

04/18/14

Schematic Design Submittal

Project Design Narrative  
Schematic Design Specifications

# Duchesne County Justice Center

DUCHESNE, UTAH

Utah Division of Facilities Construction and Management

Utah State Courts Administrative Office of the Courts

ARCHITECTURAL  
**nexus**

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AN Project #13101

# DUCHESNE COUNTY JUSTICE CENTER

DUCHESNE, UTAH

## ARCHITECTURAL DESIGN NARRATIVE

### 1) BUILDING MATERIALS AND CONSTRUCTION

Duchesne County Justice Center project consists of an addition to and remodel of an existing courts and jail facility in Duchesne, Utah. The project is located atop of a small bluff just north of Duchesne city proper, and overlooks the southern valley of Coyote Canyon. The existing facility, built in 1996, is a single-story building with a 1-1/2 story jail appended to the north. Its exterior cladding consists of painted EIFS with clear anodized aluminum punched window openings. The existing building entry is accented with red stone clad piers supporting a convex EIFS wall element. The new courts addition to the building will add just over 20,000 sf of courtrooms, jury space, holding cells, administrative support space, Judge's chambers, Duchesne County attorney offices, guardian ad litem offices, and a much needed larger common waiting area for visitors during court proceedings.

The new addition will be seismically and structurally separated from the existing building. Material used on the addition will not depart from what's already present in the existing building, with the exception of increased glass front entry, and the use of curtain wall glazing and clerestories to bring more natural daylight into the spaces. There will be a new "courtroom" entry to the new addition that will have a distinctly different presentation than the existing entry, as it will use a tall concave curtain wall system with expressive horizontal banded mullions. The concave gesture is a reflection of the previous entry, and will allow for a more distinct entrance into the courthouse portion of the Duchesne County Justice Courts building. The building will have concrete footings, foundations, and floors. A flat roof with a single-ply membrane covering will tie into the existing roofing system. Clerestories over the common waiting areas for the courts will bring in natural southern light. Courtrooms will take advantage of this southern light exposure with an interior borrowed-light window system. On the east face of the building, a large curtain wall opens to the eastern vistas, and provides a visual corridor through the new courts common waiting area.

In compliance with Utah Judicial Facility Design Guidelines (UJFDG), the courtrooms will be presented in a manner that is fit for State district and juvenile court proceedings. Finishes within the courtrooms will reflect the high level of standard, care, and respect the justice system instills. Solid wood paneling and wood veneer millwork finishes would encase the courtroom benches, while painted gypsum with acoustical treatments are strategically used on the walls to create a functional courtroom with minimal noise disturbance. Ceilings will be acoustically treated while taking full use of the borrowed light of the south facing clerestories. Suggested ceiling treatments include slat-wood ceiling clouds, wood coffers, acoustical tile, acoustically treated painted gypsum, or a combination. Bench areas will be designed to be bullet resistant, as per UJFDG standards.

Administration and support areas will provide a finish typical to 'Class A' office space, with carpet, carpet base, painted walls, acoustical ceiling tiles, and selective architectural elements. The Judges' chambers will again meet standards outlined by the UJFDG.

Common waiting areas will have finishes that are more durable and easily maintained due to higher level of activity and use this space shall endure. Tiled floor matching or complimenting the existing tile will serve these areas, while the walls will be painted gypsum. The ceilings will play a mixture of elements, including acoustical tile, ceiling clouds of a finish suited for the space, and exposed painted structure above.

Detention areas will contain low maintenance furnishes with abuse resistant elements, such as concrete masonry unit (CMU) walls, concrete floors, and impact resistant gypsum. The most abusive of areas, holding cells adjacent to the courtrooms, will have sealed concrete, painted CMU walls, and a painted gypsum ceiling with expanded steel wire mesh backing. All furnishings within the holding cells shall be secured and tamper resistant.

## 2) BUILDING LAYOUT

Existing Duchesne County Justice building is divided into 3 parts; the Justice and Juvenile Courts to the east, county Sheriff operations to the west, and county jail to the north. Public entry to both the Courts and county Sheriff currently face south, while secured entries for the Justice Courts staff and Sheriff sally port are to the east and west, respectively. The jail occupying the north part of the building is a one story jail with a mezzanine level.

The new addition to the building will extend off the east side of the current Justice Courts. After completion, the Duchesne County Justice Center will house three courtrooms; the Duchesne County Justice Court (existing to remain), the Utah State 8th District Court (new), and 8th District Juvenile Court (new). These courtrooms will be directly north of the new, larger waiting area that faces the south. Courtroom support spaces will be provided at the east end of the addition, as future programming of the facility plans for an expansion of the jail just north of this addition. Each new courtroom will be fully ADA compliant, and have adjacent holding areas for defendants-in-custody.

After the entry security screening, more public related offices will be easily accessible off the public courtroom waiting area. These include Guardian Ad Litem, Juvenile Probation, APP, 8th District Court Clerks, Justice Court Clerks, and County Attorney Offices.

Several additional new toilet rooms are also included in the building design. Their size and location are designed not only to meet occupant load requirements once the work is complete, but to also accommodate construction phasing and allow for this facility to remain in operation throughout the construction process.

## STRUCTURAL DESIGN NARRATIVE

### 1) BUILDING CLASSIFICATION

The building classification is Category II per IBC 2012 Table 1604.5

2) FOUNDATION DESIGN

The foundation design will be based on soil bearing values defined in a geotechnical report yet to be prepared for this project. It is anticipated the subsurface conditions will allow for shallow, convention spread and spot footings.

3) DESIGN LOADINGS

The structure was designed to the requirements of the following building codes:

2012 International Building Code (IBC 2012)  
ASCE 7-10

The structure is designed to support actual dead loads plus prescribed live loads and load combinations according to the International Building Code 2012 (IBC) Chapter 16 and ASCE 7-10 Minimum Design Loads for Buildings and Other Structures.

These loads are as follows:

Roof Loads:

Ground Snow Load,  $P_g$ ..... 43psf  
Snow Exposure Factor,  $C_e$ ..... 1.15  
Snow Load Importance Factor,  $I_s$ ..... 1.25  
Thermal Factor,  $C_t$ ..... 1.0  
Roof Snow Load  $P_f (0.7 \times C_e \times C_t \times I_s \times P_g)$ ..... 30 psf plus Snow Drift per IBC & ASCE 7-10

Floor Live Loads:

First Floor..... 250 psf (slab on grade)

Seismic Design Criteria:

Occupancy Category..... II  
Seismic Design Category:..... C  
Spectral Response Coefficient,  $S_s$ ..... 0.3704  
Spectral Response Coefficient,  $S_1$ ..... 0.1181  
Design Spectral Response Coefficient,  $S_{D_s}$ .... 0.371 g  
Design Spectral Response Coefficient,  $S_{D1}$ .... 0.183 g  
  
 $F_a$  ..... 1.5  
 $F_v$ ..... 2.33  
  
Basic Seismic-Force-Resisting System ..... Special Concentrically Braced Frame  
  
 $R$  ..... 6  
 $C_d$ ..... 5.0  
Omega sub-zero ..... 2.0

Importance Factor, $I_e$ .....	1.0
Design Coefficient $C_s$ .....	0.0774
Analysis Procedure.....	Equivalent Lateral Force (Static)

Wind Loads:

Basic Wind Speed (3-second gust) .....	110 mph
Importance Factor, $I_w$ .....	1.0
Exposure.....	C
Internal Pressure Coefficient, $G_{cpi}$ .....	0.18

4) MATERIAL STRENGTHS

Concrete (28 day strength)

Footings:.....	4500 psi
Slabs on Grade:.....	3500 psi
Walls:.....	4500 psi
All other site cast concrete:.....	4500 psi

Reinforcing Steel ASTM 615 Grade 60 .....	$F_y = 60$ ksi
Structural Steel.....	$F_y = 50$ ksi

5) STRUCTURAL SYSTEMS

The roof framing system of the new addition will be comprised of open web steel joists spaced at approximately 6'-0" o.c. bearing on steel open web joist girders and wide flange steel beams. These framing members will support 1.5" deep type "B" 20ga. steel roof deck.

The exterior walls of the additions will be comprised 18 gage steel studs spaced at 16". The studs will be supported on concrete foundation walls and anchored to wide flange beams above.

Concrete slabs on grade shall be 4" to 5" thick reinforced with #4 reinforcing steel bars at 16" o.c. unless otherwise noted.

6) LATERAL FORCE RESISTING SYSTEM

The lateral force resisting system for the addition will be comprised of steel frames (either braced frames or moment frames). Frames will be located as to not impact the function of the building and the intended glazing systems.

MECHANICAL / PLUMBING / ELECTRICAL | EXISTING CONDITIONS OBSERVATION

1) MECHANICAL SYSTEMS

The HVAC & Plumbing systems at the Duchesne County Justice Center are well maintained and in good working order. The systems match up fairly closely to the as-built drawings. A summary of the HVAC & Plumbing Systems and their condition and usage is as follows:

### Rooftop Units (RTU)

CONDITION: The Rooftop Units matched closely in location and type to the as-built plans. RTU-1, 2, & 3 are cooling only type. The CFM and Static Pressures match up on 1 & 2, and the CFM is correct on RTU 3 with the static being slightly less than the specified as built model (2.5" vs 2.75" on drawings). One difference was that no VFD's were noted on the units or in any of the maintenance spaces. The RTU's looked to be well maintained and in good condition.

USAGE: The RTU's serving the project area are cooling only units located on the roof. They serve VAV boxes that modulate the air and reheat the air to meet the space loads.

### AIR TERMINAL UNITS

CONDITION: The as-built drawings show Fan Powered Boxes (FPB) throughout the space. It was noted however that Variable Air Volume (VAV) boxes were used instead of FPB. The quantity and location of the units seem to match up in the areas that were accessible. It is reasonable to infer capacities would be approximately the same as those indicated on the plan. The VAV boxes seemed to be in good condition.

USAGE: The VAV boxes typically serve 2 or 3 small spaces or 1 large area and have user adjustable sliding type thermostats. The boxes have reheat coils served by hot water piping from the boiler to meet the heating needs. The controls system is a Metasys System by Johnson Controls. The facilities manager expressed interest to change the controls for the new area to a Honeywell controls system.

### Boilers

CONDITION: The boilers and accessories that provide the heating for the building match closely with the as-built drawings. The orientation of the boiler room equipment differs from the plans but is in the same general location. The pumps match the horsepower of the drawings, and it is assumed the other accessories, such as air separator, expansion tank, etc., match the original drawings closely in capacity and type. The heating system looked to be all in good operating condition.

USAGE: The boilers produce heating water that is pumped to VAV boxes throughout the building to provide the heating for the spaces based on thermostat input.

## 2) Plumbing

Plumbing fixture locations and general types match the drawings. Waste pipe routing seemed to match as built drawings based on the sewage grinder location which was added after the initial construction of the building. The fixtures seemed to be in general to be in good condition.

### DOMESTIC WATER HEATING

CONDITION: The domestic water system looks to have been almost completely replaced recently. Two, 600 MBH boilers, circulate water to a large storage tank (approximately 1,000 gallon capacity), and are connected to 4 large water softeners that soften both the hot and cold water. The piping and components all look to be in excellent condition.

USAGE: A high temp water line is run to the kitchen and recirculating line keeps the high temp water line hot. A recirculating line also serves the standard hot water line.

### 3) INTERACTION OF EXISTING MECHANICAL/PLUMBING SYSTEM WITH NEW ADDITION

It is anticipated the existing systems should be able to remain with a few minor modification to accommodate the adjustments in the existing area. Standalone heating and air side systems will need to be provide for the new area as there is not enough capacity in any of the existing equipment. No conflicts or problems between the existing system and new systems are anticipated. The highest potential for complications in the HVAC system will be adding a new controls system for the addition and maintaining the older system in the existing building. It is anticipated that at a later date or possibly during this project that the old system will all be replaced.

It may be possible to utilize the existing domestic water system, but may be more difficult and expensive than adding a small domestic water heater in the addition. Connecting to the existing system would require routing piping through the prison section and impact a large area outside the scope of this project.

## ELECTRICAL SYSTEMS

### 1) Electrical Services

The Electrical Service comes through a 500 kVA step down transformer from 12,470 volts to 120/208 volts on the East side of the building. This transformer is maintained by the local electric utility company, Moon Lake Electric. The main service size is 2,000 amps. All of the electrical distribution equipment in the Duchesne County Justice Center (DCJC) appears to be GE Equipment and in good condition. The peak demand for the Justice Court that we received from Moon Lake Electric is 250 kW (recorded in June 2013). Depending on final loads of the new addition, there is a good chance the electrical service will not have to be upgraded. The difficulty is that there are no available spares or spaces in the distribution equipment for a new feeder to the addition.

### 2) LIGHTING

The lights in the building are mostly fluorescent using T-12 and compact fluorescents. The T-12s are very inefficient but are being phased over to T-8 Lamps as the lamps need to be replaced. Fluorescent wall packs and HID (high intensity discharge) Pole lights are being used to light the exterior building and parking lot spaces. All devices appear to be in good working order and well maintained with only a few lights burnt out in all of the spaces that were reviewed. The new addition project will not replace or retrofit existing light fixtures, unless the design team is directed otherwise.

### 3) Power

Electrical outlets were consistently and equally distributed throughout the building. In the open offices floor boxes and power poles were used to provide outlets for computers, monitors and the like. There was nothing observed that requires modification or replacement.

### 4) FIRE ALARM

The system is a type GE EST system. The devices are in good condition and the system appears to be working properly. The plan will be to add to and extend the existing fire alarm system into the new addition.

#### 5) Areas of concern

Electrical Panel “C” is currently located in Room Work/Stor. E343, which is in the South East corner of the building, where significant remodeling will be done to the existing building. Electrical circuits appear to be coming out from underneath and above the panel which will increase the complexity of relocating the equipment. The relocation of this panel will cause considerable disruption in the areas serve by the panel and incur additional construction costs. If possible, this panel should be left in place in the new floor plan design.

The Main Electrical Distribution Panel has no spares or space for additional circuit breakers large enough (greater than or equal to 800 Amps) to provide power for the addition. Wall and ceiling space in the Main Electrical Room is also limited which reduces our flexibility to add equipment and gear to make the existing equipment feed the new panels necessary for the addition. Options include adding a new main distribution switchboard outdoors, re-feeding the existing service and routing a new feeder (through the building or around the outside) to the new addition; or modifying/ replacing the existing switchboard in the existing main electrical room to accommodate a new breaker and feeder to the new addition. These two options will be explored for cost and feasibility as the design progresses.

## TELECOMMUNICATIONS (VOICE/DATA)

The facility has a single main data center on the detention side of the building that also serves as the entrance facility (telephone providers, WAN, etc). Recently this existing network has been expanded to include two other locations where a new network switch has been located to facilitate the new IP camera replacements. It is expected that a new Termination Room will be part of the new courtroom addition and would be provided with fiber and copper multipair backbone cabling to extend the network. To follow through on the design however, more information is needed as to how much involvement there will be from the State DTS (Loren Casterline) for the voice/data cabling installation in the State Court areas.

#### 1) SECURITY SYSTEMS

The original access control system has been replaced and relocated to the public/court side of the building in the “Maintenance Room”. This upgrade was installed and is still serviced by Wasatch Comtech Services. For additional access control, more door controllers and power supplies will be needed.

The question at hand is whether to have this “headend” remain where it is – which would put it in a new/remodeled office (Room E173) - or move it to perhaps a new location in the new courtroom addition. Relocation of the headend is possible, but difficult and would incur costs and downtime. If the headend is moved, any existing card reader cables would need to be spliced and extended to the new location. This room also has the video surveillance equipment for the State cameras in the existing courtrooms, which will be relocated and upgraded with the new courtroom additions. The other “system” also located in this Maintenance Room is the Court Duress system that has been replaced and is no longer functioning.

With the exception of the State cameras, the rest of the facility is monitored by the Sheriff's Department with sight, sound, and control from the main security room on the detention side of the building. Currently, there is limited law enforcement presence on the court side. The State's intent is to bring a more obvious security presence to the new courtroom addition and this may very well require the need for a second "control room" to work out of on the Courtroom side of the building with system interface back to the existing detention security control room. Video surveillance has been recently upgraded to an IP platform that simplifies the addition of cameras, at least to the Sheriff's surveillance system.

# Duchesne County Justice Center - Preliminary System Comparison

March 27, 2014

Spectrum Engineers, Inc.  
324 S. State Street, Suite 400  
Salt Lake City, Utah 84111



	Option 1 - Existing System - Baseline	Option 2	Option 3	Option 4	Option 5
<b>Description</b>	Packaged VAV Rooftop with DX Cooling, Boiler, VAV	Air Cooled Chiller, Central Air Handler, Boiler, VAV	IDEC with Backup DX Type AHU, Boiler, VAV	Evaporative Condensing Packaged VAV RTU, Boiler, VAV	Water Cooled Chiller, Cooling Tower, Central Air Handler, Boiler, VAV
<b>First Cost (% More)</b>	Baseline	+ 11.3%	+ 14.7%	+ 19.3%	+ 20.4%
<b>Annual Energy Cost vs Baseline</b>	Baseline	- 5.8%	- 22.6%	- 8.1%	- 16.8%
<b>Energy Efficiency vs Baseline</b>	Baseline	- 24.0%	- 64.8%	- 31.3%	- 53.9%
<b>Square Footage Inside</b>	300	950	250	250	1,200
<b>Square Footage Outside</b>	400	300	500	400	150
<b>Maintenance Complexity (1-10, 10 = Most Complex)</b>	3	6	6	5	8
<b>Serviceable Life (years)</b>	25	30	30	25	35+
<b>Noise (1-10, 10 = Loud)</b>	5	3	3	4	2
<b>Comfort (1-10, 10 = Most Comfortable)</b>	8	8	6	8	9
<b>Flexibility (1-10, 10 = Most Flexible)</b>	7	8	7	7	9
<b>System Commonality (1-10, 10 = Most Common)</b>	9	8	5	3	7

## NOTES:

1. **First cost** is a cost percentage higher than baseline, **Annual cost savings** is the percentage lower in energy costs (energy includes lighting and receptacle loads), **Energy Efficiency** is the efficiency of the HVAC systems as a percentage better than the baseline system, **Maintenance Complexity** 1 represents easy and 10 difficult to work on, **Noise** 1 is quietest and 10 is loudest, **Comfort** 1 means occupants are often uncomfortable and 10 is occupants nearly always comfortable, **Flexibility** 1 is no ability to change the system if needed and 10 is extremely easy to change or adapt the system as the building changes, **System Commonality** 1 is a very unique system and may be harder to find people who know how to work on it, 10 is a very a common system.

2. This is a preliminary analysis done with a large number of assumptions and unknowns. A change in any of the unknowns could change costs and energy efficiency. Examples of assumptions and unknowns; Hours of operation, number of occupants, power and utility rate structure, building envelope, process or other equipment loads, maintenance cost, differing equipment lifetime expectancies, occupant comfort thresh hold, and weather patterns.

3. Annual Energy Cost & Energy Efficiency are not directly proportional as HVAC energy usage is only about a third of an average buildings energy usage. Also some system may use different energy sources for heating. Different energy sources (Natural gas, electricity, Propane, etc.) have different rate structures which effect the annual energy costs differently.

# Economic Summary

## Project Information

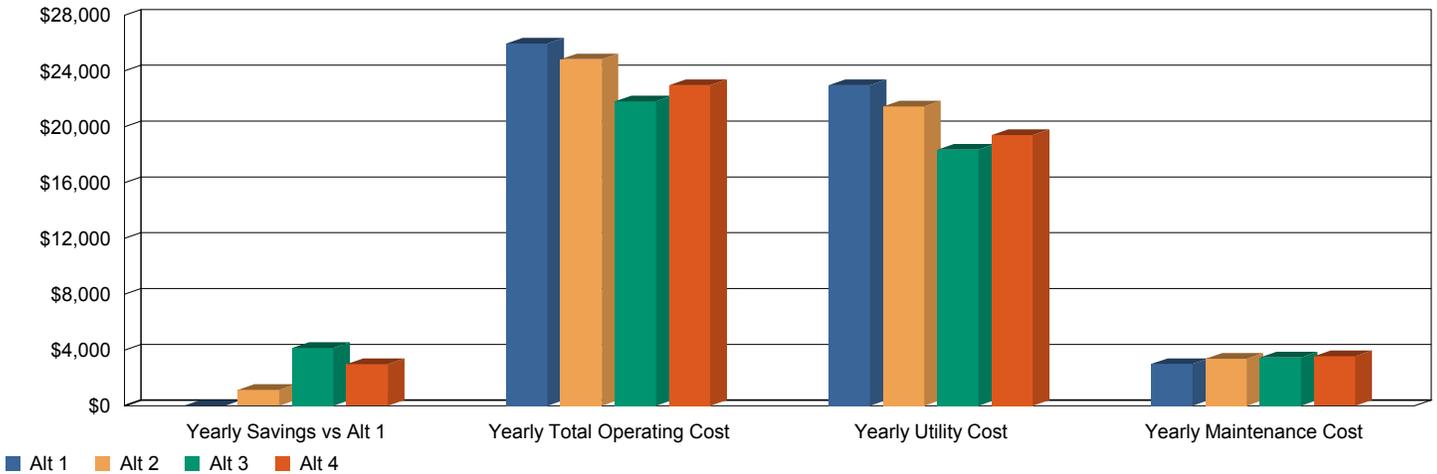
Location: Duchesne, Utah  
 Project Name: DCJC  
 User: Ryan Boogaard  
 Company: Spectrum Engineers  
 Comments:

Study Life: 35 years  
 Cost of Capital: 0 %  
 Alternative 1: Packaged VAV RTU - Existing  
 Alternative 2: Air Cooled Chiller  
 Alternative 3: IDEC AHU with DX Backup  
 Alternative 4: Water Cooled Chiller, Cooling Tower, AHU

## Economic Comparison of Alternatives

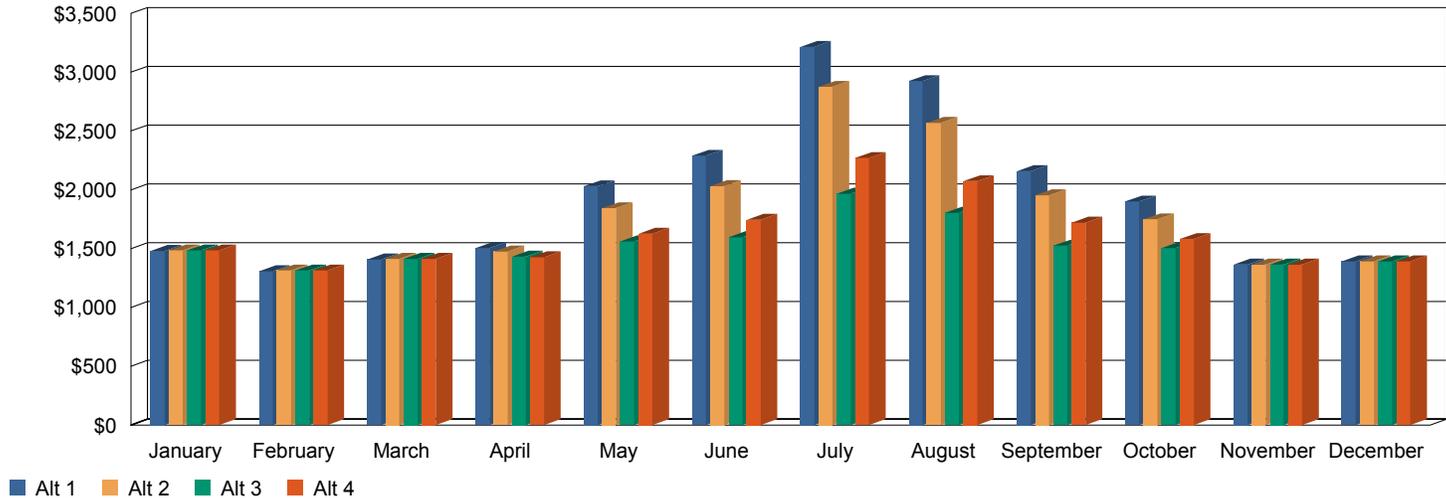
	Yearly Savings (\$)	First Cost Difference (\$)	Cumulative Cash Flow Difference (\$)	Simple Payback (yrs.)	Net Present Value (\$)	Life Cycle Payback (yrs.)	Internal Rate of Return (%)	Life Cycle Cost
Alt 2 vs Alt 1	1,137	50,000	-10,196	44.0	-10,196	No Payback	Does Not Payback	-10,196.16
Alt 3 vs Alt 1	4,150	83,000	62,235	20.0	62,235	20.0	3.5	62,234.71
Alt 4 vs Alt 1	2,996	90,000	14,875	30.0	14,875	30.0	0.9	14,875.13
Alt 3 vs Alt 2	3,012	33,000	72,431	11.0	72,431	11.0	8.6	72,430.87
Alt 4 vs Alt 2	1,859	40,000	25,071	21.5	25,071	21.5	3.0	25,071.29
Alt 4 vs Alt 3	-1,153	7,000	-47,360	No Payback	-47,360	No Payback	Does Not Payback	-47,359.58

## Annual Operating Costs



	Yearly Savings vs Alt 1	Yearly Total Operating Cost (\$)	Yearly Utility Cost (\$)	Yearly Maintenance Cost (\$)	Plant kWh/ton-hr
Alt 1	0	25,974	22,974	3,000	1.265
Alt 2	1,137	24,837	21,467	3,370	0.902
Alt 3	4,150	21,825	18,360	3,465	1.211
Alt 4	2,996	22,978	19,413	3,565	1.4743200

**Monthly Utility Costs**



# DUCHESNE COUNTY JUSTICE CENTER

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## SECTION 012500 - SUBSTITUTION PROCEDURES

### 1.1 ACTION SUBMITTALS

- A. Substitution Request Form: CSI Form 13.1A.
- B. Documentation:
  - 1. Justification.
  - 2. Coordination information.
  - 3. Detailed comparison.
  - 4. Product Data.
  - 5. Samples.
  - 6. Certificates and qualification data.
  - 7. List of similar installations.
  - 8. Material test reports.
  - 9. Research reports.
  - 10. Detailed comparison of Contractor's construction schedule.
  - 11. Cost information.
  - 12. Contractor's certification.
  - 13. Contractor's waiver of rights to additional payment or time.
- C. Architect's Action: If necessary, Architect will request additional information within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection within 15 days of receipt, or seven days of receipt of additional information.

### 1.2 SUBSTITUTIONS

- A. Substitutions for Cause: Not later than 15 days prior to time required for preparation and review of submittals.
- B. Substitutions for Convenience: Not allowed.

END OF SECTION 012500

## SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

### 1.1 REQUESTS FOR INFORMATION (RFIs)

- A. RFI Forms: DFCM RFI form.
- B. Architect's Action: Allow 14 working days for Architect's response for each RFI.
- C. RFI Log: Maintain a tabular log of RFIs. Submit log weekly . Use software log that is part of Project Web site.

### 1.2 PROJECT MEETINGS

- A. Schedule and conduct meetings.
- B. Preconstruction conference.
- C. Preinstallation Conferences: Before each construction activity that requires coordination.
- D. Project Closeout Conference: No later than 90 days prior to the scheduled date of Substantial Completion.
- E. Progress Meetings: At weekly intervals, coordinated with preparation of payment requests.
- F. Coordination Meetings: At regular intervals, in addition to specific meetings held for other purposes.

END OF SECTION 013100

## SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

### 1.1 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: PDF electronic file .
- B. Startup construction schedule.
- C. Startup network diagram.
- D. Contractor's construction schedule.
  - 1. Submit a working electronic copy of schedule.
- E. CPM reports.
- F. Daily Construction Reports: Submit at weekly intervals.
- G. Material Location Reports: Submit at monthly intervals.
- H. Site Condition Reports: Submit at time of discovery of differing conditions.
- I. Special Reports: Submit at time of unusual event.

### 1.2 QUALITY ASSURANCE

- A. Scheduling Consultant: Experienced specialist in CPM scheduling and reporting.

### 1.3 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Activity Duration: No longer than 20 days.
- B. Constraints:
  - 1. Phasing.
  - 2. Work under more than one contract.
  - 3. Work by Owner.
  - 4. Products ordered in advance.
  - 5. Owner-furnished products.
  - 6. Work restrictions.
  - 7. Work stages.
  - 8. Construction areas.
- C. Milestones: Notice to Proceed, Substantial Completion, and final completion.
- D. Updating: At monthly intervals, issued one week before each progress meeting.

END OF SECTION 013200

## SECTION 013300 - SUBMITTAL PROCEDURES

### 1.1 DEFINITIONS

- A. Action Submittals: Information that requires Architect's responsive action.
- B. Informational Submittals: Information that does not require Architect's approval. Submittals may be rejected for not complying with requirements.

