DIVISION 01

GENERAL REQUIREMENTS

SECTION 01000
EXPLANATION FOR THE SPECIFICATIONS

1.00 INTRODUCTION

The Drawings and Specifications are complementary to each other. Drawings are graphic means of showing work to be done. They are particularly suited to showing materials are located. Thus, drawings exist essentially to show dimension, location and placement. Not all works, however, can be presented in the drawings. Generalized works are usually statement form and hence, the contractor is required to read the specifications carefully.

Specifications, on the other hand, are used to describe the materials, construction techniques, samples, shop drawings, guarantees and other contract requirements. Together, the drawings and the specifications are used to inform the contractor. In cases where the specified brand carries with it the manufacturer's specifications, the manufacturer's specifications shall hold precedence over these specifications.

The Specifications are of the abbreviated type and include incomplete sentences. The selection of the sentence depends on the underlying principles of Specifications:

A. That the Technical Specifications are only one part of the contract Documents.
B. That the contract is between the Owner and the General Contractor and
C. That the General Contractor is the only party responsible for completing the work in accordance with the Contract Documents.

Therefore:

A. Only the General Contractor is referred to in the Specifications so as not to violate the intent of the contract and so as not to undermine the proper chain of command.
B. Any reference to Specialty Trade Contractors in the technical Specifications is made only in so far as selection of Specialty Trade Contractors is made through bidding. Once the Specialty Trade Contractors are selected and assigned to the General Contractor, the General Contractor assumes all the responsibilities for the execution of the whole project in accordance with the Contract Documents. Therefore, in the contract between the Owner and the General Contractor, the Specialty Trade Contractor is not referred to. In all contract Documents, the word "Contractor" means the General Contractor.
C. The brand names specified are intended to assure the level of quality needed for the project. This does not mean however that the brands specified are exclusive. The Contractor shall prove by laboratory tests and certificates that substitute materials are of the equivalent quality and the Contractor shall secure the Architect's approval prior to use of such substitutes.
D. The omission of the phrase "The Contractor shall" is intentional because the whole Specifications is directed to the Contractor. Omitted words or phrases shall be supplied by inference in the same manner as they are when a "note" occurs on the drawings.
E. Where "as shown", "as indicated", "as detailed" or words of similar import are used, it shall be understood that reference to the drawings accompanying the Specifications is made unless otherwise stated.

F. Where “as directed“, “as required”, “as permitted”, “as authorized”, “as approved, accepted” or words of similar import as used, it shall be understood that the direction, requirements, permission, authorization, approval or acceptance of the Architect is intended unless otherwise stated.
G. As used herein, “provided” shall be understood to mean “provided complete in place,” that is, “furnished and installed”.
H. Most sentences are in the imperative mood. This style is specially suited for instructions covering installation of products and equipment.

Example:

“Spread planting soil mixture to depth required to meet thickness, grades, elevations shown”
“Reuse surface soil stockpiled on site”
“Maintain ground cover by watering”

The verb is the first word of the sentence clearly defining the action to be performed. This style is readily understandable and concise.

2.00 CLARIFICATIONS

All reference to any particular brand, material, equipment, or systems in the specifications, drawings, and bid documents is indicative of the type and quality of what is required. However, any equal material or equipment or system can be used if approved by the University.

END OF SECTION 01000

Read and accepted as part of the Contract:

Bidder/Contractor

SECTION 01010
SUMMARY OF WORK

1.00 GENERAL REQUIREMENTS

1.01 DESCRIPTION OF THE PROJECT

Furnish all materials, equipment, plant tools, and other facilities and perform labor to complete all works in the design and construction of the NATIONAL INSTITUTES OF HEALTH, in accordance with the plans, specifications, the Philippine Bidding Documents, the Terms of Reference and other related contract documents.

1.02 PERMITS, LICENSES AND TAXES

A. Secure and pay all permits, fees, licenses, taxes, etc. Necessary for the execution of the general construction works
B. Prepare a monthly progress report which shall include, among others. An overall progress chart and progress value of construction work.

1.03 TEMPORARY FACILITIES

A. Construct temporary facilities like field office, bodega, housing, toilet facilities for workers. See Sections 01300 and 01400 for details.
B. Secure all existing equipment, materials and facilities which shall eventually be re-used.
C. Take all necessary measures to protect all existing facilities, site development, and equipment from damage, loss and dirt.

1.04 DEMOBILIZATION AND CLEANING

A. Demobilize, dismantle and remove all temporary facilities, including all workmen's houses, construction equipment, tools, personnel and debris out of the project site and/or University premises.
B. Clean building and site; spic and span, ready for use.

1.05 DIVISION SECTIONS

01230	Alternates (Optional)
01250	Contract Modification Procedures
01290	Payment Procedures
01300	Field Engineering
01310	Project Management and Coordination
01320	Construction Progress Documentation
01330	Submittal Procedures
01354	Special Project Procedures for Laboratories
01390	Quality Requirements
01400	Temporary Construction Facilities and Controls
01410	Structural Tests and Special Inspections List
	01410a - Schedule of Special Inspections
01457	Room Integrity Testing
01524	Construction Waste Management
01600	Product Requirements
01750	Warranties and Bonds
01770	Closeout Procedures

01781	Project Record Documents
01782	Operation and Maintenance Data
01800	Commissioning
01810	Functional Performance Testing (FPT) Procedures
01820	Demonstration and Training

2.00 SITEWORK

Section 02080	Piped Utilities – Materials and Methods
02100	Site Preparation
02115	Soil Erosion and Sediment Control
02160	Excavation Support Systems
02200	Earthwork
02230	Site Clearing and Demolition
02240	Dewatering
02280	Termite Proofing
02290	Integrated Pest Management
02350	Sanitary Sewarage
02500	Roads & Parking
02510	Water Systems
~~02515~~	~~Unit Pavers~~
02520	Roads and Sidewalks: Concrete Curbs, Gutter and Paved Walks
02630	Storm Drainage
02700	Site Drainage
02741	Asphalt Paving
02751	Cement Concrete Pavement
02764	Pavement Joint Sealants
02780	Unit Pavers
02781	Porous Plastic Unit Paving
02810	Irrigation Systems
02900	Landscaping
02920	Lawns and Grasses
02930	Exterior Plants

3.00 CONCRETE

Section 03100	Concrete Formwork
03200	Concrete Reinforcement
03300	Cast-in-Place Concrete
03400	Architectural Pre-Cast Concrete

4.00 MASONRY

Section 04100	Mortar
04200	Unit Masonry
04720	Cast Stone

5.00 METALS

Section 05100	Structural Metal Framing
05200	Miscellaneous Metals

05100	Structural Steel Framing
05200	Miscellaneous Metals
05310	Steel Decking
05400	Cold Formed Metal Framing
05500	Metal Fabrications
05511	Metal Stairs and Railings
05513	Factory-Applied Metal Coatings
05521	Aluminum Tube Railings
05531	Aluminum Equipment Screen
05532	Fiberglass Gratings
05811	Architectural Joint Systems

6.00 WOODS AND PLASTICS

Section 06200	Finish Carpentry
06100	Rough Carpentry
06200	Finish Carpentry
06402	Interior Architectural Woodwork
06416	Plastic Laminate Wood Cabinets

7.00 THERMAL AND MOISTURE PROTECTION

Section 07100	Waterproofing & Damp proofing
07210	Building & Roofing Insulation
07400	Sheet Metal Roofing
07810	Plastic Unit Skylight
07900	Joint Sealants
07100	Waterproofing and Dampproofing
07110	Building Insulation
07115	Bituminous Dampproofing
07131	Self-Adhering Sheet Waterproofing
07210	Building and Roofing Insulation
07227	Fluid-Applied Membrane Air Barriers
07400	Sheet Metal Roofing
07410	Exterior Metal Wall System
07413	Composite Metal Wall Panels
07540	Thermoplastic Membrane Roofing
07620	Sheet Metal Flashing and Trim
07720	Roof Accessories
07810	Plastic Unit Skylight
07811	Sprayed Fire-Resistive Materials
07841	Through–Penetration Firestop Systems
07842	Fire-Resistive Joint Systems
Section 07900	Joint Sealants
07951	Expansion Joint Covers

8.00 DOORS AND WINDOWS

Section 08100	Metal Doors and Windows
08110	Metal Door and Window Frames
08111	Stainless Steel Frames
08114	Custom Steel Doors and Frames
08125	Interior Aluminum Frames
08211	Flush Wood Doors
08311	Access Doors and Frames
08331	Overhead Coiling Doors
08411	Aluminum-Framed Entrances and Storefronts
08520	Aluminum Windows
08700	Hardware
08710	Door Hardware
08712	Finish Hardware
08716	Automatic Door Operators
08800	Glazing
08911	Glazed Aluminum Curtain Walls

9.00 FINISHES

Section 09111	Non-Load Bearing Steel Framing
09200	Plaster
09250	Gypsum Board
09265	Gypsum Board Shaft Wall Assemblies
09300	Tile
09511	Acoustical Panel Ceilings
09600	Stone
09605	Vapor Transmission Testing
09610	Concrete Floor Treatment
09612	Concrete Densifier and Sealer
09622	Resilient Sports Floor Covering
09651	Resilient Floor Tile
09652	Resilient Sheet Flooring
09661	Static-Control Resilient Floor Coverings
09671	Resinous Flooring
09680	Carpet Tile
09900	Painting
09960	High Performance Coatings

10.00 SPECIALTIES

Section 10155	Toilet Compartments
10200	Louvers and Vents
10265	Impact Resistant Wall and Door Protection
10400	Identifying Devices
10432	Interior Signage

10505	Metal Lockers
10522	Fire Extinguisher Cabinets
10523	Fire Extinguishers
10651	Operable Panel Partitions
10675	Mobile Storage Units
10800	Toilet and Bath Accessories

11.00 EQUIPMENT

Section 11160	Loading Dock Equipment
11530	Contractor Furnished & Installed Lab Equipment
11531	Fume Hoods and Exhaust Devices
11534	Class III Biological Safety Cabinets (for coordination, not in contract)
11535	Biological Safety Cabinets
11536	Laboratory Sterilizers (for coordination, not in contract)
11537	Modular Stainless Steel Walls (for coordination, not in contract)
11538	Cage and Rack Washers (for coordination, not in contract)
11540	Room Air Visual Indicator

12.00 FURNISHINGS

Section 12210	Window Blinds
12352	Metal Laboratory Casework
12353	Adaptable Laboratory Casework System
12354	Custom Stainless Steel Laboratory Casework
12356	Countertops
12481	Entrance Floor Mats
12494	Roller Shades
12500	Furniture Systems (for coordination, not in contract)

13.00 SPECIAL CONSTRUCTION

Section 13030	Controlled Environment Rooms
13480	Seismic Protection for Mechanical Equipment

14.00 CONVEYING EQUIPMENT

Section 14240	Electric Traction Elevators

15.00 MECHANICAL

Section 15050	Basic Mechanical Materials and Methods
15052	Common Work Results for Plumbing
15057	Common Motor Requirements for HVAC Equipment
15061	Hangers and Supports for Plumbing
15073	Vibration Controls for Plumbing
15076	Identification for Plumbing Piping and Equipment

15082	Plumbing Mechanical Insulation
15092	Sleeves and Sleeve Seals for Plumbing
15097	Escutcheons for Plumbing
15111	Valves for Plumbing
15122	Meters and Gauges for Plumbing
15123	Expansion Fittings and Loops for Plumbing
15145	Domestic Water Piping
15150	Domestic Water Piping Specialties
15155	Sanitary Waste and Vent Piping
15160	Sanitary Waste and Piping Specialties
15165	Storm Drainage Piping
15216	Storm Drainage Piping Specialties
15222	Gas Piping for Laboratory Facilities
15223	Processed Water Piping
15224	Chemical Waste Systems for Laboratory Facilities
15224	Chemical Waste Systems for Laboratory Facilities
15415	Plumbing System
15441	Drinking Fountains and Water Coolers
15444	Domestic Water Pumps
15446	Packaged Booster Pumps
15450	Sump Pumps
15451	Plumbing Fixtures and Trims
15469	Emergency Plumbing Fixtures
15471	Water Softeners
15485	High Purity Water System
15486	Fuel-Fired Water Heaters
15500	Ventilation System
15641	Cooling Towers
15726	Indoor Custom Air-Handling Units
15734	Computer-Room Air Conditioning
15751	Dehumidification Systems
15815	Metal Ducts
15817	HEPA Filter Containment Housing
15820	Duct Accessories
15836	Axial Fans
15837	Centrifugal Fans
15838	Power Ventilators
15480	Air Terminal Units
15855	Diffusers, Registers and Grilles
Section 15960	Laboratory Air Control System
15961	Testing, Adjusting and Balancing

16.00 ELECTRICAL

Section 16050	Basic Electrical Materials and Methods
16055	Overcurrent Protective Device Coordination
16060	Grounding and Bonding
16062	Lightning Protection

16065	Division of Work
16070	Electrical Testing
16073	Hangers and Supports for Electrical Systems
16075	Electrical Identification
16120	Conductors and Cables
16130	Raceways
16139	Cable Trays
16140	Wiring Devices
16145	Lighting Control Devices
16231	Packaged Engine Generator
16269	Variable Frequency Controllers
16289	Transient Voltage Suppression
16410	Enclosed Switches and Circuit Breakers
16415	Transfer Switches
16420	Electrical Distribution System
16441	Switchboards
16442	Panelboards
16450	Enclosed Bus Assemblies
16461	Low Voltage Transformers
16491	Fuses
16511	Interior Lighting
16521	Exterior Lighting
16715	Voice and Data Communications
16720	Security Systems
16721	Fire Alarm
16726	Public Address Systems

END OF SECTION 01010

Read and accepted as part of the Contract:

_____
Bidder/Contractor

Section 01020
SUMMARY OF MATERIALS AND FINISHES

1.00 GENERAL REQUIREMENTS

1.01 RELATED SECTIONS

All applicable provisions of the different divisions of the Specifications for each work trade shall apply for all items cited in this Summary.

1.02 INFERRED ITEMS AND WORK

Materials and workmanship deemed necessary to complete the works but NOT specifically mentioned in the Specifications, Working Drawings, or in the other Contract Documents, shall be supplied and installed by the Contractor without extra cost to the Owner. Such materials shall be of the highest quality available, and installed or applied in a workmanlike manner at prescribed or appropriate locations.

1.03 SPECIFICS

Materials specifically mentioned in this Summary shall be installed following efficient and sound engineering and construction practice, and especially as per manufacturer's application for installation specifications which shall govern all works alluded to in these Specifications.

1.04 ON-SITE ITEMS

Materials and finishes for on-site improvements and facilities as listed below are part of the scope of work and shall be supplied and installed by the Contractor without extra cost to the Owner.

A. Installation of engineered and drainage fills for building and landscaped areas where specified.
B. Construction of:
   1. Concrete driveways, walks, ramps, steps, posts, and miscellaneous slabs;
   2. Concrete splash slabs, steel or hard plastic gratings;
   3. Below grade utility structures such as septic vaults, cisterns, handholes, and manholes;
   4. Above-grade utility structures such as electrical poles, concrete pedestals, and the like;
C. Exterior utility lines, raceway system, fixtures, breakers, switches, buzzers, controls including fittings and accessories as required by the specialty trades under plumbing, electrical and communication works.
D. Pumps, tanks and other necessary equipment and facilities.

1.05 OFF-SITE ITEMS

Off-site improvements shall generally be under the responsibility of the Owner and not included in the Contract, with the exception of the following which shall be part of the Contractor's Work:

A. Concreting of entry slabs. This work shall neatly make connections to the existing roads or curbs, if any, and shall incorporate necessary utility ways under such as required. Access road drainage system and other existing utility lines must be kept in working condition.

B. Installation of concrete drainage pipes to neatly receive connections from the storm drainage system of the site to access road and/or to existing drainage system.

C. Permanent connections to the local utility lines for electrical, water, drainage, sewer and telephone lines including equipment, facilities, materials, fees, and/or work which utility companies or authorities may require of the applicant Owner, such as electrical transformers, electric poles, service laterals and drops, etc. by their respective Specialty Contractors.

2.00 SITEWORK

2.01 02160: EXCAVATION SUPPORT SYSTEM

A. SHORING AND BRACING SYSTEMS

Types of shoring and bracing systems include, but are not limited to the following:

1. Steel H-section (soldier) piles
2. Timber lagging
3. Steel sheet piles

2.02 02200: EARTHWORK

A. FILL MATERIALS

1. General Fill for structures and under spread footings, pavers, or concrete slabs on grade shall conform to the general requirement for soil materials above and shall be classified as GW, GM, GP, SW, SM by the ASTM 2487 and conform to the following.
   a) Liquid Limit – shall not exceed 25% when tested in accordance with ASTM 423.
   b) Plasticity Index – shall not exceed 12 % when tested in accordance with ASTM 424.
   c) Under Buildings, no more than 25% by weight shall be finer than No. 200 sieve when tested in accordance with ASTM D 1140.
2. Granular Fill shall conform to the general requirements for soil material above and shall be clean, crushed stone or gravel conforming to ASTM C 33, size 67 and with a sand equivalent of not less than 50% when tested in accordance with ASTM D 2419.
3. Backfill material behind walls shall consist of free-draining granular fills, sized in particular to provide a filter media around subsoil drainage system.
4. Drainage Fill: Fill material shall clean, well graded, free draining sand conforming to ASTM C 33 for Fine Aggregate.
5. Borrow: If additional material is required for fill in excess of that obtained by excavation at the site, obtain same from sources acceptable to the Owner's Engineer. All arrangement for obtaining borrow from off-site shall be the responsibility of the Contractor and all cost thereof shall be borne by the Contractor. Acceptable borrow will consist of suitable material for fills as herein before specified. Representative of each type of borrow materials considered suitable shall be delivered to the Testing Laboratory and tested prior to placement. Any borrow material not meeting the

standard herein specified, or considered unsuitable by the Owner's Engineer will be rejected at the site.

B. RIPRAP: Rock Boulders, natural, hard rock, high density, from 400 mm to 800 mm in diameter.

C. BATTERBOARDS: Second class, pest free lumber assembled and rendered secure for proper delineation of building lines and grades.

2.03 02282: TERMITE PROOFING

Product and application by Owner-accredited termite and pest control contractor.

A. TERMITE PROOFING: Use Termiticide Concentrate or approved equal. Dilution rating: 1 part Termiticide Concentrate to 50 parts water. There shall be no disturbance of treated soil between application of poison and pouring concrete.

2.04 02515: UNIT PAVERS

A. CONCRETE PAVERS: Rectangular paving unit, conforming to ASTM C 936, made from normal-weight aggregates. Submit sample for approval by the Architect.

B. NATURAL STONE PAVERS: 19mm thickness, conforming to ASTM C615; color and sizes as indicated. Submit sample for approval by Architect.

D. GRADED AGGREGATE SETTING BED: See Section 02200 Earthworks.

E. CONCRETE SETTING BED: See Section 03300 Cast-in-Place Concrete.

F. PRECAST CONCRETE EDGE RESTRAINTS: Precast concrete curbing, made from normal-weight aggregate, in shapes and sizes indicated.

G. CORK JOINT FILLER: Preformed strips complying with ASTM D 1752, Type II.

2.05 02520: ROADS AND PARKING - CONCRETE CURBS, GUTTER, AND PAVED WALKS

A. CEMENT: shall be as per ASTM Standard Specifications for Portland Cement (ASTM C-150: latest revision) for Type 1 Portland Cement.

B. CONCRETE AGGREGATES

1. Aggregates shall be well-graded, clean, hard particles or gravel or crushed rock conforming to the STANDARD SPECIFICATION FOR CONCRETE AGGREGATES (ASTM Designation C-33: latest revision).
2. SAND: shall be coarse sand free from injurious materials such as shells or earth or organic materials. Sand from salt water is not allowed.

C. WATER: shall be clean and free from injurious amounts of oils, acids, alkali, organic materials or other deleterious substances.

D. FORMS: shall be either wood or steel.

E. CONTROLLED STRENGTH OF CONCRETE: Concrete shall develop a minimum of 28-day cylinder strength of 21 Mpa (3,000 PSI).

2.06 02700: SITE DRAINAGE

A. DRAINAGE PIPE:
   1. Plain concrete drain pipes and fittings: 250 mm (10") and below in diameter: T & G conforming to ASTM C-14-59.
   2. Reinforced concrete pipes fittings: 300 mm (12") and bigger: Centrifugally cast or vibrated T & G conforming to ASTM C-76-59 T.
B. JOINING MATERIAL: One part cement to two parts sand.

C. BUILDING STORM DRAIN CONNECTION TO MAIN: Concrete wye branch and clean out, T & G or use junction boxes.
D. AREA DRAIN CATCH BASIN: Load-bearing 4.8 Mpa (700 PSI) concrete hollow blocks (CHB) or reinforced concrete with cover as shown on the drawings.
E. CATCH BASINS OF JUNCTION BOXES: Load-bearing 4.8 Mpa (700 PSI) concrete hollow blocks (CHB) or reinforced concrete as indicated in the drawings, with solid reinforced concrete cover.

2.07 02900: LANDSCAPING
A. TREE AND SHRUB MATERIALS
   1. General: Furnish nursery-grown trees and shrubs conforming to ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully-branched, healthy, vigorous, and stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
   2. Grade: Provide trees and shrubs of sizes and grades conforming to ANSI Z60.1 for types of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to the Landscape Architect, with a proportionate increase in size or roots or balls.
   3. Shade Trees: Single-stern trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, conforming to ANSI Z60.1 for type of trees required. Branching height shall still be 1/3 to ½ of tree height.
   4. Small Trees: Small upright or spreading type, branched or pruned naturally according to species and type, and with relationship of caliper, height and branching recommended by ANSI Z60.1, and multi-stem form of clump, with 2 or more main stems.
B. GROUND COVER MATERIALS: Provide ground covers established and well rooted in removable containers or integral peat pots and with not less than the minimum number and length of runners required by ANSI Z60.1 for the pot size indicated.
C. GRASS MATERIALS: *Paspalum conjugatum* (Carabao Grass) Sod Sprigs: Healthy living stems, rhizoms or stolons with a minimum of 2 nodes and any attached roots free of soil.
D. TOPSOIL: ASTM D 5258. pH range of 5.5 to 7, 4 percent organic material minimum, free of stones 1 inch (25 mm) or larger in any dimension, and other extraneous materials harmful to plant growth.
E. SOIL AMENDMENTS: Manure: Well-rotted, unleached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth. Mix with approved soil on site at the rate of 1 part manure per 1 part soil.

F. FERTILIZER: Commercial Fertilizer. Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic source of urea-form, phosphorus, and potassium in the following composition: 0.5 kg per 100 sqm (1 lb per 1000 sq. ft.) lawn area of actual nitrogen, 4 percent phosphorus, and 2 percent potassium, by weight.

G. MULCHES
   1. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of wood and bark chips.
   2. Peat Mulch: Provide peat moss in natural, shredded, or granulated form, of fine texture, with a pH range of 4 to 6 and a water-absorbing capacity of 1100 to 2000 percent.

H. STAKES AND GUYS
   1. Upright and Guy Stakes: Solid bamboo poles, sound, pressure-preservative-treated, free of holes and other defects, 3 pieces per tree as shown in Plans, 32 mm to 50 mm dia. by length indicated, pointed at one end.
   2. Guy and Tie Wire: ASTM A 641 (ASTM A 641M), Class 1, galvanized-iron wire, 2-strand, twisted, 2.7 mm (0.106 inch) in diameter.
   3. Rope: Abaca rope tied loosely to horizontal bars.

I. CONSOLIDATED PLANT LIST: Refer to Plans.

J. EXISTING TREES: Contractor shall secure the necessary environmental permits required to ball-out, or cut down affected existing trees with 100mm or more in trunk diameter. Cut down trees shall be the property of the Owner. All costs and logistics of the transportation and transfer of balled-out trees to the new site shall be the responsibility of the contractor.

3.00 CONCRETE

3.01 03100: CONCRETE FORM WORKS

A. FORMS:
   1. TYPE OF FORMS: Use phenolic boards for exposed and unexposed concrete works, Armourply brand or approved equal, for all cast in place and pre-cast works.
   2. SCAFFOLDS: Use metal scaffolding whenever necessary. Wood nor coco lumber are not allowed. Form work, shoring, temporary bracing, staging, construction of temporary facilities, and any other measures needed to support the structural elements or provide shelter from debris during construction shall be the responsibility of the builder.

3.02 03200: CONCRETE STEEL REINFORCEMENT

A. STEEL BARS: Use locally manufactured deformed billet-steel bars conforming to Philippine standard, Intermediate Grade of 275.8 Mpa (Fy = 40,000 psi) for bars 10mm diameter or smaller, and High Strength Grade of 415 Mpa (Fy = 60,000 psi) for bars 12mm diameter and larger. Use standard-sized deformed steel conforming with ASTM A615 / PNS 49 standards, for concrete and masonry reinforcements. Upgrade to next bigger size if specified standard sizes are unavailable.

B. TIE WIRES: Use Ga.16 Galvanized Iron (G.I.) tie wires at joints or laps of placed reinforcements.

3.03 03300: CAST IN PLACE CONCRETE

A. GENERAL:

Concrete shall be composed of Portland cement, fine and coarse aggregates, water and admixture as specified, all thoroughly mixed and brought to the proper consistency, uniformity and temperature for final placement. Strength requirements shall be (see Sheet S-01):

1) 28 MPa (4000 psi) for footings, retaining walls, footing tie beams, cistern and suspended slabs.
2) 28 MPa (4000 psi) for columns, girders, beams and RC gutters;
3) 17.2 MPa (2500 psi) for slabs-on-grade, partitions, walks, & other non-structural members;
4) 10.5 MPa (1500 psi) for lean concrete, or as required by the Engineer.

B. CEMENT:

Cement shall be Portland cement, conforming to the Standard Specifications for Portland Cement (ASTM Designation C-150 latest revision) for type 1 Portland Cement. Use only one brand of cement throughout.

C. FINE AGGREGATES:

Fine aggregates shall consist of natural sand, manufactured sand, or a combination thereof. If the fine aggregate shall be a combination of separately processed sizes, or if hatching shall result in a combination of natural and manufactured sand, the different components shall be batched separately.

Fine aggregates shall consist of hard, tough, durable, uncoated particles. The specified percentages of fines in the sand may be obtained either by the processing of natural sand or by the production of a suitably graded manufactured sand. The shape of the particles shall be generally rounded or cubical and reasonably free from flat or elongated pieces. The use of beach sand shall be prohibited. The fine aggregate shall conform to the following specific requirements:

Sieve Designation		
Standard (MM)	U.S. Standard, Square Mesh	Cumulated Percentage by Weight Passing
9.5	3/8	100
4.75	No. 4	95-100
2.36	No. 8	-
1.18	No. 16	45-80
0.60	No. 30	-
0.30	No. 50	10-30
-	No. 100	2-10

In addition to the grading limits shown above, the fine aggregates, as delivered to the mixer shall have a fineness modulus of not less than 2.3 nor more than 3.0 and during normal operations, the grading of the fine aggregate shall be controlled so that the fineness modulus of at least nine (9) of ten (10) test samples of the fine aggregate as delivered to the mixer shall not vary more than 0.20 from the average fineness modulus of all samples tested during the preceding 30-day period. The fineness modulus can be determined by dividing by 100 the sum of the cumulated percentages retained on U.S. Standard Sieves Nos. 4, 8, 16, 30, 50 and 100. At the option of the Contractor, fine aggregates may be separated into two or more sizes or classification, but the resulting combined sand shall be of uniformed grading within the limits

specified above. It can be generally assumed that fine blending sand maybe required to meet the above grading.

D. COARSE AGGREGATES:
Coarse agreement shall consist of gravel, crushed gravel or rock, or a combination thereof. The coarse aggregate as delivered to the batching plant shall have a uniform and stable moisture content. The approval of deposits shall not be construed as constituting the approval of all the materials taken from the deposits and the Contractor shall be held responsible for the specified quality of all such materials used in the work. Coarse aggregate shall consist of hard, tough, durable, clean and uncoated particles. All foreign materials and dust shall be removed by adequate processing. The particle shape of one of the smallest size of crushed coarse aggregate shall be generally rounded or cubical, and the coarse aggregate shall be reasonably free from flat and elongated particles. A thin, flat and elongated particle can be defined as a particle having a maximum dimension greater than five times the minimum dimension. The coarse aggregate shall be well graded from fine to coarse. It shall be separated into size groups.
The grading of the aggregate within the separated size groups as delivered to the mixer shall be as follows:

Sieve Sizes

Standard (MM)	U.S. Std. Sq. Mesh	Percent by Weight Sizes 1-1/2"	Passing Individual 3/4"size
50.00	2"	-	100
37.50	1-1/2"	-	90-100
25.00	1"	100	20-55
19.00	3/4"	90-100	0-15
9.50	3/8"	20-55	0-5
4.75	No.4	0-10	-

- Use 19 mm (3/4) coarse aggregate for slabs-on-grade, columns, beams, suspended slabs, tie beams.
- Use 38 mm (1 ½") coarse aggregate for footings

E. WATER:
Water shall be clean and free from injurious amounts of oils, acids, alkalis, salts and organic materials, or other substances that may be deleterious to concrete or steel.

F. ADMIXTURES: shall be subject to prior approval by the Engineer. The admixtures shall be capable of maintaining essentially the same composition and performance throughout the work.
1. Plasticizing admixtures shall be free from chlorides and shall conform to ASTM C494. The admixtures shall be used in concrete mixtures in accordance with the manufacturer's instructions.
2. Use POSSOLITH 3R or DARATARD 17 or approved equal in the amounts as recommended by the manufacturer, with the approval of the Architect.
3. Air-entraining admixtures - DAREX AEA or approved equal to improve workability or durability of concrete mixes.
4. Accelerators - DAREX SET ACCELERATOR or approved equal.
5. Water Reducing Retarders - DARATARD 17 or approved equal.
6. Integral Waterproofing Compound - SIKA or approved equal. For canopy slab. Use one kilo pack per forty kilo bag of Portland cement.

7. Calcium chloride is not allowed. Secure approval of the Engineer prior to using of any other additive.

G. EPOXY BONDING COMPOUND:
1. ASTM C881, 2-component materials suitable for use on dry or damp surfaces; material type, grade and class to suit project requirements. For bonding new to old concrete, repair of cracks, bonding grout.

NOTE: Placement Drawings: Shop drawings of each reinforcing steel detail and placement drawings shall be submitted for approval in accordance with the requirements of the General Conditions. Any material fabricated before final approval of the shop drawings will be done at Contractor's risk, but no material shall be placed until shop drawings have final approval. Shop drawings shall be in accordance with the "Manual of Standard Practice for Detailing Reinforced Concrete Structures" (ACI 315).

3.04 03400: ARCHITECTURAL PRE-CAST CONCRETE

A. MOLD MATERIALS: Metal, plastic or wood that is non-reactive with concrete and will produce required finish surface.

B. REINFORCING MATERIALS:
1. Reinforcing bars: ASTM A 615M, Grade 400 deformed.
2. Steel-Welded Wire Fabric: ASTM A 185, plain, cold drawn.

C. CONCRETE MATERIALS:
1. Portland Cement: ASTM C 150, Type 1. Use only one brand, type, and color of cement from the same mill throughout Project.
2. Normal-Weight Aggregates: ASTM C 33, with coarse aggregates meeting Class 5S and MNL-117 requirements.
a) Face-Mix Coarse Aggregates: Selected, hard, and durable; free of materials that reacts with cement or causes staining. Uniformly graded.
b) Face-Mix Fine Aggregates: Selected, natural or manufactured sand of the same material as coarse aggregate, unless otherwise acceptable to the Architect.
3. Coloring Agent: C 979, synthetic, mineral oxide pigments or colored water-reducing admixtures, color-stable, non-fading, resistant to lime and other alkalis.
4. Water: potable; free from deleterious material that may affect color stability, setting, of strength of concrete.
5. Air-entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
6. Water-Reducing Admixture: ASTM C 494, Type A.
7. Retarding Admixture: ASTM C 494, Type B.

D. CONNECTION MATERIALS:
1. Steel Shapes and Plates: ASTM A 36M.
2. Malleable Iron Castings: ASTM A 47M
3. Carbon Steel Plates: ASTM A 283M.
4. Carbon-Steel Bolts and Studs: ASTM F 568, Property Class 4.6; carbon-steel, hex-head bolts and studs; carbon-steel nuts; and flat, unhardened steel washers.
5. Welded Headed Studs: AWS D1.1, Type B headed studs, cold-finished carbon-steel bars.
6. Deformed-Steel Wire Bar Anchors: ASTM A 496.

7. Welding Electrodes: Comply with AWS standards.
8. Accessories: Provide clips, hangers, plastic shims, and other accessories required to install architectural pre-cast concrete units.

E. BEARING PADS: Elastomeric pads; AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 shore A durometer, minimum tensile strength 15.5 Mpa (2250 psi) per ASTM D 412.

F. GROUT MATERIALS: Cement Grout; Portland Cement, ASTM C 150, Type 1 and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

G. CONCRETE MIXES:

1. Normal-Weight Concrete Face and Back-Up Mixes: Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.1, using materials to be used on the Project, to provide normal weight concrete with the following properties:
   a) Compressive Strength (28-day): 20.7 Mpa (3000 psi).
   b) Maximum Water-Cement Ratio at Point of Placement: 0.40.
2. Lightweight Concrete Back-Up Mixes: Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.2, using materials to be used on the Project, to provide lightweight concrete with the following properties:
   a) Compressive Strength (28-day): 34.5 Mpa (5000 psi).
   b) Unit Weight: Calculated equilibrium unit weight of 1842 kg/cum (115 lb/cuft), plus or minus 48 kg/cum (3lb/cuft), according to ASTM C 567.

