings and will have their own agenda and meeting minutes. The CxA will lead, distribute agendas, and record meeting minutes for specific

Cx meetings, otherwise these items will be completed by parties responsible for leading the meetings.

3.3 COMMISSIONING PLAN

A. A detailed commissioning plan will be provided and reviewed with the subcontractors during the pre-construction meeting.

B. The commissioning plan is intended only as a guide for commissioning activities on the project. The specifications are the contract requirements and shall be considered the extent of the subcontractor's responsibilities.

C. The commissioning plan will be updated periodically throughout the project process, will become the depository for the commissioning documentation, and ultimately will become the basis for the final commissioning report

3.4 DOCUMENTATION

A. All documentation shall be sent to the Design Professional of Record.

3.5 NOTIFICATION

A. Contractor shall notify CxA 14-days minimum prior to equipment startup, ductwork testing, pipe testing and flushing, water treatment certification, and AHJ inspections. All documentation shall be sent to CxA for record.

3.6 SUBMITTAL REVIEWS

A. The Commissioning Authority (CxA) shall review submittals concurrent to A/E and Owner. The intent of this review is to identify long-term issues of submitted equipment and to ensure the original design intent is maintained throughout the design and construction phases. Comments of the CxA will be coordinated through A/E.

B. The CxA will send comments directly to the A/E and Owner within 7-days of receipt. The A/E will receive the CxA comments and return a combined or collective list of comments to the Contractor.

1. Submittals reviewed by the CxA will be returned to the A/E for final disposition.

2. The A/E will review and incorporate the comments, or attach them to their comments, and return a single comment list to the Contractor. A/E is the designer of record; therefore, comments from CxA are only recommendations.

3. A/E will respond to the CxA comments that are not included with reason or acceptance of comment in order to maintain and close out CxA issues in the issues log.

3.7 CONSTRUCTION CHECKLIST OVERVIEW

A. The intent of the construction checklist is to provide a formalized means to easily track construction progress.

   1. Pre-functional checklists are described in detail below. These are equipment-specific.

   2. Checklists for piping, ductwork, cable trays, wiring, etc. are different from the pre-functional checklists. Although they are not formally tracked, they will be used by the CxA during periodic field observations. These checklist items are reminders to the contractors of some common items that have been problematic on other projects.

B. Construction checklists for all pieces of equipment typically follow the same format, yet are tailored to the specific equipment being installed.

C. Construction checklists are developed for each individual piece of equipment to track and verify equipment from when they are delivered, installed, and during start-up. The CxA will develop and provide all checklists for each piece of equipment or system and the following:

   1. Instructions and Checklist Procedures.

   2. Checklists with the following sections:

      a. Pre-Installation Checks: Includes several yes/no or short answer questions to document the condition of the equipment prior to installation and several blank columns to compare delivery items such as manufacturer, model, serial no., etc. to the corresponding submitted/approved items.

      b. Installation and Startup: Includes several yes/no or short answer questions to document that the equipment is installed, electrically wired, controlled and started up and balanced according to the specified requirements. A Negative Responses section is included at the end of the checklist to document the reasons for any "no" responses or discrepancies in the various sections.

D. The checklist shall be completed by the individual actually completing the work. Prior to any work, the checklist shall be reviewed by the individual contractor for pertinent information. Any negative responses on the checklist shall be explained and documented at the end of the checklist.

E. The completion of the checklist does not eliminate the contractor's responsibility for meeting other requirements in the specifications and drawings.

F. The CxA will periodically verify the accuracy, completeness and tracking of the checklists. If consistent errors are found, the responsible contractor shall re-validate 100% of the checklists for the problem equipment or system type.

G. The Checklists are designed to detect and eliminate delivery, installation and startup problems, and problems with miscommunication. This process also serves as a convenient way to document the progress of the work.

H. CxA can provide a web based system for use by the contractors to complete the checklists.

3.8 FIELD OBSERVATION AND ISSUES LOG

A. The CxA will perform routine field observations during the construction period.

B. The CxA will maintain an Issues Log that will include construction issues, access and maintenance issues, or other issues. Each observation is intended to improve the project quality and achieve the OPR.