### 1.2 PROCEDURES

- A. Electronic copies of digital data files of the Contract Drawings will not be provided by Architect for Contractor's use.
- B. Processing Time:
  - 1. Initial Review: 15 days.
  - 2. Resubmittal Review: 15 days.
  - 3. Sequential Review: 21 days.
- C. Transmittal Form: CSI Form 12.1A .
- D. Submittal Procedures:
  - 1. Post as PDF files directly to Project Web site .
  - 2. Certificates and Certifications Submittals: Includes signature of entity responsible for preparing certification. Provide a digital signature on electronically submitted certificates and certifications where indicated.
- E. Delegated-Design Services Certification: In addition to other required submittals, submit digitally signed PDF electronic file copies of certificate, signed and sealed by the responsible design professional.
- F. Contractor's Review:
  - 1. Submittals: Marked with approval stamp before submitting to Architect.
- G. Architect's Action:
  - 1. Action Submittals: Stamped with an action stamp and returned.
  - 2. Informational Submittals: Reviewed but not returned, or rejected if they do not comply with requirements.
  - 3. Incomplete submittals will be returned without review.
  - 4. Submittals Not Required: May not be reviewed and may be discarded.

END OF SECTION 013300

SECTION 013513.16 - SPECIAL PROJECT PROCEDURES FOR DETENTION FACILITIES

1.1 SUMMARY

- A. Work of this Section to be performed by Contractor .

1.2 DETENTION WORK

A. Coordination:

1. Work of separate entities.
2. Selection and installation of products furnished by Owner.
3. Quality assurance for detention lock Installer .
4. Submittals.
5. Detention work subschedule.
6. Anchorages and embedments.
7. Security fasteners.
8. Shop Drawings.
9. Temporary facilities.
10. Interruptions of utilities.
11. Protection of detention work.
12. Project Record Documents.
13. Operation and maintenance manuals.

B. Administrative Procedures:

1. Scheduling and timing of administrative procedures.
2. Notifications.
3. Coordination Meetings: Regular intervals.

C. Field Quality Control:

1. Inspect installed work.
2. Verify wiring installation.
3. Observe installation and start-up checks.
4. Test systems.

D. Demonstration: Train Owner's personnel.

END OF SECTION 013513.16

## SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

### 1.1 SUMMARY

- A. Salvaging nonhazardous demolition and construction waste.
- B. Recycling nonhazardous demolition and construction waste.
- C. Disposing of nonhazardous demolition and construction waste.

### 1.2 PERFORMANCE REQUIREMENTS

- A. End-of-Project Rates for Salvage/Recycling: 75 percent.

### 1.3 WASTE MANAGEMENT PLAN

- A. Types and quantities of demolition and construction waste.
- B. Type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator.
- C. Net additional cost or net savings resulting from waste management plan.

### 1.4 PLAN IMPLEMENTATION

- A. Engage a waste management coordinator.
- B. Train workers, subcontractors, and suppliers on proper waste management procedures.
- C. Recycling Incentives: Revenues and other incentives for recycling will accrue to Contractor .

END OF SECTION 017419

## SECTION 017700 - CLOSEOUT PROCEDURES

### 1.1 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection, complete the following.
1. Contractor's list of incomplete items (punch list) prepared on CSI Form 14.1A.
    - a. Submit PDF electronic file.
  2. Owner advised of pending insurance changeover.
  3. Warranties, maintenance service agreements, and similar documents submitted.
  4. Releases, occupancy permits, and operating certificates submitted.
  5. Project Record Documents submitted.
  6. Tools, spare parts, and extra materials delivered.
  7. Final changeover of locks performed.
  8. Startup testing completed.
  9. Test/adjust/balance records submitted.
  10. Temporary facilities removed.
  11. Owner advised of heat and utility changeover.
  12. Changeover information for use, operation, and maintenance submitted.
  13. Owner's personnel instructed in operation, adjustment, and maintenance of equipment and systems, including demonstration and training videotapes submitted.
  14. Final cleaning performed.
  15. Touchup performed.

### 1.2 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection, complete the following:
1. Final Application for Payment submitted.
  2. List of incomplete items (punch list) endorsed by Architect as completed or otherwise resolved for acceptance.
  3. Evidence of continuing insurance coverage submitted.
  4. Final pest-control inspection report and warranty submitted.

### 1.3 SUBMITTAL OF PROJECT WARRANTIES

- A. Partial Occupancy: Submit warranties within 15 days of completion of designated portions of the Work that are occupied or used by Owner.
- B. Organize warranty documents based on Project Manual and bind in heavy-duty, three-ring, vinyl-covered, loose-leaf binders.
- C. Scan warranties and bonds into a single indexed electronic PDF file.

1.4 FINAL CLEANING

- A. Cleaning Agents: Comply with Green Seal's GS-37 and California Code of Regulations maximum allowable VOC levels.
- B. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program.
- C. Replace disposable air filters and clean permanent air filters.
- D. Clean ducts, blowers, and coils if units were operated without filters during construction.

1.5 REPAIR OF THE WORK

- A. Repair or remove and replace defective construction. Where damaged or worn items cannot be repaired or restored, provide replacements. Restore damaged construction and permanent facilities used during construction to specified condition.

END OF SECTION 017700

## SECTION 017823 - OPERATION AND MAINTENANCE DATA

### 1.1 SUMMARY

- A. Emergency operation and maintenance manuals.

### 1.2 PRODUCTS

- A. Format:
  - 1. PDF electronic files with composite electronic index on digital media acceptable to Architect. Include a complete electronically linked operation and maintenance directory.
  - 2. Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, three set(s) of copies.
- B. Emergency Manuals: Types of emergencies, emergency instructions, and emergency procedures.
- C. Operation Manuals: System, subsystem, and equipment descriptions, operating procedures, wiring diagrams, control diagrams and sequence of operation, and piped system diagrams.
- D. Product Maintenance Manuals: Source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds.
- E. Systems and Equipment Maintenance Manuals: Source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds.

END OF SECTION 017823

## SECTION 017839 - PROJECT RECORD DOCUMENTS

### 1.1 PRODUCTS

#### A. Record Drawings:

1. One set(s) of marked-up record prints.
  - a. Final Submittal:
    - 1) **[Three]** <Insert number> paper-copy set(s) of marked-up record prints.
    - 2) PDF electronic files of scanned record prints and three set(s) of prints.
  - b. Final Submittal:
    - 1) **[One]** paper-copy set(s) of marked-up record prints.
    - 2) Record digital data files and three set(s) of record digital data file plots.

### 1.2 PRODUCTS

- A. Record Prints: One set of paper copies of Contract Documents and Shop Drawings, marked to show actual installation.
- B. Record Digital Data Files: Corrected digital data files of the Contract Drawings, as follows:
  1. Format: Annotated PDF electronic file with comment function enabled.

END OF SECTION 017839

## SECTION 017900 - DEMONSTRATION AND TRAINING

### 1.1 INSTRUCTION PROGRAM

- A. Program Structure: Training modules for each system and for equipment not part of a system, including the following:
  - 1. Basis of system design, operational requirements, and criteria.
  - 2. Documentation.
  - 3. Emergencies.
  - 4. Operations.
  - 5. Adjustments.
  - 6. Troubleshooting.
  - 7. Maintenance.
  - 8. Repairs.
- B. Facilitator to prepare instruction program and training modules and to coordinate instructors.
- C. Evaluation: Demonstration performance-based test.

### 1.2 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. Commercial videographer to record demonstration and training video recordings.
- B. Narration: Describe scenes on video recording and provide a transcript of the narration.
- C. Provide video recordings used as a component of training modules.

END OF SECTION 017900

## SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

### 1.1 INFORMATIONAL SUBMITTALS

- A. Commissioning plan information.
- B. Commissioning schedule.
- C. Two-week look-ahead schedules.
- D. Commissioning coordinator letter of authority.
- E. Commissioning coordinator qualification data.
- F. List test instrumentation, equipment, and monitoring devices.
- G. Test reports.
- H. Construction checklists.

### 1.2 CLOSEOUT SUBMITTALS

- A. Commissioning report.
- B. Request for Certificate of Construction Phase Commissioning Completion.
- C. Operation and maintenance data.

### 1.3 GENERAL EXECUTION REQUIREMENTS

- A. Schedule and coordinate commissioning with the construction schedule.
- B. Perform activities identified in construction checklists, including tests, and document results of actions as construction proceeds.
- C. Perform test demonstrations for Owner's witness.
- D. Report test data and commissioning issue resolutions.
- E. Schedule personnel to participate in and perform Commissioning-Process Work.
- F. Operate the equipment and systems they install during tests.
- G. Manage, schedule, and coordinate commissioning.
- H. Request Certificate of Construction Phase Commissioning Completion.

1.4 COMMISSIONING REPORTS

A. Test Reports:

1. Pre-startup reports, including observations of the conditions of installation.
2. Test data reports.
3. Commissioning compliance issues reports.
4. Weekly progress reports.
5. Data trend logs.
6. System alarm logs.

END OF SECTION 019113

SECTION 024119 - SELECTIVE DEMOLITION

1.1 FIELD CONDITIONS

- A. Owner will not occupy portions of building adjacent to selective demolition area.

1.2 EXAMINATION

- A. Perform an engineering survey of condition of building.

1.3 PREPARATION

- A. Refrigerant: Remove according to 40 CFR 82.

1.4 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Utility Shut Off: By Contractor and coordinated with Owner.

1.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. Dispose of according to Section 017419 "Construction Waste Management and Disposal."

END OF SECTION 024119

## SECTION 033000 - CAST-IN-PLACE CONCRETE

### 1.1 PRODUCTS

- A. Concrete General: **ACI 301 (ACI 301M)** and **ACI 117 (ACI 117M)**.
- B. Form facing materials.
- C. Steel Reinforcement:
  - 1. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25] 60 <Insert number> percent.
  - 2. Reinforcing Bars: Deformed .
  - 3. Welded-Wire Reinforcement: Plain .
- D. Concrete Materials:
  - 1. Concrete manufactured within **500 miles (800 km)** of Project site from aggregates and cementitious materials extracted and manufactured within **500 miles (800 km)** of Project site.
  - 2. Portland Cement: ASTM C 150, Type I , gray .
  - 3. Fly ash.
  - 4. Slag cement.
  - 5. Blended Hydraulic Cement: Type IS .
  - 6. Silica fume.
  - 7. Aggregate: Normal weight .
  - 8. Water.
- E. Mixing: Ready mixed or Project site.

### 1.2 CONCRETE MIXTURES

- A. Portland Cement Replacement: Use fly ash, slag cement, and silica fume to reduce portland cement by 40 percent.
- B. Compressive Strength (28 Days):
  - 1. Footings: As indicated by Structural .
  - 2. Foundation Walls: As indicated by Structural .
  - 3. Slabs-on-Grade: As indicated by Structural .

### 1.3 INSTALLATION

- A. Formed Finishes: Smooth .
- B. Floor and Slab Finishes:
  - 1. Trowel: Surfaces exposed to view or to be covered with carpet, ceramic or quarry tile set over a cleavage membrane, or thin-film-finish coating system.

2. Trowel and Fine Broom: Surfaces to be covered with ceramic or quarry tile to be installed by either thickset or thinset method.
3. Broom: Exterior concrete steps and ramps.
4. Slip Resistive: Concrete ramps.

1.4 FIELD QUALITY CONTROL

- A. Testing: By Owner-engaged agency.
- B. Special Inspections: By Owner-engaged special inspector.

END OF SECTION 033000

SECTION 033543 - POLISHED CONCRETE FINISHING

1.1 QUALITY ASSURANCE

- A. Field sample panels.
- B. Mockups.

1.2 PRODUCTS

- A. Reactive stains.
- B. Penetrating stains.
- C. Penetrating liquid floor treatment.

1.3 POLISHING

- A. Polish: Level 2: Low sheen, 400 grit .

END OF SECTION 033543

## SECTION 042200 - CONCRETE UNIT MASONRY

### 1.1 PERFORMANCE REQUIREMENTS

- A. Net-Area Compressive Strengths of Structural Unit Masonry: As indicated .
- B. Determine net-area compressive strength of masonry by testing masonry prisms.

### 1.2 MATERIALS

- A. Concrete Masonry Units (CMUs):
  - 1. Manufactured within 500 miles (800 km) of Project site from aggregates and cement extracted and manufactured within 500 miles (800 km) of Project site.
  - 2. CMUs: Normal weight.
- B. Masonry Lintels: prefabricated or built-in-place CMU lintels.
- C. Reinforcing Steel: Uncoated-steel reinforcing bars.
- D. Masonry-Joint Reinforcement:
  - 1. Interior Walls: Hot-dip galvanized, carbon steel.
- E. Ties and Anchors: steel. Mill galvanized in interior walls.
  - 1. Partition top anchors.
  - 2. Rigid anchors.
- F. Reinforcing bar positioners.
- G. Masonry-Cell Fill: lightweight aggregate.
- H. Mortar:
  - 1. Aggregates, cement, and lime extracted and manufactured within 500 miles (800 km) of Project site.
  - 2. Portland cement-lime masonry cement or mortar cement mortar unless otherwise indicated.
  - 3. Portland cement-lime masonry cement or mortar cement for reinforced masonry.

### 1.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner engaged.
- B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
- C. Testing: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area.

END OF SECTION 042200

## SECTION 051200 - STRUCTURAL STEEL FRAMING

### 1.1 SUMMARY

- A. Structural steel as classified by AISC 303.
- B. Prefabricated building columns.
- C. Grout.

### 1.2 QUALITY ASSURANCE

- A. Fabricator Qualifications: AISC-Certified Plant, Category STD.
- B. Installer Qualifications: AISC-Certified Erector, Category ACSE .
- C. Shop-Painting Applicator Qualifications: AISC's Sophisticated Paint Endorsement P1 or SSPC-QP 3.
- D. Quality Standards: AISC 303, AISC 341, AISC 341s1, and AISC 360.

### 1.3 PERFORMANCE REQUIREMENTS

- A. Fabricator to select or complete simple shear connections, including engineering analysis by a qualified professional engineer, to withstand design loads.

### 1.4 MATERIALS

- A. Recycled Content of Steel: Postconsumer plus one-half of preconsumer recycled content not less than 50 percent.
- B. Structural-Steel Shapes: W-shapes channels angles plate and bar and steel pipe.
- C. Bolts, Nuts, and Washers: Tension control, high strength.
- D. Anchor Rods: Headed rods, nuts, plate washers, and washers.
- E. Connectors: Shear connectors threaded rods clevises turnbuckles eye bolts and nuts and sleeve nuts.
- F. Primer: Comply with painting Sections .
  - 1. Primers comply with LEED for Schools Credit IEQ 4.2.
- G. Grout: Nonmetallic, shrinkage resistant.
- H. Prefabricated Building Columns:

1. Fire-Resistance Rating: As indicated.

#### 1.5 FABRICATION

##### A. Shop Connections:

1. High-Strength Bolts: Snug tightened .
2. Welded connections.

##### B. Surface Preparation: SSPC-SP 2 .

##### C. Galvanize: Lintels shelf angles and welded door frames located in exterior walls.

#### 1.6 SOURCE QUALITY CONTROL

##### A. Testing Agency: Owner engaged.

#### 1.7 INSTALLATION

##### A. Field Connections:

1. High-Strength Bolts: Snug tightened .
2. Welded connections.

#### 1.8 FIELD QUALITY CONTROL

##### A. Special Inspector: Owner engaged.

##### B. Testing Agency: Owner engaged.

END OF SECTION 051200

## SECTION 051213 - ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

### 1.1 SUMMARY

- A. Architecturally exposed structural-steel (AESS) framing.
  - 1. Requirements in Section 051200 "Structural Steel Framing" also apply to AESS.

### 1.2 DEFINITIONS

- A. Category 1 AESS: Exposed structural steel that is within **96 inches (2400 mm)** vertically and **36 inches (900 mm)** horizontally of a walking surface.
- B. Category 2 AESS: Exposed structural steel that is within **20 feet (6 m)** vertically and horizontally of a walking surface.
- C. Category 3 AESS: Exposed structural steel that is not defined as Category 1 or Category 2.

### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: AISC-Certified Erector, Category ACSE .
- B. Fabricator Qualifications: AISC-Certified Plant, Category STD.

### 1.4 MATERIALS

- A. Primer: Fabricator's standard, nonasphaltic.
- B. Etching cleaner for galvanized metal.
- C. Primer for Galvanized Steel: Water based.

### 1.5 FABRICATION

- A. Special care used in handling and fabricating AESS, and the following:
  - 1. Exposed surfaces smooth, square, and free of surface blemishes.
  - 2. Grind cut edges of Category 1 AESS.
  - 3. Category 1 AESS exposed surfaces free of mill marks.
  - 4. Category 1 and Category 2 AESS exposed surfaces free of seams to maximum extent possible.
  - 5. Blemishes filled, ground, or welded and ground before shop priming.
  - 6. Piece marks hidden or removed after erection.
  - 7. Category 1 AESS fabricated to tolerances in AISC 303 for AESS.
  - 8. Category 2 and Category 3 AESS fabricated to tolerances in AISC 303 for steel that is not AESS.

9. Ends of Category 1 AESS hollow structural sections closed.
10. Curved Members: Distortion not visible from a distance of 20 feet (6 m).
11. Coping, Blocking, and Joint Gaps: Uniform gaps of 1/8 inch (3.2 mm) for Category 1 AESS.

B. Weld Connections:

1. Continuous, sealed welds at angle to gusset-plate connections and similar locations where Category 1 AESS is exposed to weather.
2. Continuous uniform welds for Category 1 AESS.
3. Butt and groove welds ground flush for Category 1 and Category 2 AESS.
4. Backing bars and runoff tabs removed and steel ground smooth for Category 1 and Category 2 AESS.
5. Exposed connections of Category 1 and Category 2 AESS ground smooth where welded on far side.
6. Fillet welds for Category 1 and Category 2 AESS made oversize and ground smooth.

C. Cleaning Corrosion-Resisting Structural Steel: SSPC-SP 6/NACE No. 3.

D. Surface Preparation: [SSPC-SP 2] [SSPC-SP 3] [SSPC-SP 7/NACE No. 4] [SSPC-SP 14/NACE No. 8] [SSPC-SP 11] [SSPC-SP 6/NACE No. 3] [SSPC-SP 10/NACE No. 2] [SSPC-SP 5/NACE No. 1] [SSPC-SP 8].

E. Galvanize: Lintels located in exterior walls.

## 1.6 ERECTION

A. Category 1 AESS erected to tolerances in AISC 303 for AESS.

B. Category 2 and Category 3 AESS erected to tolerances in AISC 303 for steel that is not AESS.

C. Connections welded per "Fabrication" Article and as follows:

1. Backing bars and runoff tabs removed and steel ground smooth for Category 1 and Category 2 AESS.
2. Erection bolts removed in Category 1 and Category 2 AESS and holes filled and ground smooth.
3. Weld access holes in Category 1 and Category 2 AESS filled and ground smooth.

END OF SECTION 051213

## SECTION 052100 - STEEL JOIST FRAMING

### 1.1 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 60 percent.
- B. K-series and KCS-type K-series steel joists for roof framing, with top chord extensions .
- C. K-series steel joist substitutes with steel-angle or -channel members for roof framing.
- D. LH-series steel joists for roof framing.
  - 1. End Arrangement: Underslung .
  - 2. Top-Chord Arrangement: Parallel .
- E. DLH-series steel joists for roof framing.
  - 1. End Arrangement: Underslung .
  - 2. Top-Chord Arrangement: Parallel .
- F. CJ-series composite steel joists for roof framing.
  - 1. End Arrangement: Underslung .
- G. Joist girders for roof framing.
  - 1. End Arrangement: Underslung [**Square**].
  - 2. Top-Chord Arrangement: Parallel .
- H. Primer: SSPC-Paint 15.
  - 1. Primer complies with LEED for Schools Credit EQ 4.
- I. Bolts: High-strength carbon steel.
  - 1. Finish: Hot-dip zinc coating .

### 1.2 INSTALLATION

- A. Connections: Field welded .

### 1.3 FIELD QUALITY CONTROL

- A. Testing of connections by Owner-engaged agency.

END OF SECTION 052100

## SECTION 053100 - STEEL DECKING

### 1.1 QUALITY ASSURANCE

- A. FM Global Listing: Steel roof deck.

### 1.2 PERFORMANCE REQUIREMENTS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

### 1.3 MATERIALS

- A. Roof Deck: Prime-painted steel sheet.
  - 1. Profile Depth: 1-1/2 inches (38 mm) .
- B. Acoustical Roof Deck: Prime-painted steel sheet.
  - 1. Profile Depth: 1-1/2 inches (38 mm) .
  - 2. Acoustical Performance: NRC 0.90.

### 1.4 INSTALLATION

- A. Roof Deck: Welded .

### 1.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner engaged.

END OF SECTION 053100

## SECTION 054000 - COLD-FORMED METAL FRAMING

### 1.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance:
  - 1. Dead Loads: As indicated.
  - 2. Live Loads: As indicated.
  - 3. Roof Loads: As indicated.
  - 4. Snow Loads: As indicated.
  - 5. Wind Loads: As indicated.
  - 6. Seismic Loads: As indicated.
  - 7. Deflection Limits: As indicated.
- B. Engineering design of cold-formed metal framing by Contractor.
- C. Design Standards: AISI S100 and AISI S200.

### 1.2 MATERIALS

- A. Recycled Content of Steel: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, metallic coated.
- C. Exterior Non-Load-Bearing Wall Framing: Standard C-shaped, punched steel studs and U-shaped, unpunched track.
  - 1. Minimum Steel Thickness: 0.0329 inch (0.84 mm) .
  - 2. Drift clips.
- D. Soffit Framing: Standard C-shaped, unpunched steel sections.
  - 1. Minimum Steel Thickness: 0.0428 inch (1.09 mm) .
- E. Framing Accessories: Supplementary framing bracing, bridging, and solid blocking web stiffeners anchor clips end clips foundation clips gusset plates stud kickers and knee braces joist hangers and end closures hole reinforcing plates and backer plates.

### 1.3 INSTALLATION

- A. Fasten framing by screw fastening.
  - 1. Exterior Non-Load-Bearing Wall Stud Spacing: 16 inches (406 mm) .

### 1.4 FIELD QUALITY CONTROL

- A. Testing: By Owner-engaged agency.

END OF SECTION 054000

## SECTION 064113 - WOOD-VENEER-FACED ARCHITECTURAL CABINETS

### 1.1 QUALITY ASSURANCE

- A. Fabricator Qualifications: Certified participant in AWI's Quality Certification Program .
- B. Mockups for typical architectural wood cabinets.

### 1.2 WOOD CABINETS FOR TRANSPARENT FINISH

- A. Grade: Premium .
- B. Manufactured within 500 miles (800 km) of Project site.
- C. FSC-certified wood.
- D. Type of Construction: Frameless .
- E. Cabinet and Door and Drawer Front Interface Style: Flush inset.
- F. Wood for Exposed Surfaces: As indicated.
  - 1. Species: As Scheduled.
  - 2. Cut: As indicated.
  - 3. Veneer Matching: Book match veneer leaves and center-balance match within panel face.
    - a. Cabinet veneers in each space from a single flitch.
    - b. Blueprint match with paneling.
- G. Cabinet Interior: Same species and cut as exterior .

### 1.3 MATERIALS

- A. Composite Wood Products: Urea formaldehyde free .
- B. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer plus one-half of preconsumer recycled content not less than 25 percent.
- C. Adhesives: Urea formaldehyde free and low-emitting to comply with LEED for New Construction.
- D. Cabinet Hardware:
  - 1. Hinges: Frameless, concealed.
  - 2. Pulls: Back mounted .
  - 3. Adjustable shelf supports.
  - 4. Locks: Door and drawer.

5. Exposed Hardware Finishes: Satin stainless steel.

#### 1.4 SHOP FINISHING

- A. Grade: Same grade as woodwork.
- B. Extent: All cabinets shop finished .
- C. Finishing Materials: Low-emitting materials for LEED for Schools.

END OF SECTION 064113

## SECTION 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

### 1.1 QUALITY ASSURANCE

- A. Fabricator Qualifications: Certified participant in AWI's Quality Certification Program .
- B. Mockups for typical plastic-laminate cabinets.

### 1.2 PLASTIC-LAMINATE-FACED CABINETS

- A. Grade: Premium .
- B. Manufactured within 500 miles (800 km) of Project site.
- C. FSC-certified wood products.
- D. Type of Construction: Frameless .
- E. Cabinet and Door and Drawer Front Interface Style: Flush inset.
- F. Laminate Cladding for Exposed Surfaces:
  - 1. Horizontal Surfaces: Grade HGS .
  - 2. Postformed Surfaces: Grade HGP.
  - 3. Vertical Surfaces: Grade VGS.
- G. Cabinet Interior: Thermoset decorative panels.

### 1.3 MATERIALS

- A. Composite Wood Products: Urea formaldehyde free .
- B. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer plus one-half of preconsumer recycled content not less than 25 percent.
- C. Adhesives: Urea formaldehyde free and low emitting for LEED for New Construction.
- D. Cabinet Hardware:
  - 1. Hinges: Frameless, concealed.
  - 2. Pulls: Back mounted .
  - 3. Adjustable shelf supports.
  - 4. Locks: Door and drawer.
  - 5. Exposed Hardware Finishes: Satin stainless steel.

END OF SECTION 064116

## SECTION 064216 - FLUSH WOOD PANELING

### 1.1 QUALITY ASSURANCE

- A. Fabricator Qualifications: Certified participant in AWI's Quality Certification Program .
- B. Mockups for typical paneling.

### 1.2 PANELING, GENERAL

- A. Manufactured within 500 miles (800 km) of Project site.
  - 1. Composite wood materials manufactured and extracted within 500 miles (800 km) of Project site.
  - 2. Veneers manufactured and extracted within 500 miles (800 km) of Project site.
  - 3. Lumber manufactured and extracted within 500 miles (800 km) of Project site.

### 1.3 FLUSH WOOD PANELING FOR TRANSPARENT FINISH

- A. Grade: Premium .
- B. FSC-certified wood.
- C. Wood Species and Cut: As Scheduled.
- D. Matching of Adjacent Veneer Leaves: Book .
- E. Matching within Panel Face: Center-balance match.
- F. Matching of Adjacent Veneer Leaves and within Panel Face: Slip, center, book match.
- G. Panel-Matching Method: Sequence matched .
- H. Vertical Panel-Matching Method: Architectural end book match .
- I. Fire-Retardant-Treated Paneling: Flame-spread index of 25 or less.

### 1.4 MATERIALS

- A. Composite Wood Products: Urea formaldehyde free .
- B. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer plus one-half of preconsumer recycled content not less than 25 percent.
- C. Adhesives: Urea formaldehyde free and low emitting for LEED for New Construction.

1.5 SHOP FINISHING

- A. Grade: Same grade as woodwork.
- B. Grade: Premium for transparent finish. Premium for opaque finish.
- C. Extent: All paneling shop finished .
- D. Finishing Materials: Low-emitting materials for LEED for Schools.

END OF SECTION 064216

## SECTION 064600 - WOOD TRIM

### 1.1 QUALITY ASSURANCE

- A. Fabricator Qualifications: Certified participant in AWI's Quality Certification Program .
- B. Mockup for typical wood trim.

### 1.2 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Grade: Premium .
- B. Manufactured within 500 miles (800 km) of Project site from materials extracted and manufactured within 500 miles (800 km) of Project site.
- C. FSC-certified wood.
- D. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.
  - 1. Species: As Scheduled.
  - 2. Cut: As Indicated.

### 1.3 MATERIALS

- A. Composite Wood Products: Urea formaldehyde free .
- B. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer plus one-half of preconsumer recycled content not less than 25 percent.
- C. Adhesives: Urea formaldehyde free and low emitting for LEED for New Construction.
- D. Installation Adhesives and Sealants: Low VOC.

### 1.4 SHOP FINISHING

- A. Grade: Same grade as woodwork.
- B. Grade: Premium for transparent finish. Premium for opaque finish.
- C. Extent: Transparent-finished wood trim shop finished; opaque-finished wood trim field finished.
- D. Finishing Materials: Low-emitting materials for LEED for Schools.

END OF SECTION 064600

## SECTION 070150.19 - PREPARATION FOR RE-ROOFING

### 1.1 SUMMARY

- A. Partial tear-off of roof areas indicated.
- B. Re-cover preparation of roof areas indicated.
- C. Removal of base flashings.
- D. Temporary roofing.

### 1.2 UNIT PRICES

- A. Unit Prices: Insulation removal and replacement .

### 1.3 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately below reroofing area.
- B. Maximum Construction Loads on Roof: As indicated by Structural Engineer.
- C. Hazardous Materials: None expected .

### 1.4 RE-COVER BOARDS

- A. Re-cover Boards: Glass-mat, water-resistant gypsum substrate .

### 1.5 EXECUTION

- A. Existing Roof Protection: Expanded polystyrene (EPS) insulation and OSB.
- B. Partial Roof Tear-Off: existing roofing membrane, roof insulation, substrate boards, and fasteners removed.

END OF SECTION 070150.19

## SECTION 072100 - THERMAL INSULATION

### 1.1 MATERIALS

#### A. Insulation:

1. Polyisocyanurate Board: Glass-fiber-mat faced, Type II, Class 2.
2. Glass-Fiber Blanket: Kraft faced .
3. Spray-Applied Cellulose: Type II (containing a dry adhesive) .