4.00 MASONRY

4.01 04100: MORTAR

A. PORTLAND CEMENT: Use only one brand of cement throughout. Portland cement shall conform to the Standard Specifications for Portland Cement (ASTM Designation C-150 latest revision) for type 1 Portland Cement.

B. SAND: ASTM C 35 – 67, clean, washed river sand, strong, free from organic and other deleterious materials. Sand from salt water or lahar is not allowed.

C. WATER: Fit for drinking, free from injurious amount of oil, acids, alkali, organic materials and other deleterious substances.

D. CONCRETE MORTAR COMPRESSIVE STRENGTH: (f'c) = 13.8 Mpa (2000 psi).

E. ADHESIVE MORTAR: Use adhesive mortar for laying vitrified ceramic tiles, with dispersion compound as an additive to adhesive mortar.

F. GROUT: Use grout pre-mixed dry wall filler for floor and wall tile joints either glazed or semi-glazed tiles. Masonry concrete grout compressive strength (fc') = 13.8 Mpa (2000 psi). For tile works.

G. PLASTER BOND: Apply on all wall areas prior to plastering.

H. MORTAR TOPPING & PLASTER REINFORCING FIBER: For plaster works thicker than 25mm (1") and for mortar topping over membrane waterproofing for roof decks and balconies.

4.02 04200: UNIT MASONRY

A. CONCRETE HOLLOW BLOCKS (CHB):
   1. Use 150 mm x 200 mm x 400 mm (6" x 8" x 16") and 100 mm x 200 mm x 400 mm (4" x 8" x 16") Non-Load Bearing Concrete Hollow Block Units of standard manufacture, machine vibrated with even texture and well defined edges, steam-cured, conforming to PNS16 Type 1, Class A, with a minimum compressive strength of 2.5 MPa (350 psi) for building exterior and interior walls and septic tank retaining wall around open court and wherever else specified. *Note:* For interior walls, use 4" CHB from floor to bottom of slab or bottom of beam, with 10mm dia. reinforcing bars at 600 mm o.c. bothways. Anchor to floor by embedding vertical bars 75mm deep into the floor slab. Anchor to slab or beam by providing 10mm dia. dowels. Provide stiffener columns and beams as required in the general notes.
B. GLASS BLOCKS: 190 mm x 190 mm x 100 mm (8" x 8" x 4").
C. REINFORCING BARS: Masonry reinforcing steel yield strength (fy) =228 Mpa (33,000 psi), Grade 33 bars, conforming to ASTM Specifications A615 / PNS 49 of sizes shown in Plans. Use standard sizes; upgrade to next bigger size if specified standard sizes are unavailable.
D. TIE WIRES: Gauge 16 Galvanized Iron (G.I.) tie wires.
E. BRICK: 203 mm x 102 mm x 57 mm. Color and design to be approved by the Architect.

5.00 METALS

5.01 05100: STRUCTURAL STEEL

Owner/Architect – approved manufacturer/sub–contractor. Conform all materials and workmanship to the requirements of the American Institute of Steel Construction "Specifications for Design, Fabrication and Erection of Structural Steel for Buildings" as amended to date or as may be specifically modified by the drawings or by these Specifications.

A. PLATES, SHEETS AND CONNECTORS: Conform to ASTM Designation A36 with specified yield point of 248 MPa (36,000 psi). From mild steel sheets or plates with standard thickness, size, shape and design as indicated in the plans. For miscellaneous stiffener, bearing anchorage and connector plates or straps. Upgrade to next higher / bigger size and thickness if specified sizes & thicknesses are unavailable.
B. STANDARD SOLID SECTION: Conform to ASTM A36 with specified yield point of 248 MPA (36000 psi). Mild steel angles, flat bars, square bars, channels, U and other sections. For structural steel trusses, purlins, building eaves framing, overhead anchorage of roll-up doors, grillworks, miscellaneous fabricated mounting brackets, straps, dowels, frames and connectors. Upgrade to next higher/bigger size and thickness if specified sizes and thickness are unavailable.
C. HIGH STRENGTH BOLTS, NUTS AND WASHERS: Conform bolts to the Specification for High Strength Bolts ASTM A 325, Type 1. See structural connection details for location of bearing-type and friction-type bolts.
D. ANCHOR BOLTS: A36.
E. WELDING ELECTRODES: Conform welding electrodes to AWS D1.1:2000 Structural Welding Code – Steel, E-60XX for structural welding.
F. GROUT: Conform non-shrink grout to ASTM C827. Grout shall be non-metallic. Use Non-shrink flowable cementitious grout. Apply using manufacturer's standards strictly.
G. STRUCTURAL STEEL PRIMER PAINT: Epoxy zinc chromate primer except as otherwise recommended by the manufacturer of the coating for all structural steel surfaces.
H. FIRE COVER: Cementitious Fireproofing System. Refer to Section 07251 Sprayed-On Fireproofing, whenever necessary.

5.02 05200: MISCELLANEOUS METALS

A. STANDARD SOLID SECTION: Conform to ASTM 611 with specified yield point of 228 Mpa (33,000 psi). Mild steel flat bars, square bars, overhead anchorage of roll-up doors, grill work, miscellaneous fabricated mounting brackets, straps, dowels, frames and connectors. Upgrade to next higher / bigger size and thickness if specified sizes & thickness are unavailable.
B. BRACING RODS: Standard structural grade steel rods with turnbuckles whenever required ex. for roof framing.
C. PAINTING: Use only approved brand of epoxy zinc chromate paint and linseed oil for all architectural steel components only. For field painting, use only approved brand of enamel paint.
D. ALUMINUM COMPOSITE PANEL (ACP) CLADDING:
Lightweight, rigid, bendable, composite aluminum; 3.0 mm thick.; front side – aluminum with advance fluorocarbon paint (PVDF),; core – nontoxic low density polyethelene (LDPE);

back side – aluminum coated with polyester; passing test for hardness (ASTM D-3363-74), flexibility (ASTM D-4145-83), adhesion (ASTM D-3359-87), abrasion (ASTM D-968-81), mortar resistance (AAMA 605, 2-91), detergent resistance ASTM D-2248-73), acid pollutants (ASTM D-1308-87; AAMA 605, 2-90), alkali resistance (ASTM D-1308-87), salt fog (ASTM B-117-85), humidity ASTM D-2247-87 D-714-87), color retention (ASTM D-2244-85, D-2244-89) and chalk resistance (ASTM D-659-86, D-4214-89). Install by manufacturer-approved installer with guarantee. Provide the necessary sealants to ensure water-tightness. Provide shop drawings for approval by the Architect before fabrication and installation. For exterior cover of solid walls, fascias, sun-shading devices, exterior parapets and other areas as shown in the plans.

E. STAINLESS STEEL: Pipes, tubes, square bars, and other sections. Manufactured and installed with guarantee. Provide shop drawings for approval by the Architect before fabrication/installation.
   1. Roof Gutter: 1.2 mm (gauge 18) thick, Stainless Steel Sheets, Type 304 bent to design shape. For all other gutters aside from RC gutters. To be approved by Architect before installation
   2. RC Precast Anchors: 10mm Stainless Steel Plain Bars
   3. Stair, ramp and corridor railings.
   4. Grab bars for toilets (where applicable).

   Note: Upgrade to next bigger size if specified standard sizes are unavailable.

F. GALVANIZED IRON:
   1. Yard Hose Bibbs: G.I. Pipes: schedule 40, painted with Epoxy Enamel Paint.
   2. Hangers: Gauge 10 G.I. wire hanger.
   3. Laundry Rods: Provide 6 laundry rods spaced 6 inches apart on the level of the balcony railing such that laundry is properly ventilated and concealed by railings.

G. BRASS NOSING: 3 mm thk. x 38 mm wide brass nosing for every stair tread and for every change in floor elevation, unless otherwise indicated or any approved equivalent by architect.

H. FASTENINGS: Commercial types, except where special types are shown or required. Fastenings for all exterior work shall be non-ferrous, unless otherwise shown. Fastening for stainless steel and aluminum and other interior work, where exposed shall match the fastened metal.

5.03 05310: STEEL DECK

A. CONCRETE FLOOR STEEL DECKING: Use 275.8 Mpa (Fy=40,000 psi) steel strength; 21 Mpa (Fc= 3,000 psi) concrete strength; effective coverage = 0.25 M; using manufacturer's specifications for thickness, reinforcements and method of construction. Use temporary proppings at 1.0 M on centers during pouring until fully cured. Installation by manufacturer and Architect approved installer with guarantee.

6.00 WOOD AND PLASTICS

6.01 06100: ROUGH CARPENTRY

Note: For K.D. Tanguile, plywood inner sides and for cut ends of Apitong joints, nailers, and framings, supplementary termite and rot treatment to be applied by Owner-approved termite and pest control company, with guarantee. Effect butt joint appearance for all T and cross intersections of exposed frames. When stronger joints are required, introduce half-laps, dowelling or mortise and tenon but still effect a simple butt joint at the exposed surface.

A. LUMBER:
   1. Yakal: generally for all plates, corbels, struts and other components of wood-based structures requiring wood which is strong, not resistant and/or capable of holding on firmly to driven nails or other connectors. For cabinet base wood blocks or as specifically called for in the drawings.

B. HARDWARE AND FASTENERS: use metal nails, screws, bolts, plates, straps, miscellaneous fasteners or anchorage concealed or countersunk whenever called for, with size, shape and type to ensure a rigid connection for laminated items and at cabinet framing joints.

6.02 06200: FINISH CARPENTRY (See 9.02 and 9.03 for all DRY WALL and CEILING Finishes)

Lumber:

A. GUIJO: quarter-sawn, sound and free from imperfections impairing its strength and finish. Kiln-dried (max. moisture content: 12%), with the same shade and color for assemblies or sets of assemblies, warp-free, treated, S4S and fine sanded lumber. For louver slats of doors and edgings, when required.

B. MEDIUM DENSITY FIBERBOARD (MDF): 19mm (3/4”). For free span shelves, and for miscellaneous components of cabinets, overhead cabinets and closet housing; for all doors and exposed and unexposed sides of closets and kitchen cabinets/overhead cabinets.

C. FIBER CEMENT BOARD: Use 4.5mm thick for ceiling boards and backing of mirrors; 6mm thick for wall boards; and 9mm thick for fascia boards; 1200 mm x 2400 mm. Install as per manufacturer’s instructions.

D. FIBER CEMENT SOFFIT: Wood-grain, 300mm wide x indicated length. Install and paint per manufacturer’s instructions. Fixings shall be rust-proof screws or nails. For all roof eaves or any approved soffit material by architect

E. PVC MOULDINGS AND TRIMS: For baseboards, use 86.3mm (3-3/4”) height, with Baseboard Molding. Provide baseboards for all walls (even if not designated in the plans), except for walls finished with tiles, stone and aluminum cladding.

H. HARDWARE AND FASTENERS: Use metal nails, screws, plates, straps, miscellaneous fasteners or anchorage; concealed or countersunk whenever called for, with size, shape and type to ensure a rigid connection for laminated items.

I. ASSEMBLY MATERIALS: Approved water-resistant glue, and nails, screws and bolts of appropriate type, shape and size for all types of joints.

J. TRADEMARK: Each separate lumber piece or assembly is required to bear an official mark of the millworks supplier.

7.00 THERMAL AND MOISTURE PROTECTION

7.01 07100: WATERPROOFING AND DAMPPROOFING

Apply with surface preparation, methods application and density as per manufacturer's specifications. To be installed only by authorized Applicator with guarantee.

A. WATERPROOFING COMPOUND: Applied as per manufacturer's specifications for all concrete sub-roofs, concrete gutters and suspended floor toilets.
B. FLUID APPLIED WATERPROOFING. Synthetic rubber, cold-vulcanized, liquid applied waterproofing membrane. Applied 1mm thick following manufacturer's specifications; for positive application on concrete gutter and plantboxes, with 3m8mm conc. topping, to be installed only by authorized Applicator or by the Architect's approved applicator.
C. SINGLE PLY WATERPROOFING MEMBRANE: Pre-formed, self-adhesive rubberized bitumen with cross-laminated PVC plastic facing, for suspended toilets.
D. EXPOSED TYPE LIQUID MEMBRANE WATERPROOFING: Single pack liquid rubber compound for concrete ledges.
E. ICE & WATER SHIELD or approved equal: Underlay Waterproofing Membrane – self-sealing and self-adhering rubberized membrane for all concrete deck roofs and canopies.
F. EPOXY SYSTEM WATERPROOFING: Fabric-reinforced, Hi-Built, food-grade, epoxy-based lining for slabs and walls of cistern.
G. DAMP-PROOFING: Vapor barrier, one layer at six mils (0.006) thick. For slabs on fill at the building interior. Provide 300 mm overlapping.
H. WATERSTOP: PVC, for all concrete joints wall and floor construction below grade.

7.02 07210: BUILDING AND ROOFING INSULATION

A. For inaccessible concrete roof deck of machine room and main stairways: Use extruded polystyrene board covered with 60mm concrete topping. Installation by Architect-approved manufacturer, with guarantee.
B. METAL ROOFING INSULATION: Thermal Barrier INSULATION. For all metal roofing, installed directly under C-purlins.
    1. Thermal Barrier INSULATION
    2. G.I. Strap Liner
    3. G.I. Tie Wire
    4. G.I. Screw

7.03 DRAINAGE SHEET AND FILTER

When necessary, use Drainage Sheets and Geotextile Filter to cover all underground exterior walls and slabs fastened Hilti DX 36M with 6.8/11 yellow cartridge case with DN 37 P 8 nail and washer or equivalent. Use stop pins, or Butyl on sheeting overlaps and DELTA-MS Profile or equivalent on top edge of sheeting; Installation by Architect-approved manufacturer with guarantee.

7.04 PROTECTION BOARD:

4.5mm (3/16") thick Fiber cement board for basement walls on positive applied membrane waterproofing to be applied by an Architect-approved installer and or supplier.

7.05 07610: ROOFING SYSTEM

A. Metal Sheet Roofing: Pre-painted long-span G.I. roofing sheets, White or any Architect-approved equal in color. For roofing as indicated in the plans.
    Base metal type: Cold rolled steel tempered to 275 Mpa (40,000 psi).

Thickness: 0.60 mm
Effective Coverage: 1030 mm
Anti-rust Coating: 55% Alum, 43.4% zinc & 1.6% silicon
Coating Standards: AZ 125 (125 gm/m2); ASTM A-792
Top Coat: 20 Microns Regular Polyester
Back Coat: 8 Microns Epoxy Primer

B. Ridge rolls, flashings, cappings, trims, mouldings and awnings: 0.60 mm thick base metal thickness, (215 g/m² zinc coating) pre-painted zinc coated from plain sheets, pre-formed with matching shape and fitting provisions for Metal Sheet Roofing.
C. Roof Gutters and Metal End Fascia at eaves and gable: 1.2 mm (Gauge 18) thick, Stainless Steel Sheets, Type 304 bent to design shape as shown in Plans.
D. Fasteners and Fixation: Use corrosion-resistant nails, anti-UV treated washer-caps, corrosion-resistant hook bolt connectors in areas as recommended by manufacturer and approved by Architect. Paint all exposed fixation and fastening devices with the same color as roof.
E. Concealed Clips: Concealed clips shall be designed to meet the wind uplift requirements. Clips will provide for thermal expansion and contraction and will not abrade the panel against the clips, substrate or fasteners. Clips shall be stainless steel or galvanized steel for steel applications.
F. Strainer: Use Brass Dome Strainers for gutters.
G. Salt Spray Test: A sample of the sheets shall withstand a salt spray test for a minimum of 1000 hours in accordance with ASTM B 117, including the scribe requirement in the test. Immediately, upon removal of the panel from the test, the coating shall receive a rating of 10, no blistering, as determined by ASTM D 714; and a rating of 7, 1/16-inch failure at scribe as determined by ASTM D 1654.

7.06 07251: SPRAYED ON FIREPROOFING:

CEMENTITIOUS FIREPROOFING SYSTEM conforming to UL 263/ ASTM E 119 to be applied to all structural steel, with fire rating of 2-hours for structural beams and girder, 3-hours for columns. Apply with surface preparation, method of application and density as per manufacturer's specifications. Installation by an Architect-approved manufacturer or supplier with guarantee. Same as Section 05100 Structural Steel Fire Cover.

7.07 07810: TRANSLUCENT PVC ROOFING (PLASTIC UNIT SKYLIGHT)

PVC Ribbed Roofing Sheets, 2.5 mm thick, Translucent for Skylights. To be installed by an Architect-approved manufacturer or supplier with guarantee.

7.08 07900: JOINT SEALANTS

A. Silicon Sealant: Use as a general purpose, neutral cure sealant. Contractor must guarantee watertightness of all joints even during strong winds. Use also as sealant for acoustic-treated walls in between classrooms.
B. Co-Polymer Clear Sealant: For roofs, awnings, roof flashings, skylights, gutters and downspouts.
C. Solvent-Based Synthetic Rubber Contact Type Adhesive: For bonding wood, plastic laminate, concrete, steel aluminum and hardwood, rubber and glass.

D. Acrylic Latex Gap Sealant: For use between windows or door frames and walls, along skirting boards, around cornices, between countertops and splashboard. In corner or between the wall and ceiling or where shrinkage or movement causes rigid fillers to crack.
E. Acid Cure Silicon: For use on non-porous surfaces such as glass, ceramics and porcelain.

8.00 DOORS AND WINDOWS

8.01 08100: METAL DOORS AND WINDOWS

A. METAL DOORS:
1. 08410: ALUMINUM DOORS: Use extruded aluminum 6063-T5 alloy for aluminum door frame sections. Use steel-strengthened aluminum; 44mm x 100mm x 2.388 mm thk. minimum dimensions or able to withstand a Design Wind Velocity of 250 km/h at project site. Complete with all components and hardware, glazing and all its accessories.
2. 08100: STEEL DOORS AND FRAMES, STEEL DOOR HEAD AND JAMBS:
a) STEEL JAMBS AND HEADER: 1.4mm (gauge 16) thick x 50mm x 100mm single rabbet and 1.4 mm (gauge 16) thick x 50mm x 150mm double rabbet; fabricated cold-rolled steel; epoxy paint finish.
b) STEEL DOOR TYPES: Use manufacturer's standard details.
1) Plain, full flush design, 44mm panel thickness, lightweight, minimum 1.0 mm (gauge 20) thick galvanized aluminum - high carbon steel sheet faces with honeycomb chemically treated core, lockformed edge. Complete with stainless steel flag-type hinges and locksets. Provide optional accessories when required.
3) For steel doors with glass: use 6mm thick wired glass on aluminum snap on frame and as shown in the plans.

B. WINDOWS: Provide and install all windows with complete locksets, hinges and accessories.

1. 08520: GLAZED ALUMINUM FIXED, CASEMENT AND AWNING WINDOWS: Use extruded aluminum 6063-T5 alloy for aluminum window frame sections. Use steel-strengthened aluminum for exterior windows, 44mm x 100mm x 2.388mm thk. minimum dimensions or able to withstand a Design Wind Velocity of 250 km/h at project site.
2. STORM RESISTANT FIXED ALUMINUM LOUVER: For clerestory level louvers, use extruded aluminum 6063-T5 alloy for aluminum louver frame sections and blades. Use steel-strengthened aluminum.
3. ALUMINUM JALOUSIE WINDOWS: Use extruded aluminum 6063-T5 alloy for aluminum window frame sections. Use approved flat 10mm THK float glass for window louvers.
3. STORM RESISTANT FIXED STEEL LOUVER: For louvers under skylight, use 1.4 mm (gauge 16) thick G.I. jamb, header and mid frames and 1.2mm (gauge 18) thick G.I. louver blades as per manufacturer's standards and details; powder coated finish (2.4 Mw).

8.02 08200: WOOD AND PVC DOORS

A. WOOD DOORS: All wood from stock, sound and free from imperfections impairing its strength and finish. Kiln-dried (max. moisture content: 12%), with the same shade and color for assemblies or sets of assemblies, warp free, S4S and fine sanded lumber.
   1. STEEL JAMBS AND HEADER: 1.4mm (gauge 16) thick x 50mm x 100mm single rabbet and 1.4mm (gauge 16) thick x 50mm x 150mm double rabbet; fabricated cold-rolled steel; epoxy paint finish.
   2. SOLID WOOD PANEL DOOR: Double-leaf swing, 44mm (1-3/4") thick. For main doors of all studio units.
   3. PVC SWING DOOR: Single-leaf, 44mm (1-3/4") thick. For toilet doors of all studio units, and other toilets, if any.

8.03 08700: FINISH HARDWARE

A. ALUMINUM DOOR AND WINDOW HARDWARE: Install all main entrance and studio unit glass doors and glazed aluminum windows, complete with all components and hardware. See Main Specifications For main entrance door handle: use Stainless Steel, 350 mm, or approved equal.
B. DOOR LOCKS AND LOCKSETS: U.S. original. Note: Provide 4 pcs Master Keys for all cylindrical locksets and deadbolt locking device.
   1. Cylindrical Locksets:
      a) Entrance Lock, (satin chromium finish), U.S. original, or approved equal. Turn-button locking in inside knob; requires use of key at all times until button is manually restored to unlock position.
      b) Privacy Lock, (satin chromium finish), U.S. original, or approved equal. Push button locking in inside knob. Can be opened from outside by screwdriver or similar tool or by turning inside knob.
   2. Deadbolts: Deadbolt Lock, (satin chromium finish), U.S. original, heavy duty, or approved equal. Deadbolt thrown or retracted by key from outside or by inside turn unit. Bolt automatically deadlocks when fully thrown.
C. HINGES:
   1. U.S. original, or approved equal: 88.5mm x 88.5 mm (3-1/2" x 3-1/2") plain bearing, stainless steel, loose pin or fixed pin, button tip, four (4) pieces per door panel for steel doors where specified.
   2. Gravity Pivot Hinge: U.S. original, Gravity Pivot Hinge, or approved equal. 2 pieces, plain bearing, for all toilets stall doors.
D. DOOR CLOSERS: Door Closers, or approved equal, 40 kg. max. door weight, satin chrome finish.
E. DOOR STOP / DOOR HOLDER: U.S. original, chrome finish, floor / wall mounting. Attached securely to floor/wall to prevent door knob from hitting the wall.
F. DOOR PULLS: 203mm x 408mm (8" x 16") Push Plate, 152mm x 405mm (6" x 16") Pull Plate, Stainless Steel. For doors requiring the hardware.
G. DOOR SILENCERS: Rubber, 3 sets per door, installed at jamb side. For all doors.
H. CABINET ACCESSORIES:
   1. Pulls: Chrome finish: For all cabinet, closets and drawers.
   2. Self Closing Hinges: For all cabinet and closet doors.

3. Drawer Runners: Use extended design mechanism where necessary. For all drawers.
4. Cabinet and Drawer Locks: Chrome finish. For all cabinet doors and drawers..

I. FLUSH BOLTS: U.S. original, chrome finish or approved equal. For all double-leaf doors. Install at top and bottom at reveal of all active leaf.
J. PADLOCK: U.S. Made, heavy duty, solid brass, general purpose padlock.
K. FIRE EXTINGUISHER CABINET LOCK: U.S. original, chrome finish for all fire extinguisher cabinets.

8.04 08800: GLAZING

A. CLEAR FLOAT GLASS: 6 mm (1/4inch) thick. Heat-Treated Float Glass: ASTM C 1048, Kind FT (fully tempered), Type 1 (transparent). Provide products of thickness indicated that have been tested for surface and edge compression according to ASTM C 1048 and for impact strength according to CPSC 16 CFR, Part 1201 for Category II materials. Complete with all components and hardware. For all exterior Aluminum Windows; must be able to withstand a Design Wind Velocity of 250 km/h at project site.
B. CLEAR FLOAT GLASS: 6 mm (1/4 inch) thick Heat-Treated Float Glass. For all interior aluminum fixed windows and aluminum doors.
C. CLEAR FLOAT GLASS: 3 mm (1/8 inch) thick. For all fire extinguisher cabinets.
D. MIRRORS: 6 mm (1/4") thick plate glass mirror, distortion-free with felt paper on 4.5 mm (1/2") thick FCB backing installed on satin-finish anodized aluminum frame. For all toilets.
E. BULK COMPOUND FOR GLASS INSTALLATIONS:
   1. Mastics – Elastic compounds and non-skinning compound.
   2. Putties – Wood sash putty, metal sash putty.
   3. Sealants – one component, two components.
F. PREFORMED SEALANTS:
   1. Synthetic Polymer – base sealants – resilient or non-resilient type.
   2. Pre-formed gaskets – compression type, structural type.
G. CAULKING: Silicon Building Sealant or approved equal. For all joint gaps between aluminum frames and concrete.
H. GLASS BLOCKS: 190mm x 190mm x 100mm clear and "waved" pattern. Provide at least 4 units in each toilet wall along the corridor. Position glass blocks to allow maximum natural light into the toilets. Color and design to be approved by the Architect.

9.00 FINISHES

9.01 09200: PLASTER

A. PLAIN CEMENT PLASTER FINISH: Consisting of the scratch and finish coats, both consisting of one (1) part Portland cement and two (2) parts of clean, washed sand, measured by volume. For all interior and exterior wall surfaces where plastering is essential to complete the work.
B. WOOD TROWEL FINISH: Provide score joints whenever required. For exterior and interior surfaces to be painted.
C. STEEL TROWEL FINISH: Provide score joints whenever required. For curbs, catch basins, septic tank.

D. SMOOTH RUBBED FINISH: For all exposed undersides of suspended floor RC slabs and beams and when required by the Architect. Use phenolic forms to attain smooth surface at exposed areas.
E. TOOLED JOINT FINISH: Surface preparation shall be plain cement plaster finish with tooled mortar joints. Joints shall be concave, clean, plumb and true to line. All joints shall be spaced as directed by the Architect.
F. BURLAP FINISH: Achieve consistent texture pattern through proper selection of burlap material and application of consistent pressure on surface. Provide 50mm plain concrete borders at all edges and at approximately every 1.00 m on center, for all exterior corridors, ramps, steps, and sidewalks.
G. PLASTERING GUIDE SYSTEM: Use for interior and exterior grooves, drip moulds, construction joints and surface wall plastering.

9.02 DRYWALL

A. GYPSUM WALL BOARDS: 12 mm thick x 1200 mm x 2400 mm gypsum board, standard type, tapered edge (T.E.) on 6 mm thick Fiber-Cement Boards (FCBs). Stagger lay-out from that of FCBs and seal all joints by using appropriate gypsum joining plaster and cotton tape as per manufacturer's instructions. Provide acoustic sealants at top of floor slab and bottom of slab/beam connections. For interior partitions between alternate walls of studio units.
B. FIBER-CEMENT BOARDS: 6 mm thick for wall boards and structural column/beam/girder enclosures; 1200 mm x 2400 mm. Install as per manufacturer's instructions. Fixings shall be rust proof screws or nails. Provide acoustic sealants at floor slab and top beam connections for acoustically treated walls. For partitions of minor rooms, such as storages.
C. LIGHT METAL FRAMES FOR WALL ASSEMBLIES: For all Drywalls. Use 35mm x 102 mm x 1.0mm (ga. 20) thick metal studs at 0.40 M on center and 35mm x 102mm x 1.0mm (ga.20) thick Metal tracks and noggings, knurling stiffeners, side assemblies, bullnoses, cornerbeads, utility holes and others to complete. Submit mock-up on site before installation.

9.03 CEILING BOARDS

A. OFF-THE-FORM SMOOTH RUBBED CEILING FINISH: For all studio units. Smooth surface for approval of Architect prior to painting.
B. FIBER CEMENT BOARD: 4.5mm thick x 1200 mm x 2400 mm, on Light Gauge Metal Frame. Install as per manufacturer's instructions. Fixings shall be rust-proof screws or nails. For all studio unit toilets and all other rooms aside from studio units.
C. METAL CEILING ASSEMBLY: Use 19mm x 50mm x 0.4 mm thick G.I. furring channel and 0.6 mm thick J-type-wall angle with 12mm x 38mm x 1.0 mm thick G.I. carrying channel, 6 mm diameter hanger rod, suspension clips, rod joiners, steel angles, furring clips, fastening devices and others to complete. Submit mock-up on site, with ceiling boards, before installation. For main ground floor common areas.

9.04 09300: TILES

A. VITRIFIED CERAMIC TILES: Use only Class A tiles (one brand from same batch throughout for each type/size):

1. 400mm x 400mm Floor Tiles – For corridors of 2nd to 3rd floors, all stairs treads and risers from lower ground to 3rd floor and all studio units from ground to 3rd floor. Use non-skid in color patterns approved by Architect.
2. 300mm x 300mm Floor Tiles – For all toilet floors. Use non-skid in color patterns approved by Architect.
3. 300mm x 300mm Wall Tiles – For all toilet walls. Use non-skid in color patterns approved by Architect.
4. Finish shall be clean, plumb and true to line. Avoid odd-size tiles. Serojos should be more than half the tile size. Provide one (1) box containing 20 pcs. of each tile type for Owner's stock upon Final Acceptance.

B. HOMOGENOUS GRANITE TILES: 600mm x 600mm x 6mm thick, for ground floor lobby, atrium and corridors only in colors assigned in particular areas by the Architect.
C. ADHESIVE, GROUT AND SEALANT: Grout and Sealant color coordinated as required
D. TILE TRIM: Use plastic tile trim to cover all exposed tile joints; color-coordinated as required.

9.05 09600: STONE

A. NATURAL BRICK WALL: Use only Class A, 50 mm x 50 mm x 2250 mm natural bricks, or of size as required by the Architect. Submit sample for approval. Fix stone to wall surface with non-rust anchors.

9.06 09900: PAINTING

Use one brand all throughout. All exposed finish hardware, lighting fixtures and accessories, plumbing fixtures and accessories, glass surfaces and the like shall be adequately protected against stains from paint and other painting materials prior to painting works. All other surfaces which would be endangered by stains or paint marks should be taped and covered with craft paper or equal.

A. EXTERIOR:
   1. ACRYTEX PLAIN FINISH; for all concrete/masonry surfaces, fascias and all exterior FCB fascias; for all front sides of concrete parapets, concrete ledges and projections. After waterproofing:

Surface Preparation: Masonry Neutralizer #44; Putty surface imperfections with Acrytex Cast # 1711; or approved equal
1st Coat: Acrytex Primer or approved equal
2nd and 3rd Coats: Acrytex Topcoat Semi-gloss Finish or approved equal.

2. SEMI-GLOSS LATEX, or approved equal; for underside of concrete ledges, exposed sides of retaining walls, concrete railing of ramps, stepped platform at front and all other minor surfaces unless otherwise specified.
   Surface Preparation: Masonry Neutralizer #44 or approved equal;
   1st Coat: Concrete Sealer #705 White or
   Latex #701 White or approved equal
   Putty minor cracks and surface imperfections with Patching Compound or approved equal.
   2nd and 3rd Coats: Semi-gloss Latex#715 or approved equal. Tint to get the required color with Latex Colors

B. INTERIOR:
1. ACRYTEX PLAIN FINISH or approved equal; for all interior concrete, masonry and FCB wall and column surfaces, from floor line to 2.40m height, of Lobbies and Corridors.
   Surface Preparation: Masonry Neutralizer #44 or approved equal; Putty surface imperpections with Acrytex Cast # 1711 or approved equal
   1st Coat: Acrytex Primer or approved equal
   2nd and 3rd Coats: Acrytex Topcoat Semi-gloss Finish or approved equal
2. SEMI-GLOSS LATEX #715 or approved equal. For all interior concrete, masonry and FCB upper wall and column surfaces above 2.40m in height up to bottom of slab, of Lobbies and Corridors. For wall areas of all other rooms; for walls above toilet tiles; for beams, girders, all ceilings including bottom of slabs and gypsum boards; for exposed walls at upper part of atrium; for maintenance offices, deck roofs and all other miscellaneous concrete areas unless otherwise specified.
   Surface Preparation: Masonry Neutralizer #44 or approved equal
   1st Coat: Concrete Sealer #705 White or
   Latex #701 White or approved equal. Putty minor cracks and surface imperfections with Patching Compound or approved equal.
   2nd and 3rd Coats: Semi-gloss Latex#715 or approved equal. Tint to get the required color with Latex Colors
   Note: Provide painted baseboards, latex or acrytex as required, 100mm wide, for all interior walls and stair walls without PVC baseboards, even if not indicated in the elevations/sections.
3. AUTOMOTIVE LACQUER #1300, or approved equal; for Steel Doors and Frames, and Steel Plate Supports. These shall be shop-applied.
   Surface Preparation: Lacquer Spot Putty # 306 or approved equal
   1st Coat: Lacquer Primer-Surfacer # 305 or approved equal

2nd Coat:	Lacquer Spot Putty # 306 or approved equal as required
3rd Coat:	Lacquer Primer-Surfacer # 305 or approved equal on puttied areas.
Top Coat:	Automotive Lacquer # 1300 or approved equal in required Coats

4. CLEAR DEAD FLAT LACQUER #1253, or approved equal; for all exposed interior wood surfaces and wood doors and jambs and where applicable:

Surface Preparation:	Wood Paste Filler #60 or Lacquer Wood Tite #61 or approved equal
1st Coat:	Lacquer Sanding Sealer #1254 or equal Oil Wood Stain Series #2700 or equal
2nd & 3rd Coats:	Clear Dead Flat Lacquer #1253 or equal
Solvent/Cleaner:	Lacquer Thinner or equal

5. FLATWALL ENAMEL #800 or approved equal; for minor unexposed wood surfaces, where applicable.

1st Coat:	#300 White Interior Primer & Sealer of Flatwall Enamel #800 or equal #311 White Glazing Putty or equal
2nd & 3rd Coats:	Flatwall Enamel #800 or equal
Thinner:	Paint Thinner or equal

C. METAL SURFACES:
1. EPOXY ENAMEL, or approved equal; for ferrous surfaces such as all structural steel surfaces, steel grille, steel louvers, steel and roof framing and other exposed steel surfaces unless otherwise specified.