C. The CxA Issue Logs are not "punch lists" in that they focus on systemic problems. Where an issue is identified, not all of the same components will have been verified by the CxA.

D. Issue Logs shall be responded to within 7-days of issuance by CxA.

3.9 START-UP

A. Startup reports shall be created by the Contractor and prepared prior to start-up and submitted to A/E, Owner, and CxA to review.

B. Startup documentation shall contain a minimum of all startup procedures recommended by manufacturer and shall encompass all accessories and sensor calibration.

C. Completed start-up reports shall be submitted 7-days prior to scheduled functional performance testing. Start-up reports will be tracked as part of the pre-functional checklists to indicated readiness for functional testing.

D. Start-up reports shall be per requirements listed in equipment or referenced documentation section of this specification.

3.10 O&M MANUALS

A. CxA will review O&M Manuals and Warranties concurrent with Owner and A/E as per any submittal.

B. O&M Manuals shall contain:

1. All requirements from other sections of Contract Documents.
2. Current IECC requirements.

3. Warranty Procedures: Provide a comprehensive procedure for warranty procedures.
4. Filter Schedule: One comprehensive schedule indicating all equipment on the project with filters and their associated filter size, quantity, and MERV rating.
5. Belt Schedule: One comprehensive schedule indicating all equipment on the project with belts and their associated belt size, type, and quantity.
6. Lamp Schedule: One comprehensive schedule indicating lamps for all luminaires on the project and their types and quantities, manufacturers, and order codes.
7. Warranty Schedule: One comprehensive schedule listing all equipment on project and their parts, labor, and extended warranties.
8. Maintenance Schedule: One comprehensive schedule indicating routine maintenance frequencies. Schedule shall indicate maintenance requirements for 2-calendar years starting from date of Owner acceptance.

C. Distribution process shall be the same as Submittal Review.

3.11 TRAINING

A. The lead subcontractor for the respective system is responsible for the development of the training material for the system. The lead subcontractor shall utilize the Operations and Maintenance Manual as a basis for instruction. Any coordination of training between different subcontractors is the responsibility of the lead subcontractor.

B. The training agendas and material shall be submitted to the CxA 30 days prior to the originally scheduled system training for review and acceptance for review. The CxA shall provide comments to supplement the training material for operations and maintenance personnel where appropriate. Training Agendas shall include:

1. Instructors Name
2. Date of training
3. Duration
4. General purpose of the system
5. Use of the O&M manuals
6. Review of control drawings and schematics
7. Start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, controls set-up and programming, troubleshooting, and alarms

8. Interactions with other systems, adjustments and optimizing methods for energy conservation, relevant health and safety issues
9. Preventative maintenance procedures and schedules. Schedule should be broken out by system and individual component requiring maintenance.
10. Special maintenance and replacement sources
11. Tenant interaction issues
12. Discussion of how the feature or system is environmentally responsive
13. The trainer shall verify that the training agenda is covered and shall obtain signatures and names of persons attending the training.

C. CxA will review training agenda and materials concurrent with Owner and A/E.

D. Distribution process shall be the same as Submittal Review.

E. Training shall be videotaped by the Contractor, unless specified otherwise in the design documents.

F. All training sessions shall be scheduled and coordinated by the Construction Professional through Owner.

G. Major component training shall be completed and accepted by Owner prior to Material Completion and occupancy.

3.12 CONTROL SYSTEM VERIFICATION:

A. Included in this work will be sample-based verification of instrument calibration, access to components, labeling of devices, clear sequences and shop drawings.

B. The verification of the control system will be accomplished as an on-going task during construction to identify and resolve systemic issues early in the project. This on-going task will involve work that occurs offsite and throughout the construction phase including the closeout phase.

C. The control system operation must be sufficiently operational prior to the TAB of the system. It is understood that a portion of the final control system startup occurs in conjunction with the TAB work. The intent of this requirement is for the TAB work to be productive and not be hampered by a control system that is not sufficiently functional.