#### B. Auxiliary Insulating Materials:

1. Insulation fasteners.

END OF SECTION 072100

## SECTION 072413 - POLYMER-BASED EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)

### 1.1 QUALITY ASSURANCE

- A. Mockups for each form of construction and finish.

### 1.2 PERFORMANCE REQUIREMENTS

- A. EIFS Performance: ASTM E 2568 and ICC-ES AC219.
  - 1. System Fire Performance: Fire-resistance rating of wall assembly .
  - 2. Impact Performance: ASTM E 2568, High impact resistance.
- B. Performance of Prefabricated Panels: Engineering design by Contractor.

### 1.3 MATERIALS

- A. Primer/sealer.
- B. Flexible-Membrane Flashing: Cold applied, self-adhering, self-healing, rubberized-asphalt and polyethylene-film composite.
- C. Insulation adhesive.
- D. Molded, (Expanded) Rigid Cellular Polystyrene Board Insulation (EPS): ASTM C 578, Type I.
  - 1. Foam build-outs.
- E. Reinforcing Mesh: Alkali-resistant, glass-fiber mesh.
- F. Base coat.
- G. Waterproof adhesive/base coat.
- H. Finish-Coat Materials: Acrylic-based coating .
- I. Trim accessories.

### 1.4 PANEL FABRICATION

- A. Panel Framing: Comply with Section 054000 "Cold-Formed Metal Framing."
- B. Sheathing: Comply with Section 061600 "Sheathing."

1.5 INSTALLATION

- A. Comply with ASTM C 1397, ASTM E 2511, and EIFS manufacturer's written instructions.

1.6 INSTALLATION OF PREFABRICATED PANELS

- A. Install by welding .

1.7 FIELD QUALITY CONTROL

- A. Special Inspections: Owner engaged.
  - 1. As stipulated in Ch. 17 of the IBC.
  - 2. According to ICC-ES AC219.

END OF SECTION 072413

SECTION 072500 - WEATHER BARRIERS

1.1 MATERIALS

- A. Building wrap.
- B. Flexible Flashing: Butyl rubber or rubberized asphalt.
- C. Drainage material.

END OF SECTION 072500

SECTION 072600 - VAPOR RETARDERS

1.1 MATERIALS

- A. Fire-Retardant, Reinforced-Polyethylene Vapor Retarders: 20 lb/1000 sq. ft. (9 kg/100 sq. m) .

END OF SECTION 072600

## SECTION 074213.53 - METAL SOFFIT PANELS

### 1.1 WARRANTY

- A. Special Warranty: Two years.
- B. Finishes: 20 years.

### 1.2 PERFORMANCE REQUIREMENTS

- A. Recycled Content of Steel: Not less than 25 percent.
- B. Structural Performance: ASTM E 1592.
  - 1. Wind Loads: As indicated on Drawings.
  - 2. Other Design Loads: As indicated on Drawings .
  - 3. Deflection Limits: 1/180 .
- C. Air Infiltration: ASTM E 283.
- D. Water Penetration: ASTM E 331.

### 1.3 PRODUCTS

- A. Solid Metal Soffit Panels:
  - 1. Profile: V-groove.
  - 2. Material: Metallic-coated steel sheet.
  - 3. Exterior Finish: Two-coat fluoropolymer .
- B. Accessories: Flashing and trim.

END OF SECTION 074213.53

## SECTION 075423 - THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

### 1.1 PREINSTALLATION MEETINGS

- A. Preliminary roofing and preinstallation roofing conference.

### 1.2 WARRANTY

- A. Manufacturer's Materials and Workmanship Warranty: 25 years.
- B. Installer's Warranty: Two years.

### 1.3 PERFORMANCE REQUIREMENTS

- A. Roofing System Design:
  - 1. Corner Uplift Pressure: As indicated by Structural Notes.
  - 2. Perimeter Uplift Pressure: As indicated by Structural Notes.
  - 3. Field-of-Roof Uplift Pressure: As indicated by Structural Notes.
- B. FM Global Listing: Class 1A-90 .
- C. Cool-Roof Performance: LEED - low slope .
- D. Exterior Fire-Test Exposure: Class A .

### 1.4 MATERIALS

- A. TPO Roofing: ASTM D 6878, internally fabric- or scrim-reinforced, fabric backed TPO sheet.
  - 1. Thickness: 60 mils (1.5 mm) , nominal.
  - 2. Color: White .
- B. Low-VOC adhesives and sealants for LEED.
- C. Sheet Flashing: Same as TPO sheet.
- D. Substrate Board: Glass-mat, water-resistant gypsum substrate .
- E. Roof Insulation: Polyisocyanurate board.
  - 1. Tapered Insulation: 1/4 inch per 12 inches (1:48) .
- F. Cover Board: Glass-mat, water-resistant gypsum substrate .
- G. Walkways: Rolls .

1.5 INSTALLATION

- A. Roof Insulation: Mechanically fastened and adhered.
- B. Membrane Roofing: Adhered .
  - 1. SPRI RP-4 System 3.

1.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner engaged.
  - 1. Electric field vector mapping (EFVM).
- B. Flood testing.

END OF SECTION 075423

## SECTION 077129 - MANUFACTURED ROOF EXPANSION JOINTS

### 1.1 WARRANTY

- A. Materials and Workmanship: Two years.
- B. Painted Finishes: 20 years.

### 1.2 PRODUCTS

- A. Extruded Bellows Roof Expansion Joint:
  - 1. Joint Movement Capability: Plus and minus 25 percent of joint size .
  - 2. Primary Seal: Silicone extrusion.
  - 3. Secondary Seal.
- B. Aluminum Roof Expansion Joint:
  - 1. Joint Movement Capability: Plus and minus 25 percent of joint size .
  - 2. Frame Members: Configured for sloped cants with integral 5-1/2-inch tall aluminum curb .
  - 3. Cover: Formed or extruded aluminum .
    - a. Aluminum Finish: Clear anodic .
  - 4. Secondary Seal with thermal insulation .
  - 5. Fire-Barrier:
    - a. Fire-Resistance Rating: 2-hour .

### 1.3 MATERIALS

- A. Adhesives: Low-VOC .

END OF SECTION 077129

## SECTION 078100 - APPLIED FIREPROOFING

### 1.1 PRECONSTRUCTION TESTING

- A. Testing service engaged by Owner .

### 1.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Design: Tested according to ASTM E 119 or UL 263 . Steel members are considered unrestrained .
- B. VOC content of sealer and topcoat:
  - 1. Flat Paints and Coatings: 50 g/L.
  - 2. Nonflat Paints and Coatings: 150 g/L.
  - 3. Primers, Sealers, and Undercoaters: 200 g/L.

### 1.3 SPRAYED FIRE-RESISTIVE MATERIALS

- A. Sprayed Fire-Resistive Material: Wet, cementitious type or Dry, fiber type for interior use:
  - 1. Bond Strength: Minimum 430 lbf/sq. ft. (20.59 kPa) .
  - 2. Compressive Strength: Minimum 100 lbf/sq. in. (689 kPa) according to ASTM E 761.
  - 3. Fungus resistant.
  - 4. Finish: As selected by Architect from manufacturer's standard finishes .
- B. Auxiliary Materials: According to fire-resistance designs indicated.
  - 1. Sealer.
  - 2. Topcoat: Water based.

### 1.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner- engaged special inspector.

END OF SECTION 078100

## SECTION 078413 - PENETRATION FIRESTOPPING

### 1.1 QUALITY ASSURANCE

- A. Installer Qualifications: FM Global approved or UL qualified.

### 1.2 PENETRATION FIRESTOPPING

- A. Penetrations in Fire-Resistance-Rated Walls: F-ratings per ASTM E 814 or UL 1479.
- B. Penetrations in Horizontal Assemblies: F-, T-, and W-ratings per ASTM E 814 or UL 1479.
- C. Penetrations in Smoke Barriers: L-ratings per UL 1479.

### 1.3 INSTALLATION

- A. Identification: Walls and penetrations.

### 1.4 FIELD QUALITY CONTROL

- A. Inspection of Installed Firestopping: By Owner-engaged agency according to ASTM E 2174.

END OF SECTION 078413

## SECTION 078443 - JOINT FIRESTOPPING

### 1.1 QUALITY ASSURANCE

- A. Installer Qualifications: FM Global approved or UL qualified.

### 1.2 FIRE-RESISTIVE JOINT SYSTEMS

- A. Joints in or between Fire-Resistance-Rated Construction: ASTM E 1966 or UL 2079.
- B. Joints at Exterior Curtain-Wall/Floor Intersections: ASTM E 119 or ASTM E 2307.

### 1.3 FIELD QUALITY CONTROL

- A. Inspection of Installed Firestopping: By Owner-engaged agency according to ASTM E 2393.

END OF SECTION 078443

## SECTION 079200 - JOINT SEALANTS

### 1.1 PRECONSTRUCTION TESTING

- A. Preconstruction laboratory testing.
- B. Preconstruction field-adhesion testing.

### 1.2 WARRANTY

- A. Installer Warranty: Two years.
- B. Special Manufacturer's Warranty: Five years.

### 1.3 JOINT SEALANTS

- A. VOC Content of Interior Sealants:
  - 1. Architectural Sealants: 250 g/L.
  - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
  - 3. Sealant Primers for Porous Substrates: 775 g/L.
- B. Low-Emitting Interior Sealants: Sealants comply with LEED for Schools Credit IEQ 4.1.
- C. Silicone joint sealants.
- D. Nonstaining silicone joint sealants.
- E. Urethane joint sealants.
- F. Immersible joint sealants.
- G. Silyl-terminated polyether joint sealants.
- H. Mildew-resistant joint sealants.
- I. Polysulfide joint sealants.
- J. Butyl joint sealants.
- K. Latex joint sealants.
- L. Joint-sealant backing.

### 1.4 FIELD QUALITY CONTROL

- A. Field-adhesion testing.

1.5 SCHEDULE

- A. Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
- B. Interior joints in horizontal traffic surfaces.
- C. Interior joints in vertical surfaces and horizontal nontraffic surfaces.
- D. Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
- E. Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
- F. Concealed mastics.

END OF SECTION 079200

SECTION 079219 - ACOUSTICAL JOINT SEALANTS

1.1 JOINT SEALANTS

A. VOC Content of Interior Sealants:

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

B. Acoustical Sealants for Exposed and Concealed Joints: Latex.

END OF SECTION 079219

## SECTION 079500 - EXPANSION CONTROL

### 1.1 INTERIOR EXPANSION CONTROL SYSTEMS

#### A. Floor-to-Floor and Floor-to-Wall:

1. Type: Center plate .
2. Exposed Metal: Aluminum .

#### B. Wall-to-Wall, Wall Corner, Wall-to-Ceiling, and Ceiling-to-Ceiling Joint Systems:

1. Type: Clip-in cover .
2. Exposed Metal: Aluminum .
3. Fire-Resistance Rating: Same as adjacent construction .

### 1.2 EXTERIOR WALL EXPANSION CONTROL SYSTEMS

#### A. Wall-to-Wall :

1. Type: Flat seal .
2. Exposed Metal: Aluminum .
3. Fire-Resistance Rating: 2 hours .

### 1.3 ACCESSORIES

#### A. Moisture Barrier: Manufacturer's standard.

END OF SECTION 079500

## SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

### 1.1 INTERIOR DOORS AND FRAMES

- A. SDI Standard Duty: ANSI/SDI A250.8, Level 1. Uncoated, cold-rolled steel sheet.
  - 1. Thickness: 1-3/4 inches (44.5 mm) .
  - 2. Edge Construction: Model 2, Seamless.
  - 3. Core: Manufacturer's standard .
  - 4. Frames: Full profile welded.
  - 5. Exposed Finish: Prime .
- B. SDI Heavy Duty: SDI A250.8, Level 2. Uncoated, cold-rolled steel sheet.
  - 1. Edge Construction: Model 2, Seamless.
  - 2. Core: Manufacturer's standard .
  - 3. Frames: Full profile welded.
  - 4. Exposed Finish: Prime .

### 1.2 EXTERIOR DOORS AND FRAMES

- A. SDI Heavy Duty: SDI A250.8, Level 2. Metallic-coated, cold-rolled steel sheet.
  - 1. Edge Construction: Model 2, Seamless.
  - 2. Core: Polyisocyanurate .
  - 3. Frames Full profile welded.
  - 4. Exposed Finish: Prime .
- B. SDI Extra Heavy Duty: SDI A250.8, Level 3. Metallic-coated, cold-rolled steel sheet.
  - 1. Edge Construction: Model 2, Seamless .
  - 2. Core: Polyisocyanurate .
  - 3. Frames Full profile welded.
  - 4. Exposed Finish: Prime .

### 1.3 INSTALLATION

- A. Metal-Stud Partitions and Concrete Walls: Frames filled with insulation.
- B. Masonry Walls: Frames filled with grout.

END OF SECTION 081113

## SECTION 081416 - FLUSH WOOD DOORS

### 1.1 QUALITY ASSURANCE

- A. Manufacturer and Vendor: FSC certified for chain of custody.
- B. Manufacturer: Certified participant in AWI's Quality Certification Program .

### 1.2 DOOR CONSTRUCTION, GENERAL

- A. Quality Standard: Architectural Woodwork Standards .
  - 1. AWI Quality Certification Labels.
- B. Regional Materials: Doors manufactured within 500 miles (800 km) from wood grown within 500 miles (800 km).
- C. Forest Certification: Doors certified as "FSC Pure."
- D. Low-Emitting Materials: Made with adhesives and composite wood products that do not contain urea formaldehyde.
- E. WDMA I.S.1-A Performance Grade:
  - 1. Heavy Duty unless otherwise indicated.
  - 2. Extra Heavy Duty: Public toilets, janitor's closets, exits, Courtrooms, and where indicated.
  - 3. Standard Duty: Closets (not including janitor's closets) and private toilets .

### 1.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors :
  - 1. Grade: Premium, with Grade AA faces .
  - 2. Species: As Scheduled.
  - 3. Cut: As Indicated.
  - 4. Match between Veneer Leaves: Book match.
  - 5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
  - 6. Special Matching:
    - a. Pair and set match.
    - b. Room Match: Match door faces within each room.
    - c. Blueprint matching.
  - 7. Core: Either glued or nonglued wood stave or structural composite lumber.
  - 8. Construction: Five plies, bonded .
  - 9. WDMA I.S.1-A Performance Grade: Heavy Duty .

B. Interior Hollow-Core Doors :

1. Grade: Premium, with Grade AA faces .
2. Species: As Scheduled.
3. Cut: As Indicated.
4. Match between Veneer Leaves: Book match.
5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
6. Pair and set match.
7. Construction: Five plies.
8. WDMA I.S.1-A Performance Grade: Heavy Duty .

1.4 LIGHT FRAMES AND LOUVERS

A. Light-Opening Frames:

1. Wood beads.
2. Wood-veneered beads for fire doors.

B. Louvers: Wood .

1. Fire-Door Louvers: Galvanized steel with fusible links.

1.5 PRIMING/FINISHING

A. Shop Priming:

1. Doors for Transparent Finish: Stain (if required) and first coat of finish.

B. Factory Finishing: All doors .

C. Finishing Materials: Low-emitting materials for LEED for Schools.

D. Transparent Factory Finishes:

1. Grade: Premium .
2. Finish: Conversion varnish .
3. Effect: Open-grain finish.

END OF SECTION 081416

## SECTION 083463 - DETENTION DOORS AND FRAMES

### 1.1 PERFORMANCE REQUIREMENTS

- A. Detention Door and Frame Assemblies: ASTM F 1450.
  - 1. Bullet Resistance: UL 752, Level 3.
  - 2. Tool-Attack Resistance: UL 437 and UL 1034.
- B. Detention Frames: ASTM F 1592, with removable stop test per NAAMM-HMMA 863.

### 1.2 PRODUCTS

- A. Detention Doors: Steel- stiffened core.
  - 1. Interior Doors: Cold-rolled steel ; .
- B. Detention Frames:
  - 1. Interior Frames: Cold-rolled steel ; .
- C. Detention Panels: Same construction as for adjoining detention doors.
- D. Accessories:
  - 1. Pass-Through Openings: Inset shutters.
  - 2. Speaking apertures.
- E. Steel Finish: Factory primed for field painting.
- F. Stainless-Steel Finish: No. 4.

### 1.3 FIELD QUALITY CONTROL

- A. Owner will have one detention door destructively tested.

END OF SECTION 083463

## SECTION 084213 - ALUMINUM-FRAMED ENTRANCES

### 1.1 WARRANTY

- A. Materials and Workmanship: 10 years.
- B. Finish: 20 years.

### 1.2 SYSTEM COMPONENTS

- A. Entrance Doors:
  - 1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness .
  - 2. Door Design: Narrow stile .
  - 3. Glazing stops and gaskets.
- B. Entrance Door Hardware: Section 087111 "Door Hardware (Descriptive Specification)."
- C. Glazing: Section 088000 "Glazing."

### 1.3 ALUMINUM FINISHES

- A. Aluminum Finishes: Class I, clear anodic .

### 1.4 MAINTENANCE SERVICE

- A. Entrance Door Hardware: Six months.

END OF SECTION 084213

## SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

### 1.1 WARRANTY

- A. Materials and Workmanship: 10 years.
- B. Finish: 20 years.

### 1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Contractor to design glazed aluminum curtain walls.

### 1.3 SYSTEM COMPONENTS

- A. Framing Members:
  - 1. Construction: Thermally broken .
  - 2. Glazing System: Gaskets on four sides .
  - 3. Glazing Plane: Front .
- B. Sun Control: Sunshades .
- C. Glazing: Section 088000 "Glazing."

### 1.4 ALUMINUM FINISHES

- A. Aluminum Finishes: Class I, clear anodic .

END OF SECTION 084413

## SECTION 087111 - DOOR HARDWARE (DESCRIPTIVE SPECIFICATION)

### 1.1 SUMMARY

- A. Mechanical door hardware for swinging doors.
- B. Cylinders for door hardware specified in other Sections.
- C. Electrified door hardware.
- D. Door hardware furnished as part of Door Hardware Allowance.

### 1.2 WARRANTY

- A. Materials and Workmanship: Three years.

### 1.3 MAINTENANCE SERVICE

- A. Full-Maintenance Service: Six months.

### 1.4 PRODUCTS

- A. Hinges :
  - 1. Weight:
    - a. Entrance Doors: Heavy-weight hinges.
    - b. Doors with Closers: Antifriction-bearing hinges.
    - c. Interior Doors: Standard-weight hinges.
  - 2. Base Metal:
    - a. Exterior Hinges: Stainless steel with stainless-steel pin .
    - b. Interior Hinges: Stainless steel with stainless-steel pin.
    - c. Hinges for Fire-Rated Assemblies: Stainless steel with stainless-steel pin.
  - 3. Electrified Functions: Power transfer and monitoring .
- B. Mechanical Locks and Latches: Mortise locks .
- C. Auxiliary Locks: mortise locks.
- D. Electric strikes.
- E. Electromagnetic Locks: With and without delayed egress.
- F. Electromechanical locks.

- G. Self-contained electronic locks.
- H. Exit locks and exit alarms.
- I. Exit Devices and Auxiliary Items:
  - 1. Panic fire rim and combination exit devices.
  - 2. Automatic-latching two-point bolts.
  - 3. Extension flush bolt sets.
  - 4. Electronic exit bars.
  - 5. Removable Mullions: Extruded aluminum .
  - 6. Dummy push bar.
  - 7. Outside trim.
  - 8. Through-bolt fasteners.
- J. Lock Cylinders: High security.
- K. Keying System:
- L. Operating Trim: Stainless steel.
- M. Accessories for Pairs of Doors:
  - 1. Coordinators.
  - 2. Carry-open bars.
  - 3. Flat overlapping astragals.
- N. Surface Closers: Modern Type, with cover .
- O. Concealed Closers: Concealed in door or head frame (overhead) .
- P. Closer holder release devices.
- Q. Mechanical Stops and Holders:
  - 1. Wall Bumper: Concave type.
  - 2. Holder: Lever type.
- R. Electromagnetic stops and holders.
- S. Overhead Stops and Holders:
  - 1. Concealed: friction slide holders .
  - 2. Surface Mounted: friction slide stops .
- T. Door Gasketing:
  - 1. Adhesive-backed perimeter gasketing.
  - 2. Meeting astragals for meeting stiles.
  - 3. Door Sweeps: Nylon brush .
  - 4. Door Shoes: Brush pile
  - 5. Automatic door bottoms.

U. Thresholds:

1. Compressing-Top Thresholds: Aluminum .
2. Saddle Thresholds: Aluminum .
3. Half-Saddle Thresholds: Aluminum .
4. Interlocking Thresholds: Aluminum .
5. Plate Thresholds: Aluminum .
6. Ramped Thresholds: Aluminum .
7. Saddle Thresholds for Door Closers: Aluminum .

V. Auxiliary Door Hardware:

1. Coat and garment hooks.
2. Door knockers.
3. Silencers: For metal door frames.

W. Auxiliary Electrified Door Hardware: monitor strikes door position switches and door and frame transfer devices.

1.5 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Owner-engaged to perform inspections.
- B. Occupancy Adjustment: After six months.

END OF SECTION 087111

## SECTION 087113 - AUTOMATIC DOOR OPERATORS

### 1.1 PRODUCTS

- A. Power Door Operators: Overhead concealed mounted.
  - 1. Standard: BHMA A156.10.
  - 2. Operation: Power opening and power-assisted spring closing.
  - 3. Operating System: Electromechanical .
  - 4. Microprocessor control unit.
  - 5. Finish: Matching door and frame .
  
- B. Low-Energy Door Operators: Overhead concealed mounted.
  - 1. Standard: BHMA A156.19.
  - 2. Operation: Power opening and power-assisted spring closing.
  - 3. Operating System: Electromechanical .
  - 4. Microprocessor control unit.
  - 5. Finish: Matching door and frame .
  
- C. Controls:
  - 1. Push-button switch.
  
- D. Accessories:
  - 1. Signage.
  - 2. Guide Rails: Anodized aluminum .

### 1.2 MAINTENANCE SERVICE

- A. Full-Maintenance Service: 12 months.

END OF SECTION 087113

## SECTION 087163 - DETENTION DOOR HARDWARE

### 1.1 MAINTENANCE SERVICE

- A. Full-Maintenance Service: 12 months.

### 1.2 WARRANTY

- A. Materials and Workmanship: Three years.

### 1.3 PERFORMANCE REQUIREMENTS

- A. Swinging Detention Door Assemblies: ASTM F 1450.
  - 1. Attack Resistance: UL 1034 and UL 437 where indicated.

### 1.4 PRODUCTS

- A. Detention Hinges:
  - 1. Continuous Pin: .
- B. Mechanical Detention Locks and Latches:
  - 1. Concealed Snaplatches: .
  - 2. Deadlatches/Deadlocks: .
- C. Cylinders and Keying: Seven pins, high-security grade.
  - 1. Keying System: Master key to existing system.
- D. Switches:
  - 1. Door Position: Concealed, magnetic .
  - 2. Strike indicator.
- E. Detention Operating Trim: Surface-mounted door pulls .
- F. Security Door Closers: Concealed.
- G. Detention Door Stops: Silencers for detention door frames.

END OF SECTION 087163

## SECTION 088000 - GLAZING

### 1.1 SUMMARY

- A. Glass for windows, doors, interior borrowed lites, storefront framing, and glazed curtain walls .

### 1.2 WARRANTY

- A. Coated-Glass Products: 10 years.
- B. Laminated Glass: 10 years.
- C. Insulating Glass: 10 years.

### 1.3 PERFORMANCE REQUIREMENTS

- A. Engineering design of glass by Contractor.

### 1.4 MATERIALS

- A. Silicone Glazing Sealants: Neutral curing, Class 100/50 .
  - 1. Sealants: Low VOC .
- B. Glazing Tapes: Back-bedding-mastic type.

### 1.5 MONOLITHIC GLASS SCHEDULE

- A. Glass Type : Clear fully tempered float glass.
- B. Glass Type : Reflective-coated vision glass; fully tempered float glass.

### 1.6 INSULATING GLASS SCHEDULE

- A. Glass Type : Low-E-coated, clear insulating glass.
  - 1. Outdoor Lite: Heat-strengthened float glass.
  - 2. Indoor Lite: Fully tempered float glass.
- B. Glass Type : Low-E-coated, tinted insulating glass.
  - 1. Outdoor Lite: Tinted heat-strengthened float glass.
  - 2. Indoor Lite: Clear fully tempered float glass.
- C. Glass Type : Reflective-coated, insulating glass.

1. Outdoor Lite: Tinted float glass.
2. Indoor Lite: Clear fully tempered float glass.

END OF SECTION 088000

## SECTION 092216 - NON-STRUCTURAL METAL FRAMING

### 1.1 MATERIALS

#### A. Steel Framing:

1. Steel studs and runners.
2. Embossed steel studs and runners.
3. Slip-Type Head Joints:
  - a. Single long-leg runner.
  - b. Double runner.
  - c. Deflection track.
4. Firestop track.
5. Flat strap and backing plate.
6. Cold-rolled channel bridging.
7. Hat-shaped, rigid furring channels.
8. Resilient furring channels.
9. Cold-rolled furring channels.
10. Z-shaped furring.

#### B. Suspension Systems:

1. Wire hangers.
2. Flat hangers.
3. Carrying channels.
4. Furring channels.
5. Grid suspension systems for ceilings.

END OF SECTION 092216

## SECTION 092900 - GYPSUM BOARD

### 1.1 QUALITY ASSURANCE

#### A. Mockups for the following:

1. Levels of exposed gypsum board finish.
2. Texture finishes.

### 1.2 MATERIALS

#### A. Gypsum Board, General:

1. Minimum Recycled Content: Postconsumer plus one-half of preconsumer recycled content not less than 25 percent.
2. Manufactured within **500 miles (800 km)** of Project site from materials extracted within **500 miles (800 km)** of Project site.

#### B. Interior Gypsum Board:

1. Gypsum wallboard.
2. Gypsum board, Type X.
3. Flexible gypsum board.
4. Gypsum ceiling board.
5. Abuse-resistant gypsum board.
6. Impact-resistant gypsum board.
7. Mold-resistant gypsum board.

#### C. Specialty Gypsum Board:

1. Glass-mat interior gypsum board.
2. Acoustically enhanced gypsum board.

#### D. Exterior Gypsum Board for Ceilings and Soffits:

1. Exterior gypsum soffit board.
2. Glass-mat gypsum sheathing board.

#### E. Tile-Backing Panels:

1. Glass-mat, water-resistant backing board.

#### F. Trim Accessories:

1. Interior.
2. Exterior.
3. Aluminum: Extruded profiles.

#### G. Auxiliary Materials:

1. Laminating Adhesive: Low emitting for LEED.
2. Recycled Content of Sound Attenuation Blankets: Postconsumer plus one-half of preconsumer recycled content not less than 25 percent.
3. Acoustical Joint Sealant: Low emitting for LEED.

H. Texture Finishes:

1. Polystyrene aggregate ceiling finish.
2. Aggregate finish.
3. Non-aggregate finish.
4. Acoustical finish.

END OF SECTION 092900

## SECTION 093013 - CERAMIC TILING

### 1.1 TILE PRODUCTS

- A. Tile Type : Glazed ceramic mosaic tile.
  - 1. Composition: Porcelain .
  - 2. Size: As Scheduled.
  - 3. Trim Shapes: Base cove Bead (bullnose) base cap Bead (bullnose) wainscot cap Bead (bullnose) external corner Coved internal corner Tapered transition.
- B. Tile Type : Glazed porcelain tile.
  - 1. Size: As Scheduled.
  - 2. Face Size Variation: Rectified.
  - 3. Trim Shapes: Base cove Bead (bullnose) base cap Bead (bullnose) wainscot cap Bead (bullnose) external corner Coved internal corner Tapered transition.
- C. Tile Type : Glazed wall tile.
  - 1. Size: As Scheduled.
  - 2. Face Size Variation: Rectified.
  - 3. Trim Shapes: Coved base Bullnose wainscot cap Bullnose external corner .

### 1.2 ACCESSORY MATERIALS

- A. Thresholds: Slate.
- B. Tile Backing Panels: Cementitious backer units .
- C. Waterproof Membrane: Fabric-reinforced, modified-bituminous sheet .
- D. Crack Isolation Membrane: Fabric-reinforced, modified-bituminous sheet .
- E. Installation Adhesives: Low VOC .
- F. Metal edge strips.

### 1.3 INTERIOR TILE INSTALLATION SCHEDULE

- A. Interior Floors on Concrete:
  - 1. TCNA F112: Cement mortar bed bonded to concrete. Standard grout.
  - 2. TCNA F113: Thinset mortar. Standard grout.
  - 3. TCNA F114: Cement mortar bed with cleavage membrane, epoxy grout.
  - 4. TCNA F115: Thinset mortar, epoxy grout.
  - 5. TCNA F116: . Standard grout.
  - 6. TCNA F121: Cement mortar bed on waterproof membrane. Standard grout.
  - 7. TCNA F122: Thinset mortar on waterproof membrane. High-performance grout.
  - 8. TCNA F125A: Thinset mortar on crack isolation membrane. Standard grout.
  - 9. TCNA F131: Water-cleanable, tile-setting epoxy; epoxy grout.