Surface Preparation:	Masonry Neutralizer #44 or equal
1st Coat:	Epoxy Red Lead Primer #2270 or Zinc Chromate Primer #2260 or equal
2nd and 3rd Coats:	Epoxy Enamel or equal. Tint to get the required color.
Thinner:	Epoxy Reducer or equal

10.00 SPECIALTIES

10.01 10400: IDENTIFYING DEVICES

A. STAINLESS STEEL SIGNAGE: Type 304, built-up, 3 mm (1/8") thick front plate and 1.0 mm (gauge 20) thick side plates, 25 mm average stroke. Size of anchorage dowels shall be as required for the fixation of masonry surface. For main building identification lettering at facade, to be approved by Architec.
B. ROOM NUMBERS: Acrylic letters with borders and background. Fabricated from plastic materials with standard size and dimensions. Colors, design and size to be approved by Architect.

C. FIRE EXIT SIGNS: White acrylic letters and green acrylic background; 2 Hours duration; complete with 1 X 8 W Fluorescent lamp and Sealed Maintenance-Free Nickel Cadmium Battery. For all fire exit doors.

10.02 10800: TOILET ACCESSORIES.

A. TOILET PAPER HOLDER: Vitreous china, one (1) beside every water closet in private toilets, white color.
B. SOAP HOLDER: Vitreous china, white color, one (1) set for each lavatory in private toilets.
D. LIQUID SOAP DISPENSER: Piston and spout-type soap dispenser. One (1) set for each public toilet .
F. STAINLESS STEEL GRAB RAIL: 38 mm (1-1/2") diameter, at toilets for the disabled.
G. MIRRORS: 6 mm (1/4") thick plate glass mirror, distortion-free with felt paper on 12 mm (1/2") thick Weatherproof Marine Plywood backing installed on satin-finish anodized aluminum frame. For public toilets, 1000m ht x width of lavatory counter; for all private toilets, provide size 1000mm ht. x 400mm wdth.

11.00 EQUIPMENT

11.01 PUMPING EQUIPMENT:

Refer to the Plumbing (P) and Fire Protection Plans.

15.00 MECHANICAL / SANITARY

15.01 15400: PLUMBING SYSTEMS

A. PIPES AND FITTINGS:
   1. COLD AND HOT WATER LINES: Main risers and branches; Polypropylene Pipe, made in Italy, Turkey or Germany.
   2. SEWER AND WASTE PIPES:
      a) Main Lines and Stacks: CAST IRON PIPES.
      b) Branches Only: POLYVINYL CHLORIDE PIPES AND FITTINGS Equivalent to ASTM D-2729. Rigid (uPVC) pipe and drainage pattern fittings or approved equal conforming to ASTM D2564.
      c) Vent Pipes: POLYVINYL CHLORIDE PIPES AND FITTINGS Equivalent to Series 1000, Class 35.
   3. STORM DRAINAGE SYSTEMS:
      a) Downspouts: POLYVINYL CHLORIDE PIPES AND FITTINGS Equivalent to Series 1000, Class 35.
      b) Storm Drainage: CONCRETE PIPES: Sizes as required, conforming to Class IV.1, reinforced for 300 mm Φ and larger.
   4. AIR-CON DRAIN: POLYVINYL CHLORIDE PIPES AND FITTINGS, Equivalent to Series 1000, Class 35, with Elastomeric Closed Cell Insulation.

B. VALVES:

1. Valves: ASTM B-61 & 62, ASTM A-197, U.S. made. For gate valves and check valves, cast brass, sizes as required in the drawings.
2. Gate valves and check valves for hydropneumatic pumps piping shall be tested at 150 psi for a period of 2 hours. As required for rehabilitation of existing pump.
3. Rubber Seated Check valves for hydropneumatic pumps, use swing check valve. As required for rehab of existing pump.

Size	2" diameter
Fits Flanges	
Pressure Class	150 ANSI
Pressure Ratings	275 psi
Temperature Range	Resilient vitron rubber seat 446 degrees F
Fluid	Water
Standard Materials	Valve Body -- Cast Iron ASTM A-48
	Valve Trim -- Stainless Steel ASTM 304

C. INDIVIDUAL WATER METERS: Provide Owner-approved individual water meter for each studio unit. Locate at designated utility cabinet or at meter center per floor.

D. TRAPS AND CLEANOUTS:
1. Cleanout plugs for PVC pipes shall be cast brass ferrule with countersunk tap screw cover.
2. Underground traps except P-traps on floor drains shall be provided with removable cleanouts. Cleanout and cleanout access cover for cast iron pipes as indicated below:

APPLICATION	TYPE	PRODUCT NO.
Concealed Drainage Lines	Horizontal Cleanouts with Access Covers	Z-1440-5
Exposed Drainage Lines	Horizontal and Vertical Cleanouts	Z-1440
Finished Floor Area	Floor Level Access Cleanouts Tile Floors	Z-1425-6 Z-1400-10
Finished Walls	With Round Plate Access Covers	Z-1440-1

E. DRAINS: ASA, METMA, as indicated or approved equal.
1. Roof Gutter - M-319-16, ASA or equal
2. Floor/Shower - M-210, ASA or equal
3. Deck - M-319-36, ASA or equal
4. Canopy - M-319-34, ASA or equal
5. Trench Drain - M-319-34, ASA or equal
6. Cleanout - M-240, ASA or equal

F. FAUCETS: See Section 15450 Plumbing Fixtures.

G. HOSE BIBBS:
1. Hose Bibbs: Chrome plated faucet for toilets and shall be size 20 mm hose thread connection, and for other faucet with bronze body as indicated in the plans shall be brass, made of male inlet threads, hexagon shoulder and three quarter inch hose connections.

H. PIPE SLEEVES:
1. Wrought iron or steel pipe schedule 40 for sleeves in walls and partitions.
2. Steel pipe schedule 40 for sleeves in concrete beams or concrete fireproofing.
3. Galvanized steel pipe schedule 40 for sleeves through floors.
4. Steel pipe sleeves in footings shall be not less than four inches larger in diameter than the pipe to be installed.

I. CATCH BASINS/JUNCTION BOXES: 140 kg/cm^2 RC with C.I. grating cover M-452 E. In-site and pre-cast reinforced slabs, with concrete hollow block walls, details as shown in the drawings. For drain terminals discharge, and generally at all intersecting points of pipes.
J. OVERFLOW DRAIN: 50 mm dia. G.I. pipe with polished brass hub adaptor or approved equal.
K. JOINTING:
Flanged Joint Gasket – GARLOCK or equal
Screwed Joints – U.S. Federal Specifications GG-P-251
PVC Pipes and Fittings – PVC cement or as per Manufacturer's recommendations.
Dissimilar Pipes – Adopter fittings shall be used.
Concrete Drain Pipe – Cement mortar
L. HYDRO-PNEUMATIC WATER TANK
M. STAINLESS STEEL ELEVATED WATER TANKS:
N. DUPLEX TYPE CENTRIFUGAL END SUCTION PNEUMATIC PUMPS:

15.02 15450: PLUMBING FIXTURES

Note: Verify roughing in dimensions and installation procedures from manufacturer before proceeding with final set of pipe inlets and mounting hardware.

PLUMBING FIXTURES: All plumbing fixtures and accessories with approval from the Architect.

A. WATER CLOSET: Institutional Model. Flush valve low consumption 6 lpf round front water closet, innoglaze finish, with seat and cover, for all toilets. Use Flush Valve, supply pipe assembly and all other fittings to complete. One (1) set for each toilet stall. White color.
B. WALL-HUNG LAVATORY: Wall-Hung Lavatory innoglaze finish, white color. Use Single Lever Ceramic Disc Faucet, chrome, with angle valve, steel braided flexible hose, strainer, P-trap, and all other fittings to complete. For all private toilets.
C. KITCHEN SINK: Stainless Steel, single drain bowl, with overall size of 560mm x 635mm (22" x 25"), for all kitchenettes or approved equal. Provide chrome finish single lever kitchen faucet with P-trap, angle valves, strainers and all other fittings, or approved equal to complete.
D. FLOOR DRAINS: Stainless Steel, 100mm x 100mm (4" x 4"). For all floor drains and slop sinks.

16.00 ELECTRICAL

16.01 16100: BASIC ELECTRICAL MATERIALS AND METHODS:

A. WIRES AND CABLES: No conductor shall be less than 3.5 mm^2 in size unless otherwise specified.
B. CONDUITS: As indicated in the Electrical (E) Plans.
1. Non-Metallic Conduit (PVC): smooth wall non-metallic conduit conforming to Philippine National Standards No. 14 for PVC Pipes. Conduit shall be in standard length of 3.05 meters including coupling
C. OUTLET BOXES AND FITTINGS:

1. Convenience Outlets: Cream color, 220V, with amperage as required. For general building interior use.
2. Weatherproof Outlets: Double device plate with cover receptacle, heavy duty. For outlets inside pump room and other exterior-located outlets, as indicated in the plans.
3. Boxes: Metal utility boxes Ga. 16, sizes and shapes as required.

D. INDIVIDUAL ELECTRIC METERS: Provide Owner-approved individual electric meter for each studio unit. Locate at designated utility cabinet or at meter center per floor.

E. SWITCHES, PANELBOARDS AND CIRCUIT BREAKERS:
1. Switches: With amperage as required. Suited to location and intended purpose. Approved type by architect.
2. Circuit Breakers: GA 16 bolt-on type, pre-painted, surface mounted, with latch lock.
3. Magnetic Starter: With casing, surface mounted with latch lock.
4. Metal Enclosures and Cabinets: FUJI-HAYA, ALLIED, MACROPOWER or approved equal.
5. Emergency: ATS – 1200A, 3P, Breaker Type, 240V, High Interrupting; EMDP – Main 1200AT – use Fixed Type.

F. HANGERS AND SUPPORTS:
1. For all suspended conduits: Angle bars with 12mm dia. hangers at 1-m intervals. Prime and finish-painted.. Joints of conduits on a staggered position. Submit shop drawings for approval.

16.02 16410: ELECTRICAL SERVICE SYSTEM

A. TRANSFORMERS, TRANSFORMER CABLES AND POSTS:
Provide as needed and/or as recommended by the local electrical cooperative. All components shall be provided by the local electrical cooperative upon representation and full payment by the Contractor.

16.03 16420: ELECTRICAL DISTRIBUTION SYSTEM

A. LIGHTING FIXTURES AND ACCESSORIES: Samples of lighting fixtures, complete with lamps and accessories, shall be submitted for approval by the Architect and University prior to fabrication and purchase.
1. LED FLUORESCENT LUMINAIRES: Consider using 1x1200mm surface mounted or recessed fixtures, for 18W LED lamps.
2. LED DOWNLIGHTS:
   a) Consider using 75mm diam x L230mm recessed downlight. Housing made of aluminum alloy material, electrostatic coating, compact design. Warm white or neutral white color temperature. Use equivalent fixtures for 18.5W and 23W.
   b) For mood lighting (where applicable): Consider using single lamp 160mm diam x L221mm or 210mm diam x L245mm ceiling or pendant mounted, complete with 15.5W-31W single lamp, or approved equal. Pure white or warm white color temperature.
3. LED WALL SCONCES AND/OR COLUMN LIGHTS:
   a) For columns at atrium: consider using glass and stainless steel wall luminaries, general diffusing. Submit sample for approval by the Architect.
4. LED FLOOD LIGHTS AND/OR HIGH BAY LIGHTS::

a) Where required: consider using floodlight fixture. Body and frame finished in a special optical design giving high performance light control.

5. LED SPOTLIGHTS:
   a) For accent lighting as directed by the Architect. Housing made of aluminum alloy. Concise tube-type appearance. With wide angle adjustment for horizontal and vertical. Submit sample for approval by the Architect.
6. LED STRIP LIGHTS: Rope Light, inserted into recess in concrete surface,
7. EMERGENCY LIGHTS: consider using twin Lamp Self-Contained Emergency Lighting Luminaire with 2 x 6 Watt Incandescent Lamps and Sealed Maintenance-Free Lead Acid Battery.
8. EXIT LIGHTS/SIGNS – EXIT SIGN, complete with 8W Lamp and Ni-Cad Battery for 2 hrs. duration

B. LAMPS AND ACCESSORIES:
   1. LED Tube Lights : 18W T8 or 14-18W T10 Tube Light
   2. LED Down Lights : 18.5-23W
   3. LED Spot Lights : 20W

Note: Luminaires of other brands as approved by the Architect and the University are acceptable. Lamps and electronic ballasts as approved by Architect, are acceptable. Submit sample for approval prior to purchase.

E. CCTV (CLOSED CIRCUIT TV), CATV
F. GROUNDING & LIGHTNING PROTECTION SYSTEM.

Note: All reference to any particular brand, material, equipment, or systems in the specifications, drawings, and bid documents is indicative of the type and quality of what is required. However, any equal material or equipment or system can be used if approved by the University.

END OF SECTION 01020

Read and accepted as part of the Contract:

Bidder / Contractor

SECTION 01200
SHOP DRAWINGS

1.00 DETAIL DRAWINGS AND INSTRUCTIONS

1.01 SUPPLEMENTARY DRAWINGS AND INSTRUCTIONS

The drawings referred to in these Specifications may be further supplemented by additional detail drawings and instructions essential to the proper interpretation of the Drawings and the proper execution of the work. The Design-Build Contractor shall furnish with reasonable promptness such additional detail Drawings and Instructions. All such additional detail drawings and instructions shall be consistent with the Contract Documents, true developments thereof, and reasonably inferable therefrom. All such additional drawings and instructions are to be considered of equal force as those which originally accompany the Specifications. The work shall be executed in conformity with such detail drawings and instructions, and the Contractor shall do no work without proper drawings and instructions.

1.02 SCHEDULE FOR SUBMISSION OF DETAIL AND SHOP DRAWINGS

The Design-Build Contractor with the Architect-Engineers shall prepare a schedule fixing the dates at which the various detail drawings will be required, and the Design-Build Contractor shall furnish them in accordance with that schedule. Under like conditions, a schedule shall be prepared, fixing the dates for submission of the shop drawings and manufacturers' fabrication and site installation requirements , in preparation for the manufacture and installation of materials and for the completion of the various parts of the work.

2.00 SHOP DRAWINGS

2.01 CONDITIONS IN THE PREPARATION OF SHOP DRAWINGS AND SCHEDULES

The Contractor shall prepare at his own expense and submit with such promptness as to cause no delay in his own work or in that of any other contractor doing work on the same building, two (2) copies of all shop or setting drawings, templates, patterns and models, as well as schedule required for the work of various trades. The Architect-Engineer of record and the Owner's representative shall review them with reasonable promptness, making desired corrections. The Contractor shall make any corrections required by the Owner's representative, file with him two (2) corrected copies and furnish such other copies as may be needed. Electronic format copies (PDF and CAD formats) shall be made available to facilitate drawings and schedule review.

2.02 CHECKING DRAWINGS OF SUB-CONTRACTORS

Before submitting shop drawings for approval, the Contractor shall check drawings of all sub-Contractors for accuracy. He shall see that all work contiguous with and having bearing on work indicated on shop drawings is accurately and distinctly illustrated and that work shown is in conformity with Contract requirements. A stamp and signature reflecting conformance with project requirements shall be placed on all copies of the shop drawings and schedule prior to submission to the Architect-Engineers of record and the Owner's representative.

2.03 IDENTIFICATION

Shop drawings shall be numbered consecutively and represent:

A. Division and section number referenced in the specifications.
B. Unique submittal identification number to facilitate document tracking and record-keeping
C. All working and erection dimensions.
B. Arrangements and sectional views.
C. Necessary details, including complete information for making connections with other work, kinds of materials and finishes.

Shop drawings shall be dated and contain (a) name of project (b) descriptive names of equipment, materials and classified item numbers, (c) location at which materials or equipment are to installed in work.

2.04 LETTER OF TRANSMITTAL

Submission of Shop Drawings shall be accompanied by a Letter of Transmittal in duplicate, containing name of project, Contractor's name, number of drawings, titles, and other pertinent data.

2.05 CORRECTIONS, CHANGES AND VARIATIONS

The Contractor shall submit three (3) sets of prints of shop drawings to the Architect-Engineers of record.. Satisfactory shop drawings will be so identified by the Architect-Engineers of record, dated, and one copy thereof shall be returned to the Contractor and one copy shall be submitted to the Owner's representative. Should shop drawings be disapproved by the Architect-Engineers of record, one set of such drawings will be returned to the Contractor with necessary corrections and changes to be made as indicated. The Owner's representative shall receive electronic copies only of the submittals.

A. The Contractor shall make required corrections and changes and re-submit shop drawings, in duplicate until the Architect's or Engineer's approval is obtained.
B. Upon receipt of approval, the Contractor shall insert date of approval on tracings and promptly furnish the Architect with three additional prints of approved drawings.
C. No work called for by shop drawings shall be executed until the Architect-Engineer's approval is given, and the Owner's representative reviews the final approved submittal and concurs.

D. If shop drawings show variations from Contract requirements because of standard shop practice or other reasons, the Contractor shall make mention of such variations in his letter of submittal.

2.06 RESPONSIBILITY FOR ACCURACY

Approval of shop drawings will be general. It shall not relieve the Contractor of the responsibility for accuracy of such drawings, nor for proper fitting and construction of work, nor for furnishing of materials or work required by the Contractor and not indicated on shop drawings. The Architect's, Engineer's and Owner representative's approval of such drawings or schedule shall not relieve the Contractor from responsibility for deviations from Drawings or Specifications, unless he has in writing, called attention to such deviation at the time of submission and secured written approval, nor shall it relieve him from responsibility for errors of any sort in shop drawings or schedules.

END OF SECTION 01200

Read and accepted as part of the Contract:

_____
Bidder/Contractor

SECTION 01230
ALTERNATES

1.00 GENERAL REQUIREMENTS

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.03 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.

2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to fully incorporate the alternate into the Work. No other adjustments are made to the Contract Sum.

B. Alternate: See Supplementary General Conditions.

1.04 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate any miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not items are indicated as such in description of each alternate.

2. Provide cost breakdown of each alternate according to CSI specification section.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

2.0 – PRODUCTS (Not Used)

3.00 - EXECUTION

3.01 SCHEDULE OF ALTERNATES

A. Alternate No. 1 – Site: Planting on Roof Deck

1. Add alternate: In lieu of planting shown on floor plans but not included in this contract, refer to specification section 02930 Exterior Plants.

B. Alternate No. 2 – Glassware Washer equipment

1. Add alternate Item: Section 11537, In lieu of owner furnisher and installed equipment, provide Glassware washer and dryer equipment (Equipment identified by Tags GW-1 and GW-2) to be furnished and installed by Contractor.
2. Locations: Five units, one pair on each laboratory floor, (5) GW-1, (5) GW-2

C. Alternate No. 3 – Steam Sterilizers, Steam Generators (Autoclaves).

1. Add Alternate: Section 11538, In lieu of providing one 150kw (ST-2a) steam generator and one blow down tank (ST-2b) for two medium sterilizers, provide one 75kw steam generator and one blow down tank for each sterilizer.
2. Location: Six single-door locations BSL-2 (one unit each floor), two small double door autoclaves in BSL-3, 1 medium double door autoclave in ABSL-2, two small double door autoclaves in ABSL-3. Five of the units shall require bioselas.
3. See Specification Section 11538 – Steam Sterilizers for basis of design equipment.

D. Alternate No. 4 Class III Glove Box

1. Add Alternate: Section 11535, In lieu of Glove Box being Owner Furnished Contractor Installed. (Equipment identified by Tag BSC-12-CLIII) the Biosafety Level 3, Class III, Glove Box shall be Contractor Furnished Contractor Installed.
2. Location: one BSC-12-CLIII to be located on the 11th or 12th floor.

E. Alternate No. 5 – Effluent Decontamination System (local)

1. Add Alternate: Section 15400- Chemical Waste Systems for Laboratory Facilities,

F. Alternate No. 6 –High Density File Storage.

1. Add Alternate: Section 10675, Provide high density storage units labeled as HDS-1 and HDS-3.

G. Alternate No. 7 – 2000 Kw Generator sets

1. Add Alternate: Provide (2) 2000 Kw gensets in lieu of the specified 1750 Kw. Refer to specification section 16231.
   a. Two (2) 3000 amp generator output breakers will be 4000 amp frames set at 3200 amps each.
   b. Two (2) associated service entrance circuit breakers will be 4000 amp in lieu of 3000 amps in plan.
   c. This alternate will include (1) additional parallel run of conductors installed in the spare conduit shown in each generator ductbank section.

H. Alternate No. 8 – Preferred Distributed Digital Control and Building Automation System Manufacturer (BAS).

1. Preferred Alternate 11: Section 15950. In the event that Siemens is chosen by the subcontractor responsible for the BAS as the manufacturer for Laboratory Airflow Controls, and a BAS manufacturer other than Siemens is chosen by the same sub-contractor, then Alternate #11 shall State the amount to be added to the Base Bid Contract to provide a BAS as manufactured by Siemens Building Technologies, Inc. as described in the plans and specifications. In addition, complete the laboratory airflow control system information and list the base bid manufacturers on the Form of Proposal.

I. Alternate No. 9 – Standby Power Generator for Auditorium and Meeting rooms

1. The addition of standby power generators for the Auditorium and Meeting rooms will provide NIH and UP Manila with an emergency event staging

location. Emergency power will be required by code for life safety devices such as fire alarms, motorized fire-separation doors and emergency lighting. Standby power will support building security systems, fume hoods, the ventilation of BSL-3 areas, and the vivarium. This add alternate will also extend reliable electrical service to amenity spaces that can be rented out.

J Alternate No. 10 – Controlled Environment Rooms

1. The addition of 6 cold rooms 3500mm wide x 8000 mm long x 3000 mm high as described in Division 13. Steel panels with insulation on walls, ceiling and floor. Floor to be in depressed slab. Units to be water cooled with 100 mm thick walls, floors and ceilings.

3.02 SCHEDULE OF MECHANICAL LCCB ALTERNATES

A. Equipment will be awarded based upon Life Cycle Cost Bid analysis (LCCB).

B. For each system (Chiller, Cooling Tower, Boiler) and each manufacturer: State the amount to be added to the Base Bid Contract to provide the equipment as scheduled, as manufactured by the named company. In addition, complete the equipment information data sheet for each manufacturer and submit with the bid tabulation form.

C. Alternate No. 12A, 12B and 12C – Chillers

1. Alternate Bid No. 12A – Carrier Chiller (R-134a): State the amount to be added to the Base Bid Contract to provide in lieu of chiller indicated elsewhere a 900 ton centrifugal chiller manufactured by Carrier using R-134a as the refrigerant and as described in the plans and specifications. In addition, complete the chiller information data sheet on the above referenced chiller and submit with the bid tabulation form.

2. Alternate Bid No. 12B - Trane Chiller (R-123): State the amount to be added the Base Bid Contract to provide in lieu of chiller indicated elsewhere a 900 ton centrifugal chiller manufactured by Trane Corporation using R-134a as the refrigerant and as described in the plans and specifications. In addition, complete the chiller information data sheet on the above referenced chiller and submit with the bid tabulation form.

3. Alternate Bid No. 12C - York Chiller (R-134a): State the amount to be added the Base Bid Contract to provide in lieu of chiller indicated elsewhere a 900 ton centrifugal chiller manufactured by York using R-134a as the refrigerant and as described in the plans and specifications. In addition, complete the chiller information data sheet on the above referenced chiller and submit with the bid tabulation form.

D. Alternate Bid No. 13A, 13B, and 13C - Cooling Towers.

1. Alternate Bid No. 13A – BAC Cooling Tower:State the amount to be added to the Base Bid Contract to provide in lieu of cooling tower indicated elsewhere a cooling tower manufactured by the BAC Cooling Tower Company and as described in the plans and specifications. In addition, complete the cooling tower information data sheet on the above referenced cooling tower and submit with the bid tabulation form.

2. Alternate Bid No. 13B – Evapco Cooling Tower: State the amount to be added to the Base Bid Contract to provide in lieu of cooling tower indicated elsewhere a cooling tower manufactured by the Evapco Cooling Tower company and as described in the plans and specifications. In addition, complete the cooling tower information data sheet on the above referenced cooling tower and submit with the bid tabulation form.

3. Alternate Bid No. 13C – Marley Cooling Tower: State the amount to be added to the Base Bid Contract to provide in lieu of cooling tower indicated elsewhere a cooling tower manufactured by the Marley Cooling Tower Company and as described in the plans and specifications. In addition, complete the cooling tower information data sheet on the above referenced cooling tower and submit with the bid tabulation form.

E. Alternate Bid No. 14A, 14B, and 14C – Boilers.

1. Alternate Bid No. 14A : State the amount to be added to the Base Bid Contract to provide a Boiler manufactured by a manufacturer as described in the plans and specifications. In addition, complete the Boiler information data sheet and submit with the bid tabulation form.

2. Alternate Bid No. 14B: State the amount to be added to the Base Bid Contract to provide a Boiler manufactured by a second manufacturer as described in the plans and specifications. In addition, complete the Boiler information data sheet and submit with the bid tabulation form.

3. Alternate Bid No. 14C: State the amount to be added to the Base Bid Contract to provide a Boiler manufactured by a third manufacturer as described in the plans and specifications. In addition, complete the Boiler information data sheet and submit with the bid tabulation form.

END OF SECTION 01230

Read and accepted as part of the Contract:

_____
Bidder/Contractor

Read and accepted as part of the Contract:

Bidder/Contractor

SECTION 01250
CONTRACT MODIFICATION PROCEDURES

1.00 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications as per the General Conditions and Philippine Bid Documents (PBD).

B. This section does NOT apply during Bid Preparation – prior to contract award.

C. Related Sections include the following:

1. PBD "Unit Prices" for administrative requirements for using unit prices.
2. PBD "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.03 MINOR CHANGES IN THE WORK

A. The Owner's representative will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions." Minor changes are described in Article 21 of the General Conditions.

1.04 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
2. Within 20 days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
c. Include costs of labor and supervision directly attributable to the change.
d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in PBD Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

C. Proposal Request Form: Use Philippine government document for Proposal Requests after the Contract is awarded.

1.05 CHANGE ORDER PROCEDURES

A. Upon Owner's approval of a Proposal Request, Architect-Engineer of record will issue a Change Order for signatures of Owner and Contractor on the Philippine government Standard Form.

1.06 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: The Owner’s representative may issue a Construction Change Directive upon Owner’s approval on Philippine government Office Standard Form.

Read and accepted as part of the Contract:

_____
Bidder/Contractor

Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
   1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

2.00 - PRODUCTS (Not Used)

3.00 - EXECUTION (Not Used)

END OF SECTION 01250

Read and accepted as part of the Contract:

_____
Bidder/Contractor

SECTION 01290
PAYMENT PROCEDURES

1.00 GENERAL REQUIREMENTS

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:
   1. Contractor's requests for payments as per requirements of the Contract and Philippine Bid Documents

B. Related Sections include the following:
   1. Division 1 Section "Unit Prices" for administrative requirements governing use of unit prices.

1.03 DEFINITIONS

A. Schedule of Values: See Philippine Bid Documents.

1.04 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule as per _____of the Philippine Bid Documents.

   1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
      a. Application for Payment forms with continuation sheets.
      b. Contractor's Construction Schedule.
      c. List of subcontractor's suppliers and fabricators.

   2. Prepare and submit the Schedule of Values to Architect within fifteen (15) consecutive calendar days from Notice to Proceed for all lump sum items. No payment will be made to Contractor until the Schedule of Values has been approved by the Owner's representative.

A. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following on the Schedule of Values:
   a. Title of Project and Location.
   b. Name and Address of Architect.
   c. Architect's Project Number.
   d. Name and Address of Contractor.
   e. Date of Submittal.

2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:

   a. Generic Name.
   b. Related Specification Section or Division.
   c. Description of the Work.
   d. Name of subcontractor.
   e. Name of manufacturer or fabricator.
   f. Name of supplier.
   g. Change Orders (numbers) that affect the Philippines peso value.
   h. Philippine peso value.
   i. Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Break principal subcontract amounts down into several line items.

4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

5. For each part of Work where an Application for Payment may include Stored Materials, provide separate line items on Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of Work. An Affidavit and Undertaking of Stored Materials form must be included with each application for payment that includes Stored Materials.

6. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

   a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in

the Schedule of Values or distributed as general overhead expense, at Contractor's option.

7. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders result in a change in the Contract Sum.

1.05 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by the Architect-Engineer of record and Owner's representative, and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Forms: Philippine government standard form and Continuation Sheets.

D. Application Preparation: Complete every entry on required forms. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
2. Include amounts of Change Orders issued before last day of construction period covered by application.
3. Stored materials shall be listed in strict accordance with ____ of the PBD General Conditions.

E. Transmittal: Submit five (5) signed and notarized original copies of each Application for Payment to the Owner's representative by a method ensuring receipt within 24 hours.

F. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors, suppliers and fabricators.
2. Approved Schedule of Values.
3. Contractor's Construction Schedule (preliminary if not final).
4. Schedule of Principal Products.

G. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
   1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
   2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

H. Final Payment Application: Administrative actions and submittals which must precede or coincide with submittal of final payment Application for Payment include following:
   1. Completion of Project closeout requirements.
   2. Completion of items specified for completion after Substantial Completion.
   3. Assurance that unsettled claims will be settled.
   4. Assurance that Work not complete and accepted will be completed without undue delay.
   5. Transmittal of required Project construction records to Owner.
   6. Removal of temporary facilities and services.
   7. Removal of surplus materials, rubbish and similar elements.
   8. Change of door locks to Owner's access.
   9. Contractor's Affidavit of Payment of Debts and Claims.
   10. Contractor's Affidavit of Release of Liens.
   11. Consent of Surety to Final Payment.

2.00 - PRODUCTS (Not Used)

3.00 - EXECUTION (Not Used)

END OF SECTION 01290

SECTION 01300
FIELD ENGINEERING

1.00 GENERAL

1.01 SERVICES OF LICENSED SURVEYOR

The Contractor shall pay for the services of a licensed Surveyor to confirm and certify the location of column centers, piers, walls, pits, trenches, pipe work, culvert work, utility lines and work of similar nature required by the Contract.

A. The Contractor shall furnish certification from a licensed Surveyor that all portions of work are located in accordance with Contract requirements and at elevations required thereby.

B. The Surveyor shall promptly verify and certify to lines and levels of any portion or subdivision of work at any time it may be deemed necessary by the Owner's representative. Any deviation from the Drawings shall be certified to the Owner's representative within 24 hours of discovery of same.

1.02 SURVEYOR REQUISITES

The Surveyor selected for the purpose of undertaking the work involved in this project shall be subject to the Owner's representative's approval. He shall not be a regular employee of the Contractor, nor shall he have any interest in the Contract. He shall be employed by the Contractor in laying out the work, it being intended that the Surveyor shall present an independent and disinterested verification of the project's layout.

1.03 CERTIFICATION BY SURVEYOR

A final certification shall be submitted upon completion of work, or upon completion of each major segment of the work, or as required by the Owner's representative, and before final certificate, and there shall be included a map, plot, note or the like necessary in the opinion of the Owner's representative to constitute a full and complete report.

END OF SECTION 01300

Read and accepted as part of the Contract:

Bidder/Contractor

SECTION 01310
PROJECT MANAGEMENT AND COORDINATION

1.0 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

B. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. Coordination Drawings.

2. Administrative and supervisory personnel.

3. Project meetings.

4. Requests for Information (RFIs) as per _____ of the General Conditions.

C. Related Sections include the following:

1. Division 1 Section "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.

2. Division 1 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.03 DEFINITIONS

A. RFI: See ___ in the General Conditions.

1.04 COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Startup and adjustment of systems.
8. Project closeout activities.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1.05 SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
b. Indicate required installation sequences.
c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension

changes and difficult installations will not be considered changes to the Contract.

2. Sheet Size: At least 8-1/2 by 11 inches but no larger than 30 by 40 inches.

3. Number of Copies: Submit three (3) opaque copies of each submittal. Architect will return one copy. Electronic PDF files shall be distributed as well.

4. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.06 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.

2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.

3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner, and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Discuss items of significance that could affect progress, including the following:
   a. Tentative construction schedule.
   b. Critical work sequencing and long-lead items.
   c. Designation of key personnel and their duties.
   d. Procedures for processing field decisions and Change Orders.
   e. Procedures for RFIs.
   f. Procedures for testing and inspecting.
   g. Procedures for processing Applications for Payment.
   h. Distribution of the Contract Documents.
   i. Submittal procedures.
   j. Preparation of Record Documents.
   k. Work restrictions.
   l. Responsibility for temporary facilities and controls.
   m. Construction waste management and recycling.
   n. Parking availability.
   o. Office, work, and storage areas.
   p. Equipment deliveries and priorities.
   q. First aid.
   r. Security.
   s. Progress cleaning.