D. The control system testing will utilize the controls system instrumentation for testing. Therefore, the first portion of the control system testing will be verification of the sensors, inputs and outputs.

E. Point-to-Point Verification: All wiring shall be checked out by the Control Contractor from end to end, point to point, from field to computer screen to ensure correct connection and a system free from wiring defects.

F. CxA verification of sensors will be made using the sampling method; an exhaustive re-test of the control system inputs and outputs will not be conducted by the CxA. Prior to CxA verification, the Control Contractor shall be responsible for complete input/output checkout quality assurance.

1. Sensor and Actuator Calibration, General:

   a. This section is included to emphasize the importance of the Control Contractor calibrating the instrumentation and to make clear the requirement for same; and that "factory calibration" or "calibration by exception" is not acceptable.

   b. All field-installed temperature, relative humidity, CO, CO2 and pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated using the methods described below. All test instruments shall have had a certified calibration within the last 12 months. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.

   c. All procedures used shall be fully documented with documentation of initial, intermediate and final results.

2. Sensor Calibration Methods

   a. All Sensors and Transducers. Verify that all sensor and transducer locations are appropriate and away from causes of erratic operation. Verify that sensors and transducers with shielded cable are grounded only at one end.

   b. Sensors without Transmitters. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor is within the specified tolerances. If not, install offset in BAS, calibrate or replace sensor.

   c. Sensors with Transmitters. Connect a signal generator. Adjust transmitter zero and span to match the signal generator until the ammeter reads 4 mA. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading is within the specified tolerances. If not, replace sensor and repeat.

   d. Sensor Tolerances. The following are the tolerances of the actual sensors in the system. Unless noted differently on the CxA test procedure, use the following:
      1) Temperature (space or room): +/- 1.0 degF.
      2) Temperature (duct):+/- 0.5 degF.
      3) Pressure (duct static): +/- 0.05 in. w.c.
      4) Pressure (other):+/- 5.0 pct of reading.
      5) Flow rates for air:+/- 5.0 pct of reading.
      6) Flow rates for water: +/- 5.0 pct of reading.

7) Relative Humidity:+/- 5.0 pct of reading.
8) Oxygen or CO2 monitor: +/- 1.0 pct of span.

e. Valve and Damper Stroke Setup and Check as follows:
   1) For all valve and damper actuator positions checked, verify the actual position against the BAS readout.
   2) Set pumps or fans to normal operating mode (If the system could be affected by this, then shut down the system). Command valve or damper closed, visually verify that valve or damper is closed and adjust output zero signal as required. Command valve or damper open, verify position is full open and adjust output signal as required. Command valve or damper to a few intermediate positions. If actual valve or damper position doesn't reasonably correspond, replace actuator.
   3) Closure for normally closed valves and dampers (spring-loaded only). Disconnect power to the actuator motor, and verify the valve or damper moves to full closed position. If not spring-loaded, conduct verification by disconnecting the signal wire. Restore to normal.
   4) Closure for normally open valves and dampers (spring-loaded only). Disconnect power to the actuator motor, and verify the valve or damper moves to full open position. If not spring-loaded, conduct verification by disconnecting the signal wire. Restore to normal.

3.13 TEST, ADJUST, AND BALANCE REVIEW

A. The CxA witness the TAB activities performed by the Contractor/subcontractors to document achievement of the OPR. The specific activities expected include:

1. CxA will review TAB deficiencies report with Owner to evaluate existing conditions and repairs that may be required.

2. Review of TAB procedures documented in TAB Plan. TAB Contractor shall verify accessibility of equipment and components required for TAB work, adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces, adequate number and placement of balancing valves to allow proper balancing and recording of water flow, adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both tab and commissioning testing.

3. Review of TAB report after TAB work is complete. See submittal review section for review process.

4. The TAB verification will be done while the system is under the same conditions and control setup as the original readings.

3.14 FUNCTIONAL PERFORMANCE TESTING

A. The CxA will witness tests performed by the Contractor that are intended to document achievement of the OPR. The specific activities expected include:

1. The CxA will provide to all commissioning team members, and others as required, the functional performance test plan 14 days prior to the scheduled testing.