10. TCNA F132: Water-cleanable, tile-setting epoxy on cured cement mortar bed bonded to concrete subfloor ; epoxy grout.

B. Interior Walls, Wood or Metal Studs or Furring:

1. TCNA W221: Cement mortar bed over waterproof membrane on solid backing. Standard grout.
2. TCNA W222: One-coat cement mortar bed over waterproof membrane on solid backing. Standard grout.
3. TCNA W223: Organic adhesive on solid backing. Standard grout.
4. TCNA W231/W241: Cement mortar bed. Standard grout.
5. TCNA W242: Organic adhesive on gypsum board. Standard grout.
6. TCNA W243: Thinset mortar on gypsum board. Standard grout.
7. TCNA W244: Thinset mortar on cementitious backer units or fiber-cement underlayment. Standard grout.
8. TCNA W245 or TCNA W248: Thinset mortar on glass-mat, water-resistant gypsum backer board. Standard grout.

END OF SECTION 093013

## SECTION 095113 - ACOUSTICAL PANEL CEILINGS

### 1.1 SUMMARY

- A. Acoustical panels and exposed suspension systems.

### 1.2 PRODUCTS

- A. Ceiling assemblies complying with low-emitting material requirements for LEED for Schools.

- B. Acoustical Ceiling Panels: ASTM E 1264.

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
2. Type and Form: Type III, mineral base with painted finish; Form 1, nodular .
3. Pattern: As Indicated.
4. LR: Not less than 0.90 .
5. NRC: Not less than 1.00 .
6. Modular Size: As indicated on Drawings .

- C. Metal Suspension Systems: ASTM C 635.

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
2. Wire hangers, braces, and ties.
3. Angle hangers.
4. Seismic perimeter stabilizer bars, struts, and clips.
5. Hold-down clips.
6. Impact clips.
7. Narrow-Face, Capped, Double-Web Steel: Heavy duty

- D. Metal Edge Moldings and Trim: Roll-formed sheet metal .

- E. Acoustical Sealants: Low VOC .

### 1.3 INSTALLATION

- A. Installation: ASTM C 636.

### 1.4 FIELD QUALITY CONTROL

- A. Special Inspection: By Owner-engaged agency for compliance of seismic design.
- B. Testing: By Owner-engaged agency to test acoustical panel ceiling hanger fasteners.

END OF SECTION 095113

## SECTION 096513 - RESILIENT BASE AND ACCESSORIES

### 1.1 PRODUCTS

- A. Flooring System: FloorScore compliance .
- B. Resilient Base: Thermoplastic rubber .
  - 1. Style and Location:
    - a. Straight: In areas with carpet .
    - b. Cove: In areas with resilient flooring .
  - 2. Minimum Thickness: 0.080 inch (2.0 mm) .
  - 3. Height: 4 inches (102 mm) .
  - 4. Outside Corners: Job formed or preformed.
  - 5. Inside Corners: Job formed or preformed.
- C. Resilient Accessories: Rubber .
  - 1. Carpet edge for glue-down applications.
  - 2. Nosing for carpet.
  - 3. Nosing for resilient flooring.
  - 4. Reducer strip for resilient flooring.
  - 5. Joiner for tile and carpet.
  - 6. Transition strips.
- D. Installation Materials:
  - 1. Trowelable leveling and patching compounds.
  - 2. Adhesives: Low VOC .
  - 3. Metal edge strips.
  - 4. Floor polish.

END OF SECTION 096513

## SECTION 096723 - RESINOUS FLOORING

### 1.1 PRODUCTS

- A. Flooring system coatings are low VOC.
- B. Resinous Flooring and Integral Cove Base :
  - 1. System Characteristics:
    - a. Color and Pattern: As selected by Architect from manufacturer's full range .
    - b. Wearing Surface: Textured for slip resistance .
    - c. Overall System Thickness: **1/8 inch (3.2 mm)** .
  - 2. System Components:
    - a. Primer: Water based .
    - b. Waterproofing Membrane: High solids .
    - c. Reinforcing Membrane with Fiberglass Scrim: High solids .
    - d. Body Coat(s):
      - 1) Resin: Epoxy .
      - 2) Formulation Description: High solids .
      - 3) Application Method: Self-leveling slurry with broadcast aggregates .
      - 4) Number of Coats: Two .
      - 5) Thickness of Coats: **1/16 inch (1.6 mm)** .
      - 6) Aggregates: Colored quartz (ceramic-coated silica) .
    - e. Grout Coat:
      - 1) Resin: Epoxy .
      - 2) Formulation Description: High solids .
      - 3) Thickness of Coat: **1/16 inch (1.6 mm)** .
    - f. Topcoat: Sealing or finish coats.
      - 1) Resin: Epoxy .
      - 2) Formulation Description: High solids .
      - 3) Number of Coats: Two .
      - 4) Thickness of Coats: **1/16 inch (1.6 mm)** .
      - 5) Finish: Matte .

END OF SECTION 096723

SECTION 096813 - TILE CARPETING

1.1 WARRANTY

- A. Materials and Workmanship for Carpet Tile: 10 years.

1.2 PRODUCTS

- A. Carpet Tile :
  - 1. Pile Characteristic: Cut-and-loop pile.
  - 2. Size: 24 by 24 inches (610 by 610 mm) .
  - 3. Applied Treatments: Soil resistant .
  - 4. Emissions: Comply with CRI's "Green Label Plus."
- B. Installation Adhesive: VOC content 50 g/L or less.

END OF SECTION 096813

## SECTION 096900 - ACCESS FLOORING

### 1.1 PRODUCTS

- A. Flooring system is low emitting for LEED for Schools.
- B. Floor Panels:
  - 1. Size: 24 by 24 inches (610 by 610 mm) .
  - 2. Attachment to Understructure: Bolted .
  - 3. Type:
    - a. Cementitious-core steel panels.
- C. Steel understructure with stringers.
- D. Accessories:
  - 1. Low-VOC adhesives .
  - 2. Service Outlets: Each with four power receptacle(s).
  - 3. Cutouts.
  - 4. Perimeter support.

### 1.2 INSTALLATION

- A. Pedestals set with mechanical anchors.

END OF SECTION 096900

## SECTION 099123 - INTERIOR PAINTING

### 1.1 PAINT, GENERAL

- A. MPI-listed products.
- B. VOC Content: Complying with LEED-NC Credit EQ 4.2.

### 1.2 INTERIOR PAINTING SCHEDULE

#### A. Concrete Substrates, Nontraffic Surfaces:

- 1. Latex system.
- 2. Latex over latex aggregate system.
- 3. Latex aggregate system.
- 4. Institutional low-odor/VOC latex system.
- 5. High-performance architectural latex system.
- 6. Water based light industrial coating system.
- 7. Alkyd system.
- 8. Concrete stain system.

#### B. CMU Substrates:

- 1. Latex system.
- 2. Latex aggregate system.
- 3. Institutional low-odor/VOC latex system.
- 4. High-performance architectural latex system.
- 5. Water-based light industrial coating system.
- 6. Alkyd system.
- 7. Clear (2-component) polyurethane system.

#### C. Steel Substrates:

- 1. Latex system, alkyd primer.
- 2. Latex over shop-applied quick-drying shop primer system.
- 3. Institutional low-odor/VOC latex system.
- 4. High-performance architectural latex system.
- 5. Water-based light industrial coating system.
- 6. Water-based light industrial coating over epoxy primer system.
- 7. Water-based dry-fall system.
- 8. Water-based dry-fall over shop-applied quick-drying shop primer system.
- 9. Alkyd system.
- 10. Alkyd over surface-tolerant primer system.
- 11. Alkyd over shop-applied quick-drying shop primer system.
- 12. Quick-dry enamel system.
- 13. Alkyd dry-fall system.
- 14. Alkyd dry-fall over shop-applied quick-drying shop primer system.
- 15. Aluminum paint system.

D. Galvanized-Metal Substrates:

1. Latex system.
2. Institutional low-odor/VOC latex system.
3. High-performance architectural latex system.
4. Water-based light industrial coating system.
5. Water-based dry-fall system.
6. Alkyd over cementitious primer system
7. Alkyd dry-fall system (cementitious primer).
8. Aluminum paint system (cementitious primer).

E. Aluminum Substrates:

1. Latex system.
2. Institutional low-odor/VOC latex system.
3. High-performance architectural latex system.
4. Water-based light industrial coating system.
5. Alkyd system.

F. Gypsum Board Substrates:

1. Latex over latex sealer system.
2. Latex over alkyd primer system (for plaster only).
3. Institutional low-odor/VOC latex system.
4. High-performance architectural latex system.
5. Water-based light industrial coating system.
6. Alkyd over latex sealer system.

G. Cotton or Canvas and ASJ Insulation-Covering Substrates: Including pipe and duct coverings .

1. Latex system.
2. Institutional low-odor/VOC latex system.
3. Alkyd system.
4. Aluminum paint system.

END OF SECTION 099123

## SECTION 099600 - HIGH-PERFORMANCE COATINGS

### 1.1 MATERIALS, GENERAL

- A. MPI-listed products.
- B. VOC Content: Complying with LEED-NC Credit EQ 4.2.

### 1.2 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Concrete Substrates, Vertical Surfaces:
  - 1. Epoxy system.
  - 2. Epoxy-modified latex system.
  - 3. Pigmented polyurethane over epoxy system.
- B. Concrete Substrates, Horizontal Surfaces:
  - 1. Epoxy non-slip deck coating system.
- C. Steel Substrates:
  - 1. Epoxy system.
  - 2. Epoxy over self-priming epoxy system.
  - 3. Epoxy deck coating over epoxy primer and high-build epoxy system.
  - 4. Epoxy deck coating over self-priming epoxy system.
  - 5. Pigmented polyurethane over epoxy system.
  - 6. Pigmented polyurethane over high-build epoxy system.
  - 7. Pigmented polyurethane over self-priming epoxy system.
  - 8. Pigmented polyurethane over epoxy zinc-rich primer system.
  - 9. Pigmented polyurethane over epoxy zinc-rich primer and high-build epoxy system.
  - 10. Pigmented polyurethane over inorganic zinc-rich primer and high-build epoxy system.
- D. Galvanized-Metal Substrates:
  - 1. Epoxy system.
  - 2. Pigmented polyurethane over epoxy primer system.
  - 3. Pigmented polyurethane over vinyl wash primer and epoxy primer system.
- E. Aluminum (Not Anodized or Otherwise Coated) Substrates:
  - 1. Epoxy system.
  - 2. Pigmented polyurethane over epoxy system.

END OF SECTION 099600

## SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

### 1.1 DIMENSIONAL CHARACTERS

- A. Cast Characters : Aluminum .
  - 1. Character Height: As Indicated.
  - 2. Finish: As selected by Architect .
  - 3. Mounting: Projecting studs .
  - 4. Typeface: As Indicated.

### 1.2 MATERIALS AND ACCESSORIES

- A. Adhesives: VOC content of 70 g/L or less.

END OF SECTION 101419

## SECTION 102113.15 - STAINLESS-STEEL TOILET COMPARTMENTS

### 1.1 SUMMARY

- A. Stainless-steel toilet compartments configured as toilet enclosures and urinal screens.
  - 1. Toilet-Enclosure Style: Overhead braced .
  - 2. Urinal-Screen Style: Wall hung with integral flanges .

### 1.2 PERFORMANCE REQUIREMENTS

- A. Recycled content of metal components.
- B. Regulatory Requirements: Comply with applicable provisions in U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

### 1.3 COMPONENTS

- A. Door, Panel, and Pilaster Construction: No-sightline system.
- B. Brackets (Fittings):
  - 1. Stirrup Type: Ear or U-brackets; stainless steel .
  - 2. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel .
- C. Stainless-Steel Finish: No. 4, anti-graffiti surface.

### 1.4 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Manufacturer's heavy-duty stainless-steel operating hardware and accessories.

END OF SECTION 102113.15

## SECTION 102600 - WALL AND DOOR PROTECTION

### 1.1 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Class A.
- B. Accessibility requirements of authority having jurisdiction.

### 1.2 PRODUCTS

- A. Wall Guards:
  - 1. Wood Chair Rail with Bumper: FSC-certified with stained finish; surface mounted; with plastic bumper and PVC-free.
- B. Corner Guards:
  - 1. Surface-Mounted, Plastic-Cover Type: 4 feet (1.2 m) high, using one-piece aluminum retainer , and PVC-free.
- C. End-Wall Guards:
  - 1. Surface-Mounted, Plastic-Cover Type: 4 feet (1.2 m) high, PVC-free.
  - 2. Abuse-Resistant Sheet: **[Full-wall]** **[Wainscot]** height.
  - 3. Laminated, Impact-Resistant Wall Panels: Plastic sheet wall covering laminated to high-impact-resistant core; **[full-wall]** **[wainscot]** height.
- D. Materials:
  - 1. Urea-formaldehyde-free particleboard.
  - 2. Adhesive VOC content of 70 g/L or less.

END OF SECTION 102600

## SECTION 104413 - FIRE PROTECTION CABINETS

### 1.1 PRODUCTS

#### A. Fire-Protection Cabinets:

1. Type: Fire extinguisher .
2. Cabinet Construction: Nonrated .
3. Mounting: Semirecessed .
4. Door Style: Fully glazed panel with frame .
5. Door Glazing: Acrylic sheet .
6. Finish:
  - a. Aluminum: Clear anodic .

END OF SECTION 104413

## SECTION 111200 - PARKING CONTROL EQUIPMENT

### 1.1 SYSTEM DESCRIPTION

- A. Parking Control System: For transient parking.

### 1.2 PRODUCTS

- A. Automatic Barrier Gates:

1. Controller: Communicating.
2. Cabinet: Aluminum .
3. Gate: Sliding chain-link fence
4. Operator: 1/2 hp.

- B. Vehicle Detectors: Vehicle loop detector system embedded in pavement .

- C. Traffic Controllers:

1. Type: Nonpenetrating (spring-activated curb).
2. Mounting: Recessed.

- D. Parking Facility Management Software: Capable of collecting data for revenue and activity reporting and for access and space control, tracking tickets, and programming parking control equipment.

- E. Access Control Units:

1. Card Reader Controlled Unit: Programmable, multiple-code system.
  - a. Reader: Proximity type.
  - b. Card Type: Proximity.
  - c. Operation: Online communication to remote computer.
  - d. Mounting: Pedestal .
2. Digital Keypad Controlled Unit: Multiple code, programmable.
  - a. Operation: Online communication to remote computer.
  - b. Mounting: Pedestal .
3. Radio-Controlled System: Coaxial receiver and programmable transmitters.

### 1.3 FIELD QUALITY CONTROL

- A. Testing: By Manufacturer's service representative.

1.4 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Provide for two years.
- B. Upgrade Service: Update software for two years.

END OF SECTION 111200

## SECTION 122413 - ROLLER WINDOW SHADES

### 1.1 PRODUCTS

- A. Motorized and Manual, chain-and-clutch operating mechanism.
- B. Roller Mounting Configuration: Double roller, offset with outside roller over and inside roller under .
- C. Installation Accessories: Recessed shade pocket .
- D. Shadeband Materials: Complying with NFPA 701 .
  - 1. Light-Filtering Fabric: Acrylic-coated fiberglass .
  - 2. Light-Blocking Fabric: Polyester-cotton blend .
- E. Product Safety Standard: WCMA A 100.1.

### 1.2 INSTALLATION

- A. Between (inside) jamb installation.
- B. Factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motorized operators for roller shades.

END OF SECTION 122413

## SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES

### 1.1 COMPONENTS

- A. Roll-up, Vinyl-Rail Hinged Mats: Slotted or perforated vinyl hinges.
  - 1. Tread Inserts: Textured surface .
- B. Recessed Frames: Extruded aluminum .
- C. Aluminum Frame Finish: Clear anodized .

END OF SECTION 124813

## SECTION 125500 - DETENTION FURNITURE

### 1.1 PRODUCTS

- A. Floor-Mounted Bench: Stainless-steel bench top.
  - 1. Capacity: Six persons.

### 1.2 INSTALLATION

- A. Furnishings anchored with security fasteners .

### 1.3 FIELD QUALITY CONTROL

- A. Field quality-control certification.

END OF SECTION 125500

SECTION 129300 - SITE FURNISHINGS

1.1 BICYCLE RACKS

- A. Material: Stainless steel .
- B. Capacity: Four bicycles.
- C. Installation Method: Cast in concrete .

END OF SECTION 129300

## SECTION 221116 - DOMESTIC WATER PIPING

### 1.1 DOMESTIC WATER PIPING

#### A. Pipe

1. Galvanized-steel pipe, galvanized fittings, and threaded joints.
2. Hard copper tube; cast- or wrought-copper, solder-joint fittings; and brazed or soldered joints.
3. Hard copper tube; copper pressure-seal-joint fittings; and pressure-sealed joints.
4. Hard copper tube; copper push-on-joint fittings; and push-on joints.

END OF SECTION 221116

SECTION 221316 - SANITARY WASTE AND VENT PIPING

1.1 MATERIALS

- A. Hub-and-spigot, service- class, cast-iron soil pipe and fittings.

END OF SECTION 221316

## SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

### 1.1 QUALITY ASSURANCE

- A. Quality Standard for Plastic Piping: NSF 14.

### 1.2 PRODUCTS

- A. Backwater Valves: Horizontal, cast iron.
- B. Cleanouts: Cast iron, wall.
- C. Floor Drains:
  - 1. Cast-Iron Floor Drains:
    - a. Pattern: Floor.
    - b. Body Material: Gray iron.
    - c. Top or Strainer Material: Stainless steel.
    - d. Top Loading Classification: Heavy Duty.
- D. Air-Admittance Valves: Fixture Air-Admittance Valves.
- E. Miscellaneous Sanitary Drainage Piping Specialties:
  - 1. Open drains, shop or field fabricate from Service class, hub-and-spigot, cast-iron, soil-pipe fittings.
  - 2. Cast-iron or bronze deep-seal traps.
  - 3. Floor-drain, trap-seal primer fittings.
  - 4. Air-gap fittings.
  - 5. Counterflashing-type, cast-iron stack flashing fittings.
  - 6. Cast-iron body vent caps.
  - 7. Frost-resistant vent terminals.
  - 8. Expansion joints.
- F. Flashing Materials:
  - 1. Lead sheet.
  - 2. Copper sheet.
  - 3. Zinc-coated steel sheet.
  - 4. Elastic-membrane sheet.

END OF SECTION 221319

SECTION 221413 - FACILITY STORM DRAINAGE PIPING

1.1 MATERIALS

- A. Hub-and-spigot, Service class, cast-iron soil pipe and fittings.

END OF SECTION 221413

## SECTION 224213.13 - COMMERCIAL WATER CLOSETS

### 1.1 WALL-MOUNTED WATER CLOSETS

- A. Water Closets Wall mounted, top spud , accessible.
  - 1. Material: Vitreous china.
  - 2. Type: Siphon jet.
  - 3. Style: Flushometer valve.
  - 4. Water Consumption: 1.28 gal. (4.8 L) per flush.
  - 5. Support: Waste-fitting assembly.

### 1.2 FLUSHOMETER VALVES

- A. Lever-Handle, Diaphragm Flushometer Valves
  - 1. Style: Exposed.
  - 2. Consumption: 1.28 gal. (4.8 L) per flush.

END OF SECTION 224213.13

## SECTION 224213.16 - COMMERCIAL URINALS

### 1.1 WALL-HUNG URINALS

- A. Urinals : Wall hung, back outlet, washout[, accessible].
  - 1. Material: Vitreous china.
  - 2. Type: Washout with extended shields.

### 1.2 FLUSHOMETER VALVES

- A. Lever-Handle, Diaphragm Flushometer Valves
  - 1. Style: Exposed.
  - 2. Consumption: 0.125 gal. (1.9 L) per flush.

END OF SECTION 224213.16

SECTION 224216.13 - COMMERCIAL LAVATORIES

1.1 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

- A. Lavatory Oval, vitreous china, undercounter mounted.
  - 1. Type: For undercounter mounting.
  - 2. Nominal Size: Oval, 19 by 16 inches (483 by 406 mm).
  - 3. Faucet-Hole Punching: No holes.
  - 4. Faucet-Hole Location: On countertop.

END OF SECTION 224216.13

## SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

### 1.1 MATERIALS

- A. Polyphase Motors: Design B, medium induction motors.
  - 1. Efficiency: Energy efficient.
  - 2. Service Factor: 1.15.
  - 3. Multispeed Motors: Variable torque.
  - 4. Rotor: Random-wound, squirrel cage.
  - 5. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
  - 6. Temperature Rise: Match insulation rating.
  - 7. Insulation: Class F.
  - 8. Code Letter Designation:
    - a. Motors 15 HP and Larger: NEMA starting Code F or Code G.
    - b. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
  - 9. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
- B. Polyphase Motors with Additional Requirements:
  - 1. Motors used with reduced-voltage and multispeed controllers.
  - 2. Energy- and premium-efficient and Inverter-duty motors used with variable frequency controllers.
  - 3. Severe-duty motors.
- C. Single-Phase Motors:
  - 1. Motors Larger than 1/20 HP: Permanent-split capacitor; split phase; capacitor start, inductor run; or capacitor start, capacitor run to suit starting torque and requirements of specific motor application.
  - 2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
  - 3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
  - 4. Motors 1/20 HP and Smaller: Shaded-pole type.
  - 5. Internal thermal protection.

END OF SECTION 230513

## SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

### 1.1 PRODUCTS

#### A. Packed Expansion Joints:

1. Flexible, Ball-Joint Packed Expansion Joints: Carbon steel with asbestos-free composition packing.
  - a. End Connections for **NPS 2 (DN 50)** and Smaller: Threaded.
  - b. End Connections for **NPS 2-1/2 (DN 65)** and Larger: Flanged.
2. Slip-Joint Packed Expansion Joints: Carbon steel with asbestos-free PTFE packing.
  - a. Configuration: Single joint class(es).
  - b. End Connections: Flanged or welded ends to match piping system.
3. Metal, Compensator Packless Expansion Joints:
  - a. Configuration for Copper Tubing: Multi-ply, phosphor-bronze bellows with copper pipe ends.
    - 1) End Connections for Copper Tubing **NPS 2 (DN 50)** and Smaller: Solder joint or threaded.
    - 2) End Connections for Copper Tubing **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Threaded.
  - b. Configuration for Steel Piping: Multi-ply, stainless-steel bellows; steel-pipe ends; and carbon-steel shroud.
    - 1) End Connections for Steel Pipe **NPS 2 (DN 50)** and Smaller: Threaded.
    - 2) End Connections for Steel Pipe **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Flanged.
4. Rubber Union Connector Expansion Joints: Twin reinforced-rubber spheres with external restraining cables.
  - a. End Connections for **NPS 2 (DN 50)** and Smaller: Threaded.
5. Flexible-Hose Packless Expansion Joints:
  - a. Expansion Joints for Copper Tubing **NPS 2 (DN 50)** and Smaller: Copper-alloy fittings with solder-joint end connections.
  - b. Expansion Joints for Copper Tubing **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Copper-alloy fittings with threaded end connections.
  - c. Expansion Joints for Steel Piping **NPS 2 (DN 50)** and Smaller: Carbon-steel fittings with threaded end connections.
  - d. Expansion Joints for Steel Piping **NPS 2-1/2 to NPS 6 (DN 65 to DN 150)**: Carbon-steel fittings with flanged end connections.

- e. Expansion Joints for Steel Piping **NPS 8 to NPS 12 (DN 200 to DN 300)**: Carbon-steel fittings with flanged end connections.
  - f. Expansion Joints for Steel Piping **NPS 14 (DN 350)** and Larger: Carbon-steel fittings with welded end connections.
6. Metal-Bellows Packless Expansion Joints:
- a. Type: Circular, corrugated bellows with external tie rods.
  - b. Configuration: Single joint class(es) unless otherwise indicated.
  - c. Expansion Joints for Copper Tubing: Single-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
    - 1) End Connections for Copper Tubing **NPS 2 (DN 50)** and Smaller: Solder joint or threaded.
    - 2) End Connections for Copper Tubing **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Solder joint or threaded.
    - 3) End Connections for Copper Tubing **NPS 5 (DN 125)** and Larger: Flanged.
  - d. Expansion Joints for Steel Piping: Single- or multi-ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.
    - 1) End Connections for Steel Pipe **NPS 2 (DN 50)** and Smaller: Threaded.
    - 2) End Connections for Steel Pipe **NPS 2-1/2 (DN 65)** and Larger: Flanged.
7. Externally Pressurized Metal-Bellows Packless Expansion Joints: Totally enclosed, multi-ply, stainless-steel bellows isolated from fluid flow by an internal pipe sleeve.
- a. Carbon-steel housing.
  - b. Drain plugs and lifting lug for the **NPS 3 (DN 80)** and larger.
  - c. Joint Axial Movement: [**4 inches (100 mm)**] [**6 inches (150 mm)**] [**8 inches (200 mm)**] <Insert compression limit> of compression and [**0.75 inch (19 mm)**] [**1 inch (25 mm)**] [**2 inches (50 mm)**] <Insert extension limit> of extension.
  - d. Permanent locking bolts.
  - e. End Connection Configuration: Flanged; one raised, fixed and one floating flange.
8. Rubber Packless Expansion Joints:
- a. Material: Fabric-reinforced rubber complying with FSA-NMEJ-703.
  - b. Arch Type: Single or multiple arches with external control rods.
  - c. Spherical Type: Single or multiple spheres with external control rods.
  - d. Material for Fluids Containing Acids, Alkalis, or Chemicals: BR CSM EPDM.
  - e. Material for Fluids Containing Gas, Hydrocarbons, or Oil: Buna-N.
  - f. Material for Water: BR Buna-N CSM EPDM NR.
  - g. End Connections: Full-faced, integral steel flanges with steel retaining rings.
- B. Grooved-Joint Expansion Joints: Factory-assembled; made of several grooved-end pipe nipples, couplings, and grooved joints.
1. Nipples: Galvanized, ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe.
  2. Couplings: Five, flexible type. Include ferrous housing sections, EPDM gasket suitable for cold and hot water, and bolts and nuts.

- C. Alignment Guides and Anchors:
  - 1. Alignment Guides: Steel, factory fabricated.
  - 2. Anchor Materials:
    - a. Steel shapes, plates, bolts, nuts, and washers.
    - b. Wedge-type mechanical anchor fasteners.

END OF SECTION 230516

## SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

### 1.1 SLEEVE-SEAL SYSTEMS

- A. Field-assembled, modular sealing-element unit for filling annular space between piping and sleeve.
  - 1. Sealing Elements: **[EPDM rubber]** **[NBR]**.
  - 2. Pressure Plates: **[Carbon steel]** **[Plastic]** **[Stainless steel]**.
  - 3. Connecting Bolts and Nuts: **[Carbon steel with corrosion-resistant coating]** **[Stainless steel]**.

### 1.2 SLEEVE-SEAL FITTINGS

- A. Manufactured plastic, sleeve-type, plastic or rubber waterstop assembly made for imbedding in concrete slab or wall.

### 1.3 GROUT

- A. Nonshrink, factory packaged.

### 1.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. All piping sleeve-seals to be Galvanized-steel wall sleeves with sleeve-seal system

END OF SECTION 230517

## SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

### 1.1 PERFORMANCE REQUIREMENTS

- A. Pipe hangers and equipment supports designed by Contractor.
- B. Seismic-restraint hangers and supports designed by Contractor and approval obtained from authorities having jurisdiction.

### 1.2 SUBMITTALS

- A. Shop Drawings: Signed and sealed by a professional engineer.

### 1.3 QUALITY ASSURANCE

- A. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. ASME Boiler and Pressure Vessel Code.

### 1.4 COMPONENTS

- A. Metal Pipe Hangers and Supports: Carbon steel stainless steel and copper.
- B. Trapeze pipe hangers.
- C. Fiberglass pipe hangers.
- D. Metal Framing Systems: Non-MFMA manufacturer.
- E. Fiberglass strut systems.
- F. Thermal-hanger shield inserts.
- G. Fastener Systems: Powder-actuated fasteners and mechanical-expansion anchors.
- H. Pipe Stands: Compact Low type, single pipe High type, single pipe High type, multiple pipes Curb-mounted type.
- I. Equipment supports.

END OF SECTION 230529

## SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

### 1.1 PERFORMANCE REQUIREMENTS

#### A. Wind-Restraint Loading:

1. Basic Wind Speed: 80 mph
2. Building Classification Category: II.
3. Minimum **10 lb/sq. ft. (48.8 kg/sq. m)** multiplied by maximum area of HVAC component projected on vertical plane normal to wind direction, and 45 degrees either side of normal.