3. Minutes: Architect will record and distribute pre-construction meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
   a. The Contract Documents.
   b. Related RFIs.

c. Related Change Orders.
d. Submittals.
e. Review of mockups.
f. Time schedules.
g. Weather limitations.
h. Manufacturer's written recommendations.
i. Warranty requirements.
j. Compatibility of materials.
k. Acceptability of substrates.
l. Temporary facilities and controls.
m. Space and access limitations.
n. Testing and inspecting requirements.
o. Installation procedures.
p. Coordination with other work.
q. Required performance results.
r. Protection of adjacent work.
s. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Conduct progress meetings at monthly intervals. Coordinate dates of meetings with preparation of payment requests.

1. Attendees: In addition to representatives of Owner, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
   1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:
   1) Interface requirements.
   2) Sequence of operations.
   3) Status of submittals.
   4) Deliveries.
   5) Off-site fabrication.
   6) Access.
   7) Site utilization.
   8) Temporary facilities and controls.
   9) Hazards and risks.
   10) Progress cleaning.
   11) Quality and work standards.
   12) Status of correction of deficient items.
   13) Field observations.
   14) RFIs.
   15) Status of proposal requests.
   16) Pending changes.
   17) Status of Change Orders.
   18) Pending claims and disputes.
   19) Documentation of information for payment requests.

3. Minutes: Architect will record and distribute to Contractor the meeting minutes.

4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
   a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

E. Coordination Meetings: Conduct Project coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and pre-installation conferences.

1. Attendees: In addition to representatives of Owner, Contractor and Architect, subcontractors, suppliers, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
   a. Construction Schedule: Review progress since the last coordination meeting. Determine whether the contract is on time, ahead of schedule, or behind schedule, in relation to Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
   b. Schedule Updating: Revise Construction Schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
   c. Review present and future needs, including the following:
      1) Interface requirements.
      2) Sequence of operations.
      3) Status of submittals.
      4) Deliveries.
      5) Off-site fabrication.
      6) Access.
      7) Site utilization.
      8) Temporary facilities and controls.
      9) Hazards and risks.
      10) Progress cleaning.
      11) Quality and work standards.
      12) Change Orders.

3. Reporting: The Contractor is to record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.07 REQUESTS FOR INFORMATION (RFIs)

A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.

1. Clarifications of RFIs shall be in accordance with Article 3 of the General Conditions.

2. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.

3. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:

1. Project name.
2. Date.
3. Name of Contractor.
4. Name of Architect.
5. RFI number, numbered sequentially.
6. Specification Section number and title and related paragraphs, as appropriate.
7. Drawing number and detail references, as appropriate.
8. Field dimensions and conditions, as appropriate.
9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
10. Contractor's signature.
11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
    a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.

C. Hard-Copy RFIs:

1. Identify each page of attachments with the RFI number and sequential page number.

D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.

1. Attachments shall be electronic files in Adobe Acrobat PDF format.

E. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow seven working days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.

1. The following RFIs will be returned without action:
   a. Requests for approval of submittals.
   b. Requests for approval of substitutions.
   c. Requests for coordination information already indicated in the Contract Documents.
   d. Requests for adjustments in the Contract Time or the Contract Sum.
   e. Requests for interpretation of Architect's actions on submittals.
   f. Incomplete RFIs or RFIs with numerous errors.

2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.

3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 1 Section "Contract Modification Procedures."
   a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

F. F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect, within seven days if Contractor disagrees with response.

G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were dropped and not submitted.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

2.00 - PRODUCTS (Not Used)

3.00 - EXECUTION (Not Used)

END OF SECTION 01310

Read and accepted as part of the Contract:

Bidder/Contractor

SECTION 01320
CONSTRUCTION PROGRESS DOCUMENTATION

1.00 GENERAL REQUIREMENTS

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Contractor's Construction Schedule as per Article 14 of the General Conditions using the Critical Path Method

2. Submittals Schedules

3. Daily construction reports

B. Related sections including:

1. Division 1, Section "Payment Procedures" for submitting the Schedule of Values.

2. Division 1, Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.

3. Division 1 Section "Submittal Procedures" for submitting schedules and reports.

1.03 SCHEDULING TERMS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring and controlling the construction of the project. Activities included in a construction schedule consume time and resources.

1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.

2. Predecessor Activity: An activity that precedes another activity in the network.

3. Successor Activity: An activity that follows another in the network.

B. Cost Loading: The allocation of the Schedule of Values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by the Owner through the Owner's representative.

C. CPM: Critical Path Method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. . Network calculations determine when activities can be performed and the critical path of the Project.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.

1. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.

2. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

1.04 SUBMITTALS

A. Qualification Data: For scheduling consultant.

B. Submittals schedule: Submit three copies of schedule. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.

2. Specification Section numbe

3. Submittal category (action or infor

4. Name of subcontractor.

5. Description of the Work covered.

6. Scheduled date for Architect's final release or approval.

C. Contractor's Construction Schedule: Submit three opaque copies of initial schedule, large enough to show entire schedule for entire construction period.

D. CPM Reports: Concurrent with CPM schedule, submit three copies of each of the following computer generated reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report – List all activities sorted by activity number and then early start date or actual start date if known.

2. Logic Report – List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.

3. Total Float Report – List of all activities sorted in ascending order of total float.

E. Daily Construction Reports – Submit three copies at weekly intervals. Electronic Copies of reports shall be made available for review.

1.05 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling reporting, with capability of producing CPM reports and diagrams within 24 hours of the Owner's or Owner representative's request.

1.06 COORDINATION

A. Coordinate Construction Schedule with the Schedule of Values, list of subcontracts, submittals schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from parties involved.

2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

B. Provide information to and communicate with Construction Management team or the Owner's representative to receive assistance with site conditions and ongoing operations that shall be maintained during construction.

2.02 - PRODUCTS

2.01 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.

1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.

2.02 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."

B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.

1. Contract completion date shall not be change by submission of a schedule that shows an early completion date unless specifically authorized by Change Order.

C. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:

1. Activity Duration: so no activity is longer than 20 days, unless allowed by the Owner’s representative.

2. Procurement Activities: Include procurement activities for the long lead items. Procurement cycle activities include but are not limited to submittals, approvals, purchasing, fabrication, and delivery.

3. Submittal Review Time: Include review and resubmittal times. Coordinate submittal review times in Contractor’s Construction Schedule with Submittal Schedule.

4. Startup and Testing Time: Include not less than 15 days for startup and testing.

5. Substantial completion: Indicate completion in advance of date established for Substantial completion, and allow time for Owner’s administrative procedures necessary for certification of Substantial Completion.

2.03 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format. analysis .

B. CPM Schedule: Prepare Contractors Construction schedule using a computerized, time scaled CPM network analysis diagram for the work as described in the General Conditions.

1. Develop network diagram in sufficient time to submit CM schedule so it can be accepted for use no later than 30 days after date established for the Notice to Proceed.
   a. Failure to include any work item required for performance of this contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of the Owner representatives approval of the schedule.

2. Conduct educational workshops to train and inform key Project personnel, including subcontractor's personnel, in proper methods of providing data and using CPM schedule information.

3. Establish procedures for monitoring and updating COM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.

4. Use "one workday" as the unit of time. Include list of non-working days and holidays incorporated into the schedule.

C. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.
   1. Include estimated time frames for the following activities:
      a. Preparation and processing of submittals
      b. Mobilization and demobilization
      c. Purchase of materials.
      d. Delivery.
      e. Fabrication.
      f. Utility Interruptions
      g. Installation.
      h. Testing

   2. Critical Path Activities: Identify critical path activities. Scheduled start and completion dates shall be consistent with Contract milestone dates.

   3. Processing: Process data to produce output report on a time-scaled diagram. Revise data, reorganize activity sequences and re-work as often as necessary to produce the CM schedule within the limitations of the Contract Time.

4. Format: Mark the critical path. Locate the critical path near the center of network; locate paths with most float near the edges.

D. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or Activity.
2. Description of activity
3. Principal events of activity
4. Immediate preceding and succeeding activities
5. Early and late start dates
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.

E. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing:

1. Activities that have changes
2. Changes in early and late start dates
3. Changes in early and late finish dates
4. Changes in activity durations in workdays
5. Changes in the critical path.
6. Changes in total float or slack time
7. Changes in the Contract time.

2.04 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at the Project site.

1. List of subcontractors at Project site.
2. Approximate count of personnel at Project site.
3. Equipment at Project site.

4. Material deliveries.
5. High and low temperatures and general weather conditions.
6. Accidents.
7. Meetings and significant decisions.
8. Stoppages, delays, shortages, and losses.
9. Equipment or system tests and start-ups

3.00 EXECUTION

3.01 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Scheduling Consultant: Engage a consultant to provide planning, evaluation and reporting using CPM scheduling.

1. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.

B. Construction Management team representing the Owner shall also maintain an independent CPM and shall report on communication and coordination with the Contractor.

C. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule at each monthly progress meeting.

D. Distribution: Distribute copies of approved schedule to Architect-Engineer of record, Owner, Owner's representative, subcontractors and inspecting agencies, and other parties identified by Contractor and Construction Manage with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01320

Read and accepted as part of the Contract:

_____
Bidder/Contractor

SECTION 01330
SUBMITTAL PROCEDURES

1.00 GENERAL REQUIREMENTS

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals as described in Article 5 of the General Conditions.

B. Related Sections include the following:

1. Division 1 Section "Closeout Procedures" for submitting warranties.
2. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
3. Division 1 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
4. Divisions 2 through 16 Sections for specific requirements for submittals in those Sections.

1.03 SUBMITTAL PROCEDURES

A. General: Electronic copies of CAD Drawings of the Contract Drawings may be provided by Design Architect for Contractor's and Construction Manager’s use in preparing and reviewing submittals.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that requires sequential activity.

2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for delivery of Submittal Log.
D. Contractor's Review: Prior to submittal to the Architect, the Contractor shall check and review shop drawings, product data and samples for conformance with requirements of the Contract Documents. Stamp each submittal to indicate review or note any deviation from the requirements. Shop drawings submitted to the Architect without Contractor's stamp will be returned without review or comment.
E. Architect's Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 20 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Resubmittal Review: Allow 5 days for review of each resubmittal.
F. Submittal Form: Use the O'Brien/Atkins "Submittal and Routing Form" for each submittal. Mark the submittal form with project name, date, contractor/subcontractor, submittal name and other information as shown on the sample of this form bound herein. Package submittal appropriately and ship with transmittal form showing above information, number of copies, and required action. Note any special deadline on review, approval period.
G. Copies: Submit the following number of copies for each type of submittal sent as a hardcopy. A single copy may be sent when submitted electronically as Portable Document Format (pdf) files. When documents are submitted to the Architect electronically, they will be returned electronically.
1. Shop Drawings: One (1) set of prints. Architect will duplicate reviewed copies and three (3) sets will be returned to the Contractor.
2. Product Data: One (1) copy. Two (2) copies will be returned to the Contractor.
3. Samples: Two (2) sets for Construction Manager's and Architect's review and retention. Furnish an additional set if the Contractor desires one to be returned.
4. Submit additional copies when more than the indicated amount must be returned to the Contractor.

2.00 – PRODUCTS

2.01 ACTION SUBMITTALS

A. Shop Drawings: Specially-prepared technical data consisting of drawings, diagrams, schedules, and similar information not in standard printed form for application to more than one project.
1. Prepare shop drawings accurately to a scale sufficient to clearly show information pertinent to the submitted item or assembly. Include the following types of information, where applicable:
a. Working erection dimensions and/or field dimensions. Sectional views and/or arrangement of components. Details including connection to other elements. Types of material and finishes.
b. Project identification including name, date, vendor's job number, drawing number and descriptive title of submitted items.
B. Product Data: Includes standard printed information on materials, products and systems; not specifically-prepared for this project, other than the designation of selections from among available choices. Collect data into one submittal for each unit of work or system; mark each copy to show choices or options applicable to project. When submittal contains multiple pages relating to a single

area of the project, submit in portfolio binders showing project identification on front cover. Include manufacturer's printed recommendations for application and use, compliance with standards, and special coordination requirements.

C. Samples: Furnish actual specimens of materials, products or units of work which accurately represent finishes, patterns, color, textures, and specified characteristics. Large mock-ups or field-constructed samples will be inspected on the job site. Label samples or sample containers with sample name, date, project identification and other pertinent data.

2.02 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.

1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Architect and Construction Management will not return copies.

2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

3. Test and Inspection Reports: Comply with requirements specified in Division 1 Section "Quality Requirements."

B. Coordination Drawings: Comply with requirements specified in Division 1 Section "Project Management and Coordination."

C. Contractor's Construction Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation."

D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

J. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 1 Section "Operation and Maintenance Data."

K. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

L. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

M. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.

5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

3.00 – EXECUTION

3.01 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

C. Routing Form for all Sign-Off Signatures – Cover with signatures shall be attached to all submittals: A Sample Copy of the project “Submittal and Routing Form” – shall be approved by the Construction Manager.

3.02 DESIGN ARCHITECT-ENGINEER REVIEWER’S ACTION

A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

1. No Exceptions Taken.
2. Make Corrections Noted.
3. Revise and Resubmit.
4. Rejected.

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

3.03 CONSTRUCTION MANAGEMEMENT TEAM ARCHITECT OR ENGINEER'S ACTION (ONSITE COORDINATION AND VERIFICATION)

A. General: Construction Management Team Architect or Engineer will not review submittals that do not bear Contractor's and Design Architect's approval stamp and will return them without action.

B. Action Submittals: CM Architect or Engineer will review each submittal, make marks to indicate oversight review for coordination at the project site, and return it. CM Architect-Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

1. No Exceptions Taken.
2. Make Corrections Noted.
3. Revise and Resubmit.
4. Rejected.

C. Informational Submittals: The Construction Management Team will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 01339

Read and accepted as part of the Contract:

_____
Bidder/Contractor

SECTION 01354
SPECIAL PROJECT PROCEDURES FOR LABORATORIES

1.00 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This section includes administrative and procedural requirements for the General Contractor to establish clean construction protocols appropriate for the laboratory areas of the project.

B. Related sections include the following:

1. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.

2. Division 1 Section "Submittal Procedures" for submitting schedules and reports.

3. Division 1 Section “Commissioning” for related administrative and procedural requirements.

4. Division 1 Section “Function Performance Testing Procedures” for testing required to validate mechanical system performance.

5. Division 7 Section “Exterior Metal Wall System” for required testing of exterior walls for moisture intrusion.

6. Division 7 Section “Joint Sealants” for sealants used in laboratories.

7. Division 9 Section “Painting” for finishes used in laboratories.

8. Division 15 Sections “Basic Mechanical Materials and Methods”, “Testing, Adjusting, And Balancing”, and “Digital Control Station (DCS) General” for necessary qualifications for subcontractors.

9. Refer to individual specification sections for Certifications, Quality Assurance, and Testing required by each section.

1.03 DEFINITIONS

A. Laboratory. For the purposes of this specification section, a laboratory area is any area designated as such on the drawings. Laboratories are typically served by a mechanical system with once through supply air (non-recirculating) that is then exhausted from the building. All laboratory areas are classified as Biosafety Level 2 spaces unless specifically noted as Biosafety Level 3 on the drawings. Biosafety Level 3 spaces have various forms or filtering, and or treatment of supply and exhausts air streams.

B. Biosafety levels.

With a few exceptions, most laboratory areas shall be designed and constructed for work at biosafety level 2 (BSL-2). The Terms of Reference include technical criteria for research laboratories and animal rooms that shall be designed for work at biosafety level 3 (BSL-3), and animal biosafety level 2 (ABSL-2) and animal biosafety level 3 (ABSL-3). All staff working in these areas shall be specially trained and inoculated to prevent accidental and harmful exposures to the specimen being studied.

1. Biosafety level 2 (BSL-2) is appropriate for handling moderate-risk agents that cause human disease of varying severity by ingestion or through percutaneous or mucous membrane exposure.

2. Biosafety level 3 (BSL-3) is appropriate for agents with a known potential for aerosol transmission, for agents that may cause serious and potentially lethal infections and that are indigenous or exotic in origin.

3. Animal biosafety level 2 (ABSL-2) is appropriate for the care and handling of generally healthy animals and requires support areas for cage and rack washing, bottle washing and refilling, and handling of bedding and food. The animal area is a suite of rooms surrounded by a barrier that has independent ventilation to prevent cross-contamination with areas outside the barrier.

4. Animal biosafety level 3 (ABSL-3) is high-containment space appropriate for working with animals that have been exposed to known agents identified under international guidelines with a potential for aerosol transmission. Work is performed under strict guidance and protocols. The animal area is sealed in a containment zone and rooms shall be tested for increasing negative air pressurization within the suite. Care is taken so that in the event of failure, there shall be no reversal of air flow in the space.

1.04 REFERENCES

A. *Biosafety in Microbiological and Biomedical Laboratories* (BMBL5), U.S. Department of Health and Human Services Public Health Service, Centers for Disease Control and Prevention, and National Institutes of Health, Fifth Edition 2007.

1.05 SUBMITTALS FOR QUALITY ASSURANCE

A. Clean Build Protocol: Prepare and submit Project-specific procedures for implementation during the construction process to provide a controlled environment suitable for constructing Laboratory spaces and infrastructure. Include the following information, as applicable:

1. Protocol Description and Goals.
2. Protocol Level Descriptions and Temporary Signage During Construction.
3. Cleaning Requirements.
4. Gowning Requirements.
5. Tools and Building Materials Restrictions.
6. Laboratory Equipment Protection.
7. Violations and Enforcement.
8. Training Requirements for subcontractors.
9. Materials Required for Implementation of the Protocol.
10. Plans showing areas of Clean Building Protocol implementation and levels of the protocol in effect to be distributed during monthly meetings.

B. Other Informational Submittals:

1. Reports documenting compliance with Clean Build Protocol.
2. Field quality-control reports documenting inspections of installed products and equipment within areas subject to protocol.

1.06 COORDINATION

A. Coordinate work to ensure efficient and orderly construction and finishing of laboratories using the approved Clean Build Protocol.

B. Coordinate sequencing and scheduling of laboratory installation work using Clean Build Protocol. Prepare a sub-schedule to Contractor's Construction Schedule for work in laboratory areas.

C. Base the sub-schedule on Preliminary Construction Schedule. Secure time commitments for performing critical construction activities from separate entities responsible for laboratory furnishing work.

1.07 PROCEDURES

A. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of work.

B. Notifications: Prepare memoranda for distribution to each party involved with laboratory work, outlining special procedures required for coordination of laboratory work. Include such items as required notices, reports, training, disciplinary actions, and attendance at meetings.

C. Coordination Meetings: Conduct coordination meetings for laboratory work at regular construction meeting once initial Clean Build Protocol level is established.

1. Attendees: In addition to representatives of Owner, Architect, and Contractor, each subcontractor, supplier, installer, and other entity concerned with progress or involved in planning, coordination, or performance of future laboratory work activities shall be represented at these meetings. All participants at conference shall be familiar with Project and authorized to conclude matters relating to the work.

2.00 - PRODUCTS

2.01 CLEAN BUILD PROTOCOL PROCEDURES BINDER

A. Scope: Describe and Define terms and conditions of the construction Clean Build Protocol, its objectives, and its applicability to subcontractors, construction means and methods, and project schedule.

B. Protocol Description: Lists general requirements and procedures of the protocol related to maintaining a clean building environment including, but not limited to:

1. Clothing required.
2. Construction waste management.
3. Cleaning.
4. Prohibited materials.
5. Prohibited activities.
6. Training.

C. Protocol Level Schedule: Lists standards of performance as they relate to the stage of completed construction and establishes milestones for differentiating level of performance. Differentiate levels of performance from least to most restrictive:

1. Level 1: until exterior tight to weather. Least restrictive of construction activities within regulated areas of the project site.

2. Level 2: until interior walls and finishes complete. Establishes a perimeter between laboratory areas and not laboratory areas. Food, eating drinking and smoking within lab areas will be prohibited.

3. Level 3: until HVAC filters are installed. Prepare spaces for HVAC start-up. Activities that may damage or contaminate filters, seals, finishes, or future use as analytical laboratory (biological contaminants) will be prohibited. Use of these spaces as storage rooms is prohibited. No food, drink, and personal use of sinks and toilet in the area for convenience shall not be allowed.

4. Level 4: until testing and balancing complete. Most restrictive of activities. Maintain level of cleanliness and prepare for certification.

D. Protocol Level Descriptions : Describe standards of performance required for each level. Provide emphasis on changes from one level to the next to indicate increasing level of care to reduce waste, dust, and contaminates in laboratory spaces.

E. Cleaning Requirements: Lists cleaning procedures required at each protocol level including clean-up procedure for specific construction related activities.

F. Gowning Requirements: Lists gowning procedures required at each protocol level. Requirements in cleanest areas shall include haircaps, gloves, reusable coats.

G. Tools and Building Materials Restrictions: Develop guidelines for clean tool and materials management practices to be implemented within clean build areas.

H. Laboratory Materials: Develop guidelines to limit exposure of sealed or protected laboratory equipment and materials to damage or contamination during storage on-site, installation, or from other construction activities.

I. Violations and Enforcement. Describe penalties for actions inconsistent with Build Clean Protocol, up to and including warning and eventual dismissal from project.

J. Materials Required for Implementation of the Protocol. Designate responsibility for materials used to implement clean build procedures.

K. Diagrammatic Plans showing laboratory areas where Clean Build practices shall be implemented.

3.0 - EXECUTION

3.01 EXAMINATION

A. Examine drawings and specifications for conditions affecting performance of clean build protocol.

3.02 CONSTRUCTION SITE ENFORCEMENT

A. Inspect work areas to verify completed work is in compliance with clean build procedures.

B. Observe work in progress to verify compliance with requirements and that work is installed and connected according to the Contract Documents.

C. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents and Clean Build Protocol.

1. Perform additional inspections to determine compliance of replaced or additional work.

2. Include site cleanliness observations in regular inspection reports.

3. Contractor to certify that installed work complies with requirements in the Contract Documents and approved Clean Build Protocol.

END OF SECTION 01354

Read and accepted as part of the Contract:

Bidder/Contractor

SECTION 01390
QUALITY REQUIREMENTS

1.00 GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. All laboratory tests shall be performed in accordance with Article 13, Paragraph d. of the General Conditions.

2. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

3. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and -control procedures that facilitate compliance with the Contract Document requirements.

4. Requirements for Contractor to provide quality-assurance and -control services required by Architect, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections include the following:

1. Division 1 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.

2. Divisions 2 through 16 Sections for specific test and inspection requirements.

1.02 TERMS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the

Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under samples submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the work will be judged.

D. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

J. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.04 CONFLICTING REQUIREMENTS

A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.05 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Testing Agency Qualifications: An NRTL or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally (and if none nationally) internationally recognized testing laboratory according to 29 CFR 1910.7.

G. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

H. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated.

2. Notify Architect seven days in advance of dates and times when mockups will be constructed.

3. Demonstrate the proposed range of aesthetic effects and workmanship.

4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.

a. Allow seven days for initial review and each re-review of each mockup.

5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

6. Demolish and remove mockups when directed, unless otherwise indicated.

1.06 QUALITY CONTROL

A. Contractor Responsibilities: Where quality-control services are indicated as the Design-Build Contractor's responsibility, Owner will engage a qualified testing agency to perform these services as described in the General Conditions.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.

2. Payment for these services will be made by the Contractor as part of the contract bid.
3. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation,

including service connections. Report results in writing as specified in Division 1 Section "Submittal Procedures."

C. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties as described in Article 13, Paragraph d. of the General Conditions. Provide qualified personnel to perform required tests and inspections.

1. Notify Construction Management, Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.

2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.

3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.

4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality control service through Contractor.

5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.

6. Do not perform any duties of Contractor.

D. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.

2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.

4. Facilities for storage and field curing of test samples.

5. Delivery of samples to testing agencies.

6. Preliminary design mix proposed for use for material mixes that require control by testing agency.

7. Security and protection for samples and for testing and inspecting equipment at Project site.

E. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

2.0 - PRODUCTS (Not Used)

3.0 – EXECUTION

3.01 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.

2. Description of the Work tested or inspected.

3. Date test or inspection results were transmitted to Architect.

4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.02 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01390

Read and accepted as part of the Contract:

_____
Bidder/Contractor

SECTION 01400
TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS

1.00 USE OF PREMISES

1.00 LIMITATIONS FOR USE

The Contractor shall confine his apparatus, the storage of materials, and the operations of his workmen to limits indicated by the law, ordinances, permits, or directions of the Owner and/or the Construction Manager and shall not unreasonably encumber the premises with his materials.

2.00 SAFEGUARD FOR STRUCTURE

The Contractor shall not load or permit any part of the structure to be loaded with weight that will endanger its safety.

The Contractor shall enforce the Owner's instructions regarding signs, advertisements, fires and smoking.

2.00 TEMPORARY STRUCTURE AND FACILITIES

2.01 TEMPORARY OFFICE AND CONTRACTOR'S BUILDING

The Contractor shall at all times provide and maintain adequate weathertight temporary office with water, light, telephone, and toilet facilities for the use of the Architect, Construction Manager, Resident Engineers, Inspectors and sub-contractors. This office shall be provided with wooden floor raised above the ground, windows, doors and locks, tables, closet, blackboard, tackboard, benches and racks for drawings. One enclosed private room shall be apportioned for the exclusive use of three Owner's representatives.

2.02 TEMPORARY HOUSING FOR WORKERS

The temporary buildings for housing men, or the erection of tents or other forms of protection will be permitted only at such places as the Owner or Construction Manager shall designate; and the sanitary condition of the grounds in or about such structures shall at all times be maintained in a manner satisfactory to the Owner and the Architect. Nobody shall be allowed to sleep or cook within the building line of the project under construction.

2.03 TEMPORARY SANITARY FACILITIES AND FIRST AID STATION

The Contractor shall provide, construct and maintain for the duration of the contract, ample sanitary toilet accommodation and other necessary conveniences including water connections for the use of personnel and laborers on the work, properly secluded from public observation, in such manner and at such points as shall be approved by the Architect, and their use shall be strictly enforced. He shall keep places clean and free from flies; remove all connections and appliances connected therewith prior to the completion of the contract, and leave the premises perfectly clean.

2.04 TEMPORARY BARRICADES AND GUARD LIGHTS

The Contractor shall furnish and put up all temporary barricades (at the boundaries of the construction site, as designated by the Owner) and guard lights necessary for the protection, proper prosecution and completion of work. The guard lights at the top of the falsework tower, barricades, railing, etc., shall be provided and maintained by the Contractor throughout the duration of the project. The Contractor shall ensure that all workers will be limited to stay within the barricaded enclosure so as not to disturb the activities of the university.

2.05 TEMPORARY WATER, POWER AND TELEPHONE FACILITIES

The Contractor shall make all necessary arrangements with the OWNER or local utility companies in order that temporary facilities for water, power, and telephone are sufficiently provided till the completion of the work. All expenses incurred in connection therewith shall be paid by the Contractor.

2.06 TEMPORARY SIGNS

No signs or advertisements will be allowed to be displayed without the Owner's approval. The Contractor may erect one painted sign as approved by the Architect, giving names and addresses of the Architect, Contractor, and various sub-contractors. The Construction Manager shall approve the size, color, lettering, and sign location.

2.07 TEMPORARY ROADWAYS

The Contractor shall construct and properly maintain temporary driveways within and adjacent to the site in order to provide proper access to the building. Temporary driveways shall adequately sustain loads to be carried on them and be so constructed as not to endanger existing or newly installed underground structures.

2.08 TEMPORARY STAIRS, LADDERS, RAMPS, RUNWAYS

The Contractor shall furnish and maintain all equipment such as temporary stairs, ladders, ramps, scaffolds, runways, derricks, chutes, and the like, as required for proper execution of work by all trades. All such apparatus, equipment, and the construction shall meet all requirements of Labor Law and other local laws applicable thereto.

2.09 TEMPORARY ENCLOSURES

The Contractor shall provide temporary weather tight enclosures for all exterior openings as soon as walls and roof are built so as to protect all work from weather. All exterior doors shall be equipped with self-closing hardware and padlocks. All exterior windows shall be provided with temporary sash frames securely fastened in place but removable when required. Such sash frames shall be covered in an approved manner.

2.10 TEMPORARY OR TRIAL USAGE

Temporary or trial usage by the Owner of any mechanical device, machinery, apparatus, equipment, or any work or materials supplied under Contract before final completion and written acceptance by the Construction Manager shall not be construed as evidence of Owner's acceptance of the same.

The Owner shall have the privilege of such temporary or trial usage, for such reasonable length of time as the Construction Manager shall deem to be proper. No claim for damage shall be made by the Contractor for injury to, or breaking of any parts of such work which may be caused by weakness or inaccuracy of structural parts or by defective material or workmanship.

If the Contractor so elects, he may, at his expense, place persons satisfactory to the Construction Manager to make such trial usage.

2.11 REMOVAL OF TEMPORARY STRUCTURES

The Contractor shall remove all temporary work from premises, erected by him and shall clean the premises as a condition for completing the work and before acceptance of work by the Owner.

3.00 PROTECTION OF WORK AND OWNER'S PROPERTY

3.01 SAFEGUARD MEASURES

The Contractor shall put up and continuously maintain adequate protection of all his work from damage and shall protect the Owner's property, as well as all materials furnished and delivered to him by the Owner. He shall make good any such damage, injury or loss, except such as may be caused by agents or employees of the Owner, or due to causes considered as Act of God.

A. The Contractor shall provide reliable and competent watchmen to guard the site and premises, from commencement of operations until building is fully operational. Provide all doorways with locks under control of the Contractor, who shall lock doors at the close of each day's work. In the event that the Construction Manager at any time deems watchmen

service inadequate or incompetent the contractor shall increase or change the watchmen personnel to the Owner's satisfaction.

B. Smoking on premises shall be prohibited. Fires shall not be built on premises except by express consent of the Architect.

C. The Contractor shall provide and maintain barrels of water and fire buckets on premises for fire protection. Such equipment shall not be used for any other purpose.

D. The Contractor shall provide and maintain in good working order an adequate number of fire extinguishers.

3.02 OLD MATERIALS

All old materials of value found by the Contractor upon the work, shall be carefully stored in an area designated by Owner or the Construction Manager; and the Contractor shall be responsible for the same until final acceptance of the work.

3.03 TREES AND OTHER PLANTS

Existing trees, plants, shrubs, etc., which are to remain shall be boxed or otherwise protected from damage. No trees within site or located outside building lines shall be cut or removed without specific approval from the Owner and the Construction Management.

A. All trees and other plants that need to be transplanted elsewhere within fifty (50) meters from the building lines shall be done by the Contractor at his own expense in accordance with instructions from the Construction Manager or from the authorities concerned.
B. Undue damage of trees, plants, shrubs, streets, sidewalks, etc., resulting from or in connection with the construction work shall be made good and or replaced by the Contractor at his own expense to the satisfaction of the Owner and the Architect.

3.04 DRAINAGE

If it is necessary in the prosecution of the work to interrupt or obstruct the natural flow of rivers or streams, the drainage of the surface, or flow of artificial drains, the Contractor shall provide for the same during the progress of the work in such a way that no damage shall result to either public or private interests. For any neglect to provide for other natural or artificial drainage which he may have interrupted, he shall solely be held liable for all damages which may result therefrom during the progress of the work.

4.00 PROTECTION OF ADJACENT PROPERTY AND EXISTING UTILITIES

4.01 CONTRACTOR'S SOLE RESPONSIBILITY

The Contractor shall adequately protect adjacent property as provided by law and the Contract Documents. The construction, building or work, in addition to any neighboring property or building which may be jeopardized in any manner, must be thoroughly and substantially braced against winds, floods, setting, falling, of like similar occurrences, and when necessary, covered and protected from sun and rain at the Contractor's expense. The Contractor shall solely be liable and pay for all damages occasioned in any manner by his acts or neglect, or of his agents, employees, or workmen.

4.02 EXISTING UTILITIES

Existing utilities, if damaged due to negligence or fault of the Contractor, shall be repaired by the Contractor at his expense.

5.00 PROTECTION OF LIFE, WORK AND PROPERTY DURING AN EMERGENCY

5.01 AUTHORIZATION TO CONTRACTOR

In an emergency affecting the safety of life or of the work or of adjoining property, the Contractor, without special instruction or authorization from the Owner or Construction Manager, is hereby permitted to act, at his discretion, to prevent such threatened loss or injury and he shall so act, without appeal, if so instructed or authorized. Any compensation claimed by the Contractor on amount of emergency work, shall be determined by agreement or arbitration.

END OF SECTION 01400

_____

Read and accepted as part of the Contract:

_____

Bidder/Contractor

SCHEDULE OF SPECIAL STRUCTURAL TESTS AND INSPECTIONS

1.00 SITEWORK AND SOILS

	Material & Item	Inspection Requirements	National Building Code	Supplemental Standard	Frequency	Inspectors
1.01	Site Preparation	• Prior to the placement of prepared fill, the special inspector will determine that the site has been prepared in accordance with the approved geotechnical report.	1704.7		Periodic	TBD
1.02	Fill Materials	• The special inspector will determine that the fill materials being used conform to those specified in the approved geotechnical report.	1704.7		Periodic	TBD
1.03	Fill Materials	• When stored on site the special inspector will verify that the fill material is maintained at proper moisture levels as described in the approved geotechnical report.				
1.04	Fill Placement	• The special inspector will verify that the maximum lift thickness complies with the approved geotechnical report.	1704.7		Continuous	TBD
1.05	Fill Placement	• The special inspector will verify that the moisture content of the fill material complies with the approved geotechnical report.				
1.06	Evaluation of In-Situ Density	• The special inspector will determine, at the approved frequency, the in-situ dry density of the compacted fill, and the special inspector will determine if the in-situ density complies with the approved geotechnical report.	1704.7	ASTM D 1556; ASTM D 2167; ASTM D 2922	Periodic	
1.07	Evaluation of Suitable Bearing	• Prior to the forming of foundation structural elements the special inspector will verify the minimum load bearing potential of the soil, whether fill or undisturbed earth.	1704.7		Periodic	
1.08	Evaluation of Suitable Bearing	• Immediately prior to concrete placement the special inspector will probe the bearing surface of the soils to verify that neither construction labor nor weather conditions have diminished the capacity of the soils.				