2. Review of test procedures: the contractor shall review the FPT procedures developed by the CxA. The contractor shall return consolidated comments from all subcontractors within 14 days of receipt from the CxA.

3. FPT's shall be accomplished prior to submitting the initial request for Material Completion and after all construction checklists have been accepted by the CxA and after acceptance of all startup and performance test reports (e.g., TAB report) by the CxA.

4. Contractor shall assign adequate personnel and tools for the following FPT's and any required retests:

a. HVAC Systems – all modes of operation, including emergency, efficiency, performance, and consistency tests – expected duration to be 3-5 days of hands on tests. This does not include setup, preparation recording, or data downloading time.

b. Electrical – Review of HVAC equipment electrical connections to validate power quality within specified tolerances in all modes of operation, including emergency, efficiency, performance, and consistency tests – expected duration to be 1-2 day of hands on tests. This does not include setup, preparation recording, or data downloading time.

c. Plumbing Systems – Review of HVAC equipment plumbing connections (hot water, chilled water, condensate drainage, etc.) in all modes of operation, including emergency, efficiency, performance, and consistency tests – expected duration to be 1-2 day of hands on tests. This does not include setup, preparation recording, or data downloading time.

B. Each subcontractor will be responsible, as required, to assist the CxA by witnessing the testing, putting the system in various modes of operation, and fixing minor problems found during the test. Manufacturer's representatives may be required to access and override controls as necessary to conduct the testing if control is not provided by the controls contractor.

C. Control system set-up, calibration and operation shall be completed and verified prior to system Adjusting and Balancing as defined in Section 23 05 93. System functional performance testing shall not be completed until the Adjusting and Balancing report has been verified and accepted by the A/E.

D. Skilled technicians shall be provided by the appropriate Contractor familiar with the system and building to execute the functional performance testing of the control system and perform functional performance testing of equipment. The Owner reserves the right to reject any technician who is not qualified to perform the required testing. Qualifications of technicians include site-specific expert knowledge relative to tested equipment and adequate documentation and tools to service and operate the systems.

E. If major problems are discovered during the test, the responsible subcontractors and Construction Professional will fix the problem and the test shall be redone. If more than one functional performance test is required, the responsible subcontractor will be back-charged for the CxA's time and expenses.

F. Re-testing Procedure:

1. Any requirement for a re-test for a given test shall constitute the back charge to the responsible Contractor by the Owner for the attendance of CxP. A re-test shall be defined in this context as any time where a test defined under this section for the project cannot be fully executed due to any of the following conditions:

    a. Date and time of test changed without a minimum of 14 days notice to CxP.

    b. Improper or insufficient personnel and/or tools on site at time of test.

    c. Deficiencies or discrepancies present at time of test that have been previously noted by CxP and remain unresolved.

    d. Any issues that require a re-test or stoppage of tests in progress.

    e. Failure of test for reason under responsibility of Contractor and/or Contractor responsible for sub or feed system (i.e. controls, electrical, etc.).

    f. Failure due to manufacturer defect.

2. The Contractor is responsible for all costs associated with re-testing, including costs incurred by Owner.

3. Re-testing by Contractor shall not be considered a reason for a claim of delay or for a time extension by the Contractor.

4. If any sample selected has more than a 10% failure rate an additional sample equal to the number of units that failed shall be selected and treated as a re-test in accordance with re-testing guidelines provided under this section. This shall be in addition to the requirement to re-test the failed units.

3.15 SEASONAL TEST

A. Contractor shall be responsible to participate in seasonal testing. Seasonal testing will be at the opposite season, within 10-months after Material Completion. Seasonal testing is to verify the system operation is stable during the opposite season.

3.16 WARRANTY REVIEW

A. Contract shall be responsible for participating in warranty review process near the end of warranty period to verify all warranty items have been resolved.

3.17 RECORD DRAWINGS

A. Comply with requirements specified in Section 01 78 00.

END OF SECTION