#### B. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: B. (BASED ON INITIAL ESTIMATES)
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.
  - a. Component Importance Factor: 1.5.
  - b. Component Response Modification Factor: 1.5.
  - c. Component Amplification Factor: 1.0.
3. Design Spectral Response Acceleration at Short Periods (0.2 Second): .
4. Design Spectral Response Acceleration at 1.0-Second Period: .

### 1.2 COMPONENTS

#### A. Vibration Isolators:

1. Elastomeric Isolation Pads: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area. Material to be oil and water resistant with elastomeric properties.
  - a. Surface Pattern: Smooth pattern.
  - b. Infused nonwoven cotton or synthetic fibers.
  - c. Load-bearing metal plates adhered to pads.
2. Double-Deflection, Elastomeric Isolation Mounts: Molded, oil-resistant rubber, neoprene, or other elastomeric material.
3. Restrained Elastomeric Isolation Mounts: All-directional isolator with seismic restraints; molded, oil-resistant elastomeric material with cast-ductile-iron or welded-steel housing.
4. Open-Spring Isolators: Freestanding, laterally stable.
5. Housed-Spring Isolators: Freestanding, laterally stable, open-spring isolators in two-part telescoping housing.
6. Restrained-Spring Isolators: Freestanding, laterally stable, open-spring isolators with vertical-limit stop restraint.
7. Housed-Restrained-Spring Isolators: Freestanding, steel, open-spring isolators with vertical-limit stop restraint in two-part telescoping housing.
8. Pipe-Riser Resilient Support: All-directional, acoustical pipe anchor.

9. Resilient pipe guides.
10. Air-Spring Isolators: Freestanding, single or multiple, compressed-air bellows.
11. Restrained-Air-Spring Isolators: Freestanding, single or multiple, compressed-air bellows with vertical-limit stop restraint.
12. Elastomeric hangers.
13. Spring Hangers: Combination coil-spring and elastomeric-insert hangers with spring and insert in compression and with vertical-limit stop.

B. Seismic Restraint Devices:

1. Snubbers: Welded structural-steel shapes and replaceable resilient isolation washers and bushings.
2. Restraint Channel Bracings: MFMA-4, shop- or field-fabricated bracing assemblies.
3. Restraint Cables: ASTM A 603 galvanized-steel cables.
4. Hanger-Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
5. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
6. Anchor Bolts: Mechanical type, seismic rated.

C. Vibration Isolation Equipment Bases:

1. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.
2. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for field-applied, cast-in-place concrete.

1.3 FIELD QUALITY CONTROL

- A. Testing: By Contractor-engaged agency.

END OF SECTION 230548

## SECTION 230800 - COMMISSIONING OF HVAC

### 1.1 SUMMARY

- A. Requirements for commissioning HVAC&R systems, assemblies, and equipment.
- B. Allowances for labor, instrumentation, tools, and equipment costs for technicians for performance of commissioning testing.
- C. Unit prices for adjusting allowances.
- D. Contractor's Responsibilities:
  - 1. Perform commissioning tests at the direction of the CxA.
  - 2. Attend construction phase controls coordination meeting.
  - 3. Attend testing, adjusting, and balancing review and coordination meeting.
  - 4. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection.
  - 5. Provide information to CxA for final commissioning documentation.
  - 6. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data.
- E. CxA's Responsibilities:
  - 1. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components.
  - 2. Direct commissioning testing.
  - 3. Verify testing, adjusting, and balancing of Work are complete.
  - 4. Provide test data, inspection reports, and certificates in Systems Manual.
- F. Commissioning Documentation:
  - 1. Submittals delivery and review plan.
  - 2. Identification of installed systems, assemblies, equipment, and components.
  - 3. Construction checklists.
  - 4. Certificate of completion.
  - 5. Certificate of readiness.
  - 6. Test and inspection reports and certificates.
  - 7. Corrective action documents.
  - 8. Verification of testing, adjusting, and balancing reports.
- G. Submittals:
  - 1. Certificates of readiness.
  - 2. Certificates of completion.

1.2 EXECUTION

- A. Testing Preparation: Certification and verification that systems, subsystems, and equipment are ready for testing.
- B. Testing and Balance Verification:
  - 1. CxA witnesses testing and balance Work.
  - 2. Verification of final testing and balance report.
- C. Scope of Testing:
  - 1. Provide testing technicians, instrumentation, and tools.
  - 2. Entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space.
  - 3. All modes of operation.
  - 4. Assist in preparation of testing procedures.
  - 5. Simulation of conditions when required.
  - 6. Boiler testing and acceptance procedures.
  - 7. HVAC&R instrumentation and control system testing.
  - 8. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment.
  - 9. Energy supply system testing.
  - 10. Refrigeration system testing.
  - 11. HVAC&R distribution system testing.
  - 12. Vibration and sound tests.

END OF SECTION 230800

## SECTION 230923 - DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

### 1.1 SYSTEM DESCRIPTION

- A. System Description: Microprocessor-based monitoring and control including analog/digital conversion and program logic.
- B. DDC System: Web based.
- C. Delegated Design: Engage a qualified professional engineer to design DDC system.

### 1.2 SYSTEM COMPONENTS

- A. Panel-Mounted, Manual Override Switches:
  - 1. Manual override of control dampers.
  - 2. Manual override of control valves.

### 1.3 SYSTEM ARCHITECTURE

- A. System architecture shall consist of no more than two or three levels of LANs.
- B. Minimum Data Transfer and Communication Speed:
  - 1. LAN Connecting Operator Workstations and Network Controllers: 100 Mbps.
  - 2. LAN Connecting Programmable Application Controllers: 100 kbps.
  - 3. LAN Connecting Application-Specific Controllers: 76,800 bps.
- C. Modular and able to expand to not less than two times system size.
- D. Perform modifications without having to remove and replace existing network equipment.
- E. Number of LANs and associated communication transparent to operator.
- F. Independence of any single device for system alarm reporting and control execution.
- G. Special Network Architecture Requirements:
  - 1. Air-Handling Systems and VAV Terminals: Dedicated LAN.

### 1.4 DDC SYSTEM OPERATOR INTERFACES

- A. Operator Means of System Access:
  - 1. Desktop and portable operator workstation with hardwired connection.
  - 2. Portable operator terminal with hardwired connection through LAN port.
  - 3. Portable operator workstation with wireless connection through LAN router.

4. PDA with wireless connection through LAN router.
  5. Remote connection using outside of system personal computer or PDA through Web access.
  6. Remote connection using portable operator workstation and telephone dial-up modem.
- B. Operator transparent access to system, regardless of operator means used.
- C. Hardwired Network Ports:
1. Each mechanical equipment room.
  2. Each boiler room.
  3. Each chiller room or outdoor chiller yard.
  4. Each cooling tower location.
  5. Each different roof level with roof-mounted air-handling units or rooftop units.
  6. Security system command center.
  7. Fire-alarm system command center.
- D. Desktop Workstations:
1. Connect to Level one LAN through a communications port directly on LAN or through a communications port on a DDC controller.
  2. Able to communicate with any device located on any DDC system LAN.
  3. Able to communicate, with modems, remotely with any device connected to any DDC system LAN.
- E. Portable Workstations:
1. Connect to DDC system Level one LAN through a communications port directly on LAN or through a communications port on a DDC controller.
  2. Able to communicate with any device located on any DDC system LAN.
  3. Connect to DDC system Level two or Level three LAN through a communications port on an application-specific controller, or a room temperature sensor connected to an application-specific controller.
  4. Connect to system through a wireless router connected to Level one LAN.
  5. Able to communicate with any device connected to any system LAN regardless of point of physical connection to system.
  6. Monitor, program, schedule, adjust set points, and report capabilities of I/O connected anywhere in system.
  7. Have dynamic graphic displays that are identical to desktop workstations.
- F. POT:
1. Connect DDC controller through a communications port local to controller.
  2. Able to communicate with any DDC system controller that is directly connected or with LAN or connected to DDC system.
- G. Personal Digital Assistant:
1. Connect to system through a wireless router connected to LAN.
  2. Able to communicate with any DDC controller connected to DDC system.

H. Telephone Communications:

1. Through use of a standard modem to communicate with any device connected to any system LAN.
2. Have auto-dial and auto-answer communications.
3. Desktop and Portable Operator Workstation Computers with Modems:
  - a. Operators able to perform control functions, report functions, and database generation and modification functions.
  - b. Automatically answer calls, and either file or display information sent remotely.
  - c. Communications transparent to operator.
4. DDC Controllers: No modems.
5. DDC Controllers with Modems:
  - a. Automatically place calls to report critical alarms, or to upload trend and historical information for archiving.
  - b. Analyze and prioritize alarms to minimize initiation of calls.
  - c. Buffer noncritical alarms in memory and report them as a group of alarms, or until an operator manually requests an upload.
  - d. Make provisions for handling busy signals, no-answers, and incomplete data transfers.
  - e. Call default devices when communications cannot be established with primary devices.

I. Critical Alarm Reporting:

1. Operator-selected critical alarms sent by DDC system.
2. Send alarm notification to multiple recipients.
3. Notify recipients by any or all means, including e-mail, text message, and prerecorded phone message to mobile and landline phone numbers.

J. Simultaneous Operator Use: 20 simultaneous operators.

1.5 NETWORKS

A. Acceptable Networks for Connecting Operator Workstations and Network Controllers:

1. ATA 878.1, ARCNET.
2. CEA-709.1-C.
3. IP.
4. IEEE 8802-3, Ethernet.

B. Acceptable Networks for Connecting Programmable Application Controllers:

1. ATA 878.1, ARCNET.
2. CEA-709.1-C.
3. IP.
4. IEEE 8802-3, Ethernet.

C. Acceptable Networks for Connecting Application-Specific Controllers:

1. ATA 878.1, ARCNET.
2. CEA-709.1-C.
3. EIA-485A.
4. IP.
5. IEEE 8802-3, Ethernet.

1.6 NETWORK COMMUNICATION PROTOCOL

A. Industry Standard Protocols:

1. ASHRAE 135.
2. CEA-709.1-C.
3. Modbus Application Protocol Specification V1.1b.

1.7 DDC SYSTEM WIRELESS NETWORKS

- A. Honeywell branded technology.
- B. Hardwired controllers are able to be retrofitted to wireless devices.
- C. Wireless interface between programmable application controllers, application-specific controllers, and network controllers.
- D. Wireless coordinators.
- E. Wireless routers.
- F. Wireless temperature sensors.
- G. One-to-one wireless network receivers.
- H. One-to-one wireless network sensors.

1.8 DESKTOP OPERATOR WORKSTATIONS

- A. Personal computer.
- B. Keyboard.
- C. Pointing device.
- D. Flat panel display monitor.
- E. Speakers.
- F. I/O cabling.

1.9 PORTABLE OPERATOR WORKSTATIONS

- A. Network interface card.
- B. Digital video disc rewrite recorder (DVD+/-RW).
- C. Leather carrying case.
- D. Docking station.
- E. Wireless-N communication card.
- F. Bluetooth module with 2.1 standard technologies.
- G. Mobile broadband card.
- H. Wireless optical mouse.
- I. 5 TB portable hard drive.
- J. Light-sensitive Web cam and noise-cancelling digital array microphone.

1.10 POT

- A. Capability:
  - 1. Display and monitor BI point status.
  - 2. Change BO point set point (on or off, open or closed).
  - 3. Display and monitor analog point values.
  - 4. Change analog control set points.
  - 5. Command a setting of AO point.
  - 6. Display and monitor I/O point in alarm.
  - 7. Add a new or delete an existing I/O point.
  - 8. Enable and disable I/O points, initiators, and programs.
  - 9. Display and change time and date.
  - 10. Display and change time schedules.
  - 11. Display and change run-time counters and run-time limits.
  - 12. Display and change time and event initiation.
  - 13. Display and change control application and DDC parameters.
  - 14. Display and change programmable offset values.
  - 15. Access DDC controller initialization routines and diagnostics.

1.11 SERVERS

1.12 PRINTERS

- A. Black and white laser printer.
- B. Color laser printer.

- C. Color inkjet printer.
- D. Dot matrix printer.

### 1.13 SYSTEM SOFTWARE

#### A. System Software Minimum Requirements:

1. Real-time multitasking and multiuser 64-bit operating system.
2. Capable of operating DOS and Microsoft Windows applications.
3. Database management software.
4. Network communications software manages and controls multiple network communications.
5. Operator interface software includes day-to-day operator transaction processing, alarm and report handling, operator privilege level and data segregation control, custom programming, and online data modification capability.
6. Scheduling software shall schedule centrally based time and event, temporary, and exception day programs.

#### B. Operator Interface Software:

1. English language.
2. Minimize use of a typewriter-style keyboard.
3. Manual operator sign-off.
4. Programmable automatic sign-off period.
5. Recorded and printed operator sign-on and sign-off activity.
6. Security access.
7. Data segregation.
8. Operators Commands:
  - a. Start or stop selected equipment.
  - b. Adjust set points.
  - c. Add, modify, and delete time programming.
  - d. Enable and disable process execution.
  - e. Lock and unlock alarm reporting for each point.
  - f. Enable and disable totalization for each point.
  - g. Enable and disable trending for each point.
  - h. Override control loop set points.
  - i. Enter temporary override schedules.
  - j. Define holiday schedules.
  - k. Change time and date.
  - l. Enter and modify analog alarm limits.
  - m. Enter and modify analog warning limits.
  - n. View limits.
  - o. Enable and disable demand limiting.
  - p. Enable and disable duty cycle.
  - q. Display logic programming for each control sequence.

#### 9. Reporting:

- a. General listing of points.
  - b. List points currently in alarm.
  - c. List of off-line points.
  - d. List points currently in override status.
  - e. List of disabled points.
  - f. List points currently locked out.
  - g. List of items defined in a "Follow-Up" file.
  - h. List weekly schedules.
  - i. List holiday programming.
  - j. List of limits and deadbands.
10. Summaries: For specific points, for a logical point group, for an operator selected group(s), or for entire system without restriction due to hardware configuration.
- C. Graphic interface software.
- D. Project-specific graphics.
- E. Customizing software.
- F. Alarm handling software.
- G. Reports and logs.
- H. Standard Reports:
1. All I/O: With current status and values.
  2. Alarm: All current alarms, except those in alarm lockout.
  3. Disabled I/O: All I/O points that are disabled.
  4. Alarm Lockout I/O: All I/O points in alarm lockout, whether manual or automatic.
  5. Alarm Lockout I/O in Alarm: All I/O in alarm lockout that are currently in alarm.
  6. Logs:
    - a. Alarm history.
    - b. System messages.
    - c. System events.
    - d. Trends.
- I. Custom reports.
- J. Tenant override reports.
- K. HVAC equipment reports.
- L. Project-specific utility reports.
- M. Weather reports.
- N. Standard trends.
- O. Custom trends.

P. Programing software shall be as follows:

1. Graphic based.

Q. Database management software.

#### 1.14 OFFICE APPLICATION SOFTWARE

A. Multiple separate applications using a common platform for all applications and including the following:

1. Database.
2. E-mail.
3. Presentation.
4. Publisher.
5. Spreadsheet.
6. Word processing.

#### 1.15 MAINTENANCE MANAGEMENT SOFTWARE

A. Schedule preventive maintenance and generate work orders for mechanical and electrical equipment and systems.

B. Inventory tracking database.

C. Dedicated printer.

#### 1.16 ASHRAE 135 (BACnet) GATEWAYS

A. Gateway Minimum Requirements:

1. Read and view all readable object properties on non-BACnet network to BACnet network and vice versa where applicable.
2. Write to all writeable object properties on non-BACnet network from BACnet network and vice versa where applicable.
3. Include single-pass (only one protocol to BACnet without intermediary protocols) translation from non-BACnet protocol to BACnet and vice versa.
4. Includes data sharing read property, data sharing write property, device management dynamic device binding, and device management communication control.
5. Hardware, software, software licenses, and configuration tools for operator-to-gateway communications.
6. Backup programming and parameters on CD media and the ability to modify, download, backup, and restore gateway configuration.

#### 1.17 ASHRAE 135 (BACnet) PROTOCOL ANALYZER

A. Analyzer minimum capabilities:

1. Capture and store to a file data traffic on all network levels.
2. Measure bandwidth usage.
3. Filtering options with ability to ignore select traffic.

#### 1.18 CEA-709.1-C (LON) NETWORK HARDWARE

- A. Routers.
- B. Gateways.

#### 1.19 WIRELESS ROUTERS FOR OPERATOR INTERFACE

- A. Single-band wireless routers.
- B. Dual-band wireless routers.

#### 1.20 DDC CONTROLLERS

- A. Input and Output Point Interface:
  1. Controller AIs perform analog-to-digital (A-to-D) conversion with a minimum resolution of 12 bits or better to comply with accuracy requirements indicated.
  2. Controller AOs perform analog-to-digital (A-to-D) conversion with a minimum resolution of 12 bits or better to comply with accuracy requirements indicated.
  3. BIs include a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against effects of contact bounce and noise.
  4. Controller BOs include relay contact closures or triac outputs for momentary and maintained operation of output devices.

#### 1.21 NETWORK CONTROLLERS

- A. Communication: Communicate with other devices on DDC system Level one network.
- B. Operator Interface: Equipped with a service communications port for connection to a portable operator's workstation.
- C. Local keypad and display.

#### 1.22 PROGRAMMABLE APPLICATION CONTROLLERS

- A. Communication: Communicate with other devices on network.
- B. Operator Interface: Equipped with a service communications port for connection to a portable operator's workstation.
- C. Local keypad and display.

1.23 APPLICATION-SPECIFIC CONTROLLERS

- A. Microprocessor-based controllers.
- B. Operator interface with a service communications port for connection to a portable operator's workstation. Connection shall extend to port on space temperature sensor that is connected to controller.

1.24 CONTROLLER SOFTWARE

- A. General Controller Software Requirements: I/O points shall be identified by up to 30-character point name and up to 16-character point descriptor. Same names shall be used at operator workstations.
- B. Security: Individual security passwords and user names.
- C. Scheduling:
  - 1. Weekly Schedule: Include separate schedules for each day of week.
  - 2. Exception Schedules: Operator able to designate any day of the year as an exception schedule.
  - 3. Holiday Schedules: Operator able to define up to 99 special or holiday schedules.
- D. System Coordination: Operator able to group equipment based on function and location.
- E. Binary Alarms: Alarm based on operator-specified state.
- F. Analog Alarms: Both high and low alarm limits and able to be automatically and manually disabled.
- G. Alarm Reporting: Able to determine action to be taken in event of an alarm, routed to appropriate operator workstations based on time and other conditions, and able to start programs, print, be logged in event log, generate custom messages, and display graphics.
- H. Remote Communication: Able to dial out in the event of an alarm.
- I. Electric power demand limiting.
- J. Maintenance Management: Monitor equipment status and generate maintenance messages based on operator-designated run-time, starts, and calendar date limits.
- K. Sequencing: Application software to properly sequence chillers, boilers, and other applicable HVAC equipment.
- L. Control Loops
  - 1. Support Control Loops:
    - a. Two-position (on/off, open/close, slow/fast) control.
    - b. Proportional control.
    - c. Proportional plus integral (PI) control.

- d. Proportional plus integral plus derivative (PID) control.
- e. Adaptive (automatic tuning).

- M. Staggered-start applications.
- N. Energy calculations.
- O. Anti-short cycling.
- P. On and off control with differential.
- Q. Run-time totalization.

#### 1.25 RELAYS

- A. General-purpose relays.
- B. Multifunction time-delay relays.
- C. Latching relays.
- D. Current sensing relay.
- E. Combination on-off status sensor and on-off relay.

#### 1.26 ELECTRICAL POWER DEVICES

- A. Transformers.
- B. Power-line conditioner.
- C. Transient voltage suppression and high-frequency noise filter unit.
- D. DC power supply.

#### 1.27 UNINTERRUPTABLE POWER SUPPLY (UPS) UNITS

- A. 250 through 1000 VA.
- B. 1000 through 3000 VA.

#### 1.28 PIPING AND TUBING

- A. Pneumatic, and Pressure Instrument Signal Air, Tubing and Piping:
  - 1. Copper tubing.
  - 2. Copper tubing connectors and fittings.
  - 3. Galvanized-steel piping.

4. Polyethylene tubing.
5. Polyethylene tubing connectors and fittings.

B. Process Tubing:

1. Copper tubing.
2. Copper tubing connectors and fittings.
3. Stainless-steel tubing.
4. Stainless-steel tubing connectors and fittings.

1.29 CONTROL WIRE AND CABLE

- A. Wire: Single conductor control wiring above 24 V.
- B. Single Twisted Shielded Instrumentation Cable above 24 V.
- C. Single Twisted Shielded Instrumentation Cable 24 V and Less.
- D. LAN and Communication Cable: Comply with DDC system manufacturer requirements for network being installed.

1.30 RACEWAYS FOR CONTROL WIRING, CABLING, AND TUBING

A. Metal Conduits, Tubing, and Fittings:

1. GRC.
2. ARC.
3. IMC.
4. PVC-Coated Steel Conduit: Rigid steel conduit.
5. EMT.
6. FMC Zinc-coated steel or Aluminum.
7. LFMC.

B. Nonmetallic Conduits, Tubing, and Fittings:

1. ENT.
2. RNC: Type EPC-40-PVC.
3. LFNC.
4. Rigid HDPE.
5. Continuous HDPE.
6. Coilable HDPE.
7. RTRC.

C. Metal Wireways and Auxiliary Gutters:

1. Description: Sheet metal, Type 4.
2. Wireway Covers: Flanged-and-gasketed type.

D. Surface Metal Raceways: Galvanized steel with snap-on covers.

1.31 FIBER-OPTIC CABLE, CONNECTORS, AND RACEWAY

- A. Fiber: Multimode graded index.
- B. Connection: Fiber-optic connectors.
- C. Cable suitable for use with 100Base-FX or 100Base-SX standard (as applicable).
- D. Connectors.
- E. Splice organizer cabinet.
- F. Raceways: Nonmetallic, flexible raceway system manufactured specifically for routing fiber-optic cables.
- G. Cable Identification: Numeric designation, source, destination, and cable type.

1.32 ACCESSORIES

- A. Pneumatic pressure gages.
- B. Pressure electric switches.
- C. Damper blade limit switches.
- D. I/P and E/P transducers.
- E. E/P switches.
- F. Instrument enclosures.
- G. Manual valves.
  - 1. Needle type.
  - 2. Ball type.
- H. Wall-mounted portable operator's workstation cabinet.

1.33 IDENTIFICATION

- A. Instrument Air Pipe and Tubing: Engraved tags with the service and pressure range.
- B. Control Equipment, Instruments, and Control Devices: Engraved tags.
- C. Valve tags: Brass tags and brass chains attached to valve.
- D. Raceway and Boxes: Painted labels on cover plates.
- E. Equipment Warning Labels: Acrylic label with pressure-sensitive adhesive back and peel-off protective jacket.

END OF SECTION 230923

## SECTION 231123 - FACILITY NATURAL-GAS PIPING

### 1.1 SUMMARY

- A. Natural-gas piping within the building and distribution on the Project site.

### 1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig (690 kPa).
2. Service Meters: 5 psig (34.5 kPa).

- B. Natural-Gas System Pressures within Buildings:

1. Two Pressure Ranges: More than 0.5 psig (3.45 kPa) but not more than 2 psig (13.8 kPa), and 0.5 psig (3.45 kPa) or less.

### 1.3 MATERIALS

- A. Piping Specialties:

1. Appliance flexible connectors.
2. Quick-disconnect devices.
3. Y-Pattern strainers.
4. Weatherproof vent cap.

- B. Manual Gas Shutoff Valves:

1. One- and two-piece ball valves.
2. Two-piece, full-port bronze ball valves with bronze trim.
3. Bronze plug valves.
4. Cast-iron, nonlubricated and lubricated plug valves.
5. PE ball valves.
6. Valve boxes.

- C. Electrically operated motorized gas valves.

- D. Earthquake Valves: Cast-aluminum body with stainless-steel internal parts.

- E. Pressure Regulators:

1. Service pressure regulators.
2. Line pressure regulators.
3. Appliance pressure regulators.

- F. Service Meters:

1. Furnished by natural-gas supplier.

2. Diaphragm type.
3. Rotary type.
4. Turbine.
5. Service-meter bars.
6. Service-meter bypass fittings.

- G. Dielectric Fittings: Dielectric unions.
- H. Detectable warning tape for underground piping.

#### 1.4 OUTDOOR PIPING SCHEDULE

- A. Underground Piping: Steel pipe with welded joints.
- B. Aboveground Piping: Steel pipe with threaded joints.
- C. Branch Piping in Cast-in-Place Concrete: Annealed-temper copper tube with brazed joints.
- D. Containment Conduit: Steel pipe with welded joints.

#### 1.5 INDOOR PIPING SCHEDULE FOR PRESSURES LESS THAN 0.5 PSIG (3.45 kPa)

- A. Aboveground Branch Piping NPS 1 (DN 25) and Smaller: Steel pipe with threaded joints.
- B. Aboveground Distribution Piping: Steel pipe with threaded joints.
- C. Underground Piping: Steel pipe with welded joints.
- D. Containment Conduit and Vent Piping: Steel pipe with welded joints.

#### 1.6 INDOOR PIPING SCHEDULE FOR PRESSURES MORE THAN 0.5 PSIG (3.45 kPa) AND LESS THAN 5 PSIG (34.5 kPa)

- A. Aboveground Branch Piping NPS 1 (DN 25) and Smaller: Steel pipe with threaded joints.
- B. Aboveground Distribution Piping: Steel pipe with threaded joints.
- C. Underground Piping: Steel pipe with welded joints.
- D. Containment Conduit and Vent Piping: Steel pipe with welded joints.

END OF SECTION 231123

## SECTION 232113 - HYDRONIC PIPING

### 1.1 PERFORMANCE REQUIREMENTS

#### A. Minimum Working Pressures and Temperatures:

1. Hot-Water Heating Piping: 100 psig (kPa) at 200 deg F (93 deg C).
2. Chilled-Water Piping: 100 psig (kPa) at 200 deg F (93 deg C).
3. Condenser-Water Piping: 100 psig (kPa) at 150 deg F (66 deg C).
4. Glycol Cooling-Water Piping: 100 psig (kPa) at 150 deg F (66 deg C).
5. Makeup-Water Piping: 80 psig (552 kPa) at 150 deg F (66 deg C).
6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

### 1.2 QUALITY ASSURANCE

#### A. Quality Standard: ASME B31.9.

### 1.3 PRODUCTS

#### A. Bypass chemical feeder and chemicals[ **and glycol**] for first year of operation.

### 1.4 PIPING APPLICATIONS

#### A. Hot-water heating piping, aboveground, NPS 2 (DN 50) and smaller, shall be any of the following:

1. Copper tubing and soldered brazed or pressure-seal joints.
2. Steel pipe, cast-iron fittings, and threaded joints.
3. Steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.
4. CPVC plastic pipe and solvent-welded joints.

#### B. Hot-water heating piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be any of the following:

1. Copper tubing and soldered brazed joints.
2. Steel pipe and welded and flanged joints.
3. Steel pipe and grooved, mechanical joints.
4. CPVC plastic pipe and fittings and solvent-welded joints.

#### C. Hot-water heating piping installed belowground and within slabs shall be either of the following:

1. Copper tubing and soldered joints. Use the fewest possible joints.
2. RTRP and RTRF with adhesive or flanged joints.

#### D. Chilled-water piping, aboveground, NPS 2 (DN 50) and smaller, shall be any of the following:

1. Copper tubing and soldered brazed or pressure-seal joints.
  2. Steel pipe; cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
  3. Steel pipe; steel, pressure-seal couplings and fittings; and pressure-seal joints.
  4. CPVC plastic pipe and fittings and solvent-welded joints.
- E. Chilled-water piping, aboveground, **NPS 2-1/2 (DN 65)** and larger, shall be any of the following:
1. Copper tubing and soldered joints.
  2. Steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
  3. Steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
  4. CPVC plastic pipe and fittings and solvent-welded joints.
  5. RTRP and RTRF with adhesive or flanged joints.
- F. Chilled-water piping installed belowground and within slabs shall be either of the following:
1. Copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
  2. RTRP and RTRF with adhesive or flanged joints.
- G. Makeup-water piping installed aboveground shall be either of the following:
1. Copper tubing, wrought-copper fittings, and soldered joints.
  2. CPVC plastic pipe and fittings, and solvent-welded joints.
- H. Makeup-Water Piping Installed Belowground and within Slabs: Annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
- I. Condensate-Drain Piping: Copper tubing, wrought-copper fittings, and soldered joints or PVC plastic pipe and fittings and solvent-welded joints.
- J. Condensate-Drain Piping: PVC plastic pipe and fittings and solvent-welded joints.
- K. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- L. Air-Vent Piping:
1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
  2. Outlet: Copper tubing with soldered or flared joints.
- M. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

1.5 CHEMICAL TREATMENT

- A. Chemical Treatment: Water analysis by Contractor.
- B. Glycol solutions for hot- chilled-water piping for freeze protection.