2.0 SHALLOW FOUNDATIONS

	Material & Item	Inspection Requirements	National Building Code	Supplemental Standard	Frequency	Inspectors
2.01	Forming	• The special inspector will verify that spread footings and foundations where required by the contract documents are placed using formwork.	Table 1704.4	ACI 318-05 Section 5.7 SCIE	Periodic	
2.02	Forming	• The special inspector will verify that no deleterious materials, such as rubbish or loose soil, are present in the confined area to receive concrete.	Table 1704.4	ACI 318-05 Section 5.7 SCIE		
2.03	Forming	• The special inspector will verify that the confined area to receive concrete is free of standing water.	Table 1704.4	ACI 318-05 Section 5.7 SCIE		

2.04	Reinforcement	• The special inspector will verify that the reinforcing steel is placed in the proper orientation, is of the correct size and is of orientation, is of the correct size and is of the correct quantity required by the contract documents.	Table 1704.4	ACI 318-05 Section 5.7 SCIE	Periodic
2.05	Reinforcement	• The special inspector will verify that the reinforcing steel has been supported above the earth on chairs of sufficient size and quantity to afford proper clear dimensions.	Table 1704.4	ACI 318-05 Section 5.7 SCIE	
2.06	Reinforcement	• The special inspector will verify that the reinforcing steel has the proper side and top clearances.	Table 1704.4	ACI 318-05 Section 5.7 SCIE	
2.07	Reinforcement	• The special inspector will verify that all reinforcing steel is properly tied to prevent displacement and is free of rust, mud, or ice.	Table 1704.4	ACI 318-05 Section 5.7 SCIE	

2.08	Concrete	• The special inspector will perform the inspections and observations for cast-inplace concrete found elsewhere in this document.			Periodic

3.0 CAST-IN-PLACE CONCRETE

	Material & Item	Inspection Requirements	National Building Code	Supplemental Standard	Frequency	Inspectors
3.01	Material	• The special inspector will verify that all constituent concrete ingredients and reinforcing conform to the quality and type specified in the contract documents and the applicable ASTM specifications. (Certifications Required)	1704.4.1	ACI 318-05, Chapter	Periodic	
3.02	Material	• The special inspector will verify the proposed concrete mixture conforms to the proposed concrete mixture conforms to the requirements specified in the contract documents		ACI 318-05, Chapter 5 Sections 5.2, 5.3, 5.4 & 5.8		
3.03	Formwork	• The special inspector will inspect all forms for concrete, verifying compliance with ACI 318 standards and the contract documents.	Table 1704.4; 1906.1	ACI 318-05, Section 5.7; ACI 318-05, Section 6.1	Periodic	
3.04	Formwork	• The special inspector will verify the removal and re-shoring of form work complies with ACI 318.	1906.2	ACI 318-05, Section 6.2	Periodic	
3.05	Installation of Reinforcing	• The special inspector will observe that the location and installation details of reinforcing steel, including lap splice lengths, complies with the approved contract documents and applicable provisions of ACI 318.	Table 1704.4; 1906.1	ACI 318-05, Chapter 7	Periodic	
3.06	Installation of Reinforcing	• The special inspector will verify the weldability of reinforcing steel other than weldability of reinforcing steel other than weldability of reinforcing steel other than ASTM A706		AWS D1.4; ACI 318-05, Section 3.5.2	Periodic	
3.07	Installation of Reinforcing	• The special inspector will monitor the wwlding of all reinforcement.			Continuous	

4.0 MASONRY

	Material & Item	Inspection Requirements	National Building Code	Supplemental Standard	Frequency	Inspectors
4.01	Materials	• The special inspector will verify the materials used in masonry construction comply with the contract documents. (Certifications Required)		ACI 530.1, Article 1.4B	Periodic	
4.02	Materials	• The special inspector will verify the masonry compressive strength for the materials provided				
4.03	Demonstration Panel	• The special inspector will observe the construction methods employed to construct the in-place demonstration panel.		ACI 530.1, Article 3.5F	Continuous	
4.04	Demonstration Panel	• The special inspector will non-destructively test the in-place demonstration panel using surface penetrating radar or infrared testing for verification of grout consolidation.		ACI 530.1, Article 3.5F	Periodic	
4.05	Construction	• The special inspector will verify the proportions of site prepared mortar		1704.5.1 ACI 530.1, Article 2.6A	Periodic	
4.06	Construction	• The special inspector will observe the construction of mortar joints		ACI 530.1, Article 3.3B		
4.07	Construction	• The special inspector will verify the location of reinforcement and connectors		ACI 530.1, Article 3.4		
4.08	Verifications	• The special inspector will verify the size and location of structural elements.		ACI 530.1, Article 3.3G		
4.09	Verifications	• The special inspector will verify the locations of anchors, including other details of anchorage of masonry to structural members, frames or other construction.		ACI 530, Section 1.15.3, 2.1.4		
4.10	Verifications	• The special inspector will verify the specified size, grade and type of reinforcement.	2108.9.2.1	ACI 530, Section 1.13; ACI 531, Articles 2.4 & 3.4		
4.11	Verifications	• The special inspector will observe the welding of reinforcing steel.		AWS D1.4	Continuous	
4.12	Verifications	• The special inspector will verify the protection of masonry construction from inclement weather (above 90° F or below 40° F).		ACI 531, Article 1.8		
4.13	Grouting	• The special inspector will verify that the grout space is clean prior to grouting.		ACI 531, Article 3.2D SMIE		
4.14	Grouting	• The special inspector will verify that connectors and reinforcing are in place prior to grouting.		ACI 530, Section 1.12		
4.15	Grouting	• The special inspector will verify the proportions of the site prepared grout prior to grouting.		ACI 531, Article 2.2		
4.16	Grouting	• The special inspector will verify the construction of mortar joints prior to grouting.		ACI 531, Article 3.3B		
4.17	Sampling	• The special inspector will verify that grout is placed according to construction documents.		ACI 531, Article 3.5		

5.00 STRUCTURAL STEEL

	Material & Item	Inspection Requirements	National Building Code	Supplemental Standard	Frequency	Inspectors
5.01	Fabricator (Load Bearing Members)	• The entity employed to fabricate load bearing structural steel elements will be certified by the AISC as meeting the Building Category Classification. The fabricator will be required to fulfill all documentary, reporting, and quality control requirements commensurate with the prescribed certification. No additional special inspection will be required at the site of fabrication.	1704.2.2	AISC Building Certification	Periodic	
5.02	Fabricator	• Upon completion of fabrication a statement will be prepared affirming that the fabrication work has been performed in adherence to the quality control requirements prescribed by the AISC and that the structural steel has been fabricated in accordance with the structural design documents.				
		Bolts, Nuts, & Washers Table		ASTM Material Specifications; AISC ASD Section A3.4, or AISC LRFD Section A3.3	Periodic	
5.03	Materials	• The special inspector will verify that the supplied bolts, nuts, and washers conform to those specified in the approved contract documents.				
5.04	Materials	• The special inspector will verify the use of proper bolting materials using identification markings conforming to ASTM or AISI standards.				
		Structural Steel				
5.05	Materials	• The special inspector will verify the supplied material conforms to ASTM standards specified in the approved contract documents. (Certified test reports are required.)		ASTM Material Specifications	Periodic	Fabricator
5.06	Materials	• The special inspector will verify the material identification markings conforming to contract documents.		ASTM A6 or ASTM A588	Periodic	
		Weld Filler Material				
5.07	Materials	• The special inspector will verify the supplied weld fillers conforms to those specified in the contract documents. (Certificate of compliance is required.) Periodic SER		AISC ASD, Section A AISC LRFD, Section A3.5 AWS Material SpecS	Periodic	
5.08	Materials	• The special inspector will verify the use of the proper weld filler for each welding application using identification markings conforming to AWS specifications. AISC ASD, Section A3.6 AISC LRFD, Section A3.5 AWS Material Specification				

6.00 MECHANICAL SYSTEMS

	Material & Item	Inspection Requirements	National Building Code	Supplemental Standard	Frequency	Inspectors
6.01	Manufacturer	• Each manufacturer of designated seismic system components will test or analyze the component and its mounting system or anchorage and submit a certificate of compliance for review and acceptance by the registered design professional in responsible charge of the design of the designated seismic system and for approval by the building official. Qualification shall be by an actual test on a shake table, by three-dimensional shock tests, by an analytical method using dynamic characteristics and forces, by the use of experience data (i.e., historical data demonstrating acceptable seismic performance) or by amore rigorous analysis providing for equivalent safety		ICC-ES AC 156	Periodic	Manufacturer
6.02	Anchorage	• The special inspector will verify the anchorage of piping systems intended to carry flammable, combustible, or highly toxic contents.	1707.8		Periodic	Anchor Manufacturer
6.03	Anchorage	• The special inspector will verify the anchorage of mechanical equipment being served by piping systems intended to carry flammable, combustible, or highly toxic contents.	1707.8		Periodic	Anchor Manufacturer
6.04	Ductwork	• The special inspector will inspect the installation of ductwork intended to carry hazardous materials.	1707.8		Periodic	
6.05	Vibration Isolation System	• The special Inspector will inspect the installation of vibration isolation systems where the construction documents require nominal clearance of 3mm or less between the equipment support frame and restraint.	1707.8		Periodic	

7.00 ELECTRICAL SYSTEMS

	Material & Item	Inspection Requirements	National Building Code	Supplemental Standard	Frequency	Inspectors
7.01	Manufacturers	• Each manufacturer of designated seismic system components will test or analyze the component and its mounting system or anchorage and submit a certificate of compliance for review and acceptance by the registered design professional in responsible charge of the design of the designated seismic system and for approval by the building official. Qualification shall be by an actual test on a shake table, by three-dimensional shock tests, by an analytical method using dynamic characteristics and forces, by the use of experience data (i.e., historical data demonstrating acceptable seismic performance) or by amore rigorous analysis providing for equivalent safety	1708.5	ICC-ES AC 156	Periodic	
7.02	Anchorage	• The special inspector will verify the anchorage of electrical equipment for emergency or standby power systems..	1707.8		Periodic	Anchor Manufacturer
7.03	Vibration Isolation System	• The special Inspector will inspect the installation of vibration isolation systems where the construction documents require nominal clearance of ¼" or less between the equipment support frame and restraint.	1707.8		Periodic	

SECTION 01410
STRUCTURAL TESTS AND SPECIAL INSPECTIONS

1.00 GENERAL

1.01 RELATED DOCUMENTS

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

B. Schedule of Special Inspections: prepared by the responsible design professional is in charge of each given item listed. (Appended to this section)

1.02 SUMMARY

A. This Section includes administrative and procedural requirements to which the Contractor will be bound.

B. Where responsibilities of the Owner or the testing and inspecting entities are given, it is for the information of the Contractor only. This Section does not establish any relationship between the Owner and the testing and inspecting entities. These relationships are established in documents outside of this Section, and may differ from the information presented herein based upon contractual agreement.

C. Structural Tests and Special Inspections is a code mandated requirement to verify compliance with the requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Schedule of Special Inspections and the Program of Special Inspections. Requirements in those documents may also cover production of standard products.

2. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and -control procedures that facilitate compliance with the Contract Document requirements. Examples of these items include the pre-construction testing of concrete mixtures and the concrete strength tests required by Philippine building codes and regulations.

3. Requirements for Contractor to provide quality-assurance and -control services required by the Structural Engineer of Record, Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.03 DEFINITIONS

A. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
   1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades-people of the corresponding generic name.

D. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

F. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

G. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by the Design Professional of Record.

H. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

I. Special Inspector: A qualified person who demonstrating competence, to the satisfaction of the code enforcement official and registered design professional in responsible charge, for inspection of the particular type of construction or operation requiring special inspection. The special inspector shall be a licensed professional engineer or engineering intern or a qualified representative from the testing agency.

J. Special Inspection, Continuous: The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.

K. Special Inspection, Periodic: The part-time or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work has been or is being performed and at the completion of the work.

L. Structural Observation: Visual observation of the structural system by a representative of the registered design professional's office for general conformance to the approved construction documents. Structural observations are not considered part of the structural tests and special inspections and do not replace inspections and testing by the testing agency or special inspector.

M. Testing Agency: A qualified materials testing laboratory under the responsible charge of a licensed professional engineer, approved by the code enforcement official and the registered design professional in responsible charge, to measure, examine, test, calibrate, or otherwise determine the characteristics or performance of construction materials and verify confirmation with construction documents.

1.04 CONFLICTING REQUIREMENTS

A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to the Design Professional of Record for a decision before proceeding.

1.05 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required for entities hired by the Contractor who are directly involved in Structural Tests and Special Inspections; individual Specification Sections specify additional requirements.

B. Installer/Applicator/Erector Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or products that are similar to those indicated for this Project in material, design, and extent.

F. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.06 RESPONSIBILITIES AND LIMITATIONS

A. OWNER

1. The Owner will procure professional services to carry out all phases of the Structural Tests and Special Inspections Program.
2. The Owner, through the Registered Design Professional, will provide construction documents to the entities employed to perform Structural Tests and Special Inspections.
3. The Owner will provide the Contractor with a directory of all entities involved in Structural Tests and Special Inspections.

B. CONTRACTOR

1. The Contractor will cooperate at all times with the inspecting and testing agency personnel.

2. The Contractor will prepare an affidavit acknowledging awareness of structural tests and special inspections, the control exercised to obtain conformance with the construction documents, the procedures for exercising control within the Contractor’s organization, the method and frequency of reporting and the distribution of reports, and the names and qualifications of the persons exercising control within the Contractor’s organization.

3. The Contractor will provide access to the work.

4. The Contractor will furnish any copies of mill test reports received.

5. The Contractor will furnish all inspecting and testing entities with the site safety plan. The Contractor will contact the individual in Responsible Charge of the site personnel if failing to comply with safety plan.

6. The Contractor will coordinate the sequence of activities to accommodate all required testing and inspecting with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

7. The Contractor will schedule all tests and inspections with the appropriate testing or inspecting entities a minimum of forty-eight hours prior to the required tests or inspections.

8. The Contractor will schedule all structural observations with the appropriate registered design professional a minimum of 48 hours prior to the required observations.

9. The Contractor will have present at the site at the time of the tests and inspections an individual or individuals capable of and with authority to correct work not conforming to the Contract Documents.

10. The Contractor will provide preliminary representative samples of materials to be tested in required quantities.

11. The Contractor will establish suitable benchmarks required for measurements.

12. The Contractor will furnish labor and facilities:

    a. To obtain and handle samples at site
    b. To facilitate inspections and tests
    c. To store and cure samples for testing agency's exclusive use

13. The Contractor will arrange and pay for the following testing and inspections.

    a. Re-testing of Owner provided tests (due to failure). The initial cost will be borne by the Owner. The Owner will then adjust payments to the Contractor to cover the costs. In no instance may the Contractor enter into a financial arrangement with the testing or inspecting entities without the written approval of the Owner.
    b. Concrete testing for qualification of materials and for Contractor's convenience
    c. Concrete testing necessary for stripping of forms and as required for shoring and re-shoring
    d. Concrete testing required to monitor the curing of in-place concrete
    e. Contractor's duties for Owner provided tests, as specified.
    f. Field cured concrete cylinders to comply with OSHA Title 29 CFR 1926.752(a)
    g. Tests and inspections not explicitly part of Structural Tests and Special Inspection or assigned to the Owner are the Contractor's responsibility.

B. TESTING AND INSPECTING AGENCIES

1. The testing and inspecting entities will obtain from the Owner a complete set of Contract Documents including addenda, specifications, and construction bulletins.

2. The testing and inspecting entities will cooperate with Designer and Contractor.

3. The testing and inspecting entities will familiarize field personnel with scope and nature of work to be inspected.

4. The testing and inspecting entities will contact the Designer before start of construction to clarify any design intent not understood by field personnel.

5. The testing and inspecting entities will schedule personnel to arrive promptly as to not delay the work of the Contractor.

6. The testing and inspecting entities will adhere to all safety plans and requirements put in place by the Contractor.

7. The testing and inspecting entities will promptly notify Designer and Contractor of irregularities, or deficiencies of work which are observed during performance of services.

8. The testing and inspecting entities will not release, revoke, alter, or enlarge on requirements of Contract Documents.

9. The testing and inspecting entities will not approve or accept any portion of Work.

10. The testing and inspecting entities will not perform any duties of Contractor.

2.0 - PRODUCTS (Not Used)

3.0 – EXECUTION

3.01 STRUCTURAL TEST AND SPECIAL INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was requested by the Contractor

2. Date test or inspection was conducted.

3. Description of the Work tested or inspected.

4. Date test or inspection results were received by the Contractor.

5. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for reference during normal working hours.

3.02 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.

2. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

Note: Schedule of Structural Tests and Special Inspections Follows

END OF SECTION 01410

Read and accepted as part of the Contract:

Bidder/Contractor

SECTION 01457
ROOM INTEGRITY TESTING

1.00 GENERAL

1.01 SUMMARY

A. The purpose of testing the containment room(s) or envelope is to determine if the walls, floors, ceilings, penetrations, and other containment barrier features have adequate integrity to meet room integrity acceptance criteria.

B. Section Includes

1. Directional airflow testing.

2. Test reports.

C. Responsibility

1. Contractor shall provide materials, joint sealants at ALL joints and construction methods that are mindful of the performance test in this Section. The failure of rooms to perform will require corrections to joints and balancing of the HVAC system and a re-test until rooms pass and the work is accepted.

2. Compliance with the acceptable leakage rates defined in the acceptance criteria is the responsibility of the Contractor.

3. Work of this section shall be coordinated and performed by the Commissioning Agent CxC.

1.03 SUBMITTALS

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES.

A. Test Reports - Reports

1. Submit factory test report forms for review and approval minimum 2 weeks prior to testing.

Factory test reports for CLASS II biosafety cabinet
CABINET INTEGRITY TESTS
HEPA FILTER LEAK TEST
NEGATIVE PRESSURE/ VENTILATION RATE
ALARMS AND INTERLOCKS

ELECTRICAL SAFETY
ELECTRICAL LEAKAGE
GROUND FAULT INTERRUPTER
OTHER
LIGHTING INTENSITY
NOISE LEVEL
VIBRATION

2. Commissioning reports for HVAC, plumbing, and electrical equipment per section 01800 Commissioning.

3. Report on performance of all rooms during smoke tests to demonstrate integrity of seals and directional airflow at wall and ceiling penetrations, doors, vents, windows, autoclave and other vented areas.

4. Report on visually inspections of bioseals at autoclaves and isolation valves.

B. Certificates

National Institutes of Health Biosafety Level 3 Checklist and Certification for use before initial operation and subsequently on annual schedule.

1.04 SCHEDULING

A. Schedule tests and notify the Government two weeks prior to testing date.

1.05 ACCEPTANCE CRITERIA

A. Directional Air Flow Testing.
Observable directional airflow created by differential air pressure between tested area and adjacent area of 0.5-inch WG (plus or minus 0.25-inch).

2.00- PRODUCT

2.01 EQUIPMENT

A. Manometer - Calibrated digital or inclined manometer, accuracy to 0.05-inch W.C., for pressures up to 3-inches W.C.
1. Provide certificate of calibration prior to commencing test.

B. Fan/Blower - Fan/blower unit with capacity to create and maintain 2-inch water column (W.C.). differential pressure, complete with seal valve.

3.00 - EXECUTION

3.01 GENERAL

A. Initial Testing

1. Contractor shall conduct initial testing of applicable rooms, and provide appropriate support from sub-contractors to assist and perform testing. Testing to be conducted by a qualified person.

2. List deficiencies found during initial testing. Document resolution of discrepancies and variations on Deficiency Tracking List. Identify deficiencies to the Construction Manager and Owner who will determine if initial testing will continue or will be on hold until corrections are made before continuing with testing activities on other rooms or areas. Include completed room integrity test reports in the Cx final report.

B. Final Testing

1. Final testing to be witnessed by the *Cx,* Contractor Quality Control (CQC), and Construction Management Team Leader.

2. List deficiencies found during final testing. Document resolution of discrepancies and variations on Deficiency Tracking List. Identify deficiencies to Construction Management representative who will determine if final testing will continue or will be on hold until corrections are made before continuing with testing activities on other rooms and areas. Include completed room integrity test reports in Cx final report.

3.02 NOTIFICATION

Provide 10 business days notice to Construction Management team leader before start of Final testing. Cx shall select the rooms to be tested the day prior to testing to allow for time to prepare the rooms for testing.

3.03 EXAMINATION

A. Joint Sealants

1. Verify that joint sealers at room penetrations have been installed and are sufficiently cured.

B. Door Seals

1. Verify that door seals have been installed and are in working order, and that doors close and latch in normal manner.

3.04 DIRECTIONAL AIRFLOW TESTING

3.4.1 Preparation

A. Conduct testing after HVAC *testing and* balancing activities have been completed. Room shall be in normal operating condition with doors closed.

B. Smoke Pencil Testing:

1. Perform test within room.

2 Review each window, mechanical/electrical penetration and piece of laboratory equipment integrated into containment barrier floor, walls and ceiling. Move smoke pencil along perimeter of work at a rate of 25 mm per second (1 inch/second). Observe movement of air along test area. Air leakage will be noted by disturbance in pattern of smoke created.

3. Report points of air leakage.

4. Reseal points of air leakage and confirm with smoke pencil testing.

C. Differential Pressure: Using a handheld mini-manometer, confirm and record differential pressure within the room.

D. Directional Air Flow:

1. Perform test outside room. Slowly open door 1/8 inch (3 mm).

2. Move smoke pencil along edge of door at a rate of 25 mm per second (1 inch/second). Smoke shall be drawing into room confirming directional air flow.

3.06 RETESTING

A. Examination

1. Examine rooms having leakage.
2. Locate faulty joint seals or improperly adjusted door seals.

B. Corrections -

1. Have corrections made by responsible trade.

C. Retest

1. After corrections, retest rooms until allowable leakage rate is achieved.

3.07 TEST SCHEDULE

A. Directional Airflow Testing

Individually test rooms within ABSL-2, ABSL-3, and BSL-3 that operate at a different air pressure from adjacent spaces.

Additional testing of DNA and Molecular Laboratories designed for work at BSL-2 may also be tested to confirm that ventilation design provides for manufacturer recommended laboratory conditions for instruments.

3.08 REPORTS

A. Directional Air Flow Test Report -
Provide signed and dated written report including the following minimum information:

1. Mini-manometer data (brand, model, serial number, date of last calibration, full scale reading, and smallest scale increment).

2. Pressure differential of each room.

3. Written description of smoke pencil test and visual result for each room.

END OF SECTION 01457

SECTION 01524
CONSTRUCTION WASTE MANAGEMENT

1.00 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This section includes requirements for the following:

1. Disposing of non-hazardous construction waste.

B. Related Sections include the following:

1. Division 1 Section “Temporary Facilities and Controls” for environmental-protection measures during construction.
2. Division 2 Section "Site Clearing" for disposition of waste resulting from site clearing.
3. Division 4 Section "Unit Masonry Assemblies" for disposal of masonry waste.

1.03 TERMS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

1.04 PERFORMANCE GOAL

A. General: Develop waste management plan that results in waste material and debris being promptly removed from the site and the Owner’s property. Salvage/recycle where possible.

1. Construction Waste: Building and site improvements and other solid waste resulting from construction, remodeling, renovation or repair operations includes:
   a. Site-clearing waste.

b. Concrete, Masonry and CMU.
c. Lumber.
d. Plywood.
e. Metals.
f. Roofing.
g. Insulation.
h. Carpet.
i. Gypsum board.
j. Piping.
k. Electrical conduit.
l. Glass
l. Packaging: Regardless of salvage/recycle goal indicated above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
   1) Paper.
   2) Cardboard.
   3) Boxes.
   4) Plastic sheet and film.
   5) Polystyrene packaging.
   6) Wood crates.
   7) Plastic pails.
   8) Glass bottles

PART 2 - PRODUCTS (Not Used)

3.00 EXECUTION

3.01 PLAN IMPLEMENTATION

A. General: Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

3.02 DISPOSAL OF WASTE

A. General: Remove waste materials from Project site and legally dispose of them in an off-site landfill acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

3. The Contractor shall be responsible for the procurement of all permits or rights as governed by local ordinances for disposal of materials at said landfill or disposal site.

4. The Contractor shall take appropriate measures, while hauling waste materials to a landfill or disposal site, to prevent demolition debris from spilling and thus affecting the safe use of public roads. Debris control during the course of disposal and removal from the project site on public and/or haul roads will be considered incidental to the Work covered under the Contract Documents.

B. Burning: Do not burn waste materials.

C. Off-Site Disposal: Transport waste materials off Owner's property and legally dispose of them, except as otherwise specified.

3.03 RECYCLING CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Procedures: Separate recyclable waste from other waste materials, trash and debris. Separate recyclable waste by type at Project site to the maximum extent practical.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.

4. Store components off the ground and protect from the weather.

5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.04 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.

2. Polystyrene Packaging: Separate and bag materials.

3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.

4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Site-Clearing Wastes: Chip brush, branches, and trees on site.

3.05 DUST, DEBRIS AND SMOKE CONTROL

A. The Contractor shall control dust, debris and smoke throughout the life of the project within the project site. Dust, debris and smoke control shall not be considered effective where the amount of dust, debris or smoke creates a potential or actual unsafe condition, public nuisance, or condition endangering the value, utility, or appearance of any property.

END OF SECTION 01524

SECTION 01600
PRODUCT REQUIREMENTS

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract Documents, including Instructions to Bidders, General and Supplementary General Conditions and other Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 1 Section "Closeout Procedures" for submitting warranties for Contract closeout.

2. Divisions 2 through 16 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.02 TERMS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.

2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials where specified. Products salvaged or recycled from other projects are not considered new products.

3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

1.03 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces

2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units. 2. Store materials in a manner that will not endanger Project structure.

3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.

4. Store cementitious products and materials on elevated platforms.

5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.

6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.

7. Protect stored products from damage and liquids from freezing.

1.04 PRODUCT WARRANTIES

A. This Section includes administrative and procedural requirements for warranties required by Contract Documents, including manufacturer's standard warranties on products and special warranties. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of warranty on Work that incorporates products. Manufacturer's disclaimers and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

B. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as result of such failure or must be removed and replaced to provide access for correction of warranted construction.

C. Reinstatement of Warranty: When Work covered by warranty has failed and been corrected by replacement or rebuilding, reinstate warranty by written endorsement. Reinstated warranty shall be equal to original warranty with equitable adjustment for depreciation.

D. Replacement Cost: Upon determination that Work covered by warranty has failed replace or rebuild Work to an acceptable condition complying with requirements of Contract Documents. Contractor is responsible for cost of replacing or rebuilding defective Work regardless of whether Owner has benefited from use of Work through portion of its anticipated useful service life.

E. Owner's Recourse: Expressed warranties made to Owner are in addition to implied warranties, and shall not limit duties, obligations, rights and remedies otherwise available under law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, or remedies.

F. Rejection of Warranties: Owner reserves right to reject warranties and to limit selection to products with warranties not in conflict with requirements of Contract Documents.

G. Submit written warranties to the Architect prior to date certified for Final Payment. If the Construction Manager's and Architect's Certificate of Final Payment designates commencement date for warranties other than date of Final Payment for Work, or designated portion of Work, submit written warranties upon request of the Construction Manager.

H. Form of Submittal: At Final Completion compile two (2) copies of each required warranty properly executed by Contractor, or by Contractor, subcontractor, supplier, or manufacturer. Organize warranty documents into an orderly sequence based on table of contents of Project Manual. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2" by 11" paper.

1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark tab to identify product or installation. Provide typed description of product or installation, including name of product, and name, address, and telephone number of installer.

2. Identify each binder on front and spine with typed or printed title "WARRANTIES", Project title or name, and name of Contractor.

3. When warranted construction requires operation and maintenance manuals, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

2.00 – PRODUCTS

2.01 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.

2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.

3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

4. Where products are accompanied by the term "as selected," Architect will make selection.

5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.

6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

B. Product Selection Procedures:

1. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.

2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.

3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies the requirements.

4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.

5. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named.

6. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.

a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.

b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.02 PRODUCT SUBSTITUTIONS

A. Timing: As per Article 12 of the Instructions to Bidders, the Architect will consider requests for substitution if received no later than ten (10) calendar days prior to the deadline for submission of bids. The Architect will consider requests for substitution after this deadline only if the request for substitution is due to circumstances beyond the Contractor's control, such as when the specified product is no longer available, and such requests will be accepted or rejected at the discretion of the Architect.

B. Substitution Requests: Provide complete information as to the requested item and how it compares to the specified. Incomplete data will be reason for immediate rejection of request.

C. Contractor's submittal and the Architect's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with Contract Documents do not constitute an acceptable or valid request for substitution, nor does it constitute approval.

3.00 – EXECUTION (Not Used)

END OF SECTION 01600

SECTION 01750
WARRANTIES AND BONDS

1.00 CONTRACTOR'S INSURANCE AND BONDS

1.01 CONTRACTOR'S LIABILITY INSURANCE

The Contractor shall secure and maintain such insurance from an insurance company approved by the Owner as will protect himself, his sub-contractors, and the Owner from claims of bodily injury, death or property damage which may arise from operations under this Contract. The Contractor shall not commence work under this Contract until he has obtained all insurance required under this section and shall have filed the certificate of insurance or the certified copy of the insurance policy with the Owner. Such insurance policy shall contain a clause providing that it shall not be canceled by the insurance company without ten (10) days written notice to the Owner of intention to cancel. The amounts of such insurance shall be as agreed upon.

1.02 CONTRACTOR'S FIRE INSURANCE

In addition to such Fire Insurance as the Contractor elects to carry for his work protection, he shall secure and maintain in the name of the Owner policies upon such structures and materials and in such amount as shall be designated. These policies shall be secured from a company which is satisfactory to the Owner and delivered to the Owner.

1.03 CONTRACTOR'S PERFORMANCE BOND AND PAYMENT BOND

The Contractor, prior to signing the Contract, shall furnish a Performance and Payment Bond equal to 10% of the Contract amount for the faithful performance of his work and to cover payments and obligations arising from his Contract. Such bonds shall be in the forms of sureties as approved by the Owner. Such bonds shall remain in effect until replaced by the Contractor's Guarantee Bond.

1.04 CONTRACTOR'S GUARANTEE BOND

The Performance and Payment Bond will be released by the Owner after the expiration of two (2) months from the final acceptance of the work and only after the Contractor has furnished the Owner, a Guarantee Bond in the amount of 30% of the Total Contract Cost. The Guarantee Bond shall be for a period of one (1) year commencing from the date of acceptance as a guarantee that all materials and workmanship installed under Contract are of good quality.

1.05 CONTRACTOR'S GUARANTY-WARRANTY

A. The Contractor shall, in case of work performed by his sub-contractors and where guarantees are required, secure warranties from said sub-contractors and deliver copies of same to the Owner upon completion of work.

B. The Contractor shall and thereby warrants all work performed by him directly and for which guarantee are required.

C. The Contractor shall and thereby warrants and/or guarantees for a period of one year, or for longer periods where so provided in Specifications, as evidenced by date of Final Certificate issued by the ~~*Architect*~~ Construction Manager, all materials and workmanship installed under Contract to be of good quality in every respect and to remain so for period described herein.

D. Should any defects develop in aforesaid work, within the specified period due to faults in material and/or workmanship, the Contractor thereby agrees to make all repairs and do all necessary work to correct defective work to the Architect's satisfaction. Such repairs and corrective works shall be done without cost to the Owner and at entire cost and expenses of the Contractor within five (5) days written notice to the Contractor by the Owner.

E. In case the Contractor fails to do the work so ordered, the Owner may have the work done and charge the cost thereof against monies retained as provided for in the Agreement and, if said retained monies shall be insufficient to pay such cost, or if no money is available, the Contractor and his sureties agree to pay to the Owner the cost of such work.

F. All the foregoing are without prejudice to the right of the Owner under the New Civil Code and other laws now or hereafter that may be applicable.

END OF SECTION 01750

Read and accepted as part of the Contract:

Bidder/Contractor

SECTION 01770
CLOSEOUT PROCEDURES

1.00 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Inspection procedures.
2. Warranties.
3. Final cleanin
4. Correction of work prior to final payment.
5. Corrections of work after final payment.
6. Owner's right to do work.

B. Related Sections include the following:

1. Division 1 Section "Payment Procedures" for requirements for Applications for Payment for Final Completion.
2. Division 1 Section "Execution Requirements" for progress cleaning of Project site.
3. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
4. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
5. Division 1 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
6. Divisions 2 through 16 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.03 FINAL PROJECT ACCEPTANCE

A. Preliminary Procedures: Before requesting inspection for determining date of Final Acceptance by the Owner, complete the following. List items below that are incomplete in progress meetings with the Construction Manager and Owner..

1. Prepare a list of items to be completed and corrected (punch list).

2. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

3. Prepare and submit Project Record Documents, operation and maintenance manuals and similar final record information.

4. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.

5. Complete startup testing of systems.

6. Submit test/adjust/balance records.

7. Submit required Commissioning reports.

8. Submit required Certification reports.

9. Terminate and remove temporary facilities from Project site.

10. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

11. Complete final cleaning requirements, including touchup painting.

12. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Final Acceptance. On receipt of request, Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Construction Manager and Architect of Record will prepare the Certificate of Final Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Construction Manager, that must be completed or corrected before certificate will be issued.

1. This “preliminary final inspection” will be conducted as described in the General Conditions.

2. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

3. Results of completed inspection will form the basis of requirements for Final Acceptance.

1.04 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."

2. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Construction Manager and Owner will either proceed with inspection or notify Contractor of unfulfilled requirements. Construction Manager and Owner will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. This “final inspection” will be conducted as described in Article 25 of the General Conditions.

2. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

C. Project warranties begin upon “Project Acceptance” by the State of North Carolina as per the General Conditions.

1.05 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit two copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction.

1. Include the following information at the top of the first page:

a. Project name.

b. Date.

c. Name of Architect and Engineers of Record

d. Construction Management Team, Construction Manager and Project Staff.

d. Name of Contractor.

1.06 WARRANTIES

A. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Provide guarantees as required in the General Conditions.

2. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive A4 sized (8-1/2-by-11-inch) paper.

3. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.

4. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

B. Provide additional copies of each warranty to include in operation and maintenance manuals.

2.00 PRODUCTS

2.01 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

3.00 EXECUTION

3.01 FINAL CLEANING

A. General: Provide final cleaning in accordance with the General Conditions. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and national environmental and antipollution regulations.

B. Environmental Requirements: Conduct cleaning and waste disposal operations in compliance with local laws and ordinances. Comply fully with federal and local environmental and antipollution regulations.

1. Do not dispose of volatile wastes such as mineral spirits, oil or paint thinner in storm or sanitary drains.

2. Burning or burying of debris, rubbish or other waste material on the premises will not be permitted.

C. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.

b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.

c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.

d. Remove tools, construction equipment, machinery, and surplus material from Project site.

e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, manholes, attics, and similar spaces.

g. Sweep concrete floors broom clean in unoccupied spaces.

h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.

i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

j. Remove labels that are not permanent.

k. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be

satisfactorily repaired or restored or that already show evidence of repair or restoration.

l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

o. Leave Project clean and ready for occupancy.

D. Removal of Protection: Remove temporary protection and facilities installed during construction to protect previously completed installations during remainder of construction period.

E. Compliance: Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

1. Where extra materials of value remain after completion of construction, inquire of the Owner as to their disposition.

END OF SECTION 01770

Read and accepted as part of the Contract:

Bidder/Contractor

SECTION 01780
PROJECT RECORD DOCUMENTS

1.00 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.

B. Related Sections include the following:

1. Division 1 Section "Closeout Procedures" for general closeout procedures.

2. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.

3. Divisions 2 through 16 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.03 SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set of marked-up Record Prints.

2.00 - PRODUCTS

2.01 RECORD DRAWINGS

A. Record Prints: Maintain one fullsized set of black-line white prints of the Contract Drawings at the project site and.

1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who

obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.

b. Accurately record information in an understandable drawing technique.

c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.

b. Revisions to details shown on Drawings.

c. Depths of foundations below first floor.

d. Locations and depths of underground utilities.

e. Revisions to routing of piping and conduits.

f. Revisions to electrical circuitry.

g. Actual equipment locations.

h. Duct size and routing.

i. Locations of concealed internal utilities.

j. Changes made by Change Order.

k. Field records for variable and concealed conditions.

3. Mark the Contract Drawings completely and accurately.

4. Mark record sets with colors to distinguish between changes for different categories of the Work at same location.

5. Mark important additional information that was either shown schematically or omitted from original Drawings.

6. Note Change Order numbers, and similar identification, where applicable.

3.00 - EXECUTION

Read and accepted as part of the Contract:

_____
Bidder/Contractor

3.01 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

B. Architect of Record as part of the Design-Build team should update the computer-aided design (CAD) model during construction and submittal reviews, in order to avoid delays in submitting the CAD files for record keeping purposes at project close.

END OF SECTION 01781

SECTION 01782
OPERATION AND MAINTENANCE DATA

1.00 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.

2. Emergency manuals.

3. Operation manuals for systems, subsystems, and equipment.

4. Maintenance manuals for the care and maintenance of products, materials, finishes, systems and equipment.

B. Related Sections include the following:

1. Division 1 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

2. Division 1 Section "Closeout Procedures" for submitting operation and maintenance manuals.

3. Division 1 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.

4. Divisions 2 through 16 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.03 TERMS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.04 SUBMITTALS

A. Final Submittal: Submit one copy of each manual in final form at least 15 days after final inspection.

1.05 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

2.00 PRODUCTS

2.01 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:
   1. List of documents.
   2. List of systems.
   3. List of equipment.
   4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.02 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

   1. Title page.

   2. Table of contents.

3. Manual contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name, address, and telephone number of Contractor.
6. Name and address of Architect.
7. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.

b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major

components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.

4. Supplementary Text: Prepared on A4 or 8-1/2-by-11-inch white bond paper.

2.03 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.04 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.

8. Required sequences for electric or electronic systems.

9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.05 PRODUCT MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:

1. Product name and model number.

2. Manufacturer's name.

3. Color, pattern, and texture.

4. Material and chemical composition.

5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.

2. Types of cleaning agents to be used and methods of cleaning.

3. List of cleaning agents and methods of cleaning detrimental to product.

4. Schedule for routine cleaning and maintenance.

5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.06 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard printed maintenance instructions and bulletins.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.

3. Identification and nomenclature of parts and components.

4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.

2. Troubleshooting guide.

3. Precautions against improper maintenance.

4. Disassembly; component removal, repair, and replacement; and reassembly instructions.

5. Aligning, adjusting, and checking instructions.

6. Demonstration and training videotape, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly,

monthly, quarterly, semiannual, and annual frequencies.

2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

3.00 EXECUTION

3.01 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.

2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Comply with Division 1 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01782

Read and accepted as part of the Contract:

Bidder/Contractor

SECTION 01800
COMMISSIONING

1.00 GENERAL

1.01 SECTION INCLUDES

A. This Section includes general commissioning requirements (not validation) that apply to the implementation of commissioning without regard to specific systems, assemblies, or components. Additional commissioning requirements may be included in individual specification sections.

B. The Work described in this Section provides information to the Contractor for coordination and scheduling only, regarding the general commissioning process to be performed through the third-party Construction Management contract by the a Commissioning Agent (CxA) , including:

1. Design/construction document review.
2. Systems/equipment submittal review.
3. Installation inspections.
4. Pre-functional and functional performance testing on systems/equipment.
5. Review of record drawings.
6. Review of operations and maintenance data.
7. Assembly of a systems manual.
8. Review of operations staff training procedures.
9. Final systems check approximately ten (10) months after Substantial Completion of the construction phase.

1.02 DESCRIPTION

A. The commissioning process is not intended to conflict with applicable Building Codes, nor rules, regulations and/or requirements of governing bodies. Apparent conflicts shall be submitted in writing to the Owner.

B. Commissioning is generally understood to be the process of verifying for the Owner that systems, equipment, and controls function as designed to satisfy the performance requirements and design intent specified in the Contract Documents.

C. Under this Section of Work, details of the commissioning process and procedures shall be incorporated into a final Commissioning Plan. The Plan shall be designed, coordinated, and implemented by the Commissioning Authority (CxA).

D. The CxA shall have the overall responsibility for planning and coordinating the commissioning process, and shall ensure that all parties participate in accordance with their designated roles and responsibilities. This shall include the Owner, facility operator, Architect, Engineers,

Contractor, Subcontractors, specialty subcontractors, equipment suppliers, vendors, and other entities as required.

E. Each Contractor involved in the commissioning process shall provide instrumentation as required for the commissioning process; shall designate one person to represent it's own company as the full-time Lead Commissioning Coordinator; and shall also designate an equally-qualified secondary support for that person. Each Lead Commissioning Coordinator shall participate as a member of the Commissioning Authority's Commissioning Team.

1. All instruments used for measurements shall be accurate and calibrated. Calibration histories for each instrument shall be available for examination. Calibration and maintenance of all instruments and accuracy of measurements shall be in accordance with the requirements of AABC or NEBB Standards.

F. Construction phasing requirements that affect the commissioning process will be identified by the Commissioning Authority in the Commissioning Plan and shall be adhered to by the Contractor.

1.03 RELATED DOCUMENTS AND SECTIONS

A. The following Divisions of specifications contain additional installation, testing and acceptance requirements in addition to the commissioning requirements of this Section:

1. Division 1 - General Requirements.
2. Division 15 - Plumbing
3. Division 15 - Heating, Ventilating and Air Conditioning.
4. Division 15 – Building Automation System
5. Division 16 - Electrical.

B. Systems Requiring Commissioning:

1. National Institutes of Health Building – Auditorium and Offices, Laboratory Areas
   a. Mechanical Systems:
      1) Heating system (including controls, boilers, piping, pumps and variable speed drives).
      2) Pumps (other pumps serving mechanical and plumbing systems other than HVAC).
      3) Air handling units (Supply fans, return fans, packaged units, roof top units, specialized fans).
      4) Cooling system (chillers, cooling towers, evaporative cooling, controls, piping and pumps).
      5) Exhaust fans.
      6) Variable-air-volume (VAV) units.
      7) Fan coil units & Terminal units (air and water).
      8) Building Automation System, including but not limited to temp control devices, program loops, system integration, web-interface).
   b. Electrical Systems:
      1) Emergency Generators.

2) Transformers & Main Switch Boards.
3) Automatic Transfer Switches.
4) Variable Frequency Drive (VFD) and Motor Starters.
5) Interior/Exterior Lighting Controls & Lighting Occupancy Sensors.
6) Life Safety Systems.
7) Fire Alarm and Notification Systems.
8) Security System.

c. Plumbing/Piping Systems:
1) Chilled Water System.
2) Hot Water System.
3) Condensate Drainage.
4) Irrigation systems.

d. Ductwork and Air Distribution Systems:
1) Intake/Exhaust Systems.
2) Duct Leakage.
3) Filter Systems.
4) Balance Dampers & Smoke/Fire Dampers.

2. Special Laboratory Systems
a. Effluent Waste Treatment
b. Sterilizers
c. Icemakers
d. Security and Access Systems
e. Data Center / Server Room reliability

1.04 INSTALLER SUBMITTALS (INFORMATIONAL): Follow Terms of Reference.

A. Work Schedules: Detailed work schedules for each system shall be provided to the Contractor, Construction Manager, and Owner's representative at least thirty (30) days before beginning work of this Section.

B. Startup Procedures: Six (6) copies of detailed startup procedures based on manufacturer's recommendations for each system component at least thirty (30) days before startup work.

C. Work Plans: Six (6) copies of detailed plans showing each step of the work of this Section at least thirty (30) days before beginning this work. Submit names of individuals, company affiliation, and who will be performing the work, and who are managing the work. Show locations in the system that will be manned for observing results.

D. Certification of Work Conditions: Certification that conditions required to start each item of work are completed. Submit certification at least five (5) days prior to beginning work on the subject system.

E. Field Reports.

F. Installation and Operational Checklist Forms.

G. System and Design Document Identification Sheets.

1.05 QUALITY ASSURANCE: Comply with:

A. Associated Air Balance Council (AABC). National Standards for Total System Balance.

B. National Environmental Balancing Bureau (NEBB). Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.

C. Air-Conditioning and Refrigeration Institute (ARI) Standards.

D. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standards for commissioning.

E. American Society of Mechanical Engineers (ASME) Standards.

F. National Fire Protection Association (NFPA) Standards including, but not limited to, NFPA 70, National Electrical Code (NEC).

G. U.S. Pharmacopoeia Requirements.

H. U.S. Food and Drug Administration (FDA) Requirements, 21 CFR 211, “Current Good Manufacturing Practice (CGMP) for Finished Pharmaceuticals”.

1.06 ABBREVIATIONS

A. A/E: Architect/Engineer.

B. CxA: Commissioning Authority.

C. CC: Controls Subcontractor.

D. Cx: Commissioning.

E. EC: Electrical Contractor.

F. EE: Electrical Engineer.

G. FPT: Functional Performance Test.

H. MC: Mechanical Contractor.

I. ME: Mechanical Engineer.

J. MEP: Mechanical/Electrical/Plumbing.

K. O&M: Operations and maintenance.

L. PFC: Pre-functional Checklist.

M. PFT: Pre-functional Test.

N. CPM: Construction Project Manager.

O. RE: Resident Engineer.

P. TAB: Testing, Adjusting, and Balancing.

Q. TE: Test Engineer.

R. VAV: Variable air volume.

S. VFD: Variable frequency drive.

T. WBDMS: Web-based data management system.

1.07 DEFINITIONS

A. Acceptance Phase: The phase of construction after start-up and initial checkout when FPT and O&M documentation review and training occurs.

B. Architect/Engineer (A/E): The prime consultant team which consists of the Architect and design engineers may sometimes be referred to collectively as the A/E.

C. Areas of Conflict: Where commissioning requirements conflict with technical design provisions or other requirements of the Contract Documents, requiring the CxA to request that the Contractor issue a request for clarification.

D. Commissioning Authority: An independent entity who implements the Commissioning Plan and leads, plans, schedules and coordinates the Cx team. Initially participates in the project with the Construction Management team to become engaged in the design and construction at an early stage.

E. Commissioning: Documented confirmation by the Commissioning Authority that building systems requiring commissioning function in compliance with the requirements described in the Contract Documents and Owner operational criteria.

F. Commissioning Plan: A document prepared by the CxA that outlines the Cx team organization, communication paths, schedule, allocation of resources, matrix of responsibilities and documentation requirements of the commissioning process. The plan can shall be implemented by the CxA at the start of the construction. The plan shall be updated by the CxA during all phases of the construction process.

G. Contract Documents, Contractor and Subcontractors: As defined in the General Conditions.

H. Contractor's Pre-Commissioning Checklists: Includes installation and start-up work as specified to be completed by the appropriate contractors independent of the CA Commissioning Plan.

I. Control System: The central building energy management control system.

J. Deferred Functional Tests: Tests that are performed after substantial completion due to partial occupancy, equipment, seasonal requirements, design or other site conditions that disallow the test from being performed at it's appropriate time.

K. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the requirements of the Contract Documents.

L. Final Commissioning Report: Document prepared by the CxA detailing the actual Cx procedures performed, inspection and testing results, and the final Issues Log indicating that all issues discovered through the Cx process have been verified as resolved or accepted by the National Institutes of Health, University of the Philippine Manila and/or it's designated representative. The report shall also include key items for maintenance staff, including, but not limited to fan and pump curves for equipment furnished. A copy of the final report shall be furnished to the Owner.

M. Functional Performance Test (FPT): The FPT checklists shall be prepared by the CA and used to test the dynamic function and operation of systems/equipment by manual (direct observation) or monitoring methods. The CA shall develop the written functional test procedures form in a sequential format and then shall coordinate, oversee and document the actual testing which shall be performed by the installing contractor or vendor. Functional performance testing shall take place after pre-functional (installation and start-up) tests have been completed.

N. Issues Log: A list of systems/equipment or procedural deficiencies and issues prepared by the CxA that have been observed. The list shall include the current disposition of each issue and the projected date of final resolution. Deficiencies include, but are not limited to, products/material, installation, service, or systems/equipment performance that does not comply with the design and performance requirements of the Contract Documents and/or Commissioning Plan.

O. Monitoring: Recording parameters includes, but is not limited to, flow, current, status, pressure of equipment operation using data loggers or the trending capabilities of control systems.

P. O&M Manuals: Manuals used for the training, operations and maintenance of systems and equipment. Contractor shall refer to additional requirements in the appropriate specification sections.

Q. Pre-functional Test (PFT): The PFT checklists shall be prepared by the CxA and are intended to be used to verify systems/equipment installation and start-up activities comply

with the Contract Documents and approved equipment submittals. CA verification shall include inspections, tests and procedures, such as cleanliness, belt tension, oil levels, labels affixed, gauges in place, sensors calibrated, initial settings, to prepare equipment for initial start-up and proper/continuous operation. The check sheets shall be used to verify system set points, operating strategies, required component testing, correct rotation, and damper positions prior to functional performance tests, and also incorporate manufacturers' start-up instructions. The check sheets shall contain final sign-offs by the Contractor and CxA prior to continuing the commissioning process.

R. Project Manager (PM): A staff position for a particular entity with decision making authority.

S. Project Manual (Specifications): A bound manual containing the general administrative and trade section specifications.

T. Seasonal Performance Tests: Functional performance tests that are deferred until system design conditions can be replicated or simulated.

U. Start-up: The initial start-up or activation of equipment, a system or component of the Work.

V. Owner Representative: Contracting Officer or entity with the highest level of responsibility for directing the project. The Contractor shall keep the Commissioning Plan up-to-date with the names and contact information for each of the Owner's Representatives.

W. Owner-Contracted Tests: Tests paid for by the Owner outside the Contractor's contract and for which the CA does not oversee.

X. Training: Provided by the Contractor and including Instructions and hands-on demonstration of operating and maintaining systems and equipment.

Y. Trending: Monitoring of equipment and sequences using the building control system or data loggers performed by the Controls Contractor after final balancing has been performed and accepted. Trending shall capture building performance for a 24-hour period.

Z. Vendor: Supplier of equipment of service.

1.08 THE COMMISSIONING TEAM

A. The commissioning team consists of all members necessary to execute the approved Commissioning Plan. The team includes the CxA, Contractor, Subcontractors, suppliers, vendors, Owner, operations staff, A/E team, certification agencies, members of the local building authority having jurisdiction and others deemed appropriate to execute the Commissioning Plan.

B. Members appointed by the Contractor and Subcontractors include individuals (Commissioning Coordinators) having the authority to act on behalf of the entity they represents, explicitly organized to implement the commissioning process through coordinated

action. Team members representing the Contractor shall include the project superintendent; and commissioning coordinators representing the subcontractors, installers, suppliers, vendors, and specialists deemed appropriate by the CxA.

C. Members appointed by Owner:

1. Commissioning Authority.
2. Construction Management Team
3. Facility user's staff members.
4. Operation and maintenance personnel.
5. Architect and engineering design professionals.

1.09 OVERVIEW OF THE COMMISSIONING PROCESS

A. CxA shall coordinate its efforts with the Owner and A/E team to ensure that it understands that systems/equipment operating and performance expectations will be promptly implemented in coordination with systems/equipment acceptance criteria.

B. CxA shall document all interactions and coordination meetings concerning the commissioning aspects of the project. The Lead Commissioning Coordinators shall be included in the meetings and copied with exchange of coordination materials.

C. CxA shall have developed a draft Commissioning Plan prior to the bidding phase and shall finalize the draft Commissioning Plan during the construction phase.

D. CxA shall conduct a review of all Contractor submittals which relate to commissioned equipment.

E. CxA will prepare PFT and FPT checksheets and submit to the Contractor for his use with execution of the Commissioning Plan.

F. CxA will conduct and record minutes of a site pre-installation commissioning "kick-off" meeting at an agreed-upon time after the Contractor and Subcontractors have been identified. The CxA shall explain the Cx process in detail and identify specific commissioning-related responsibilities of the Contractor and each subcontractor.

G. On-going Cx status meetings shall be scheduled by the CxA to occur during the construction phase to monitor progress and to help facilitate the Cx process. The Contractor's Lead Commissioning Coordinators shall be required to attend these meetings. The CxA shall record and take minutes of these meetings.

H. Once Contractors have provided the CxA with written verification indicating that the installation and start-up PFT check sheets have been completed, the CxA shall conduct an on-site inspection, coordinated with the presence of the appropriate subcontractor, of the specific systems and equipment. The CxA shall provide the PFT check sheets to the Contractor.

I. Upon confirmation of system readiness, the CxA shall schedule with the Contractor and appropriate subcontractors, to perform functional performance tests to verify compliance with the Contract Documents. The CxA shall provide the FPT check sheets to the Contractor and oversee the process for these tests.

J. All results of such tests which indicate performance not in accordance with the requirements of the test documents shall be documented by the CxA on the Issues Log. When easily corrected, issues shall be resolved by the Contractor at the time of discovery. All other issues shall be resolved by the responsible Contractor in a timely manner. All deficiencies will be noted by the CxA as either resolved or pending resolution. When resolved, the Contractor shall return communications to the CxA for his review and action.

K. The construction phase Cx process will be complete when all noted deficiencies have been corrected and proven to comply with the Contract Documents or otherwise resolved to the satisfaction of the Owner.

L. Following the date of substantial completion, at no later than ten (10) months thereafter, the Cx process shall include a review of systems performance with the Owner's operations staff present. Such review shall identify aspects of performance not in accordance with the requirements of the Contract and development of a resolution plan to make the necessary corrections.

1.10 COMMISSIONING AUTHORITY'S RESPONSIBILITIES

A. The primary role of the CxA is to develop and coordinate execution of the Commissioning Plan through its organization and leadership of the project Cx team.

B. The CxA is not responsible for the design concepts, design criteria, code compliance, construction scheduling, means and methods, cost estimating, or construction management.

C. The CxA shall provide a draft and final Commissioning Plan.

D. The CxA shall review Cx-related record construction documents prepared by the A/E, and approved submittals which relate to aspects of Work requiring Commissioning. And shall communicate noted deficiencies and concerns to the Owner.

E. The CxA shall review and approve training and maintenance criteria as developed by the Contractor.

F. The CxA shall develop detailed and specific operational and functional testing procedures for equipment and systems to be commissioned (including project-specific construction checklists).

G. The CxA shall coordinate Cx meetings as necessary to facilitate the Cx process, maintain the project schedule, assist with resolving identified issues, and provide meeting minutes to Cx team.

H. The CxA shall review the TAB specifications and reports, and randomly check not less than 10 percent of the items identified in the TAB report. Performance results shall be compared against the design requirements stated in the Contract documents and approved submittals.

I. Perform site inspections and verify Contractor readiness for the operational and functional testing process. Document observed conditions in site visit reports and distribute to the Owner.

J. Verify the execution of Cx process activities. Verification shall include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, random sampling, tests, and test reports to verify compliance with the project requirements.

K. Prepare and maintain the commissioning issues log.

L. Attend Contractor-performed systems, assemblies, equipment, and component start-up whenever scheduled in advance or required by the Owner.

M. Collect all related documentation from the Contractor, including, but not limited to, start-up forms, flush-out verification, pressure tests, testing and balancing data, PFT and FPT checklists, site visit reports, issues log, and all other forms used to document the commissioning process. Review the closeout documentation with the mechanical and electrical engineers and prepare the agenda of items to be clarified or tested to complete the commissioning process for the Owner's acceptance of the systems.

N. Recommend acceptance of systems/equipment to the Owner after all items of commissioning have been successfully completed.

O. Provide the Owner with a final Cx report to document the Cx process and to verify that the Cx process has been completed.

1.11 OWNER'S RESPONSIBILITIES

A. Ensure the participation of Owner's chosen representatives as required to complete the commissioning process.

B. Assign O&M personnel and schedule them to participate in Cx team activities.

1.12 ARCHITECT/ENGINEER'S RESPONSIBILITIES

A. Notwithstanding any related designations of performance on the part of the A/E which may appear in the executed A/E Agreement with the Owner, the A/E will generally, to the best of the A/E's knowledge, information and belief, perform the following in connection with Commissioning. Where conflicts occur, the requirements contained in the executed A/E Agreement with the Owner shall prevail.

B. The A/E will review the Cx documentation and provide written comments as necessary to the CxA and the Owner.

C. The A/E will provide, in a timely manner, the necessary representatives as required to allow the CxA to complete the commissioning process. The A/E team members will, to the best of their ability provide timely replies to RFI requests issued during the Cx process. Copies of all submittals pertaining to equipment to be commissioned will be transmitted by the Owner to the CxA for review and comment.

D. The A/E will assist the CxA in determination of final controls system input/output points list and sequences of operation as required to complete functional test procedures with the Owner, CxA, and controls contractor.

E. Assist the Cx team in resolving technical problems that arise during construction, start-up and functional testing.

1.13 CONTRACTOR'S RESPONSIBILITIES

A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform Cx process activities including, but not limited to, the following:

1. Prepare equipment submittals for review by A/E and CxA.
2. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation and performance, recommend corrective action.
3. Cooperate with the CxA for resolution of issues recorded in the issues log.
4. Attend Cx meetings as required to facilitate the Cx process.
5. Integrate and coordinate Cx process activities with the current Master Construction Schedule, required building purge, or occupancy schedules. The schedule generally will identify milestones, including but not limited to, the completion of all Contractor pre-commissioning checklists, preliminary TAB reports, operational and functional performance testing, initiation and completion of the performance period indicated in the appropriate specification, and training for the systems specified. The initial schedule shall identify the pertinent Cx milestones as outlined herein.
6. Coordinate all subcontractor or vendor training required per Contract Documents.
7. Coordinate all subcontractor or vendor activities necessary to identify and correct deficiencies during the Warranty period.
8. Factory-test and commission critical systems for the modular BSL-3 swings space prior to partial disassembly, packing and shipping for re-assembly at the project site. Provide documentation regarding factory testing for the commissioning of critical systems at the project site prior certification for BSL-3 select agent work.

1.14 MECHANICAL CONTRACTOR'S RESPONSIBILITIES

A. Coordinate participation of the Mechanical Subcontractors in the Cx process. This shall include but not be limited to ensuring compliance with the Project Specifications and approved submittals for HVAC, Piping, Plumbing, Fire Protection, and other related Disciplines.

B. Coordinate installation of mechanical systems and equipment with equipment suppliers, mechanical subcontractors, and electrical contractor. Verify that coordination, installation, quality control, and final subcontractor testing have been completed to ensure that installed systems and equipment comply with construction documents.

C. Notify the CxA and Contractor immediately upon becoming informed of any issues identified during construction that may affect the Cx process or final system performance.

D. Complete PFT and FPT documentation.

E. Process the CxA's issues log to the appropriate parties for timely resolution and return to CxA for recheck.

F. Perform start-up and testing of mechanical equipment and systems and document performance inappropriate with start-up reports, and submit to the CxA.

G. Attend Cx meetings as required to facilitate the Cx process.

H. Operate equipment and systems as required for operational and functional performance testing.

I. Provide appropriate assistance during the fine tuning or troubleshooting of systems or equipment to ensure proper performance.

J. Provide complete operation and maintenance information and final record drawings to the Contractor for verification, organization, and distribution.

K. Provide training for the systems specified. Submit the training plan and agenda, at least two (2) weeks in advance of the scheduled trainings, to the CxA for acceptance. Training shall not be performed until the Cx process is complete and the training plan and agenda have been approved by the CxA.

1.15 ELECTRICAL CONTRACTOR'S RESPONSIBILITIES

A. Coordinate participation of the electrical subcontractors in the Cx process. This shall include, but not be limited to, ensuring compliance with the Project Specifications and approved submittals for Fire Alarm, Controls, and other related Disciplines.

B. Coordinate the installation of electrical systems and equipment with equipment suppliers, electrical subcontractors, and mechanical contractor.

C. Verify that coordination, installation, quality control, and final subcontractor testing have been completed to ensure that installed systems and equipment comply with construction documents.

D. Notify the CxA and Contractor immediately upon becoming informed of any issues identified during construction that may affect the commissioning process or final system performance.

E. Complete PFT and FPT documentation provided by the CA as required.

F. Perform start-up and testing of electrical system equipment and systems and document performance inappropriate with start-up reports, and submit to the CxA.

G. Operate equipment and systems as required for FPT.

H. Provide proper assistance during fine-tuning or troubleshooting of system performance to ensure proper performance.

I. Provide complete operation and maintenance information and final record drawings to the contractor for verification, organization and distribution.

J. Provide training for the systems specified. Submit the training plan and agenda, up to two (2) weeks in advance of the scheduled trainings, to the CxA for acceptance. Training shall not be performed until the Cx process is complete and the training plan and agenda have been approved by the CxA.

1.16 FIRE ALARM CONTRACTOR'S RESPONSIBILITIES

A. Provide CxA and control contractor with fire alarm system and wiring diagrams, narrative sequences of operation prior to Cx.

B. Provide proper assistance during in all efforts to finalize sequences of operations with the Owner, A/E, and CxA, to ensure proper performance.

C. Coordinate installation of fire alarm system with equipment suppliers, mechanical subcontractors, and electrical contractor.

D. Verify that coordination, installation, quality control, and final subcontractor testing have been completed to ensure that installed systems and equipment comply with construction documents.

E. Notify the CxA and Contractor immediately upon becoming informed of any system installation issues identified during construction that may compromise system control capability.

F. Provide proper assistance during start-up and operational and functional testing to ensure proper performance.

G. Provide complete supporting documentation as required to demonstrate completion of fire alarm system installation, point verification, start-up and testing, and submit to the CxA.

H. Attend Cx meetings as required to facilitate the Cx process.

I. Provide the CxA with final documentation of all installed conditions, including final record drawings and detailed narrative sequences of operation as determined during Cx process.

J. Provide training for the systems specified. Submit the training plan and agenda, up to two (2) weeks in advance of the scheduled trainings, to the CxA for acceptance. Training shall not be performed until the Cx process is complete and the training plan and agenda have been approved by the CxA.

1.17 CONTROLS CONTRACTOR'S RESPONSIBILITIES

A. Provide CxA, mechanical and electrical contractors with controls system and wiring diagrams, narrative sequences of operation, and software documentation printout of actual programmed sequences prior to Cx.

B. Provide proper assistance in all efforts to finalize sequences of operations with the Owner, A/E, subcontractors and CxA to ensure proper performance.

C. Coordinate installation of controls system with equipment suppliers, mechanical subcontractors, and electrical contractor. Verify that coordination, installation, quality control, and final subcontractor testing have been completed such that installed systems and equipment comply with construction documents.

D. Notify the CxA and Contractor immediately upon becoming aware of any system installation issues identified during construction that may compromise system control capability.

E. Provide proper assistance during start-up and operational and functional testing to ensure proper performance.

F. Complete contractor pre-commissioning checklist and other supporting documentation as required to demonstrate completion of control system installation, point-to-point verification (including sensor calibration), start-up and testing, and submit to the CxA.

G. Review and provide evaluation of CxA furnished functional performance test sheets with regard to adherence to the approved sequence of operation.

H. Participate in FPT of mechanical equipment. Place specific systems as directed by CxA into test modes for FPT.

I. Attend Cx meetings as required to facilitate the Cx process.

J. Participate in the controls integration meetings to discuss control sequences, devices, scope of work and Owner's operation of the systems.

K. Provide proper assistance in fine-tuning or troubleshooting of system performance if either of these measures becomes necessary.

L. Provide the CxA with final documentation of all installed conditions, including final record drawings and detailed narrative sequences of operation as determined during Cx process.

M. Provide training for the systems specified. Submit the training plan and agenda, up to two (2) weeks in advance of the scheduled trainings, to the CxA for acceptance. Training shall not be performed until the Cx process is complete and the training plan and agenda have been approved by the CxA.

1.18 TEST, ADJUST, AND BALANCE (TAB) CONTRACTOR'S RESPONSIBILITIES

A. Review the Cx plan, schedule, and functional test procedures. Provide information assistance and documents required to develop final plans and procedures.

B. Coordinate balancing activities with those of the mechanical and controls contractors. Verify that coordination, installation, quality control, and final subcontractor testing have been completed to allow proper balancing work to be performed.

C. Notify the CxA and Contractor immediately upon becoming aware of any system installation or performance issues that may compromise the ability of the system to be balanced.

D. Provide proper assistance during start-up and testing to ensure proper performance.

E. Attend Cx meetings as required to facilitate the Cx process.

F. Provide preliminary TAB report, indicating all actual field values recorded, to the CxA and designer, prior to initiation of operational and functional testing. A preliminary TAB report shall be submitted within seven (7) business days after completion of the balancing work. Should Project conditions require that the TAB work be divided by logical systems, the preliminary TAB report shall be submitted in logical sections within seven (7) business days after completion of the balancing work on each system.

G. Provide proper assistance during the operational and functional testing to ensure proper performance.

H. Coordinate with CxA a minimum of 10 percent verification of selected systems identified by the CxA.

I. Provide proper assistance during fine-tuning or troubleshooting of system performance if either of these measures becomes necessary.

2.00 PRODUCTS

2.01 TEST EQUIPMENT

A. All standard testing equipment required for performing PFT and FPT on each piece of equipment or system shall be provided by the Contractor who provided that piece of equipment or system.

B. Special or proprietary equipment, tools and instruments (only available from vendor or specific to a piece of equipment) required for testing equipment shall be included in the Contractors' base bid price and shall remain on-site as required for use by the CxA. When no longer required, such items may be removed by the party that provided them.

C. The provider of such testing equipment shall ensure that such equipment is of sufficient quality and accuracy to test and/or measure system performance with the tolerances indicated in the specifications. Equipment shall be certified to have been calibrated within the last year and in accordance with the manufacturer's specifications. Equipment that has been dropped or otherwise damaged, shall either be re-calibrated immediately or removed from the site. Calibration certificates shall be readily available upon request by the CxA.

D. All test equipment shall utilize Standard measurements unless otherwise required by the Commissioning Authority.

2.02 SYSTEM PFT AND FPT CHECKSHEETS

A. The PFT and FPT check sheets are formatted and provided to the Contractor by the CxA. The check sheets include fields that shall be filled in by the construction team and CxA as required in the Commissioning Plan. Examples of information requested the check sheets include, but are not limited to:

1. Design values.
2. Equipment identification numbers.
3. Manufacture make and model numbers.
4. Submittal data.
5. Sequences of operation.
6. Installation verification.
7. Start-up and operational verification.
8. Acceptance test procedures.
9. Functional verification.