END OF SECTION 232113

## SECTION 232116 - HYDRONIC PIPING SPECIALTIES

### 1.1 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressures and Temperatures:
1. See hydronic piping specifications.

### 1.2 PRODUCTS

A. Valves:

1. Plastic Ball Valves: Full port.
2. Plastic Butterfly Valves: EPDM-coated steel disc.
3. Plastic Check Valves: Swing or ball type.
4. Bronze, Calibrated-Orifice, Balancing Valves: Ball or plug type with calibrated orifice or venturi.
5. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves: Ball, plug, or globe pattern with calibrated orifice or venturi.
6. Pressure-Reducing Valves: ASME labeled bronze or brass, with glass and carbon-filled PTFE disc and brass seat.
7. Safety Valves: ASME labeled bronze or brass, with glass and carbon-filled PTFE disc and brass seat.
8. Automatic Flow-Control Valves: Brass or ferrous metal body; stainless-steel piston and spring assembly; combination assemblies include bronze or brass-alloy ball valve.

B. Air Control Devices:

1. Air Vents: Manual and automatic.
2. Expansion Tanks: ASME labeled with bladder or diaphragm.
3. Air Separators: In-line.

C. Hydronic Piping Specialties:

1. Strainers: Y-pattern, basket, and T-pattern.
2. Flexible Connectors: Stainless-steel bellows with woven-wire jacket.

### 1.3 VALVE APPLICATIONS

- A. Shutoff-duty valves for branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Calibrated-orifice, balancing valves for branch connection to return main.
- C. Calibrated-orifice, balancing valves for return pipe of each heating or cooling terminal.
- D. Check valves for each pump discharge and elsewhere as required to control flow direction.
- E. Safety valves for hot-water generators.

- F. Pressure-reducing valves for makeup-water connection to regulate system fill pressure.

END OF SECTION 232116

## SECTION 232123 - HYDRONIC PUMPS

### 1.1 PRODUCTS

#### A. Close-Coupled, In-Line Centrifugal Pumps:

1. Casing: Radially split, cast iron.
2. Impeller: Cast bronze.
3. Pump Shaft: Stainless steel.
4. Seal: Mechanical.
5. Pump Bearings: Permanently lubricated ball bearings.

#### B. Close-Coupled, End-Suction Centrifugal Pumps:

1. Casing: Radially split, cast iron.
2. Impeller: Cast bronze.
3. Pump Shaft: Stainless steel.
4. Seal: Mechanical.
5. Pump Bearings: Permanently lubricated ball bearings.

#### C. Separately Coupled, Base-Mounted, End-Suction Centrifugal Pumps:

1. Casing: Radially split, cast iron. Integral mount on volute to support the casing and attached piping.
2. Impeller: Cast bronze.
3. Pump Shaft: Stainless steel.
4. Seal: Mechanical.
5. Pump Bearings: Grease-lubricated ball bearings in cast-iron housing.
6. Shaft Coupling: Drop-out type molded-rubber insert and interlocking spider with EPDM coupling sleeve for variable-speed applications.
7. Coupling Guard: Dual rated, steel, removable, attached to mounting frame.
8. Mounting Frame: Welded-steel frame and cross members.

#### D. Automatic Condensate Pump Units: Package units with corrosion-resistant pump, plastic tank with cover, and automatic controls.

#### E. Specialty Fittings:

1. Suction diffuser.
2. Triple-duty valves.

### 1.2 Startup services

- #### A. Startup service by a factory-authorized service representative.

### 1.3 DEMONSTRATION

- #### A. By a factory-authorized service representative.

END OF SECTION 232123

## SECTION 232500 - HVAC WATER TREATMENT

### 1.1 PERFORMANCE REQUIREMENTS

#### A. Water Quality:

1. pH: 8.0 to 9.1.
2. "P" Alkalinity: Maximum ppm.
3. Chemical Oxygen Demand: Maximum 100 ppm.
4. Soluble Copper: Maximum 0.20 ppm.
5. TSS: Maximum 10 ppm.
6. Ammonia: Maximum 20 ppm.
7. Free "OH" Alkalinity: Maximum zero ppm.
8. Microbiological Limits:
  - a. Total Aerobic Plate Count: Maximum 10,000 organisms/mL.
  - b. Total Anaerobic Plate Count: Maximum 1000 organisms/mL.
  - c. Nitrate Reducers: Maximum 100 organisms/mL.
  - d. Sulfate Reducers: Maximum zero organisms/mL.
  - e. Iron Bacteria: Maximum zero organisms/mL.
9. Polymer Testable: Minimum 10 to 40.

#### B. Passivation for Galvanized Steel:

1. pH: 7 to 8.
2. Calcium Carbonate Hardness: 100 to 300 ppm.
3. Calcium Carbonate Alkalinity: 100 to 300 ppm.

### 1.2 PRODUCTS

#### A. Bypass Feeders: Steel, with corrosion-resistant exterior coating.

1. Capacity: 5 gal. (19 L).
2. Minimum Working Pressure: 125 psig (860 kPa).

#### B. Automatic Chemical-Feed Equipment:

1. Water Meter: Turbine-type, magnetic-drive, totalization meter.
  - a. Body: Bronze.
  - b. Controls: Flow-control switch with normally open contacts; rated for maximum 10 A, 250-V ac; and that will close at adjustable increments of total flow.

#### C. Chemical Solution Tanks: High-density opaque polyethylene with minimum 110 percent containment vessel.

#### D. Chemical Solution Injection Pumps: Self-priming, positive displacement.

- E. Ozone-Generator Biocide Equipment: Corona discharge generator with stainless-steel generating cells, and transformer.
- F. Self-Contained Breathing Apparatus: Open-circuit, pressure-demand, compressed air.
- G. Stainless-steel pipes and fittings.
- H. UV Biocide Equipment: Minimum 30,000 microwatts x s/sq. cm.
- I. Chemicals recommended by water-treatment system manufacturer.
- J. HVAC Makeup-Water Softeners: Twin mineral tanks and one brine tank, factory mounted on skid.
- K. RO Equipment for HVAC Makeup Water: RO membrane elements in housings, with high-pressure pumps and motors, controls, valves, and prefilter; mounted on skid.
- L. Multimedia Filters: Simplex, multimedia filter system of filter tank, media, strainer, circulating pump, piping, and controls.
- M. Self-Cleaning Strainers: Cast-iron or steel, self-cleaning strainer system of tank, strainer, backwash arm or cleaning spiral, drive and motor, piping, and controls.
- N. Bag- and Cartridge-Type Filters: Floor-mounting housing with filter.
- O. Centrifugal Separators: Simplex separator housing with baffles and chambers.
- P. Water softener chemicals.

END OF SECTION 232500

## SECTION 233113 - METAL DUCTS

### 1.1 QUALITY ASSURANCE

- A. Mockups for system static-pressure classifications higher than **[3-inch wg (750 Pa)]** <Insert static-pressure class>.

### 1.2 MATERIALS

- A. Single-wall rectangular ducts and fittings.
- B. Double-wall rectangular ducts and fittings.
  - 1. **[Fibrous-glass] [Flexible elastomeric]** duct liner for interstitial insulation.
  - 2. **[Perforated] [Solid]** inner duct.
- C. Single-wall round[ **and flat-oval**] ducts and fittings.
- D. Double-wall round[ **and flat-oval**] ducts and fittings.
  - 1. **[Fibrous-glass] [Flexible elastomeric]** duct liner for interstitial insulation.
  - 2. **[Perforated] [Solid]** inner duct.
- E. Sheet Metal Materials:
  - 1. Galvanized sheet steel.
  - 2. PVC-coated, galvanized sheet steel.
  - 3. Carbon-steel sheets.
  - 4. Stainless-steel sheets.
  - 5. Aluminum sheets.
  - 6. Factory-applied antimicrobial coating.
- F. Duct Liner:
  - 1. Fibrous glass, **[Type I, flexible] [Type II, rigid]**.
    - a. With antimicrobial erosion-resistant coating.
  - 2. Flexible elastomeric.
  - 3. Natural fiber.
- G. Sealant Materials:
  - 1. Two-part tape sealing system.
  - 2. Water-based joint and seam sealant.
  - 3. Solvent-based joint and seam sealant.
  - 4. Flanged joint sealant.
  - 5. Flange gaskets.
  - 6. Round duct joint O-ring seals.

### 1.3 SEISMIC-RESTRAINT DEVICES

- A. Channel support system.
- B. [**Galvanized**] [**Stainless**]-steel restraint cables.
- C. Hanger Rod Stiffener: [**Steel tube or steel slotted-support-system sleeve with internally bolted connections**] [**Reinforcing steel angle clamped**] to hanger rod.

### 1.4 DUCT CLEANING

- A. Clean [**new**] [**existing**] [**new and existing**] duct system(s) before testing, adjusting, and balancing.
- B. Clean the following items:
  - 1. Air outlets and inlets.
  - 2. Supply, return, and exhaust fans.
  - 3. Air-handling units.
  - 4. Coils and related components.
  - 5. Return-air ducts, dampers, actuators, and turning vanes.
  - 6. Supply-air ducts, dampers, actuators, and turning vanes.
  - 7. Dedicated exhaust and ventilation components and makeup air systems.

### 1.5 DUCT SCHEDULE

- A. All ducts shall be galvanized steel except as follows:
  - 1. Commercial Kitchen Hood Exhaust Ducts:
    - a. Exposed to View: Type 304, stainless-steel sheet, [**No. 4**] [**No. 3**] <**Insert finish**> finish.
    - b. Concealed: [**Type 304, stainless-steel sheet, No. 2D finish**] [**Carbon-steel sheet**].
    - c. Welded seams and joints.
  - 2. Dishwasher Hood Exhaust Ducts:
    - a. Type 304, stainless-steel sheet.
    - b. Exposed to View: [**No. 4**] [**No. 3**] <**Insert finish**> finish.
    - c. Concealed: [**No. 2D**] <**Insert finish**> finish.
    - d. Welded seams and flanged joints with watertight EPDM gaskets.
  - 3. Acid-Resistant (Fume-Handling) Ducts:
    - a. Type [**316**] [**304**], stainless-steel sheet.
    - b. Exposed to View: [**No. 4**] [**No. 3**] <**Insert finish**> finish.
    - c. Concealed: [**No. 2D**] <**Insert finish**> finish.
  - 4. Acid-Resistant (Fume-Handling) Ducts: PVC-coated galvanized steel with thicker coating on duct interior.

5. Moist Environment Duct Material: Aluminum.
6. Underground Ducts: [**Concrete-encased galvanized steel**] [**PVC-coated galvanized steel with thicker coating on duct exterior**].

END OF SECTION 233113

## SECTION 233300 - AIR DUCT ACCESSORIES

### 1.1 QUALITY ASSURANCE

- A. Installation Standards: NFPA 90A, NFPA 90B, and SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### 1.2 PRODUCTS

- A. Backdraft and Pressure Relief Dampers: Multiple blade, parallel action, gravity balanced with return springs.
- B. Barometric Relief Dampers: Horizontal or vertical mounting; multiple blade, parallel action, gravity balanced with return springs.
- C. Manual Volume Dampers: Multiple and single blade, parallel- and opposed-blade design, with linkage outside airstream.
  - 1. Standard, steel, manual volume dampers.
  - 2. Standard, aluminum, manual volume dampers.
  - 3. Low-leak, steel, manual volume dampers.
  - 4. Low-leak, aluminum, manual volume dampers.
- D. Control Dampers: Opposed-blade design; stainless-steel frame and blades.
- E. Fire Dampers: Electric heat-responsive device.
- F. Ceiling Radiation Dampers: Replaceable heat-responsive device.
- G. Smoke Dampers:
  - 1. Curtain type with blades outside airstream.
  - 2. Leakage: Class II.
- H. Combination Fire and Smoke Dampers: , electric heat-responsive device.
- I. Corridor Dampers: Replaceable heat-responsive device and damper motors with modulating or two-position action.
- J. Flange connectors.
- K. Duct Silencers: Factory fabricated and tested, round or rectangular.
- L. Turning Vanes: Double-blade, galvanized sheet steel.
- M. Remote damper operators.
- N. Duct-Mounted Access Doors: Double wall, rectangular, galvanized sheet steel with insulation.

- O. Pressure Relief Access Doors: Double wall with insulation fill.
- P. Flexible Connectors: ,; and with thrust limits for flexible connections at high-pressure fan discharge.
- Q. Flexible Ducts: Insulated.
- R. Duct security bars.
- S. Duct accessory hardware.

END OF SECTION 233300

## SECTION 233416 - CENTRIFUGAL HVAC FANS

### 1.1 FANS

- A. Housings: Reinforced steel.
- B. Wheels: Steel.
- C. Shafts: Statically and dynamically balanced; steel with keyway.
- D. Bearings: Prelubricated and sealed type, with rating life of 120,000 hours.
- E. Belt Drives: Factory mounted and field adjustable.
  - 1. Service Factor: 1.5.
  - 2. Fan Pulleys: Cast iron or cast steel; split, tapered.
  - 3. Motor Pulleys: Adjustable pitch for motors through 5 hp; fixed pitch for larger motors.

END OF SECTION 233416

## SECTION 233423 - HVAC POWER VENTILATORS

### 1.1 QUALITY ASSURANCE

- A. AMCA-Certified Ratings Seal.

### 1.2 CENTRIFUGAL ROOF VENTILATORS

- A. Direct-drive or belt-driven centrifugal type, with extruded-aluminum housing.
  - 1. Variable-speed controller.
  - 2. Disconnect switch outside fan housing.
  - 3. Bird screens.
  - 4. Backdraft dampers.
  - 5. Motorized dampers.
  - 6. Galvanized-steel roof curbs with built-in raised cant and mounting flange.

### 1.3 CEILING-MOUNTED VENTILATORS

- A. Housing: Steel with acoustical insulation.
- B. Grille: Painted aluminum, louvered.
- C. Accessories:
  - 1. Variable-speed controller.
  - 2. Manual starter switch.
  - 3. Time-delay switch.
  - 4. Motion sensor.
  - 5. Ceiling radiation damper.
  - 6. Washable filter.
  - 7. Vibration isolators.
  - 8. Roof jack or wall cap and transition fittings.

### 1.4 IN-LINE CENTRIFUGAL FANS

- A. In-line, belt-driven centrifugal type, with split, spun-aluminum housing, wheel, and outlet guide vanes.
  - 1. Variable-speed controller.
  - 2. Volume-control damper.
  - 3. Companion flanges.
  - 4. Fan guards.
  - 5. Motor and drive cover (belt guard).

END OF SECTION 233423

## SECTION 233600 - AIR TERMINAL UNITS

### 1.1 QUALITY ASSURANCE

- A. Installation Standard: ASHRAE 62.1 and NFPA 70.

### 1.2 PRODUCTS

A. Series Fan-Powered Air Terminal Units:

1. Configuration: Volume-damper assembly inside unit casing.
2. Casing: Steel double, wall with removable access panels.
  - a. Casing Lining: 1-inch- (25-mm-) thick,.
3. Volume Damper: Normally open, galvanized steel with maximum airflow leakage of 2 percent at 6-inch wg (1500 Pa) inlet static pressure.
4. Velocity sensors.
5. Motor:
  - a. Type: Electronically commutated motor.
  - b. Enclosure: Open dripproof.
  - c. Enclosure Materials: Rolled steel.
  - d. Motor Speed: Multispeed.
6. Filters: Pleated cotton-polyester media, thick.
7. Attenuator Section: Steel sheet.
  - a. Lining: 1-inch- (25-mm-) thick,.
8. Hydronic Coils: Copper tube and aluminum fins.
9. Electric-Resistance Heating Coils: Slip-in-type, open-coil design with factory-installed controls.
10. Factory-mounted and -wired, electronic controls.

B. Induction Air Terminal Units:

1. Configuration: Volume-damper assembly inside unit casing.
2. Casing: Steel double, wall with removable access panels.
  - a. Casing Lining: 1-inch- (25-mm-) thick,.
3. Volume Damper: Normally open, galvanized steel with maximum airflow leakage of 2 percent at 6-inch wg (1500 Pa) inlet static pressure.
4. Induction Damper: Galvanized steel, multiblade.
5. Hydronic Coils: Copper tube and aluminum fins.
6. Electric-Resistance Heating Coils: Slip-in-type, open-coil design with factory-installed controls.
7. Factory-mounted and -wired electronic controls.

C. Shutoff, Single-Duct Air Terminal Units:

1. Configuration: Volume-damper assembly inside unit casing.
2. Casing: Steel double, wall with removable access panels.
  - a. Casing Lining: 1-inch- (25-mm-) thick,.
3. Volume Damper: Normally open, galvanized steel with maximum airflow leakage of 2 percent at 6-inch wg (1500 Pa) inlet static pressure.
4. Attenuator Section: Steel, internally insulated.
  - a. Lining: 1-inch- (25-mm-) thick,.
5. Hydronic Coils: Copper tube and aluminum fins.
6. Electric-Resistance Heating Coils: Slip-in-type, open-coil design with factory-installed controls.

D. Seismic restraints.

1.3 SOURCE QUALITY CONTROL

- A. Air terminal units rated according to ARI 880.

1.4 FIELD QUALITY CONTROL

- A. [Owner] [Contractor]-engaged testing agency.

END OF SECTION 233600

## SECTION 235216 - CONDENSING BOILERS

### 1.1 WARRANTY

#### A. Warranty Period for Fire-Tube Condensing Boilers:

1. Leakage and Materials: 10 years from date of Substantial Completion.
2. Heat Exchanger Damaged by Thermal Stress and Corrosion: Prorated 5 for years from date of Substantial Completion.

#### B. Warranty Period for Water-Tube Condensing Boilers: 20 years from date of Substantial Completion.

#### C. Warranty Period for Water-Jacketed Condensing Boilers:

1. Leakage and Materials: Eight years from date of Substantial Completion.
2. Heat Exchanger Damaged by Thermal Stress and Corrosion: Prorated for five years from date of Substantial Completion.

### 1.2 PERFORMANCE REQUIREMENTS

#### A. Quality Standard: ASME Boiler and Pressure Vessel Code.

#### B. Minimum Efficiency: ASHRAE/IESNA 90.1.

#### C. UL Compliance: UL 795.

### 1.3 MANUFACTURED UNITS

#### A. Forced-Draft, Fire-Tube Condensing Boilers:

1. Heat Exchanger: Nonferrous combustion chamber and forced-draft burner for natural gas.
2. Pressure Vessel: Carbon steel with welded heads and tube connections.
3. Burner: Natural gas, forced draft.
4. Blower: Centrifugal fan.
5. Gas Train: Combination gas valve with manual shutoff and pressure regulator.
6. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.
7. Casing: Factory-finished sheet metal jacket, with insulation.

#### B. Water-Tube Condensing Boilers:

1. Heat Exchanger: Finned-copper primary and stainless-steel secondary, with stainless-steel combustion chamber, and forced-draft burner for natural gas.
2. Burner: Natural gas, forced draft drawing from gas premixing valve.
3. Blower: Centrifugal fan.
4. Gas Train: Combination gas valve with manual shutoff and pressure regulator.

5. Ignition: Silicon carbide hot-surface ignition that includes flame safety supervision and 100 percent main-valve shutoff.
  6. Casing: Factory-finished sheet metal jacket, with insulation.
- C. Water-Jacketed Condensing Boilers:
1. Heat Exchanger: Stainless-steel combustion chamber, and forced-draft burner for natural gas.
  2. Pressure Vessel: Carbon steel with welded heads and tube connections where not in contact with combustion or flue gases.
  3. Burner: Natural gas, forced draft; swing-open front and burner observation port.
  4. Blower: Centrifugal fan.
  5. Gas Train: Combination gas valve with manual shutoff and pressure regulator.
  6. Ignition: Electric-spark ignition with 100 percent main-valve shutoff with electronic flame supervision.
  7. Casing: Factory-finished sheet metal jacket, with insulation.
- D. Trim:
1. Aquastat controllers.
  2. Safety Relief Valve: ASME rated.
  3. Pressure and temperature gage.
  4. Boiler Air Vent: Automatic.
  5. Drain valve.
  6. Circulation pump.
- E. Trim:
1. Pressure controllers.
  2. Safety Relief Valve: ASME rated.
  3. Pressure gage.
  4. Water column.
  5. Drain valves.
  6. Blowdown valves.
  7. Stop valves.
  8. Stop-check valves.
- F. Controls:
1. Boiler Operating Controls:
    - a. Control transformer.
    - b. Operating pressure control.
    - c. Low-water cutoff and pump control.
    - d. Sequence of Operation: Reset supply-water temperature.
  2. Burner Operating Controls:
    - a. High Cutoff: Automatic reset.
    - b. Low-Water Cutoff Switch: Automatic reset.
    - c. Blocked inlet safety switch.

- d. Audible alarm.
- 3. Building management system interface.
- G. Electrical Power: Single-point field power connection to fused disconnect switch.
- H. Venting Kits:
  - 1. Kit: Stainless steel.
  - 2. Combustion-Air Intake: Stainless steel.

1.4 SOURCE QUALITY CONTROL

- A. Boilers: Factory tested and inspected.

END OF SECTION 235216

## SECTION 236200 - PACKAGED COMPRESSOR AND CONDENSER UNITS

### 1.1 QUALITY ASSURANCE

- A. Quality Standard: ASHRAE 15 ASHRAE/IESNA 90.1 ASME Boiler and Vessel Code: Section VIII.

### 1.2 WARRANTY

- A. Warranty Period: 10 years from date of Substantial Completion.
  - 1. Warranty Period (Compressor Only): 10 years from date of Substantial Completion.
  - 2. Warranty Period (Components Other Than Compressor): 10 years from date of Substantial Completion.
  - 3. Warranty Period (Condenser Coil Only): Five years from date of Substantial Completion.

### 1.3 PRODUCTS

- A. Air-Cooled Units, **1 to 5 Tons (3.5 to 17.6 kW)**:
  - 1. Compressor: Scroll, hermetically sealed and isolated, single speed.
  - 2. Refrigerant: R-407C or R-410A.
  - 3. Condenser Coil: Copper-tube, aluminum-fin coil with liquid subcooler.
  - 4. Condenser Fan: Direct-drive, aluminum propeller fan; with permanently lubricated, totally enclosed fan motor.
  - 5. Accessories: Coastal filter, crankcase heater, cycle protector, electronic programmable thermostat, evaporator freeze thermostat, filter-dryer, high-pressure switch, liquid-line solenoid, low-ambient controller, low-pressure switch, PE mounting base, precharged and insulated suction and liquid tubing, sound hood, thermostatic expansion valve, time-delay relay, reversing valve.
  - 6. Unit Casing: Galvanized steel.
- B. Air-Cooled Units, **6 to 120 Tons (21 to 422 kW)**:
  - 1. Compressor: Hermetic or semihermetic rotary, with variable-frequency controller.
  - 2. Refrigerant: R-407C, R-410A, or R-134a.
  - 3. Condenser Coil: Copper-tube, aluminum-fin coil with subcooler.
  - 4. Condenser Fan: Propeller type.
  - 5. Controls: Factory mounted and wired.
  - 6. Accessories: Electronic programmable thermostat, low-ambient controller, gage panel, hot-gas bypass kit, part-winding-start, timing relay, circuit breakers, and contactors, reversing valve .
  - 7. Unit Casing: Galvanized or zinc-coated steel.
- C. Water-Cooled Units:

1. Compressor: Hermetic or serviceable hermetic type, with oil pump, operating oil charge, and suction and discharge shutoff valves.
  - a. Capacity Control: Cylinder unloading.
2. Refrigerant: R-407C, R-410A, or R-134a.
3. Condenser: Multipass, shell-and-tube type.
4. Accessories: Discharge-line muffler, gage panel, electric solenoid cylinder unloaders, pump-down relay package, and crankcase cover plates with equalizer connections.
5. Controls: Factory mounted and wired.
6. Unit Casing: Galvanized steel.

#### 1.4 SOURCE QUALITY CONTROL

- A. Compressor and Condenser Units: Rate according to ARI 210/240.

END OF SECTION 236200

## SECTION 236419 - RECIPROCATING WATER CHILLERS

### 1.1 SUMMARY

- A. Packaged, water or air-cooled, reciprocating water chillers.

### 1.2 QUALITY ASSURANCE

- A. Certification: ARI 590.
- B. Performance Rating: ARI 550/590.
- C. Compliance: ASHRAE 15, ASHRAE/IESNA 90.1, ASME Boiler and Pressure Vessel Code, and NFPA 70.

### 1.3 COMPONENTS

- A. Compressors: Positive-displacement, direct drive, semihermetic.
  - 1. Capacity Control: Combinations of cylinder unloading and on-off compressor cycling of multiple compressors , plus hot-gas bypass.
  - 2. Expansion Valve: Electronic.
  - 3. Sound-Reduction Package: Acoustic enclosure around compressors.
- B. Compressor Motors: Hermetically sealed, refrigerant cooled, high-torque, four-pole induction type with inherent thermal-overload protection on each phase.
- C. Motor Controllers: Across-the-line controller.
- D. Refrigerant circuit isolation valves.
- E. Evaporator: Brazed-plate or shell-and-tube direct-expansion design.
- F. Condenser for Water-Cooled Water Chillers: Brazed plate or shell and tube.
- G. Air-Cooled Condenser: Copper tubes with copper fins with corrosion-resistant coating, leak tested at 150 psig (1034 kPa).
- H. Electrical Power: Factory wired for single-point field power connection.
  - 1. Enclosure: NEMA 250, Type 1, lockable hinged access door.
  - 2. Field Power Interface: Heavy-duty, nonfused disconnect switch.
- I. Controls: Microprocessor based.
  - 1. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, backlit, liquid-crystal display or light-emitting diodes.
  - 2. Interface with DDC System for HVAC: Communication interface.

- J. Insulation for Cold Surfaces: Closed cell, flexible elastomeric.
- K. Accessories:
  - 1. Factory-installed, hot-gas bypass capacity control.
  - 2. Low ambient control.
  - 3. Chilled- and condenser-water flow switch.
  - 4. Suction and discharge pressure gages.

#### 1.4 SOURCE QUALITY CONTROL

- A. Water Chillers: Factory functionally tested.
- B. Performance tested according to ARI 550/590.
- C. Evaporator and Water-Cooled Condenser: Factory tested and inspected according to ASME Boiler and Pressure Vessel Code.
- D. Sound Power Level: ARI [370] [575] rating procedures.

END OF SECTION 236419

## SECTION 236500 - COOLING TOWERS

### 1.1 QUALITY ASSURANCE

- A. ASHRAE/IESNA 90.1 for energy efficiency.
- B. ASME Compliance: ASME Boiler and Pressure Vessel Code: Section VIII, Division 1 for heat-exchanger coils.
- C. CTI Certification: CTI STD 201 for thermal performance.

### 1.2 WARRANTY

- A. Materials and Workmanship: [**Five**] <Insert number> years.

### 1.3 PRODUCTS

- A. Open-Circuit, Induced-Draft, Crossflow Cooling Towers:
  - 1. Casing: Galvanized steel.
  - 2. Collection Basin: Stainless steel.
  - 3. Collection Basin Water-Level Control: Electric/electronic water-level controller with solenoid valve.
  - 4. Basin Heater: Electric.
  - 5. Gravity Water Distribution Basin: Stainless steel with.
  - 6. Fill: PVC;
  - 7. Drift Eliminator: FRP or PVC.
  - 8. Air-Intake Louvers: Matching casing.
  - 9. Air-Intake Screens: Removable-steel wire mesh.
  - 10. Fan: Axial; aluminum blades.
  - 11. Fan Drive: One-piece, multigrooved, solid-back belt.
  - 12. Fan Motor: ; NEMA Premium Efficient.
  - 13. Fan Discharge Stack: Manufacturer's standard design.
  - 14. Vibration Switch: For each fan drive.
  - 15. Gear Drive, Oil-Level Switch: Low-oil-level warning switch for connection to BMS.
  - 16. Controls: Factory installed and wired, and functionally tested at factory before shipment.

### 1.4 SOURCE QUALITY CONTROL

- A. Cooling Towers: Tested and certified according to CTI STD 201.

### 1.5 FIELD QUALITY CONTROL

- A. Testing: By Contractor-engaged agency.
- B. Testing Procedures: CTI ATC 105, "Acceptance Test Code for Water Cooling Towers."

END OF SECTION 236500

## SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

### 1.1 COMPONENTS

#### A. Concealed Evaporator-Fan Components:

1. Galvanized-steel chassis and drain pan.
2. Insulated.
3. Copper-tube refrigerant coil.
4. Forward-curved galvanized fan.
5. Multispeed motor.
6. Permanent filters.

#### B. Floor-Mounted, Evaporator-Fan Components:

1. Enameled-steel cabinet with discharge grille.
2. Insulated.
3. Copper-tube refrigerant coil.
4. Centrifugal fan.
5. Multispeed motor.
6. Disposable filters.

#### C. Wall- or Ceiling-Mounted, Evaporator-Fan Components:

1. Enameled-steel cabinet.
2. Copper-tube refrigerant coil.
3. Electric heating coil.
4. Centrifugal fan.
5. Multispeed motor.
6. Disposable filters.