3.00 EXECUTION

3.01 NOTIFICATION OF SYSTEM COMPLETION AND RE-INSPECTION COSTS

A. Commissioning shall commence after punch list items are completed.

B. Two (2) weeks prior to the beginning of start-up or test activities for each system, the Contractor shall provide a detailed projected schedule. This schedule shall be updated weekly and shall provide information including date, time, beginning location, and anticipated duration of each start-up or test activity. Contractor shall notify the CxA in writing at least 72 hours in advance of any changes to this schedule. The CxA will witness the equipment start-up by the manufacturer's representative per the specifications.

C. When systems are ready for final Cx verification, Contractor shall notify the CxA in writing at least 72 hours in advance.

D. Should the initial verification test for systems/equipment reveal items that are not performing in accordance with the requirements of the Contract Documents, the CxA will provide one re-inspection of the item at no additional cost to the Contractor. The Contractor shall be responsible for re-inspection and other related costs incurred by CxA if the second and subsequent systems/equipment verification tests do not indicate performance as specified.

3.02 VERIFICATION OF PERFORMANCE

A. Verification of performance will take place after formal written notice by the Contractor that the pre-functional test (installation and operational) checklists have been signed-off.

B. Performance demonstration shall be done by the systems and equipment trade representatives and will be witnessed by the CxA.

C. Verification will include demonstration of performance listed in the functional testing data sheets.

D. The specified, submitted and other data shall be entered on the equipment data sheets prior to the verification.

E. The witnessed performance data will be added to the data sheet at the time of verification.

3.03 COMMISSIONING DOCUMENTATION

A. The Contractor shall complete PFT and FPT check sheets for all systems/equipment and provide documentation that states that the check sheets are accurate.

B. The Contractor shall provide the approved O&M manuals to the Owner and CxA prior to commencement of training. The manuals shall include, but not be limited to the following information:

1. Design data.
2. Operating data:
    a. Performance curves.
    b. Acceptance criteria.
    c. Control sequence of operation.
    d. Start-up reports.
    e. TAB reports.
    f. Maintenance recommendations and requirements.

C. The CxA shall review record drawings, O&M manuals, and resolution of items listed on the Cx Issues Log for completeness prior to approval of the training schedule.

D. The Contractor shall provide training to the Owner's operations and maintenance personnel (and, if applicable, contracted maintenance vendors) prior to Substantial Completion of the project. Training shall utilize the final record drawings as part of the training materials.

E. The CxA shall document and communicate, in writing, deficiencies with the PFT and FPT check sheets, O&M manuals, Record Drawings, and readiness for commencement of systems/ equipment training directly to the Owner.

3.04 TRAINING THE OWNER'S OPERATIONS AND MAINTENANCE STAFF

A. The Owner's operations and maintenance personnel (and, if applicable, the Owner's contracted maintenance vendors) will be given comprehensive training in the understanding of the systems and the operation, maintenance, and repair of each major piece of equipment and system in accordance with the approved agenda and curriculum.

B. The Contractor, in cooperation with the CxA, shall be responsible for coordinating and scheduling the training. Hands-on training shall include start-up, operation in all modes possible, repair, safety, shutdown and emergency procedures, if any.

C. On-site classroom training sessions shall be scheduled as part of the training requirements.

D. The Contractor or his authorized representative, including associated manufacturers' representatives, shall conduct all sessions and shall include in each session all special information relating to the details of commissioning as it might impact the operation, maintenance, and repair.

E. Training shall include a review of approved submittals, the as-built drawings and O&M data.

F. Each subcontractor and vendor responsible for training shall submit a written training plan to the CxA for review and approval prior to commencement of training. The training plan shall include, but not be limited to, the following elements:

1. Equipment included in each training session.
2. Location of the equipment.
3. Intended audience including names and contact information.
4. Location, date/time and duration of each training session.
5. Topics and learning objectives.
6. Instructor including individual's contact information and qualifications for each topic.
7. All training methods shall include a classroom lecture and an actual operational demonstration of start-up, turn-down and maintenance procedures.

G. Video taping is required and shall be the responsibility of the Contractor for all training sessions. Tapes or DVD's shall be cataloged and added to the O&M manuals. The Contractor shall submit samples of video/audio quality for approval prior to commencement of the first training session.

3.05 COMMISSIONING ACCEPTANCE CRITERIA

A. The CxA acceptance criteria will be developed as a result of reviews of the Contract Documents and approved submittals, as well as equipment manufacturer's operating criteria. The Contractor is responsible for complying with contractual requirements.

3.06 FINAL COMMISSIONING REPORT REQUIREMENTS

A. The CxA shall submit a final report to the Owner which includes a statement that the project conforms to the requirements of the Contract documents and approved submittals, and such report shall include a narrative of the results of the completed inspections, operational and functional testing. The final report shall also include an outline of the deficiency list and dates identifying items found and dates items corrected. All unresolved items shall be identified in the report. Technical data from the equipment shall be included as well as all test results, manufacturer's start-up sheets, and testing, adjusting, & balancing (TAB) reports. The CxA will furnish a CD to the Owner. The CD shall be menu-driven and include all required documentation included in the final report.

B. At the conclusion of the commissioning process and after the final summary has been completed, the CxA shall be required to formally recommend, in writing, system and equipment performance acceptance to the Owner. Copies will be forwarded to the Contractor.

C. The final commissioning report will include, but is not limited to the following:

1. Summary.
2. Commissioning plan.
3. Commissioning site visit reports.
4. Submittal reviews.
5. O&M data reviews.
6. Training record & evaluations.
7. Pre-functional and Functional Test procedures.
8. System/equipment data sheets.
9. Contractor pre-commissioning checklists with start-up reports.
10. Pre-functional and Functional Test check sheets.
11. Inspection reports.
12. Issues Log (accepted and unaccepted items).

END OF SECTION 01800

Read and accepted as part of the Contract:

_____
Bidder/Contractor

SECTION 01810
FUNCTIONAL PERFORMANCE TESTING

1.00 GENERAL REQUIREMENTS

1.01 WORK INCLUDED

A. Functional Performance Testing (FPT) of systems.

B. Documentation of Functional Performance Tests and Results.

C. Acceptance criteria.

1.02 SCOPE

A. This section describes the Functional Performance Testing (FPT) process, procedures, and requirements. It is intended to illustrate (i) the Contractor's requirements for assisting the Commissioning Authority (CxA) with the functional performance testing of systems, and (ii) to demonstrate the level at which systems and equipment will be tested prior to being deemed 'Acceptable' to the Owner.

B. The CxA will prepare itemized and detailed testing plans and procedures that:

1. Specify individual tests and procedures that meet the general requirements of the Cx Plan and commissioning process;

2. Serve to document and record the testing procedures and the results of the tests.

C. The Contractor shall provide technical input to the CxA as needed during the development of the final project FPTs.

D. Example (referred herein to as 'generic') FPTs are provided as illustration to the Contractor of the level of detail to which FPTs will be conducted.

1.03 RELATED WORK AND DOCUMENTS

A. Commissioning Plan: The Cx Plan is part of the Contract Documents and outlines many of responsibilities, procedures and tasks throughout the Cx process. It encompasses the entire Cx process including phases prior to construction and roles of all Parties. It also describes the Functional Performance Tests that will be performed during the Acceptance Phase.

B. Section 01800: Specifies the general facility commissioning procedures common across all Divisions and the Contractor's responsibilities for the commissioning process.

C. Section 15959 – Building Automation Systems Commissioning: Details the commissioning procedures specific to the Building Automation System.

D. Section 15995 – Mechanical Systems Commissioning: Details the commissioning procedures specific to Division 15 work.

E. Individual Specification Sections: Individual sections stipulate installation, start-up, warranty, O&M documentation, and training requirements for the system or device specified in the Section.

1.04 DEFINITIONS AND ABBREVIATIONS

A. Refer to Section 01800.

1.05 FUNCTIONAL PERFORMANCE TESTING

A. Objectives and Scope: Each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.

1. Normal Operation: In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. These series of tests will demonstrate that the systems and equipment operate throughout typical operation including normal adjusting, cleaning, media replacement, and maintenance.

2. Abnormal Operation: Test each system to simulate possible abnormal conditions and verify proper responses to such modes and conditions as power failure, equipment and component failure, freeze condition, deviation of operating parameters outside of normal, no flow, supporting utility failure, human error, etc. This series shall demonstrate proper and safe response to the focus systems and the other systems that it affects or integrates with. These test shall also demonstrate proper enunciation of abnormal conditions to quickly and effectively notify users and operators of such condition. Specific modes required in this project are given in this section and any other sections where test requirements are found.

B. Development of Test Procedures. CxA shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Prior to execution, the CxA shall provide a copy of the test procedures to the Contractor who shall review the tests for feasibility, safety, equipment and warranty protection, and scope. The CxA will also submit the tests to the design architect and engineer and Construction Manager for review.

1. Contractor shall review the FPTs in detail and approve them.

2. The CxA shall review Owner-contracted testing, factory testing, or required Owner acceptance tests for which the CxA is not responsible to oversee. Review shall include content, scope, and documentation format, and shall determine what further testing or format changes may be required. Redundancy of testing shall be minimized.

3. The purpose of any given specific FPT is to verify and document compliance with the stated criteria of acceptance.

C. Scheduling: After Contractors notification that systems are ready for testing and submittal and review of all the required submittals has occurred, GC shall schedule the testing. To the extent practical, tests shall be scheduled to allow efficient and contiguous testing of inter-related systems and equipment.

D. Participation: CxA will direct and conduct functional performance tests after Start-Up Procedure documentation of systems and equipment has been reviewed and accepted. Conceptual procedures for the functional performance testing are outlined elsewhere in this Section. CxA will execute the FPTs unless otherwise specified. Contractor shall assist as described above with manipulation of the systems or equipment, provision of supporting equipment or materials (lifts, ladders, specialty test equipment, safety equipment), and on-the-spot remediation of minor identified deficiencies whenever possible. Required participation is outlined in the generic FPTs provided elsewhere in this Section.

1. Required participating Parties shall be as indicated with each individual FPT. Typically, multiple Parties are required for any given test, yet participation for any given Party is only required for the respective portion of the test for which the Party is responsible. For instance, BAC does not have to be present for capacity testing of an air handler, only the control-related portion of the test. In many cases, the maximum required time in hours is indicated in parenthesis for any given test. The time is typically total time for all covered units, unless indicated otherwise. If no time is indicated, participation is required throughout the entire test.

2. Frequently, on multiple samples where a given Party does not directly conduct the test, the participation of that Party will only be required for an initial quantity of systems/equipment. Whenever practical and at the discretion of the CxA, the CxA will continue with the remaining portion of the sample without assistance from the Contractor. In this case the time requirement will be

indicated as total. However, the Contractor is allowed to be present at their option for any or all FPTs conducted.

3. It is required that the required Parties be available on-site throughout the testing of any given system for which they are required participants. Therefore, time for which they are not directly involved can be spent performing other work (typically addressing identified punch list items or failed tests).

4. No Party involved with the project is prohibited from participation in or witnessing of any tests. Any Contractor may elect to witness all tests on their systems even if their involvement is not directly required (for instance, BAC involvement is sometimes required on the first few of a sample and not on the entire sample).

5. CxA will endeavor to coordinate effectively with the individual Contractors throughout FPT and minimize their required involvement.

6. Contractor assumes responsibility for damage to systems conducted in accordance with the approved procedures.

F. Detailed Test Procedures and Contractor Review: CxA will prepare detailed and itemized testing procedures to define and document the FPT. These will be developed during the Construction Phase and completed during the Acceptance Phase. The CxA shall submit these procedures to the Contractor for review. Contractor shall indicate all required limitations, safety procedures, maximum thresholds, and any other parameters during the FPT development. Contract shall be responsible for any damage to the equipment caused by functional performance testing done per the procedures and within the limitations of the approved procedures.

G. Completeness: All systems must be completed and ready for FPT. All start up, factory authorized field testing, independent testing agency tests, and TAB procedures must be complete and the control systems must be tested and started for the respective system or component.

H. Test Documentation: CxA will conduct tests, and/or witness tests as applicable. CxA will record all test results on the forms developed for the testing. CxA will 'Pass' or 'Fail' the testing and record the date and time of the test. Deficiencies shall clearly be indicated when the test is failed. When all related testing is completed successfully, CxA shall recommend acceptance of the system or component.

I. Deficiencies and Re-Testing: When deficiencies are identified during testing, depending on their extent or magnitude, they can be corrected during the test and the testing can continue to successful completion. More significant deficiencies will require failure of the test and re-testing. Deficiencies of this magnitude will result in an Action Item on the Action List. The resolution of the deficiency will then subsequently be

tracked by the CxA via the Action List. All tests shall be repeated until successful completion. Refer to more specific provisions below.

J. Sampling: Some types of identical equipment (such as terminal devices) will be tested using a sampling strategy. The sample percentage is indicated in the generic FPT provided elsewhere in this Section.

K. Max Failure Limit and Sample Percentages: A Maximum Failure Limit is indicated along with the Sampling Percentages. The Max Failure Limit indicates the maximum percentage of the tested devices that may have any test that fails before an entirely new sample must be tested. This is based on the concept that if many failures occur, it is a result of inadequate start-up by the Contractor. When the maximum number of failures is reached, testing on that sample will be terminated and re-testing will be scheduled.

1. If no Max Failure Limit is indicated, all tested samples must pass (Max Failure Limit 0%).
2. Where sample tests involve multiple systems (i.e., checking strainers on different hydronic systems) the Maximum Failure Limit will apply per system.
3. The responsible Contractors shall pay the CxA cost of that sample test, and redo the start-up/TAB for the applicable devices/systems.
4. The responsible Contractors shall redo the start-up/TAB for the applicable devices/systems.
5. The CxA will repeat the sample. The CxA cost (fee and expenses) to the Owner for repeating tests will be deducted from the Contract Price as reinspections under the terms of the General Conditions.
6. All work necessitated by sample failures shall be at no cost to the Owner.

L. Opposite Season Testing: Testing procedures shall be repeated and/or conducted as necessary during appropriate seasons. Opposite Season testing will be required where scheduling prohibits thorough testing in all modes of operation. Air handler and central heating system testing for heating-related modes of operation and control loops shall be tested during outside air temperatures below 35°F.

M. Approval. The CxA passes each test and subsequently recommends approval to Owner who reviews and approves the FPT.

1.06 COORDINATION BETWEEN TESTING PARTIES.

A. Factory Start-Ups: For many systems and equipment, Factory Start-Ups are specified. These Factory Start-Ups will be reviewed and checked during functional performance testing. All costs associated with the Factory Start-Ups are included with the bid unless otherwise noted. In general, Contractor shall make notification of when Factory Start-

Ups are occurring and coordinate these with witnessing Parties. The CxA and CxT members may witness Factory Start-Ups at their discretion. Aspects of functional performance testing accomplished during the Factory Start-Ups may be accomplished and approved by the CxA if they meet the intent of the FPT.

B. Independent Testing Agencies: For systems where Independent Testing Agencies are specified, the cost of this testing is included with the bid unless otherwise noted. Much of the testing performed by these independent agencies will cover aspects required in the Start-Up Procedures and functional performance tests.

1. Contractor and testing agencies shall coordinate with the CxA so that the CxA can witness the testing and approve the applicable aspects of the FPTs.

2. The CxA may in some cases independently spot-check work of the testing agencies if the tests were not witnessed. However, it is not the intent for the CxA to reaccomplish testing by others that is specified in the construction specifications. For instance, much of the testing requirements for the electrical systems will be performed by the independent electrical testing agency provided under the bid. The CxA shall witness the indicated sample of the testing and record the results in the record of functional performance tests.

3. Contractor is responsible for coordinating the efforts of testing agency with that of the Cx process. Documentation shall be contiguous and seamless and duplicationshould be avoided. Testing agencies shall complete the documentation of the Cx process as required.

C. Specialized Testing by Contractor: Where specialized testing is specified in the technical specifications, Contractor, subcontractor, vendor, or factory representative as applicable shall conduct the specified testing and provide all specialized instrumentation and equipment. CxA and other CxT members may witness tests at their discretion. The CxA may in some cases independently spot-check the results of the tests if the tests were not witnessed. However, it is not the intent for the CxA to re-accomplish testing that is specified in the construction specifications. All specialized testing procedures shall be integrated with the Cx process and all documentation shall be coordinated and integrated with the documentation of the Cx process. Examples of specialized testing include:

1. Generator load testing (not building power outage functional testing which will be administered by CxA)
2. Acceptance testing of the Fire Alarm System
3. Water purity tests on a RO/DI system
4. Fire suppression system hydraulic tests
5. Laboratory Gas Cross Connection testing
6. Uninterruptible Power Supply

7. Fume Hood Acceptance Testing
8. Electrical System Testing per NETA
9. Liquid Waste Decontamination System

1.06 FPT ACCEPTANCE CRITERIA

A. The Acceptance Criteria shall be as follows unless more specifically indicated within individual tests. CxA may exercise professional judgment to relax requirements and pass tests and recommend approval when appropriate.

1. Capacity and/or equipment performance will generally be as specified ±5%.
2. Efficiency where specifically indicated in the documents will be ±5%. When inferred from manufacturer's catalogue data, criteria will be ±10%.
3. Balancing-related criteria will be ±10% for water and ±10% for air.
4. Accuracy/repeatability on sensing devices will be as specified for the device. CxA and TAB will use calibrated gages for independent validation and use judgment in passing or failing the devices. In many cases, the coordination of multiple related sensors is more important than absolute accuracy.
5. Loop response and setpoint deviation criteria will be as specified in Section 15959 and 15960 as applicable.
6. HVAC sequence-related criteria will be as explicitly specified in the documents and as interpreted by the CxA. Code required sequencing shall be per the applicable code.
7. System sequences shall be as required by the approved shop drawings.
8. Motor Phase Imbalance: Shall be no more than 2% (Amps and Volts).
9. Noise Levels:
    a) Occupied spaces: As indicated in the *Basis of Design* document or equipment specifications. Otherwise, noise level shall be as recommended in the most current version of the ASHRAE Handbooks for the applicable occupancy.
    b) Max 77dBa at 960 mm (3'-0") from a UPS.
    c) Max 65dBa at 7' from an Engine Generator Set.
    d) At limits of the enterprise or facility: As required by current local ordinances.

10. Indoor Environmental Parameters (T, RH, CO2, VOC): Shall be as indicated in the *Basis of Design* document. Otherwise, as recommended in the most current version of the ASHRAE Handbooks for the applicable occupancy.

11. Air Pressurization: As indicated in the *Basis of Design* document. Otherwise, as indicated in the most current version of the ASHRAE Handbooks for the applicable occupancy. Smoke/shaft pressurization shall be as required by NFPA to maintain maximum door opening forces and to restrict the passage of smoke.

12. Indoor Lighting Levels: As indicated in the *Basis of Design* document. Otherwise, as recommended in the most current version of the IES Handbooks for the applicable occupancy.

13. Electrical Systems: Shall be in accordance with manufacturer's recommendations of individual components and devices, NFPA 70B and International Electrical Testing Association (NETA) testing specifications NETA ATS-Latest Version.

14. Inter-system interfaces and coordination: as specified and generally to ensure safe, reliable, and robust operation.

15. Biosafety Cabinets: With fans off and sash at normal position:
    a) Average Face Velocity 100 fpm +- 10 cfm
    b) Max Face Velocity Deviation: 15%

16. Fume Hood Response: As defined in the modified ASHRAE procedure. This includes:
    a) Face Velocity 100 fpm±5%
    b) Time to Steady State upon a sash movement (no excursion beyond ±10% of steady state): <2 sec.
    c) Rate of Response to a sash movement: <.5 sec.
    d) Overshoot (peak max and min deviation from steady state in percent of steady state): <15%

2.00 PRODUCTS

2.01 INSTRUMENTATION

A. General: All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. All equipment shall be calibrated according to the manufacturer's recommended intervals. Calibration tags

shall be affixed or certificates readily available. Supplier of instrumentation shall submit the calibration certificates along with the start up documentation.

B. Standard Testing Instrumentation: Standard instrumentation normally used for performance assessment and diagnosis will be provided by the CxA for tests being conducted by CxA. All other instrumentation shall be provided by the Contractor. The instrumentation to be provided by the CxA includes:

1. Electronic Manometer (for Air and Flow Hood)
2. Electronic Manometer (for Water)
3. Temperature Instruments and Gages
4. Humidity Instrument and Gage
5. CO2 Instrument
6. Sound Meter
7. Light Level Meter
8. Electronic Multimeter
9. Power Analyzer (including power factor and THD)
10. Receptacle Tester
11. Tachometer
12. Belt Tensioner
13. Ultrasonic Flow Meter
14. Vibration meter capable of measuring acceleration peak to peak

C. Special Tools: Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and provided to the Owner.

3.00 FUNCTIONAL PERFORMANCE TESTS (SYSTEMS AND EQUIPMENT RELATED)

3.01 PREREQUISITES

A. All equipment, components, and devices applicable to the FPT must be started and the Start-Up must be documented and passed. This includes completion of Start-Up Procedures, pressure testing of equipment, duct, piping; flushing/cleaning of applicable systems; completed labeling and identification; completed insulation of applicable systems; and all other requirements for placing system into dynamic operation.

B. Unless specifically agreed to by the Owner and CxA, all support systems shall be complete prior to FPT. For instance, an air handler will require that:

1. The electrical system serving it is completed and tested;

2. The hydronic systems serving it have been pressure tested, flushed, and functional performance tested;

3. Balancing has been accomplished on the air and water sides;

4. The control systems have been started and calibrated.

C. The CxA shall determine the optimal sequence of testing.

3.2 FUNCTIONAL TESTING PROCESS

A. Functional Testing on any given system shall generally begin with testing device level elements; progress to component level; to system level, to inter-system level to building level.

B. Functional Testing of systems shall generally proceed from the utilities to the central systems, to the distribution systems, to the zone terminal units and services. CxA shall plan this process and communicate it through a precedent diagram (in Gantt and Pert format). Construction Manager shall reflect that process in the Construction Schedule. Subcontractors shall perform work in accordance with the schedule.

3.03 COMMON ELEMENTS FOR ALL SYSTEMS

A. Required submittal documentation shall be present and located convenient to testing area. Validate that all required documentation has been submitted and is per the contract requirements.

B. Contractor shall provide the completed Start-Up Procedures at the time of testing. CxA shall review the Start-Up Procedure documentation and spot-check at the beginning of FPT.

C. Contractor shall demonstrate that access is sufficient to perform required maintenance.

D. BAS trends shall have been established as required in the documents. These shall generally be reviewed prior to or during FPT.

E. All dynamic systems powered by electricity shall be tested to simulate a power outage to ensure proper sequencing. Those on emergency power or uninterruptible power shall be tested on all sources.

F. Capacities and adjusted/balanced conditions as applicable shall be subject to check.

G. Sequencing Verification: All modes of operation and actions shall be verified for equipment/system samples.

H. System and equipment configurations shall be compared against the contract documents.

I. Verify functions (such as heating and cooling) are coordinated and do not overlap or 'fight'.

J. All adjusted, balanced, controlled systems shall be assessed to determine the optimal setting for the system as applicable. The optimal settings should be determined to establish reliable, efficient, safe and stable operation.

K. BAS or Local Panel Dynamic Graphics: The graphic displays for all components, systems, and areas required to be represented by a graphic shall be checked for adequacy and accuracy. Furthermore, when setpoints or other parameters are required to be adjustable, CxA shall verify that they can be adjusted directly from the graphic screen.

L. Emergency power tests for mechanical systems will be conducted in concert with the testing of the emergency power systems. Mechanical contractor shall be available for the power outage test to test mechanical systems under a power outage. This is in addition to the requirements specified for the mechanical system.

M. Where system and zones are designed for various modes of operations and are indicated as such in the Systems Guide, test representative systems in all modes of operation. This includes:

1. Seasonal Modes

2. Sequencing Modes

3. Emergency Modes

3.04 TAB VERIFICATION OF MECHANICAL SYSTEMS

A. CxA shall review TAB reports.

B. Participants shall include: CxA, Owner/GC, and TAB.

C. The CxA will select up to 10% of the readings from the Balancing Reports and spot-check them. The maximum failure rate for this sample is 10% and the system shall be rebalanced and re-documented if this rate is exceeded. The readings selected by the CxA may include supply air diffuser readings (both minimum and maximum readings for VAV boxes), main and branch supply duct traverse readings, outside/return air flow readings, exhaust air flow readings, water flow readings, amp readings, and water pressure drop readings through coils, heat exchangers, and other hydronic elements. For all readings a deviation of more than 10% between the verification reading and reported data shall be considered as failing the FPT. All readings that fail the FPT shall require re-balancing.

3.05 HVAC SYSTEM PUMPS

A. Participants shall include: CxA, MC (4), and ATC (1) (ATC only where pumps are automatically controlled).

B. Sample: 100%.

C. CxA shall review Start-Up Procedures and TAB report.

D. Contractor shall demonstrate that strainers are clean.

E. CxA shall spot check start up procedures

F. Pumps shall be manually started individually. Pressure differential, kW (or slip on the motor), and flow shall be checked at shut-off, wide open, and balanced (or controlled) condition. Generally, the reading from the instrumentation provided with the pump (thermometers and pressure gages and flow meters as applicable) will be acceptable if used to validate an action as opposed to checking balancing.

G. For pumps designed with automatic starting of back-up pump on primary pump failure, test shall include (1) Enable automatic controls; (2) Start primary pump; (3) Open disconnect switch of primary pump; and (4) Validate that standby is energized. Perform this test on both pumps.

H. For variable speed pumps, manipulate control valves to change flow conditions and observe control response. Ensure stable control response to step change in flow conditions. Check for the applicable acceleration and deceleration of the pumps. Manually ramp the pump speed from min. to max. to ensure stable operation of pumps and record/defeat any critical frequencies. Record representative part-load output from the drive (using VSD read out). Check calibration of control input. Check drive bypass operation if applicable.

I. Simulate power outage and ensure orderly and automatic restart.

3.06 HYDRONIC SYSTEMS FPT

A. Participants shall include: CxA, MC (4)

B. Sample: 100% of systems; 20% of strainers, Max Failure Limit: 5%.

C. Check system make-up and pressurization. Check bladder expansion tank precharge pressure. Record optimal settings. Ensure air is removed by bleeding the sample rate of coils or high points. Ensure expansion tanks are properly charged.

D. CxA shall review Start-Up Procedures, pressure test documentation, and TAB report.

E. CxA shall spot check start up procedures

F. Verify sequencing of all pumps. Simulate pump failure and restart, pumps capacity stage up and stage down as applicable, and automatic rotation of lead/priority.

G. Blow off selected strainers to ensure the system is flushed and clean.

H. Refer to TAB verification.

I. Simulate and observe maximum and minimum loading conditions on the system from a flow and thermal perspective.

3.07 VARIABLE SPEED DRIVES

A. Participants shall include: CxA, MC (1), BAC (2), EC (1) VFD Factory Startup Technician (2). Additional time is generally included with the systems that include the drives.

B. Sample: 100%

C. CxA shall review Start-Up Procedure.

D. Verify the overload protection.

E. Test the operation of the controller local and remote start/stop and speed control. Spotcheck insulation resistance on the controller bus and control circuits.

F. Validate setup parameters are coordinated with motor application.

G. Validate Acceleration and Deceleration Rates on start and stop.

H. Verify ranging of control input and coordination with that displayed on Operator Interfaces.

I. Verify 'Bypass' functionality where applicable

J. Verify restart after power outage.

K. Verify any Skip Frequencies.

L. Verify alarming and shutdown sequences.

M. Conduct insulation resistance, short circuit, and ground tests of motors.

3.08 WATER-COOLED CHILLER

A. Participants shall include: CxA, MC (1), BAC (2) and chiller vendor startup technician (2).

B. Sample: 100%

C. Run up the loads by starting the air handling units, chilled water pumps, condenser water pumps and enable the chiller control system.

D. Verify that flow is established by the condenser water proof of flow switch.

E. Verify that flow is established by the chilled water proof of flow switch.

F. Verify the chiller start sequence.

G. Verify functioning of "soft start" sequences, record motor amperage as a time function.

H. Verify cooling tower controls function properly.

I. Confirm that the control system calculates the chiller load and provides a trend log of the load imposed. Record chiller amperage and voltage at full load and part load conditions.

J. Verify the chiller shut down sequence when the loads are shut down (removing load on the chilled water system).

K. Verify the operation of the condenser pump, chilled water pumps and the cooling tower when the loads (air handling or terminal units) are restarted.

L. Verify proper stage-up and stage-down sequence of multiple chillers. Check for excessive chiller cycling at part load for chillers with staged capacity control.

M. Check capacity and efficiency of the chiller.

N. Check calibration of remote current limit or remote setpoint indication.

O. Verify proper suction, head, and oil pressures.

P. Verify the rotation and re-prioritization of the chillers per the sequence.

Q. Simulate power outage and ensure automatic and orderly restart.

3.09 PRIMARY CHILLED WATER (OR GLYCOL) SYSTEM

A. Participants shall include: CxA, MC (1), and BAC (1).

B. Sample: 100%

C. CxA shall review Start-Up Procedures and TAB reports.

D. Verify the cooling enable/disable sequences.

E. Verify proper stage-up and stage-down of the chillers by the control system as load is varied. Load can be varied by manipulating valves, starting/stopping chilled water terminals and/or changing the staging control parameters.

F. Verify proof and enunciation of individual chillers upon failure. Simulate failures that cause both an automatic reset of the chiller (typically temporary condenser water flow loss) and manual reset of the chillers. Verify that chiller requests are removed appropriately and the next chiller in rotation is energized.

G. Verify rotation and/or re-prioritization of multiple chillers as applicable, whether manual or automatic rotation is employed.

H. Ensure the static pressure setting of the make-up water system is coordinated and that the entire system is under positive pressure throughout all modes of operation.

3.10 COOLING TOWER CHEMICxAL TREATMENT

A. Participants shall include: CxA, MC (1), and BAC (0.5).

B. Treatment supplier shall sample cooling tower water weekly and test for suspended solids. Record solids meter reading for each sample to verify accuracy. Continue sampling to assure solids concentration maintenance of 2000 ppm for three samples.

C. Record reading on tower make-up water supply meter, compare to chiller load summation of ton-hours. Make-up water use should be 4 gal per ton or 2.5% of the total flow. Report variance. Record amount of chemical used, forward to water treatment contractor for review and approval based upon amount of make-up water used.

3.11 HOT WATER (OR GLYCOL) PRIMARY SYSTEM

A. Participants shall include: CxA, MC (2), and BAC (2).

B. Sample: 100%

C. CxA shall review Start-Up Procedures and TAB reports.

D. Verify the heating enable/disable sequences.

E. Verify proper stage-up and stage-down of the boilers by the control system as load is varied. Load can be varied by manipulating valves, starting/stopping hot water terminals and/or changing the staging control parameters.

F. Verify proof and enunciation of individual boilers upon failure. Verify that boiler requests are removed appropriately and the next boiler in rotation is energized.

G. Verify rotation and/or re-prioritization of multiple boilers as applicable, whether manual or automatic rotation is employed.

H. Ensure the static pressure setting of the makeup water system are coordinated and that the entire system is under positive pressure throughout all modes of operation.

3.12 COOLING TOWER WATER SYSTEM

A. Participants shall include: CxA, MC (1), and BAC (2).

B. Sample: 50%, Max Failure Limit: 20%

C. CxA shall review Start-Up Procedures and TAB reports.

D. Verify the tower enable/disable sequences. Verify air is not trapped on start-up.

E. Verify proper stage-up and stage-down of the towers by the control system as load is varied. Load can be varied by manipulating valves, starting/stopping hot water terminals and/or changing the staging control parameters

F. Verify proof and enunciation of individual towers upon failure. Verify that tower requests are removed appropriately and the next tower in rotation is energized.

G. Verify rotation and/or re-prioritization of multiple boilers as applicable, whether manual or automatic rotation is employed.

H. Check the NPSH (net positive suction head) on the pumps throughout various modes of operation.

I. Check the sump level control to ensure air is not drawn into the system and that no air pockets exist in the suction piping.

3.13 HOT WATER BOILER

A. Participants shall include: CxA, MC (1), BAC (1) and boiler vendor startup technician (2).

B. Sample: 100%

C. CxA shall review Start-Up Procedure and TAB report.

D. Contractor shall start and warm-up the boiler.

E. Verify that burner modulates/stages to maintain water temperature.

F. Verify proper operation of makeup water system, including chemical treatment, flow regulation, and other parameters.

G. Observe combustion efficiency tests conducted by the Contractor for boiler at full load and part load conditions.

H. Verify combustion controls, fuel rate input and range, flame failure cutouts, gas train safeties, and other firing controls.

I. Check for gas leaks.

J. Test all applicable safeties and verify remote enunciation.

K. Simulate power outage and ensure automatic and orderly restart.

3.14 ADIABATIC HUMIDIFIERS

A. Participants shall include: CxA, MC (2), and BAC (1).

B. Sample: 100%

C. CxA shall review Start-Up Procedure.

D. Contractor shall start the humidifier.

E. Verify that pumps/valves modulates/stages to maintain setpoint.

F. Verify proper operation of makeup water system, including chemical treatment, water softening, reverse osmosis and other parameters.

G. Test all applicable safeties and verify remote enunciation.

H. Simulate power outage and ensure automatic and orderly restart.

3.15 AIR HANDLING UNIT

A. Participants shall include: CxA, MC (2), and BAC (8).

B. Sample: 100%

C. CxA shall review Start-Up Procedures and TAB reports.

D. Verify automatic start/stop of fan and open/close of outdoor air damper.

E. Start heating and cooling system, manipulate control device to obtain maximum cooling and heating. Measure temperatures and pressures to determine capacity.

F. Weather permitting, cause all applicable modes of operation using false loading where practical. Check proper sequence for switching modes and proper operation within a mode.