#### D. Air-Cooled, Compressor-Condenser Components:

1. Enameled-steel casing.
2. Hermetically sealed scroll compressor.
3. Copper-tube refrigerant coil.
4. Heat-pump components.
5. Aluminum-propeller fan.

#### E. Water-Cooled, Compressor-Condenser Components:

1. Enameled-steel casing.
2. Hermetically sealed scroll compressor.
3. Heat-pump components.
4. Copper-tube heat exchanger.

#### F. Accessories: Refrigerant line kits.

END OF SECTION 238126

## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### 1.1 MATERIALS

#### A. Conductors and Cables:

1. Conductors: copper.
2. Conductor Insulation: Type THHN/THWN-2.
3. Multiconductor Cable (Type MC): Not allowed.

### 1.2 CONDUCTOR MATERIAL APPLICATIONS

#### A. Feeders: Copper, stranded.

#### B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.

### 1.3 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

#### A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.

#### B. Feeders: Type THHN/THWN-2, single conductors in raceway.

#### C. Branch Circuits: Type THHN/THWN-2, single conductors in raceway.

### 1.4 FIELD QUALITY CONTROL

#### A. Testing: By Contractor.

#### B. Infrared Scanning: For each splice in cables and conductors No. 3 AWG and larger.

END OF SECTION 260519

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### 1.1 QUALITY ASSURANCE

- A. Quality Standard for Grounding and Bonding Materials and Equipment: UL 467.

### 1.2 PRODUCTS

- A. Insulated Conductors: Copper wire or cable.
- B. Bare Copper Conductors:
  - 1. Solid conductors.
  - 2. Stranded conductors.
  - 3. Tinned conductors.
  - 4. Stranded bonding conductors.
  - 5. Copper tape braided bonding jumpers.
  - 6. Tinned-copper braided bonding jumpers.
- C. Grounding Bus: Predrilled rectangular copper bars with stand-off insulators.
- D. Connectors: Bolted and exothermic-welded type.
- E. Grounding Electrodes:
  - 1. Ground Rods: Copper-clad steel.

### 1.3 FIELD QUALITY CONTROL

- A. Ground Resistance Testing: By Contractor-engaged agency.

END OF SECTION 260526

## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### 1.1 PERFORMANCE REQUIREMENTS

- A. Rated Strength: Minimum structural safety factor of five times the applied force.

### 1.2 PRODUCTS

- A. Support, Anchorage, and Attachment Components:
  - 1. Steel slotted support systems with metallic coatings.
  - 2. Nonmetallic slotted support systems.
  - 3. Raceway and cable supports.
  - 4. Steel conduit and cable hangers, clamps, and associated accessories.
  - 5. Support for non-armored conductors and cables in vertical conduit risers.
  - 6. Structural steel for fabricated supports and restraints.
  - 7. Mounting, Anchoring, and Attachment Components:
    - a. Powder-actuated fasteners.
    - b. Mechanical-expansion anchors.
    - c. Concrete inserts.
    - d. Clamps for attachment to steel structural elements.
    - e. All steel, springhead toggle bolts.
    - f. Threaded hanger rods.
- B. Fabricated Metal Equipment Support Assemblies: Welded or bolted steel shapes.
- C. Concrete Bases: 3000-psi (20.7-MPa), 28-day compressive-strength concrete.

END OF SECTION 260529

## SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

### 1.1 MATERIALS

#### A. Metal Conduits, Tubing, and Fittings:

1. GRC.
2. EMT.
3. FMC: Zinc-coated steel.
4. LFMC.
5. Fittings:
  - a. EMT: Steel, setscrew or compression type.
  - b. Expansion fittings.

#### B. Nonmetallic Conduits, Tubing, and Fittings:

1. RNC.
2. Fittings: Match conduit.

#### C. Metal Wireways and Auxiliary Gutters: Sheet metal with hinged covers.

#### D. Surface Metal Raceways: Metal, galvanized steel, with snap-on covers.

#### E. Boxes, Enclosures, and Cabinets:

1. Metal Outlet and Device Boxes: Ferrous alloy.
2. Metal Floor Boxes: Sheet metal, fully adjustable.
3. Small sheet metal pull and junction boxes.
4. Cabinets: Galvanized steel.

#### F. Handholes and Boxes for Exterior Underground Wiring: Polymer concrete with polymer-concrete frame and cover, prototype tested for compliance with SCTE 77.

1. Configuration: Open bottom.
2. Weatherproof cover.
3. Cover Legend: "ELECTRIC."

### 1.2 RACEWAY APPLICATION

#### A. Outdoors:

1. Exposed: GRC.
2. Concealed, Aboveground: GRC.
3. Underground: RNC.
4. Connection to Vibrating Equipment: LFMC.
5. Boxes and Enclosures, Aboveground: Type 3R.

#### B. Indoors:

1. Exposed, Not Subject to Physical Damage: EMT.
  2. Exposed and Subject to Severe Damage: GRC.
  3. Concealed: EMT.
  4. Connection to Vibrating Equipment: FMC, except LFMC in damp or wet locations.
  5. Damp or Wet Locations: GRC.
  6. Boxes and Enclosures: Type 1, except Type 4 nonmetallic in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Threaded rigid steel conduit fittings.
  2. PVC Externally Coated, Rigid Steel Conduits: Fittings listed for use with this type of conduit.
  3. EMT: Setscrew or compression, steel fittings.
  4. Flexible Conduit: Fittings listed for use with flexible conduit.

END OF SECTION 260533

## SECTION 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

### 1.1 CABLE TRAY TYPES

- A. Wire basket type.

### 1.2 MATERIALS

- A. Cable Trays, Fittings, and Accessories: Steel.
  - 1. Factory-standard primer; with chromium-zinc-plated hardware.
  - 2. Mill galvanized before fabrication; with chromium-zinc-plated hardware.
  - 3. Electrogalvanized before fabrication; with chromium-zinc-plated hardware.
- B. Cable Tray Accessories:
  - 1. Cable tray supports and connectors.

### 1.3 SOURCE QUALITY CONTROL

- A. Tested according to NEMA FG 1.

END OF SECTION 260536

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

1.1 MATERIALS

A. Sleeves:

1. Schedule 40 steel pipe.
2. Cast-iron pipe.
3. Galvanized-steel sheet for conduits penetrating non-fire-rated gypsum-board assemblies.
4. Schedule 40 PVC pipe.
5. Molded-PVC pipe.
6. Molded-PE or -PP pipe.
7. Galvanized-steel sheet for rectangular openings.

B. Sleeve-Seals:

1. EPDM rubber sealing elements.
2. Carbon-steel pressure plates.
3. Carbon-steel, with corrosion-resistant coating, connecting bolts and nuts.

C. Hydraulic-cement grout.

D. Silicone Sealants:

1. Single-component, silicone-based, neutral-curing elastomeric sealant.
2. Multicomponent, silicone-based liquid elastomeric nonshrinking foam.

END OF SECTION 260544

## SECTION 260548.16 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

### 1.1 PERFORMANCE REQUIREMENTS

- A. Designed delegated to contractor to meet IBC/ASTM requirements.
- B. Deferred submittal to code authorities.

### 1.2 COMPONENTS

- A. Restraint Channel Bracings: MFMA-4, shop- or field-fabricated bracing assemblies.
- B. Restraint Cables: ASTM A 603 galvanized-steel cables.
- C. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- D. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- F. Anchor Bolts: Mechanical type, seismic rated.

END OF SECTION 260548.16

## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### 1.1 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.

### 1.2 PRODUCTS

- A. Power and Control Raceway Identification: Tape and stencil.
- B. Power and Control Cable Identification: Self-adhesive, self-laminating polyester labels.
- C. Conductor Identification: Color-coding conductor tape.
- D. Underground-Line Warning Tape: Detectable three-layer laminate.
- E. Warning Labels and Signs: Self-adhesive warning labels.
- F. Instruction Signs: Engraved, laminated acrylic or melamine plastic.
- G. Equipment Identification Labels: Engraved, laminated acrylic or melamine plastic.

END OF SECTION 260553

## SECTION 260923 - LIGHTING CONTROL DEVICES

### 1.1 PRODUCTS

- A. Outdoor Photoelectric Switches: Solid state, with dry contacts, 30-second time delay, and metal-oxide varistor surge protection.
- B. Daylight-harvesting switching controls.
- C. Daylight-harvesting dimming controls.
- D. Indoor Occupancy Sensors: Dual-technology type, with separate, externally mounted relay unit.
- E. Switchbox-mounted occupancy sensors.
- F. Lighting Contactors: Electrically operated and mechanically held, with fusible switch.
- G. Emergency Shunt Relay: Normally closed, electrically held, arranged for wiring in parallel with manual and automatic switching contacts.
- H. Control Cables:
  - 1. Power Cables: Not smaller than No. 12 AWG.
  - 2. Classes 2 and 3 Control Cables: Stranded-copper conductors, not smaller than No. 18 AWG.
  - 3. Class 1 Control Cables: Stranded-copper conductors, not smaller than No. 14 AWG.

END OF SECTION 260923

## SECTION 260933 - CENTRAL DIMMING CONTROLS

### 1.1 SYSTEM DESCRIPTION

- A. Microprocessor-based digital central dimming controls, including:
  - 1. Control network.
  - 2. Master-control stations and manual switches.
  - 3. Partitioned-space master-control stations.
- B. Operation: Push button.
- C. Control the following light sources:
  - 1. Fluorescent lamps with electronic ballasts.
  - 2. Non-dimmed loads.
  - 3. LED lamps.
- D. Interface with controls for the following accessory functions:
  - 1. Curtains and drapes.
  - 2. Blackout curtains.
  - 3. Projectors and screens.
  - 4. Motorized partitions.
  - 5. Manually positioned partitions.
- E. Control Network: 24- or 10-V dc ESTA E1.11/USITT DMX 512-A.

### 1.2 PRODUCTS

- A. Master-Control Stations: Control adjustment of the lighting level for each scene of each zone, and adjustment of fade-time setting for each scene change from one preset scene to another. Controls use digital rocker switches with LCD light level display.
- B. Partitioned-Space Master-Control Station:
  - 1. Automatically combine and separate lighting and accessory function controls as spaces are configured with movable partitions; with controls for adjustment of the lighting level for each scene of each dimmer, and adjustment of fade-rate setting for each scene change from one preset scene to another.
  - 2. Graphical display of room configurations and the names for each. Indicate the current spaces configuration with LCD graphic or LED-illuminated indicators, and show which wall stations are active. Inactive wall stations are automatically deactivated.
- C. Wall Stations:
  - 1. Wall stations function as a submaster to a master station, containing limited control of selected scenes of the master station.

2. Hand-Held Cordless Control: Scene-select and accessory function push buttons using infrared transmission.
- D. Dimmer Cabinets: Factory wired, convection cooled without fans, with barriers to accommodate 120- and 277-V feeders and suitable to control designated lighting equipment or accessory functions.
- E. Portable Computer: As recommended by master-control-station manufacturer, to program master station and associated wall stations, and all interconnected master stations.
- F. Manual switches and plates.
- G. Conductors and Cables:
  1. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors.
  2. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors.
  3. Unshielded, Twisted-Pair Data Cable: Category 5e.

### 1.3 INSTALLATION

- A. Wiring Method: In raceways.

### 1.4 FIELD QUALITY CONTROL

- A. Testing: By Contractor.

END OF SECTION 260933

## SECTION 260943.23 - RELAY-BASED LIGHTING CONTROLS

### 1.1 PRODUCTS

- A. Networked Lighting Control Panels: Mechanically latched relays to control lighting and appliances, interconnected with digital communications to appear as a single lighting control system.
  - 1. Main Control Unit: Installed in the main lighting control panel only; powered from the branch circuit of the standard control unit.
    - a. Control Unit: Power supply and electronic control for operating and monitoring individual relays.
    - b. Timing Unit: 365-day calendar; astronomical clock; four independent schedules, each having 24 time periods.
    - c. Sequencing control with override.
    - d. Override control "blink warning" approximately five minutes before off sequence.
    - e. Nonvolatile memory retains setup configurations.
  - 2. Ethernet Communications: MS Windows TCP/IP protocol.
  - 3. Operator Interface: At the main control unit, provide interface for a tethered connection of a portable PC running MS Windows for configuring networked lighting control panels using setup software designed for the specified operating system.
- B. Manual Switches and Plates: Modular, momentary contact, three wire, for operating one or more relays and to override automatic controls.
- C. Field-Mounted Signal Sources:
  - 1. Daylight harvesting switching controls.
  - 2. Indoor occupancy sensors.
- D. Conductors and Cables:
  - 1. Power Wiring: Not smaller than No. 12 AWG.
  - 2. Control Cables: Multiconductor copper cables.
  - 3. Digital and Multiplexed Signal Cables: Category 5e, unshielded, twisted-pair, copper conductors.

### 1.2 INSTALLATION

- A. Wiring Method: In raceways.
- B. Testing Agency: Contractor engaged.
- C. Adjusting: On-site assistance in adjusting system to suit occupied conditions.
- D. Software:

1. Software technical support and upgrade services for two years.
2. Upgrade Notice: At least 30 days.

END OF SECTION 260943.23

## SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

### 1.1 PRODUCTS

#### A. Distribution Transformers:

1. Core: One leg per phase.
2. Coils: Aluminum or copper, continuous windings without splices except for taps.
3. Enclosure:
  - a. Ventilated.
  - b. Type 2.
4. Taps for Transformers Smaller than 3 kVA: One 5 percent tap above normal full capacity.
5. Taps for Transformers 7.5 to 24 kVA: Two 5 percent taps below rated voltage.
6. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
7. Insulation Class: 220 deg C, with maximum 150 deg C rise above 40 deg C.
8. Features:
  - a. K-factor rating.
  - b. Wall brackets.
  - c. Low sound level.

### 1.2 SOURCE QUALITY CONTROL

- A. Transformers: Factory tested and inspected.
- B. Factory Sound-Level Tests: Conduct prototype sound-level tests on production-line products.

### 1.3 FIELD QUALITY CONTROL

- A. Testing: By Contractor.

END OF SECTION 262200

## SECTION 262413 - SWITCHBOARDS

### 1.1 PRODUCTS

- A. Quality Standards: NEMA PB 2, NFPA 70, and UL 891.
- B. Manufactured Units:
  - 1. Front-connected, front-accessible switchboards.
    - a. Main Devices: Fixed, individually mounted.
    - b. Branch Devices: Panel mounted.
    - c. Sections front and rear aligned.
  - 2. Constructed to withstand seismic forces.
  - 3. Indoor Enclosures: Steel, Type 1.
    - a. Finish: Standard gray color.
  - 4. Outdoor Enclosures: Type 3R.
  - 5. Utility metering compartment.
  - 6. Customer metering compartment.
  - 7. Bus transition and incoming pull sections.
  - 8. Hinged front panels.
  - 9. Pull box on top of switchboard.
  - 10. Buses and Connections: Three phase, four wire, plus ground; copper or tin-plated aluminum.
  - 11. Future device provisions.
- C. Surge Protection Devices:
  - 1. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase not less than 200 kA.
  - 2. Protection modes and grounded wye circuits, three-phase, four-wire circuits shall be as follows:
    - a. Line to Neutral: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
    - b. Line to Ground: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
    - c. Neutral to Ground: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
  - 3. SCCR: Equal or exceed 100 kA.
- D. Disconnecting and Overcurrent Protective Devices:
  - 1. Molded-case circuit breaker (MCCB), with interrupting capacity to meet available fault currents.
    - a. Lugs: Mechanical style.
    - b. Ground-Fault Protection: Integrally mounted.
    - c. Shunt trip.

- d. Undervoltage trip.
  - e. Auxiliary Contacts: One SPDT switch.
- 2. Insulated-Case Circuit Breaker (ICCB): 100 percent rated, fixed mounting.
    - a. Fixed circuit-breaker mounting.
    - b. Full-function microprocessor-based trip units.
    - c. Control Voltage: 125-V dc or 120-V ac.
  - 3. Fused Switch: NEMA KS 1, Type HD.
- E. Instrumentation:
- 1. Potential transformers.
  - 2. Current transformers.
  - 3. Control-power transformers.
  - 4. Current transformers for neutral and ground-fault current sensing.
  - 5. Multifunction digital-metering monitor.
  - 6. Ammeters, voltmeters, and power-factor meters.
  - 7. Instrument switches.
  - 8. Feeder ammeters.
  - 9. Watt-hour meters and wattmeters.
- F. Control Power: 120-V ac.
- G. Accessories:
- 1. Accessory set including tools.
  - 2. Portable test set.
  - 3. Spare-fuse cabinet.
- H. Identification:
- 1. Service equipment label.
- 1.2 FIELD QUALITY CONTROL
- A. Testing: By Contractor.
  - B. Tests: Infrared scanning, ground-fault protection, and NETA ATS.

END OF SECTION 262413

## SECTION 262416 - PANELBOARDS

### 1.1 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

### 1.2 PRODUCTS

A. General Requirements for Panelboards:

1. Constructed to withstand seismic forces.
2. Enclosures: Flush and Surface mounted.
  - a. Front: Hinged cover.
  - b. Directory card.
3. Incoming Mains: Convertible between top and bottom.
4. Phase, Neutral, and Ground Buses: Tin-plated aluminum or copper.
  - a. Optional Buses: Equipment ground, isolated ground, extra-capacity neutral.
5. Conductor Connectors:
  - a. Material: Tin-plated aluminum and hard-drawn copper.
  - b. Main and Neutral Lugs: Mechanical type.
  - c. Ground Lugs and Bus-Configured Terminators: Mechanical type.
  - d. Feed-Through and Subfeed (Double) Lugs: Mechanical type.
  - e. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs.
6. Percentage of Future Space Capacity: 20 percent.
7. Service equipment label for panelboards incorporating one or more main service disconnecting and overcurrent protective devices.

B. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices.

1. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
2. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger than 125 A: Bolt-on circuit breakers.
3. Branch Overcurrent Protective Devices: Fused switches.

C. Lighting and Appliance Branch-Circuit Panelboards:

1. Mains: Circuit breaker and lugs only.
2. Branch Overcurrent Protective Devices: Bolt-on circuit-breaker type.
3. Doors: Door in door construction with concealed hinges.

D. Electronic-Grade Panelboards:

1. Doors: Secured with vault-type latch.
2. Bolt-on, thermal-magnetic circuit-breaker main and branch overcurrent protective devices.
3. Built-in SPDs.
  - a. Peak Single-Impulse Surge Current Rating: Not less than 100 kA; the arithmetic sum of the ratings of the individual MOVs in a given mode.
  - b. Protection modes and VPR for grounded wye circuits with three-phase, four-wire circuits shall not exceed the following:
    - 1) Line to Neutral: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.
    - 2) Line to Ground: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.
    - 3) Neutral to Ground: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.
    - 4) Line to Line: 2000 V for 480Y/277 V 1200 V; for 208Y/120 V.
  - c. SCCR: Equal to the SCCR of the panelboard in which installed.
  - d. Nominal Rating: 20 kA.

E. Disconnecting and Overcurrent Protective Devices:

1. MCCB: Interrupting capacity.
  - a. Circuit Breakers: Thermal-magnetic, adjustable trip settings and GFCI types.
  - b. MCCB Features and Accessories:
    - 1) Lugs: Mechanical style.
    - 2) Appropriate for Application: Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
    - 3) Ground-Fault Protection: Integrally mounted relay and trip unit.
    - 4) Shunt Trip: 120-V trip coil.
    - 5) Rating Plugs: Three-pole breakers with ratings greater than 150 A.
    - 6) Multipole units enclosed in a single housing with a single handle.
    - 7) Handle padlocking devices and clamps.
2. Type-HD fused switch.

F. Identification:

1. Panelboard labels.
2. Breaker labels.
3. Circuit Directory: Computer generated, metal frame with transparent protective cover.

1.3 FIELD QUALITY CONTROL

- A. Testing: By Contractor.

END OF SECTION 262416

## SECTION 262713 - ELECTRICITY METERING

### 1.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

- A. Utility-company-compliant current-transformer cabinets.
- B. Meter sockets.

### 1.2 EQUIPMENT FOR ELECTRICITY METERING BY OWNER

- A. Accuracy: 0.5 percent of reading.
- B. Kilowatt-Hour Meter: Electronic three-phase meters, measuring electricity used. Digital liquid-crystal display.
- C. Kilowatt-Hour/Demand Meter: Electronic three-phase meters, measuring electricity use and demand. Digital liquid-crystal display, including historic peak demand.
  - 1. Demand Signal Communication Interface: Match signal to remote building automation system.
  - 2. Programmable contact module.
  - 3. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.
- D. Data Transmission: Transmit KY pulse data over Class 1 control-circuit conductors in raceway.

END OF SECTION 262713

## SECTION 262726 - WIRING DEVICES

### 1.1 PRODUCTS

- A. Receptacles: Duplex, 125 V, 20 A.
  - 1. Straight Blade: .
  - 2. GFCI: Feed through, duplex tamper resistant.
  - 3. Hazardous (classified) location receptacles.
  - 4. Twist-locking type.
- B. Pendant cord-connector devices.
- C. Cord and plug sets.
- D. Toggle Switches: 120/277 V, 20 A.
  - 1. Pilot-light switches.
  - 2. Key-operated switches.
  - 3. Single-pole, double-throw, momentary-contact, center-off switches.
  - 4. Key-operated, single-pole, double-throw, momentary-contact, center-off switches.
- E. Wall-Box Dimmers:
  - 1. Modular, full-wave, solid-state units with slider control.
    - a. Fluorescent: Trim potentiometer for low-end dimming.
    - b. LED: Compatible with driver.
- F. Wall Plates:
  - 1. Material for Finished Spaces: To be selected from full range of finished metal or colored plastic.
  - 2. Material for Unfinished Spaces: Galvanized steel.
  - 3. Material for Damp and Wet Locations: Cast aluminum.
- G. Floor Service Fittings: Modular, dual service, with power receptacle and voice and data communication outlet.
  - 1. Type: Flush.
  - 2. Service Plate: Rectangular.
- H. Poke-Through Assemblies: Below-floor junction box with multichanneled, through-floor raceway/firestop and detachable floor service-outlet assembly.
  - 1. Service-Outlet Assembly: Flush type.
  - 2. Size: 3 inches (75 mm).
- I. Multioutlet Assemblies: Metal raceways.
- J. Finishes:

1. Connected to Normal Power System: Selected by Architect.
2. Connected to Emergency Power System: Red.
3. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

END OF SECTION 262726

## SECTION 262813 - FUSES

### 1.1 PRODUCTS

- A. Quality Standards: NEMA FU 1 for cartridge fuses.
- B. Cartridge Fuses: Nonrenewable.
- C. Spare-Fuse Cabinet: Wall-mounted steel unit with fuse pullers for each size of fuse.

### 1.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
  - 1. Feeders: Class J, time delay.
  - 2. Motor Branch Circuits: Class RK5, motor duty, time delay.
  - 3. Other Branch Circuits: Class CC, fast acting.
  - 4. Control Transformer Circuits: Class CC, time delay, control transformer duty.

END OF SECTION 262813

## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### 1.1 PRODUCTS

#### A. Fusible and Non-fusible Switches:

1. Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, Type HD.
2. Accessories:
  - a. Equipment ground kit.
  - b. Neutral kit.
  - c. Class R fuse kit (if fusible).
  - d. Auxiliary contact kit.
  - e. Hookstick handle.
  - f. Lugs: Mechanical.
  - g. Service-rated switches.
  - h. Accessory control power.

#### B. Molded-Case Circuit Breakers:

1. Thermal-magnetic type.
2. Adjustable instantaneous-trip type.
3. Electronic-trip type.
4. GFCI type.
5. Features and Accessories:
  - a. Lugs: Mechanical.
  - b. Type SWD for switching fluorescent lighting loads.
  - c. Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
  - d. Ground-Fault Protection: Integrally mounted, self-powered type.
  - e. Shunt trip.
  - f. Auxiliary Contacts: One SPDT switch.
  - g. Accessory control power.

#### C. Enclosures:

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
6. Hazardous Areas: NEMA 250, Type 7.

### 1.2 FIELD QUALITY CONTROL

- #### A. Testing: By Contractor.

1.3 Adjusting

- A. Set field-adjustable circuit-breaker trip ranges.

END OF SECTION 262816

## SECTION 262913 - ENCLOSED CONTROLLERS

### 1.1 PRODUCTS

#### A. Full-Voltage Controllers:

1. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; nonreversing.
2. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; nonreversing.
3. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; nonreversing.
4. Magnetic Controller: Full voltage, electrically held.
  - a. Overload Relay: Solid state.
5. Combination Magnetic Controller: Fusible disconnecting means, and with auxiliary contacts.

#### B. Multispeed Magnetic Controllers:

1. Configuration: Nonreversing; consequent pole and two winding types.
2. Overload Relay: Solid state.
3. Combination Controller: Fusible disconnecting means.

#### C. Enclosures: NEMA ICS 6.

1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 3R.
3. Kitchen Wash-Down Areas: Type 4X, stainless steel.
4. Other Wet or Damp Indoor Locations: Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.
6. Hazardous Areas: Type 7.

#### D. Accessories:

1. Push Buttons: Covered types; momentary as indicated.
2. Pilot Lights: LED types; colors as indicated; push to test.
3. Selector Switches: Rotary type.
4. Contactor auxiliary contact(s).
5. Solid-state, phase-failure, phase-reversal, and undervoltage and overvoltage relays.
6. Terminals for connecting power factor correction capacitors to the load side of overload relays.
7. Spare control wiring terminal blocks.

### 1.2 FIELD QUALITY CONTROL

#### A. Testing: By Contractor.

END OF SECTION 262913

## SECTION 262923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

### 1.1 PRODUCTS

- A. Manufactured Units: Pulse-width modulated; variable torque for inverter-duty motors.
- B. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
- C. Unit Operating Requirements:
  - 1. Internal Adjustability:
    - a. Minimum Speed: 5 to 25 percent of maximum rpm.
    - b. Maximum Speed: 80 to 100 percent of maximum rpm.
    - c. Acceleration: 0.1 to 999.9 seconds.
    - d. Deceleration: 0.1 to 999.9 seconds.
    - e. Current Limit: 30 to minimum of 150 percent of maximum rating.
  - 2. Self-Protection and Reliability Features:
    - a. Surge suppression.
    - b. Loss of input signal protection.
    - c. Under- and overvoltage trips.
    - d. VFC and motor-overload/overtemperature protection.
    - e. Critical frequency rejection.
    - f. Loss-of-phase protection.
    - g. Reverse-phase protection.
    - h. Motor-overtemperature fault.
  - 3. Bidirectional autospeed search.
  - 4. Torque boost.
  - 5. Motor temperature compensation at slow speeds.
    - a. Panel-mounted operator station.
    - b. Historical logging information and displays.
    - c. Digital indicating devices.
  - 6. Control Signal Interfaces: Electric.
  - 7. PID control interface.
  - 8. DDC system for HVAC Protocols for Network Communications: ASHRAE 135.
- D. Line Conditioning:
  - 1. Input line conditioning.
  - 2. Output filtering.
- E. Bypass Systems:

1. Bypass Mode: Manual operation only.
2. Bypass Controller: Two-contactor style, with bypass and output isolating contactors and isolating switch.
3. Bypass Contactor Configuration: Full-voltage (across the line) type.

F. Source Quality Control: Test each VFC while connected to its specified motor.

## 1.2 FIELD QUALITY CONTROL

A. Testing: By Contractor-engaged agency.

END OF SECTION 262923

## SECTION 265100 - INTERIOR LIGHTING

### 1.1 QUALITY ASSURANCE

- A. Quality Standard for Fixtures in Hazardous Locations: FM Global.
- B. Quality Standard for Emergency Fluorescent Power Units: UL 924.

### 1.2 WARRANTY

- A. Emergency Lighting Unit Batteries: 10 years.

### 1.3 PRODUCTS

#### A. Ballasts for Linear Fluorescent Lamps:

- 1. General Requirements for Electronic Ballasts:
  - a. Sound Rating: Class A.
  - b. Total Harmonic Distortion Rating: Less than 10 percent.
  - c. Transient Voltage Protection: Category A or better.
  - d. Lamp Current Crest Factor: 1.7 or less.
  - e. BF: 0.88 or higher.
  - f. Power Factor: 0.95 or higher.
  - g. Parallel Lamp Circuits: Multiple lamp ballasts connected to maintain full light output on surviving lamps if one or more lamps fail.
- 2. Electronic Programmed-Start Ballasts for T8, T5 and T5HO Lamps:
  - a. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
  - b. Automatic lamp starting after lamp replacement.
- 3. Electromagnetic Ballasts: Energy saving, high-power factor, Class P, automatic-reset thermal protection.
- 4. Ballasts for Low-Temperature Environments:
  - a. Temperatures 0 Deg F (Minus 17 Deg C) and Higher: Electronic.
  - b. Temperatures Minus 20 Deg F (Minus 29 Deg C) and Higher: Electromagnetic.
- 5. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
  - a. Dimming Range: 100 to 5 percent of rated lamp lumens.
  - b. Ballast Input Watts: Can be reduced to 20 percent of normal.
- 6. Ballasts for Bi-Level and Controlled Lighting Fixtures: Electronic type.
  - a. High-Level Operation: 100 percent of rated lamp lumens.
  - b. Low-Level Operation: 30 percent of rated lamp lumens.