G. Check calibration of control devices and for stable control response and component performance including chilled water coils, hot water coils, steam coils, humidifiers, economizer cycles, and others. Ensure proper coordination of control loops and that no fighting or energy wastes result.

H. Check for free and adequate flow of AC condensate.

I. For variable speed fans, manipulate air terminal units to change flow conditions and observe control response. Ensure stable control response to step change in flow conditions. Manually ramp fan speed from minimum to maximum to ensure stable operation of fans. Record representative part load output from the drive. Check calibration of control input. Check drive bypass operation if applicable.

J. For fans with inlet vanes, manipulate air terminal units to change flow conditions and observe control response. Ensure stable control response to step change in flow conditions. Manually modulate vanes from minimum to maximum to ensure stable operation of fans. Record representative part-load power draw on the motor. Check calibration of control input.

K. Ensure minimum required ventilation rates are maintained across the full range of control (where applicable).

L. Test all interfaces with the fire alarm system and all smoke control sequences.

M. Verify interlocks with exhaust fans where applicable.

N. Test proof alarming where applicable.

O. Test operation of applicable safeties including freezestats, high and low static devices, smoke detection, duct humidity, and others. Check AHU component status in each event.

P. Check system status and operation in the Off, Unoccupied, and Occupied modes of operation. Validate proper start up and shut down sequences.

Q. Test all Fireman Control and Override sequences.

R. Simulate power outage and ensure automatic and orderly restart.

3.16 COMPUTER ROOM COOLING UNIT

A. Participants shall include: CxA, MC (0.5), and BAC (0.5)

B. Sample: 100%

C. CxA shall review Start-Up Procedures and TAB reports.

D. Verify automatic start/stop of supply fan

E. Start heating and cooling system, manipulate control device to obtain maximum cooling and heating. Measure temperatures and volumes to determine capacity.

F. Verify operation of condensing system including head pressure control and staging of condenser fans where applicable.

G. Cause all applicable modes of operation using false loading where practical. Check proper sequence for switching modes and proper operation within a mode.

H. Check calibration of control devices and for stable control response and component performance including compressor cycling, economizer cycles, and others. Ensure proper coordination of control loops and that no fighting or energy wastes result.

I. Check for free and adequate flow of AC condensate. Check operation of condensate pump where applicable.

J. Test all interfaces with the fire alarm system.

K. Test remote alarming where applicable.

L. Test operation of applicable safeties including smoke detection, and others.

M. Validate proper start up and shut down sequences.

N. Simulate power outage and ensure automatic and orderly restart.

3.17 DRYCOOLER

A. Participants shall include: CxA, MC (0.5), and BAC (0.5)

B. Sample: 100%

C. CxA shall review Start-Up Procedures and TAB reports.

D. Verify automatic start/stop of fan, and interlocks with computer room units.

E. Verify operation of temperature control system including fan cycling or variable speed fans as applicable.

F. Check specific gravity of glycol solution to verify glycol concentration.

G. Verify glycol system pressurization, fill, pressure relief valve and venting.

H. Cause all applicable modes of operation using false loading where practical. Check proper sequence for switching modes and proper operation within a mode.

I. Simulate power outage and ensure automatic and orderly restart.

3.18 VAV AIR TERMINAL (HVAC; NON-LAB)

A. Participants shall include: CxA, MC(0.5), and BAC(1).

B. Sample: 5 units; Max Failure Limit: zero

C. CxA shall review Start-Up Procedures and reports.

D. Check the calibration of zone temperature sensors.

E. Set boxes for both minimum and maximum flow (typically by setting the space temperature setpoint up and down) and check the calibration of the flow settings.

F. Check the stability of the zone temperature control loop for the damper and any associated heating devices by changing the space setpoints and observing the response.

G. Cause all applicable modes of operation using false loading where practical. Check proper sequence for switching modes and proper operation within a mode.

H. Determine the optimal settings for the control parameters

I. Simulate and test the unoccupied and emergency mode response of the VAV box where applicable.

J. Check the capacity of the heating device where applicable.

3.19 HEAT RECOVERY UNITS

A. Participants shall include: CxA, MC (1), and BAC (1).

B. Sample: 100%

C. CxA shall check the Start-Up Procedure.

D. Inspect the installation visually for proper configuration and undamaged coils.

E. Check the full sensible recovery efficiency at peak winter conditions.

F. With different weather conditions, check the mode of control. In winter, check the discharge loop control and make sure sensors are calibrated and that heating does not overshoot and require cooling. In mild conditions, ensure pumps are off. In summer conditions, ensure maximum recovery.

G. Check the frost protection override control loop.

H. Test operation during power outage in the context of the associated system.

3.20 FAN/AIR SYSTEM

A. Participants shall include: CxA, MC(1), and BAC(4).

B. Sample: 100%, Max Failure Limit: 10%

C. CxA shall review Start-Up Procedures and TAB reports.

D. Verify start/stop control sequences.

E. Check the capacity of the fan at maximum conditions.

F. Cause all applicable modes of operation using false loading where practical. Check proper sequence for switching modes and proper operation within a mode.

G. For variable speed fans, manipulate air terminal units to change flow conditions and observe control response. Ensure stable control response to step change in flow conditions. Manually ramp fan speed from minimum to maximum to ensure stable operation of fans. Record representative part load output from the drive. Check calibration of control input. Check drive bypass operation if applicable.

H. Verify interlocks with exhaust fans where applicable.

I. Test all interfaces with the fire alarm system and all smoke control sequences.

J. Test proof alarming where applicable.

K. Simulate failures of fans and ensure proper start-up of backup fans.

L. Test operation of applicable safeties including freezestats, high and low static devices, smoke detection, duct humidity, and others.

M. Simulate power outage and ensure automatic and orderly restart.

3.21 NATURAL GAS SYSTEMS

A. Participants shall include: CxA and MC (1).

B. Sample: 100% systems and 20% of outlets.

C. CxA shall review Start-Up Procedure.

D. Validate successful results of the cross-contamination testing.

E. Test operation of safety devices including earthquake shut-off and electrically operated shut-off valves.

F. Test outlets to ensure proper pressure and delivery. Test pressures throughout systems.

3.22 BUILDING AUTOMATION SYSTEM

A. Participants shall include: CxA and BAC (Time is typically included in the individual systems. However an additional 8 hrs shall be for workstation and administrative aspects.)

B. Refer also to Section 15959 for BAS Commissioning requirements

C. CxA shall review Start-Up Procedure.

D. Controls system sampling will typically correspond to the sampling rate of a system or piece of equipment. These sampling rates are indicated above for the respective item.

E. Operate the equipment and subsystems through all specified modes of control and sequences of operation including full and part load conditions, and emergency conditions.

F. Verify that equipment operates in accordance with design intent and approved control diagrams. This shall include checking the operation of dampers, valves, smoke detectors, high and low limit controls, of a sample of 25% of components with a maximum failure limit of 10%.

G. Analog Input (AI) Sensors: (at a sample of 50% of the inputs on the sampled devices (see above for device samples) with a maximum failure rate of 10%). Spot-check AI sensors (space temperature sensors, outside, return, and mixed air temperature sensors, discharge air temperature sensors, chilled water and hot water temperature sensors, and humidity sensors, air and water differential pressure sensors, airflow monitoring stations, etc.) for acceptable accuracy (which is generally as specified for the device).

H. Analog Outputs - Valves, Dampers and Actuators: (at a sample of 50% of the inputs on the sampled devices (see above for device samples) with a maximum failure rate of 10%) Ensure that valves and dampers and their actuators close-off or seal against the maximum pressure differential. Ensure that the actuators stroke throughout the correct

range (correlated with the programmed range) under operations pressures anticipated and that the positioners are set correctly where applicable.

I. Establish trends of control system points for a minimum of a two week period prior to and throughout the Acceptance period. Trends shall be analyzed to identify any control problems, lack of capacity, control loops fighting or unstable, or other operational anomalies.

J. Automatic Switches: Spot-check (at a sample of 50% of the inputs on the sampled devices (see above for device samples) with a maximum failure rate of 10%) the operation of all automatic switches (pressure switches, current switches, flow switches, and others) to ensure that they are adjusted to proper make and break settings.

K. Verify the standalone functionality of the controllers. Generally disconnect LAN communication wiring and ensure that the controller functions properly and that the loss of communication is acknowledged by the interface. Restore communications and ensure an orderly restoration to normal control.

L. Verify that the BAS interface, BAS software, graphics and functions are in accordance with design intent and approved control diagrams.

M. Check dial-in communications and internet access where applicable to ensure functionality.

3.23 LAB ZONE AIR FLOW TRACKING SYSTEM

A. Participants shall include CxT members, MC (2), LCC (8) and ATC (8).

B. BSL 2 Lab Zone: Sample 5 zones, max failure limit: zero

C. BSL 3 Lab Zone: Sample 100%, max failure limit: zero

D. CxA shall review start-up check-lists and TAB reports.

E. Adjust the control parameters to obtain both minimum airflow and maximum zone air flow conditions. This will typically be accomplished by setting the room temperature setpoint up and down and or opening and closing the sashes on the hoods. Check the operation of all boxes in the zone and ensure that the system tracks correctly in a stable fashion. Refer to the VAV Air Terminal and the applicable Fume Hood functional performance tests for further tests on the individual air terminals.

F. Throughout testing, monitor and trend the room pressure differential sensors

G. Check the room pressure at both minimum and maximum conditions and while the system is controlling mid range to ensure that the tracking is adequate and stable. . If

the room pressure differential goes positive, or exceeds (goes more negative) than -.1" for more than 5 seconds, test will fail.

H. Cause all applicable modes of operation. Check proper sequence for switching modes and proper operation within a mode.

I. Check door operation/closure and any other pressure sensitive elements. Check door interlocks and verify that security system operates per sequence

J. Isolate BSCs as would be for decontamination and validate air flows are properly adjusted and room pressure and thermal loops work properly.

K. Determine and record optimal control parameters for the zone

L. Check operation in all emergency mode like emergency hood exhaust, smoke control, emergency purge, etc. as applicable

M. In progressively pressure controlled zone, measure and adjust the air flow offsets to validate the progressive pressurization required throughout the suite.

3.24 BSL-3 ENVIRONMENT TESTING AND MONITORING

A. Participants shall include CxA, MC (4) and LCC (4), Safety Authority for applicable portions, User Representatives.

B. Sample 100%

C. FPT shall include 'Common Elements for All Systems' (above) to the extent applicable.

D. CxA will review TAB reports and box and controls Start-Up Documentation.

E. Establish the required trends for all points associated with the BSL 3 Suite.

F. Verify system response and sequences for both heating and cooling modes. Validate airflows and balancing as well as temperature control loops. Monitor room differential pressure throughout testing to ensure it stays within range without cause door closing/locking problems.

G. Refer to 'Room Leakage Testing' FPT (participation is indicated with that test).

H. Refer to 'Zone Air Flow Tracking' FPT.

I. Refer to 'Lab Fume Hoods' and 'Biological Safety Cabinet' FPTs when applicable.

J. Refer to 'Containment Zone Envelope Safety Testing' FPT.

K. Ensure proper pressure gradient throughout all rooms in the suite in all proposed modes of operation. Establish target pressure differentials.

L. Cause loss of pressurization on room differential pressure monitors and validate proper enunciation both locally and remotely.

1. As part of this test, simulate a stuck-open exhaust and then a stuck-open supply damper simulating maximum potential room pressures in both directions. Confirm enunciation. Confirm safe door opening force and ability of door to be closed to maintain containment.

M. Simulate failures of both supply air fans and exhaust air fans. Ensure proper redundancy and recovery.

N. Test isolation dampers to ensure decontamination ability.

O. Test systems with HEPA filter boxes isolated as would be the case during filter replacement. Active HEPA circuits shall be simulated under loaded condition.

P. Monitor space throughout Endurance Period.

3.25 BSL-3 SUITE TESTING

A. Participants shall include CxA, MC (4), LCC (4) and BAC (4), EC (1), Safety Authority for applicable portions, User Representatives for applicable portions.

B. Sample: 100% except for 'Room Leak Testing' which shall be per that test.

C. FPT shall include 'Common Elements for All Systems' (above) to the extent applicable.

D. CxA shall review Start-Up Documentation and TAB reports.

E. Spot-check operation of the isolation dampers. Validate free and full travel. Indication of seal will be the result of the containment tests for the applicable zone.

F. Validate that deep seal traps are used throughout.

G. Measure and adjust the air flow offsets to validate the progressive pressurization required throughout the Suite.

H. Configure suites to currently selected pressure gradient mode. Test the zone in this condition.

I. Refer to 'BSL-3 Zone Environmental Testing and Monitoring' FPT.

J. Refer to 'Containment Zone Envelope Safety Testing' FPT.

K. Refer to applicable specification Section covering fume hood field testing for all fume hood testing conducted within the BSL-3 suite.

L. Refer to applicable specification Section covering biological safety cabinet (BSC) field testing for all BSC testing conducted within the BSL-3 suite.

M. Refer to 'Environment Testing and Monitoring' FPT.

N. Refer to 'Lab High Purity Water System Testing' FPT.

O. Refer to 'Compressed Air System' FPT.

P. Refer to 'Vacuum System' FPT.

Q. Refer to 'CO2 and N2 Cylinder Gas System' FPT.

3.26 ROOM LEAKAGE TESTING (BSL-3)

A. This test is done on a sampling of high containment rooms to ensure the envelope construction and sealing is adequate.

B. Participants shall include: Cx Team Members.

C. FPT shall include 'Common Elements for All Systems' (above) to the extent applicable.

D. Room Leakage testing shall be performed on the following rooms:

1. 33% of BSL-3 Suites

2. 33% of Isolation Rooms

E. CxA reviews close-in inspection approvals.

F. This test shall be done to both assess the construction quality (door leakage sealed) and net resulting leakage with the door configured as used.

G. Provide duct pressure testing apparatus with orifices appropriate to the leakage thresholds allowable.

H. For negative spaces, configure the pressurization fan in an exhaust configuration. For positive, configure in a supply configuration.

I. Establish reference pressure measurement to the access corridor or ante room.

J. Construction Quality Test:

1. Seal the door with tape to ensure it is airtight.

K. As-Used Test:

1. Remove tape from the door and allow the door to close naturally. Ensure sweeps are in place.

L. Both tests:

1. Configure the pressure testing apparatus to supply or exhaust the space. When bubble tight dampers are used in the space, use them to isolate the ductwork. When bubble tight dampers are not used, disconnect the supply and exhaust air ductwork and seal the duct connected to the room.

2. Where decontamination systems are used, consider using disinfectant supply tubes for the pressurization air path.

3. Isolate the affected areas from pressure fluctuations that will affect the testing.

4. Monitor room differential pressures (DPs) at static conditions (no air flow or pressurization air) to ensure that there are no external affects that will invalidate the results.

5. Pressurize or depressurize the room to +/- 0.1" w.c. and maintain it at that pressure until stable conditions are achieved. Monitor leakage flow for 5 minutes with the room pressurization. Room DP must remain between 0.08" and 0.12" w.c.

6. Average the pressurization airflow over 5 minutes to establish the test values.

M. In the event of a failure, use local smoke generator to identify leaks and reseal and retest as required.

3.27 CONTAINMENT ZONE ENVELOPE SAFETY AND EGRESS TESTING

A. This refers to the zone itself and not the elements within that zone. Refer to the tests for the applicable equipment and systems within the room such as fume hoods, chemical showers, breathing air, etc.

B. Participants shall include Cx Team, Safety Authorities, and User Representatives. C. Sample (apply the higher percentage when systems can be classified as more than one of the below):

1. 100% of BSL-3 spaces/suites.

2. 100% of Necropsy Rooms.

3. 100% of Isolation Rooms.

D. FPT shall include 'Common Elements for All Systems' (above) to the extent applicable.

E. Witness: This series of tests shall be witnessed by the Safety Authority and the End User Representatives.

F. Refer to 'Room Leak Testing' for BSL-3 zones.

G. Under Normal Operation:

1. Demonstrate pressure gradient and use local smoke generator to demonstrate directional air flow.

2. Demonstrate HEPA filter redundancy and ability to change filters without affecting zone conditions.

3. Demonstrate door operation and measure door opening force.

4. Demonstrate autoclave seal operation.

H. Cause loss of pressurization on Room Differential Pressure Monitors and validate proper enunciation both locally and remotely.

1. As part of this test, simulate a stuck-open exhaust and then a stuck-open supply damper simulating maximum potential room pressures in both directions. Confirm:

a) Enunciation.

b) Safe door opening force and ability of door to be closed to maintain containment.

c) Maintenance of traps/dunk tanks.

d) Adjacent spaces in BSL-3 suites are not adversely affected.

3.28 LABORATORY VAV GENERAL EXHAUST AND SUPPLY AIR TERMINAL

A. Participants shall include: CxA, MC and LCC.

B. Refer to the HVAC 'VAV Air Terminal' FPT for individual box testing. All tests indicated therein apply.

C. Refer to 'Zone Air Flow Tracking System' for lab zone related tests.

D. Refer to the Modified ASHRAE 110 Test for fume hoods.

3.29 FUME HOODS (PRE-CERTIFICATION TESTING)

A. Purpose: This is a test during the acceptance phase and prior to the certified Fume Hood Field Testing to assure that the Field Test will pass. The formal certification and testing will be done by a certified testing agency, procured under Division 11.

B. Participants shall include: CxA, BAC (first 3 hoods), LCC (first 3 hoods), Fume Hood Manufacturer (first 3 hoods).

C. Sample: 3 hoods; Max Failure Limit: 0%

D. FPT shall include 'Common Elements for All Systems' (above) to the extent applicable.

E. CxA shall review Start-Up Documentation.

F. Check fume hood configuration and fume hood monitor.

G. Check airfoil positioning, sash stops, and sash counter-weighting to ensure proper fume hood set up.

H. Measure a grid of face velocities at both the 'maximum sash stop' position and the 'minimum sash stop' positions. Ensure average face velocities are within 5% of the target 100 fpm and that no measurement deviates more than 15% from the mean.

I. Select a representative face velocity sampling location and monitor the control loop response to the moving of the hood. Ensure the loop response is fast and stable. Record the length of time the it takes to the face velocity fluctuation to stay within the range and 10% of the target face velocity.

J. Perform large and small volume smoke visualization tests per ASHRAE 110.

K. Set the zone air flow to maximum and use puffers or smoke generators near the face of the hood to test capture at various sash positions. Operate any adjacent doors or windows that may affect the capture.

L. Measure the cross-draft and down-draft at 12' in front of the hood. Identify any room air drafts that are in excess of 50% of the nominal face velocity.

M. Test emergency mode and setback modes.

N. Reduce airflow to validate Fume Hood Monitor Alarm enunciation, remote reporting, and silence.

3.31 BIOLOGICAL SAFETY CABINETS (PRE-CERTIFICATION TESTING)

A. Purpose: This is a test during the acceptance phase and prior to the certified Biosafety Cabinet Field Testing to assure that the Field Test will pass. The formal certification and testing will be done by a certified testing agency accredited by NSF 49 in accordance with NSF/ANSI 49 (1992; Addendum 1- 2002), procured under Division 11.

B. Participants: CxA (first 3 BSCs), BAS or laboratory controls system contractor, and TAB (first 3 BSCs) on ducted exhaust BSCs (Type 2), BSC Manufacturer (first 3 BSCs).

C. Sample: 3 BSCs; Max Failure Limit: 0%

D. Prerequisites:

1. Ensure all equipment has been started and tested.

2. Zone HVAC system must be fully started and balanced

3. All controls and utilities must be started and fully functional

E. BSCs shall also be monitored throughout the associated critical exhaust and supply failures and building power outage tests. Acceptance criteria is specified in Part 1.

3.32 BSL-3 PRESSURE GRADIENT TESTING

A. Purpose: To confirm adequate containment and the proper pressure gradient per the design intent. This test shall confirm final setup and be performed during the Acceptance Period

B. Participants shall include: CxA, GC, LCC, MC (first 4 hour short term period only).

C. Prerequisites: Aspects of other Functional Performance Tests will be done in concert with this test. Coordinate this test only after all systems, zone balancing, and zone control functional tests are complete

D. Confirm all pressure sensors are calibrated. Place pressure sensors in both trend for long term analysis (at 5 minute intervals) and create a real time plot for short term analysis.

E. Short-Term, Real-Time Analysis: monitor the ranges of all controlled static pressures. This shall be done on 3 separate 4 occasions for 4 hours each. During each one of these periods gradually change the temperature setpoint of zones to span operational range from full cooling to full heating then release. Confirm the controlled pressure remains within the range allowed in Part 1 Acceptance Criteria.

F. Long-Term Analysis: This shall be done as a function of the Endurance Period analysis. Assess the ranges of the trended controlled static pressures to confirm that containment pressure remains in the ranges specified in Part 1 Acceptance Criteria.

3.33 HIGH CONTAINMENT DECONTAMINATION

A. Purpose: To test the standard cycle of decontaminating a zone.

B. Participants: CxA, GC, User Representative that has been trained on the decontamination protocol.

C. Sample: 30% of rooms with decontamination systems.

D. Prerequisites:

1. Decontamination system start up completed.

2. All zone HVAC systems functionally tested.

3. All zone pressure testing successfully completed.

E. Complete a decontamination cycle in the high containment area. Isolate the space per the SOP and initiate the decontamination/neutralization/purge cycle as applicable. Reactivate the system per the SOP. Ensure the decontamination gas is adequately contained and that the space purges adequately.

3.34 HIGH CONTAINMENT ZONE DAMPER FAILURE

A. Purpose: To ensure that the high containment zone can safely handle a failed exhaust damper.

B. Participants: CxA, GC, LCC (first 2 of each type of space)

C. Sample:

1. 50% of BSL-3 zones

D. Prerequisites:

1. All zone HVAC systems functionally tested.

2. All APR doors started and tested.

3. All traps sealed and dunk tanks filled.

4. All zone pressure testing successfully completed.

E. Simulate a failure of the exhaust air damper controlling the volume to a high containment area. Allow pressures to stabilize. Validate enunciation. Measure the door opening force. Validate that all traps maintain containment. Validate that all containment devices maintain containment.

F. Simulate a failure of the supply air damper controlling the volume to a high containment area. Allow pressures to stabilize. Validate enunciation. Measure the door opening force. Validate that all traps maintain containment. Validate that all containment devices maintain containment.

3.35 HIGH CONTAINMENT ZONE CONTROLLER FAILURE

A. Purpose: To ensure that the high containment zone can safely handle a failed BAS controller.

B. Participants: CxA, GC, LCC (first 2 of each type of zone)

C. Sample:

1. 50% of BSL-3 zones

D. Prerequisites:

1. All zone HVAC systems functionally tested.

2. All APR doors started and tested.

3. All traps sealed and dunk tanks filled.

4. All zone pressure testing successfully completed.

E. Simulate a failure of the controller processor. Observe HVAC system reaction and monitor space pressure and temperature sensors. Measure door opening force and confirm safe egress. Ensure proper enunciation of failure and pressure excursion as applicable.

3.36 CRITICAL AIR HANDLER FAILURE

A. Purpose: This test is to simulate failure of air handlers serving critical areas. It is to confirm that all affected terminals and areas respond properly and that the available redundancy is used to the maximum potential.

B. Participants shall include: CxA, MC, BAC, GC, Owner's Operating Personnel (specifically the HVAC shop shall be represented), MC shall provide personnel to monitor zones that are affected. BAC shall provide personnel to staff theoperator interface.

C. Prerequisites: Aspects of zone Functional Performance Tests will be done in concert with this test. Coordinate this test only after all systems and zones are ready for air handler failure tests.

1. Assess expected results and response of the outage on all systems. Ensure that there is a plan to safely respond to the air handler outage before conducting the test.

2. This test is not to test the backup and recovery sequence, as that is part of the applicable air handler system test. The back up and recovery sequence shall already be verified. This test is to check the net impact on the zones during air handler failure.

D. Sample Test Protocol:

1. Progressively fail specific air handlers serving the critical system. Ensure design conditions are maintained with the designated minimum number of air handlers running.

E. Coordination: Start test with a meeting to coordinate responsibilities. During test phases, confirm all teams are ready for the next phase before proceeding to the next phase. End with a meeting to discuss results and need for further testing.

F. Progressively fail headered air handlers serving each critical zone or occupancy. Fail air handlers to the point that the minimum air supply for which the system is designed is operational. Assess conditions at that point to ensure the design conditions are maintained. Continue to fail air handlers to assess the performance of served terminals and zones.

G. Monitor and trend all sensed values in the areas affected during the test at 1 minute intervals. During the outage, inspect affected areas. Check door opening forces to ensure safe egress during the most extreme failure. Ensure required critical environmental parameters are maintained in critical spaces.

H. Ensure required pressure differentials and gradients throughout the spaces meet the requirements.

I. Verify any applicable responses of the associated exhaust systems.

3.37 CRITICAL AREA EXHAUST FAN FAILURE

A. Purpose: This test is to simulate failure of exhaust fans serving critical areas or critical equipment. It is to confirm that all affected terminals and areas respond properly and that the provided redundancy is used to the maximum potential.

B. Participants shall include: CxA, MC, BAC, GC, Owner's Operating Personnel (specifically the HVAC shop shall be represented), MC shall provide personnel to monitor zones that are affected. BAC shall provide personnel to staff theoperator interface.

C. Prerequisites: Aspects of zone Functional Performance Tests will be done in concert with this test. Coordinate this test only after all systems and zones are ready for air handler failure tests.

1. Assess expected results and response of the outage on all systems. Ensure that there is a plan to safely respond to the exhaust fan failures before conducting the test.

2. This test is not to test the backup and recovery sequence, as that is part of the applicable air handler system test. The back up and recovery sequence shall already be verified. This test is to check the net impact on the zones during air handler failure.

D. Sample Test Protocol:

1. Progressively fail specific exhaust fans serving the critical system. Ensure design conditions are maintained with the designated minimum number of exhaust fans running.

E. Coordination: Start test with a meeting to coordinate responsibilities. During test phases, confirm all teams are ready for the next phase before proceeding to the next phase. End with a meeting to discuss results and need for further testing.

F. Progressively fail headered exhaust fans serving each critical zone or occupancy. Fail fans to the point that the minimum air exhaust, for which the system is designed, remains operational. Assess conditions at that point to ensure the design conditions are maintained. Continue to fail exhaust fans to assess the performance of served terminals and zones. On BSL-4 areas, continue to the point of failing all exhaust fans and ensure pressure directions are maintained and that door opening forces are within that allowable by code.

G. Monitor and trend all sensed values in the areas affected during the test at 1 minute intervals. During the outage, inspect affected areas. Check door opening forces to ensure safe egress during the most extreme failure. Ensure required critical environmental parameters are maintained in critical spaces.

H. Ensure required pressure differentials and gradients throughout the spaces meet the requirements.

I. Verify any applicable responses of the associated supply systems.

3.38 CRITICAL CONTROLLER FAILURE

A. Purpose: This test is to simulate the failure of any of the critical controllers. Critical systems will be designed to continue to operate in the event of a controller failure. This test validates that this will happen per the requirements.

B. Participants shall include: CxA, MC, BAC, GC, Owner's Operating Personnel (specifically the HVAC shop shall be represented), MC shall provide personnel to monitor systems that are affected.

C. Prerequisites: Aspects of system Functional Performance Tests will be done in concert with this test. Coordinate this test only after all systems are ready for controller failures.

1. Assess expected results and response of the outage on all systems. Ensure that there is a plan to safely respond to the controller failures before conducting the test.

D. Sample Test Protocol:

1. Progressively fail specific controllers. Ensure critical system operation is maintained with the designated controllers failed.

E. Coordination: Start test with a meeting to coordinate responsibilities. During test phases, confirm all teams are ready for the next phase before proceeding to the next phase. End with a meeting to discuss results and need for further testing.

F. Fail the controller. Observe systems served by the controller shut down and observe redundant equipment start up and assume load. Monitor critical equipment or areas served by these systems and validate that the redundancy objectives are met.

G. Monitor and trend all sensed values in the areas affected and on the affected equipment during the test at 1 minute intervals. During the outage, inspect affected areas. Check door opening forces to ensure safe egress during the most extreme failure. Ensure required critical environmental parameters are maintained in critical spaces.

H. Ensure required pressure differentials and gradients throughout the spaces meet the requirements.

I. Verify any applicable responses of the associated back-up systems.

3.39 LAB COMPRESSED AIR SYSTEM

A. Participants shall include: CxA and MC (2).

B. Sample: 100% of compressors and systems, 20% of the outlets.

C. CxA shall witness manufacturer's start-up tests.

D. CxA will review Start-Up Procedure

E. CxA will review the pressure and cross connection testing certifications. Refer to Section 15360.

F. Verify automatic drain operation.

G. Monitor normal operation of the compressor under peak load and under light load. Open outlets to approximate peak loads. Measure 'Run' and 'Off' cycle times to ensure proper operation (maximum starts per hour per the manufacturers recommendations) Bleed air at variable rates to ensure capacity. Ensure proper rotation.

H. Verify compressor rotation and runtime equalization sequences. Compare control settings to the system pressures at remote parts of the system. Ensure coordination or compressor capacity control with pressure relief valve settings.

I. Check all indications, safeties, enunciations, and interfaces with the BAS.

J. Open disconnect on one compressor and validate the standby operation of the compressor.

K. Verify the operation of the driers in all modes.

L. Validate filter loading indications and alarms.

3.40 LAB VACUUM SYSTEM

A. Participants shall include: CxA, MC (2)

B. Sample: 100% of systems and 20% of outlets

C. CxA shall witness manufacturer's start up tests.

D. CxA will review the pressure and cross connection testing certifications. Refer to Section 15340.

E. CxA shall review Start-Up Procedures.

F. CxA shall spot check start up procedures

G. Monitor normal operation of the vacuum pump. Measure 'Run' and 'Off' cycle times to ensure proper operation (per the manufacturers recommendations). Admit air at variable rates by opening lab outlets to ensure capacity. Ensure proper rotation of compressors.

H. In the course of opening inlets to load and unload the system, spot check labeling, vacuum and flow of the turrets

I. Verify compressor rotation and run time equalization sequences. Compare control settings to the system pressures at remote parts of the system.

J. Check all indications, safeties, interface with the BAS and enunciation.

K. Open disconnect on one compressor and validate the standby operation of the compressor.

3.41 CARBON DIOXIDE AND NITROGEN CYLINDER GAS SYSTEMS

A. Participants shall include: CxA and MC (1).

B. Sample: 100% of systems and 20% of outlets

C. CxA shall review Start-Up Procedures and generally review the installation configuration.

D. In the course of opening inlets to load and unload the system, spot check labeling, vacuum and flow of the turrets

E. Test adequate pressure and flow to random outlets throughout the facility.

F. Check all indications, safeties, interface with the BAS and enunciation.

G. Test the standby bank switching functions of the manifold. Verify the switchover is enunciated.

3.42 LAB HIGH PURITY WATER SYSTEM

A. Participants shall include: CxA and MC (1).

B. Sample: 100%

C. Refer to Sections 15222. Functional test will be performed in concert with the Factory Representative functional testing.

3.43 GAS-FIRED DOMESTIC WATER HEATER

A. Participants shall include: CxA, MC (2), and BAC (1).

B. Sample: 100%

C. CxA shall review Start-Up Procedure.

D. Contractor shall start and warm-up the water heater.

E. Verify that burner modulates/stages to maintain water temperature.

F. Observe combustion efficiency tests conducted by the Contractor for steam generator at full load and part load conditions.

G. Verify combustion controls, fuel rate input and range, flame failure cutouts, gas train safeties, and other firing controls.

H. Check for gas leaks.

I. Test all applicable safeties and verify remote enunciation.

J. Simulate power outage and ensure automatic and orderly restart.

3.44 FIRE PUMP AND FIRE SUPRESSION SYSTEMS

A. Participants shall include CxT , MC, FAC, FPC

B. Functional tests shall be coordinated with the Local Authority Acceptance Process

C. Test shall generally be conducted by and documented as a part of the start up and Acceptance criteria. The intent is to not duplicate witnessed tests for the fire suppression systems. Consequently most testing that will be considered and documented as functional, is specified in Section 13920. This testing generally includes

1. Perform a Fire Pump Hydraulic Acceptance test per NFPA 20 as specified in Section 13285.

   a) Perform Flow Test

   b) Perform Loaded Start test (start into peak capacity)

   c) Perform Phase Reversal Test

   d) Perform Controller Acceptance test

2. Test all wet pipe zones through the inspector's test station. Ensure proper alarming and draining. Simulate one head and jockey pump operation. Then simulate multiple zones and full fire pump operation

3. For Dry Pipe Systems: Test the dry pipe valve alone and with a quick-opening device, if installed, by opening the inspector's test connection. The test shall measure the time to trip the valve and the time for water to be discharged from the inspector's test connection. All times shall be measured from the time the inspector's test connection is completely opened. The results shall be recorded using the contractor's material and test certificate for aboveground piping.

4. For Deluge or Preaction Systems: test the automatic operation of a deluge or preaction valve in accordance with the manufacturer's instructions. The manual and remote control operation, where present, shall also be tested.

5. Open and close all hydrants with full water pressure on the hydrant

6. As a part of the Building Power Outage Functional test, or as part of a dedicated test, test operation of fire pump and jockey pump during a loss of normal power to the building. Ensure transfer switch and controls function correctly on an outage and during a return to normal. Conduct tests in accordance with NFPA 20.

a) With pump operating at peak conditions, simulate building power outage. Operate for a minimum of 1 hour and return to normal with pump still operating at peak conditions

b) With jockey pump operating, simulate power outage and return to normal.

END OF SECTION 01810