7. Ballasts for Tri-Level Controlled Lighting Fixtures: Electronic type.
  - a. High-Level Operation: 100 percent of rated lamp lumens.
  - b. Low-Level Operation: 30 and 60 percent of rated lamp lumens.
  
- B. Ballasts for Compact Fluorescent Lamps: Electronic.
  1. Lamp end-of-life detection and shutdown circuit.
  2. Automatic lamp starting after lamp replacement.
  3. Sound Rating: Class A.
  4. Total Harmonic Distortion Rating: Less than 20 percent.
  5. Transient Voltage Protection: Category A or better.
  6. Operating Frequency: 20 kHz or higher.
  7. Lamp Current Crest Factor: 1.7 or less.
  8. BF: 0.95 or higher.
  
- C. Emergency Fluorescent Power Units:
  1. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast; emergency connector operates one fluorescent lamp(s) continuously at an output of 1100 lumens each.
  2. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more fluorescent lamps, remote mounted from lighting fixture.
  
- D. Ballasts for HID Lamps:
  1. Electromagnetic Type for Metal-Halide Lamps: Constant-wattage autotransformer or regulating high-power-factor, low-noise type.
  2. Electronic Type for Metal-Halide Lamps:
    - a. Bi-Level Dimming Ballast: Electronic ballast circuit and leads provide for remote control of the light output of the associated fixture between high- and low-level and off.
  3. High-Pressure Sodium Ballasts: Electromagnetic type, with solid-state igniter/starter. Igniter/starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.
  
- E. Exit Signs: Internally lighted.
  1. Lamps for AC Operations: 50,000-hour light-emitting diodes.
  2. Self-Powered Exit Signs (Battery Type): Sealed, maintenance-free, nickel-cadmium battery with fully automatic, solid-state charger with sealed transfer relay, remote test switch, integral self-test.
  
- F. Emergency Lighting Units: Self-contained, with sealed, maintenance-free, lead-acid battery and fully automatic, solid-state charger, integral time-delay relay, and integral self-test.
  
- G. Fluorescent Lamps:
  1. T8 rapid-start lamps, rated 32 W maximum.

2. T5 rapid-start lamps, rated 28 W maximum.
3. T5HO rapid-start lamps, rated 54 W maximum.
4. Compact Fluorescent Lamps: As required.

H. HID Lamps:

1. High-pressure sodium lamps.
2. Metal-halide lamps.
3. Pulse-start, metal-halide lamps.
4. Ceramic, pulse-start, metal-halide lamps.
5. Low-pressure sodium lamps.

I. Lighting fixture support components.

J. Retrofit kits for fluorescent lighting fixtures.

END OF SECTION 265100

## SECTION 265600 - EXTERIOR LIGHTING

### 1.1 PERFORMANCE REQUIREMENTS

- A. Pole Wind Load:
  - 1. Wind speed for poles 50 feet (15 m) high or less is 100 mph (45 m/s).

### 1.2 QUALITY ASSURANCE

- A. Quality Standard: AASHTO LTS-4-M.

### 1.3 WARRANTY

- A. Materials and Workmanship for Luminaires: Five years.
- B. Poles and Mast Arms Metal Corrosion: Five years.
- C. Finish, Materials, and Workmanship for Poles: Three years.

### 1.4 PRODUCTS

- A. Luminaire Finishes: Manufacturer's standard finish
  - 1. Steel Luminaires: Factory-painted, polyurethane enamel.
  - 2. Aluminum Luminaires: Class I, color anodic finish.
- B. Fluorescent Ballasts and Lamps: Suitable for low-temperature environments.
  - 1. Ballasts for low-temperature environments.
  - 2. Ballast Characteristics:
    - a. Power Factor: 90 percent, minimum.
    - b. Sound Rating: Class A.
    - c. Total Harmonic Distortion Rating: Less than 10 percent.
    - d. Electromagnetic Ballasts: Energy-saving, high power factor, Class P, automatic-reset thermal protection.
    - e. Case Temperature for Compact Lamp Ballasts: 65 deg C, maximum.
    - f. Transient-Voltage Protection: Category A or better.
  - 3. Low-Temperature Lamp Capability: minus 20 deg F (minus 29 deg C) and higher.
- C. HID Lamp Ballasts: Constant-wattage autotransformer or regulating high-power-factor type and suitable for low-temperature starting.
- D. Steel Poles:
  - 1. Mast Arms.

2. Brackets for luminaires.
3. Pole-top tenons.
4. Grounding and bonding lugs.
5. Cable support grip.
6. Finish: Factory painted.

E. Aluminum Poles: Seamless, extruded structural tube.

1. Pole-top tenons.
2. Grounding and bonding lugs.
3. Brackets for luminaires.
4. Finish: Class I, color anodic.

F. Pole Accessories:

1. Breakaway supports.
2. Duplex receptacle.
3. Base covers.
4. Banner arms.

END OF SECTION 265600

## SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

### 1.1 QUALITY ASSURANCE

- A. Installer Qualifications: Layout, supervision, and inspection by BICSI-registered personnel.

### 1.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Equipment frames shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

### 1.3 MATERIALS

- A. Backboards: Plywood, fire-retardant treated.
- B. Equipment Frames: Steel.
  - 1. Floor-mounted racks.
  - 2. Modular freestanding cabinets.
  - 3. Modular wall cabinets.
- C. Floor-mounted racks, modular type, steel or aluminum construction.
- D. Modular freestanding cabinets.
- E. Cable management for equipment frames.
- F. Grounding Connectors: Solderless compression type.

END OF SECTION 271100

## SECTION 271300 - COMMUNICATIONS BACKBONE CABLING

### 1.1 PERFORMANCE REQUIREMENTS

- A. Transmission Standards: TIA/EIA-568-B.1.

### 1.2 QUALITY ASSURANCE

- A. Installer Qualifications: BICSI certified as an RCDD.
- B. Testing Agency Qualifications: An NRTL with a field supervisor certified by BICSI as an RCDD.
- C. Quality Standards:
  - 1. For Telecommunications Pathways and Spaces: TIA/EIA-569-A.
  - 2. Grounding: ANSI-J-STD-607-A.
- D. Products: NRTL listed and labeled.

### 1.3 MATERIALS

- A. Cable Supports: Support brackets, lacing bars, spools, J-hooks, and D-rings.
- B. Cable Trays: Metal, electroplated zinc galvanized.
  - 1. Basket cable trays.
  - 2. Ladder cable trays.
- C. Conduit and boxes. Flexible metal conduit shall not be used.
- D. Backboards: Plywood, fire-retardant treated.
- E. UTP Cabling:
  - 1. Connecting hardware.
  - 2. Connecting Blocks: 110-style IDC for Category 5e and 6, with 25 percent spare blocks for future use.
  - 3. Modular patch panels, one for each four pairs.
  - 4. Jacks and Jack Assemblies: Eight-position modular.
  - 5. Patch cords, length as required
- F. Optical Fiber Cabling: Multimode and singlemode types.
  - 1. Connectors: Simplex and duplex, Type SC, Type ST, Type LC connectors. Type SFF connectors may be used in termination racks, panels, and equipment packages.

1.4 INSTALLATION

- A. Wiring Method: in raceways and cable trays.
- B. Identification: TIA/EIA-606 [**Class 2**] [**Class 3**] [**Class 4**] level of administration including optional identification requirements of this standard.

1.5 FIELD QUALITY CONTROL

- A. Testing: By Contractor-engaged agency.

END OF SECTION 271300

## SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

### 1.1 QUALITY ASSURANCE

- A. Installer Qualifications: BICSI certified as an RCDD.
- B. Testing Agency Qualifications: An NRTL with a field supervisor certified by BICSI as an RCDD.
- C. Quality Standards:
  - 1. Telecommunications Pathways and Spaces: TIA/EIA-569-A.
  - 2. Grounding: J-STD-607-A.

### 1.2 PERFORMANCE REQUIREMENTS

- A. Transmission Standards: TIA/EIA-568-B.
- B. Products: NRTL listed and labeled.

### 1.3 MATERIALS

- A. Backboards: Plywood, fire-retardant treated.
- B. UTP Cabling: 100-ohm, four-pair cable, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.
  - 1. Communications, General Purpose: Type CM or CMG[; or MPP, CMP, MPR, CMR, MP, or MPG].
  - 2. Communications, Plenum Rated: Type CMP[ or MPP], complying with NFPA 262.
  - 3. Communications, Riser Rated: Type CMR[; or MPP, CMP, or MPR], complying with UL 1666.
  - 4. Communications, Limited Purpose: Type CMX[; or MPP, CMP, MPR, CMR, MP, MPG, CM, or CMG].
  - 5. Multipurpose: Type MP or MPG[; or MPP or MPR].
  - 6. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
  - 7. Multipurpose, Riser Rated: Type MPR[ or MPP], complying with UL 1666.
- C. UTP Cable Hardware:
  - 1. Connecting Blocks: [110-style IDC for Category 5e] [110-style IDC for Category 6].
  - 2. [Modular array of connecting blocks to terminate building cables and permit interconnection between cables] [Modular patch panels, one for each four pairs].
  - 3. Jacks and Jack Assemblies: Eight-position modular.
  - 4. [36-inch (900-mm)] [48-inch (1200-mm)] <[Insert length]> patch cords.
- D. Consolidation Points and Multiuser Telecommunications Outlet Assembly (MUTOA): [Recessed in ceiling] [Wall] [Desk] [Furniture] mounted.

- E. Twisted-Pair Telecommunications Outlet/Connectors: Four-pair, eight-position modular.
- F. Workstation Outlets: [Two] [Four] <Insert number>-port-connector assemblies mounted in [single] [or] [multigang] faceplate.
- G. Cable Management System: Computer-based cable management system, with integrated database[ and graphic] capabilities. Direct download circuit labeling into labeling printer.

#### 1.4 INSTALLATION

- A. Wiring Method: In raceways and cable trays.
- B. Identification: TIA/EIA-606 [Class 2] [Class 3] [Class 4] level of administration[ including optional identification requirements of this standard].

#### 1.5 SOURCE QUALITY CONTROL

- A. Testing: By Contractor-engaged agency.

#### 1.6 FIELD QUALITY CONTROL

- A. Testing: By Contractor-engaged agency.

END OF SECTION 271500

## SECTION 27 4113 - AUDIO SYSTEMS

### 1.1 SUMMARY

- A. The audio system will provide for voice amplification and media device audio program amplification. Media device audio program and voice audio amplification will originate from various media sources and microphones, be switched through a source selection switcher, and/or be mixed, processed and amplified to the speaker system. In addition provide multi-channel audio routing between all processors.
- B. This Section includes requirements for audio system components including, but not limited to, the following:
  - 1. Microphones
  - 2. Mixers
  - 3. Power Amplifiers
  - 4. Cabinets
  - 5. Racks
  - 6. Loudspeaker Systems
  - 7. Microphone Inputs
  - 8. Processors
  - 9. Combiners
  - 10. Source Devices
  - 11. Digital Signal Processors
  - 12. Telephone System Interfaces
  - 13. Wire, Cable, and Connectors
- C. Functional Performance: Components and system features and functions shall include, but are not limited to, the following:
  - 1. Meet the following performance parameters as measured in 1/3 octave bands:
    - a. From 100 Hz to 2kHz, flat within plus or minus 2dB.
    - b. Above 2kHz, slope down along an approximate 3dB octave slope to 8kHz.
  - 2. Sound pressure levels at 2kHz octave band shall not deviate more than plus or minus 2dB.
  - 3. When driven to maximum output, clipping shall first occur in power amplifiers.
  - 4. No noise, hum, RFI pickup or distortion shall be audible under normal operating conditions.
  - 5. Sound system shall reproduce program material at a level of 90 dBA without audible distortion.

### 1.2 QUALITY ASSURANCE

- A. EIA Compliance: Comply with the following Technology Industries Association Standards:
  - 1. Sound Systems, EIA-160.
  - 2. Loudspeaker, Dynamic Magnetic Structures, and Impedance, EIA-299-A.
  - 3. Racks, Panels, and Associated Equipment, EIA-310-A.
  - 4. Amplifiers for Sound Equipment, SE-101-A.
  - 5. Speakers for Sound Equipment, SE-103.
  - 6. Microphones for Sound Equipment, SE-105.
- B. UL Compliance: Comply with requirements of UL 50.

1.3 EQUIPMENT AND MATERIALS

- A. General: Provide equipment selected from equipment list on drawings, or as substituted following the proscribed substitution process, using all solid-state components fully rated for continuous duty at the ratings indicated or specified. Select equipment for normal operation on input power supplied at 105-130 V, 60 Hz.

1.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide services of a factory authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

END OF SECTION 274113

## SECTION 27 4114 - VIDEO SYSTEMS

### 1.1 SUMMARY

- A. The video system will provide for large screen projection and flat panel monitor display of multiple video sources in multiple video resolutions and formats. Video signals will originate in media devices, be processed, selected and displayed.
- B. This Section includes requirements for video system components including, but not limited to, the following:
  - 1. Video Projectors
  - 2. Front Projection Screens
  - 3. Switchers
  - 4. Matrix Switchers
  - 5. Computer Interfaces
  - 6. Various Media Source Devices
  - 7. Scalers
  - 8. Distribution Amplifiers
  - 9. Monitors
  - 10. Video Distribution Systems
  - 11. CODECS
  - 12. Cameras
  - 13. Racks
  - 14. Wire, Cable, and Connectors
- C. Video Functional Performance: Components and system features and functions shall include, but not be limited to:
  - 1. Switching, processing, routing, distribution, and display of any video, data, or graphic signal up to and including native resolutions of 1920 x 1200 using HD Base T technology.
  - 2. Switching, processing, routing, distribution, and display of the specified video signal input formats include, but are not limited to composite video, S-video, component video, computer video, HDMI video, Display Port video, and DVI video.
  - 3. Where specified, video systems will provide the capability to annotate (write electronically) on displayed video images.

### 1.2 QUALITY ASSURANCE

- A. EIA Compliance: Comply with the following Technology Industries Association Standards.

### 1.3 SYSTEM REQUIREMENTS

- A. General: Provide a complete and fully functional video system using materials and equipment of types, sizes, ratings, and performances as indicated in the project drawings. Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction in accordance with published product information. Coordinate the features of materials and equipment so they form an integrated system with components and interconnections matched for optimum performance of specified functions.

- B. Video Display Systems: Provide complete video display system set up services including but not limited to convergence, focusing, preset programming, and alignment. Include manufacturer direct services and on site support.
1. Set Up: Provide complete setup and convergence services as defined in the manufacturer's installation manual. Assure that all display devices automatically lock onto all owner designated resolutions and save to memory locations. Provide all equipment required to accomplish programming. At a minimum, without implying limitation, and in addition to those resolutions requested by the owner during the final system set up phase, program display systems to accurately display the following resolutions pixel for pixel:
    - a. NTSC
    - b. VGA
    - c. WGA
    - d. SVGA
    - e. XGA
    - f. WXGA
    - g. WXGA+
    - h. SXGA
    - i. SXGA+
    - j. WSXGA+
    - k. UXGA
    - l. WUGA
    - m. QXGA
    - n. WQXGA
    - o. MAC II
    - p. MAC QUADRA
    - q. IBM workstations
    - r. UNIX workstations
    - s. SUN workstations
    - t. 720p
    - u. 1080i
    - v. 1080p
    - w. 1920 x 1200
  2. Mounting, Alignment, and Focusing: Provide all mounting brackets, threaded rod, unistrut, fasteners, safety cable, and associated mounting hardware to securely affix the specified display devices to the building structure. Suspend display devices in compliance with industry recognized rigging procedures and in compliance with seismic codes. Coordinate exact mounting locations with the project architect, building structure, signal raceway systems, mechanical systems and electrical systems. Align projectors with the optical center of the screens and focus projectors in relation to the image size, mounting systems, and video projection screen. All images/display devices shall be level, square, and aligned for optimum overall positioning with respect to the optical center line. Do not engage electronic keystone correction on any projector.
  3. All display devices and projected images shall be free from visible vibration and/or motion. Provide vibration isolation and dampening equipment where required.

#### 1.4 EQUIPMENT AND MATERIALS

- A. General: Provide equipment selected from equipment list on drawings, or as substituted following the proscribed substitution process, using components fully rated for continuous duty

at the ratings indicated or specified. Select equipment for normal operation on input power supplied at 105-130 V, 60 Hz.

- B. Furnish and install adaptor cables and patch cables which comply with all requirements specified in the project notes.

#### 1.5 FIELD QUALITY CONTROL

- A. **Manufacturer's Field Services:** Provide services of a factory authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

END OF SECTION 274114

## SECTION 274115 - CONTROL SYSTEMS

### 1.1 SUMMARY

- A. The control system will be a microprocessor based, modular card frame and card system, with control system intercommunication via a serial loop. Human interface will occur using color, programmable touch screen control panel(s), and/or miscellaneous control panels. The control system will control all room A/V functions and equipment, as well as lighting control systems for the room lighting system, and motorized window coverings where applicable. The control system will interface to components via Ethernet, infra-red, serial, and contact closure control signals. The control system will include all hardware, firmware, software, and programming to provide complete system control functions including but not limited to all requirements specified in the programming outline included herein.
- B. This Section includes requirements for control system components including, but not limited to, the following:
  - 1. Touch Panels
  - 2. Control Panels
  - 3. Button Panels
  - 4. Modular card frame systems
  - 5. Control cards
  - 6. Volume controllers
  - 7. General bus devices
  - 8. Racks
  - 9. Wireless Access Points
  - 10. Ethernet Network Switches
  - 11. Wire, Cable, and Connectors

### 1.2 SYSTEM DESCRIPTION

- A. Comply with the Control System Programming Outline in developing the software programming for control system operations. The programming outline provides an in-depth narrative which describes the touch panel page design and specific button operating details. All button panel labels, and all touch panel buttons, graphics, and page configurations shall be developed and designed by the installer as required to produce a fully functioning system. All final page layouts shall be approved by the Designer/Engineer and the Owners representative prior to final programming. This shall include all "help" pages, and all new pages and/or buttons which may not be described in the programming outline, but, nevertheless are required to provide a fully functional A/V control system. Submit proposed page layouts for approval in conjunction with the specified submittal process. The intent of the programming outline is not to eliminate the field engineering required of the contractor, but rather to give a clear course of logic desired for the touch panel buttons and pages.
- B. The control panels shall communicate with all specified A/V system components via the specified control system devices. All programming source code required to make the touch panel/button panel buttons operational shall be developed and written by the installer as required to produce a fully functioning system.
- C. Where applicable, the control system software will be written to include the video conference code as a single block of programming. All other A/V system code will be written as a separate block,

and added to the code for video conferencing code. Provide sufficient "remark statements" to identify various blocks of code.

- D. In rooms where lighting control systems are specified, the fluorescent and/or incandescent overhead lights shall be controlled by the control system.
- E. The Installer shall provide the complete source code to the Owner for the completed functioning control system. The source code shall be un-locked, and in a format that can be fully accessed by the Owner. In addition, the Installer must relinquish ownership of said software code, in writing, to the Owner.
- F. The control system shall facilitate easy operation of all room functions from a single unified panel. This shall include all "technician level" set-up parameters, default settings, presets, and other operational functions as described in this specification and/or required to accomplish fully functioning system.
- G. The control system shall include complete help functions as detailed in the Control System Programming Outline.
- H. The control system shall include operation of power controllers to energize the designated rack mounted system equipment per the Control System Programming requirements, and the system installation guidelines.
- I. The control system hardware shall be supplied by a manufacturer that offers factory-level training in advanced control operations and system programming. This training shall be available to enable the Owner's technical staff to acquire the technician-level skills needed to maintain the control system, and make programming modifications after the initial programming and installation of these system at the completion of the warranty period.
- J. The control system, and its associated equipment, shall interface and operate all equipment and devices, as detailed in the control system programming outline, and as illustrated in the supplied design.
- K. The control system shall include a "technician level" of operation separate from the "user level" of operation. This shall be provided to prevent unauthorized manipulation of set-up and control parameters, as detailed in the control system programming section, and as deemed appropriate by the owner. This shall include additional features as dictated by equipment and control operations.

### 1.3 QUALITY ASSURANCE

- A. **Manufacturer's Qualifications:** Firms regularly engaged in manufacture of control system, components and accessories, of types, capacities and characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. **Codes and Standards:** Comply with the following Codes and Standards:
  - 1. Racks, Panels, and Associated Equipment, EIA-310-A.
  - 2. NESC Compliance: Comply with National Electrical Safety Code requirements.
  - 3. FCC Compliance: Comply with Subpart J of PART 15, FCC Rules pertaining to computing devices including Class A, Class B, personal and peripheral types. Provide equipment which complies with technical standards for both radiated and power line conducted interference.

4. UL Compliance: Comply with applicable requirements of UL Standards 486A and B, 813, 983, 1409, 1410, 1412, 1414, 1416, 1417, and 1418 pertaining to control system products. Provide control system and components which are UL-listed and labeled.
  5. All installation practices shall be in accordance with, but not limited to, these specifications and drawings. Installation shall be performed in accordance with the applicable standards, requirements, and recommendations of the Uniform Building Code, the National Electrical Code and all local authorities having jurisdiction. All installation work shall follow "standard broadcast wiring" and installation practices, as excerpted from "Recommended Wiring Practices," Sound System Engineering, (2nd Edition), D. Davis, and performed to the highest standards of acknowledged industry practices.
- C. The control system programming outline, as defined in these specifications, constitutes the minimum control system requirements for adequate control of the A/V, lighting, and motorized window covering systems. The programming outline is a guideline only, provided for the sole purpose of demonstrating intent. It is likely that touch panel/control system buttons, pages, and/or programming will be required which are not identified in the programming outline. During the final software programming, the installer shall work in a close and cooperative manner with the Designer/Engineer and Owner's representative, to make additional modifications, and/or changes in programming procedural events, changes in touch panel functions, and changes in programming features as needed at no additional cost to the owner. These adjustments to the system programming outline in this section shall include, but not be limited to, changes in the system programming code, page layouts, equipment operating modes, and system logic from the parameters outlined here to ensure the flexible and user friendly operation of the A/V system. Include all costs necessary to make moderate changes to the control system programming code and touch panel buttons and pages in the base bid.
- D. The final program shall have sufficient "remark statements" at various points in the program to enable easy identification of blocks of programming code.
- E. A/V system components will be controlled utilizing the most advanced protocol available. In every case, two way, serial control or Ethernet control will be used where available.
- F. The Installer shall include a complete functioning code for the lighting system via control from both the touch panel pages as well as from the wall mounted lighting control panel as described.
- G. The control system in each individual room will be part of a building-wide network of control systems which report to, and can be globally accessed by central help desk location(s) utilizing an HTML-based Ethernet/Web Browser application. The building-wide functionality will include Ethernet based control (e-control), electronic mail instant messaging (e-Mail), and the integration of database management software in order to log system usage (e-Database).
- H. Upon completion of system installation, a complete set of backup source code programs for the touch panels and mainframe technology of each room shall be provided on thumb drive or CD to the owner's representative.
- 1.4 EQUIPMENT AND MATERIALS
- A. General: Provide equipment selected from equipment list on drawings, or as substituted following the proscribed substitution process, using all solid-state components fully rated for continuous duty

at the ratings indicated or specified. Select equipment for normal operation on input power supplied at 105-130 V, 60 Hz.

1.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide services of a factory authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

END OF SECTION 274115

## SECTION 275123 - INTERCOMMUNICATIONS AND PROGRAM SYSTEMS

### 1.1 PRODUCTS

#### A. Manually Switched System Functions:

1. Master Station:
  - a. Station selection.
  - b. All call.
  - c. Master station privacy.
  - d. Conference call.
  - e. Paging.
  - f. Conversation override.
2. Speaker-Microphone Station:
  - a. Privacy.
  - b. Hands-free operation.
  - c. Call initiation.
  - d. Busy signal.
  - e. Noise and distortion free.

#### B. User-Programmable, Microprocessor-Switched System Functions:

1. Master Station:
  - a. Station selection.
  - b. Master station privacy.
  - c. Conference call.
  - d. Paging.
  - e. Conversation override.
  - f. Station display.
2. Speaker-Microphone Station:
  - a. Privacy.
  - b. Hands-free operation.
  - c. Call initiation.
  - d. Busy signal.
  - e. Noise and distortion free.

#### C. Equipment and Materials:

1. Expansion Capability: 25 percent.
2. Equipment: Modular with solid-state components.

#### D. Master Station for Manually Switched Systems:

1. Station-selector and talk-listen switches.
2. Volume control.
3. Light annunciation.
4. Tone annunciation.
5. Speaker microphone.
6. Handset with hook switch.
7. Central-control cabinet.

E. Master Station for Microprocessor-Switched Systems:

1. 12-digit keypad selector.
2. Volume control.
3. Light annunciation.
4. Tone annunciation.
5. Handset with hook switch.
6. Reset control.
7. Central-control cabinet.

F. Speaker-Microphone Stations:

1. Flush mounting.
2. Stainless-steel or aluminum faceplate.
3. Speaker.
4. Reoccurring tone for incoming calls.
5. Call switch.
6. Privacy switch.
7. Handset with hook switch.

G. Call-Switch Unit: Call switch, privacy switch, volume control, and handset with hook switch.

H. Amplifiers: All call, intercommunication, and paging.

I. Loudspeakers/Speaker Microphones: Cone type.

J. Horn-type explosion-proof loudspeakers.

K. Conductors and Cables: Jacketed, twisted pair and twisted multipair, solid-copper conductors.

## 1.2 INSTALLATION

A. Wiring Method: In raceways except within consoles, cabinets, desks, and counters.

## 1.3 FIELD QUALITY CONTROL

A. Testing: By Contractor.

END OF SECTION 275123

## SECTION 275319 - IN-BUILDING WIRELESS DISTRIBUTED ANTENNA SYSTEM

### 1.1 SUMMARY

- A. In-building wireless distributed radio system used for emergency responders, public safety communications, and law enforcement. The system shall be specific to those frequencies associated with public safety with no additional design required for other wireless services such as cellular telephone or wireless LAN distribution (IEEE 802.11).
- B. The contractor selected for the work shall design, install, test, and certify a complete and fully operating "radio enhancement system"
  - 1. Contractor shall provide all site surveys, frequency coordination, and integration to any Owner provided equipment.

### 1.2 SYSTEM DESCRIPTION

- A. General: System shall operate without causing interference to other parts of the public safety radio system. There shall be a 15 dB minimum isolation between donor and coverage antennae.
- B. Radio Coverage: For critical areas, (command and control centers, fire pump rooms, exit stairwells and passageways, elevator lobbies, standpipe cabinets, and other areas deemed critical by the AHJ) shall have 99% coverage. For general areas, the coverage shall be 90%.
- C. Radio Frequency Bands: Provide radio enhancement for all the following.
  - 1. Current UHF frequencies
  - 2. Current UCAN State frequencies
- D. Signal Strength: Provide a minimum of inbound and outbound signal strengths of -88 dBm.
- E. System Components: System power/signal components, including bi-directional amplifiers, shall have FCC acceptance and must operate in accordance with commission rules, (FCC 47 CFR 90.219)
- F. Power Supply: System requires a secondary power source. This power shall be provided by an emergency power source (generator). Provide a minimum of 1 hour battery backup (UPS) to allow for the start up and switch over to emergency power.
- G. System Monitoring: Provide an automatic monitoring system that alarms for antenna malfunction, signal amplifier failure, and power supply monitoring including loss of AC, and battery "charge" status. Alarm panel shall be located in the Security/Fire Annunciator Room.

### 1.3 SYSTEM COMPONENTS

- A. Bi-Directional Amplifiers: Provide a dedicated amplifier designed for the specified frequencies and performance criteria listed above, with any required "rejection" filtering

and/or technologies to mitigate interference from adjacent channels and to meet the antenna isolation issues. The amplifiers shall have the following features:

1. Frequency Range (as specified)
  2. Automatic Gain Control
  3. Thermal management
  4. Monitoring with Self Diagnostics and Alarm Notification
  5. Serial interface
- B. Low Profile Broadband Log Periodic Antenna (Directional) and Broadband Omni Antenna: (Omni-Directional)
1. Frequency Range (MHz): 450 to 960.
  2. Polarization: Vertical Linear.
  3. Impedance: 50 ohms.
  4. Interfaces: Female Type N connector.
  5. Mounting: Pre-affixed bracket for bolting onto flat and non-metallic ceiling and wall structure. Must be able to mount above lay-in ceiling.
  6. Radome must be rated to UL 94V0 Plenum standards for installation above ceiling in plenum rated lay in ceilings.

#### 1.4 SIGNAL TRANSMISSION COMPONENTS

- A. Radiating Cable:
1. Size: 1/2"
  2. Nominal Impedance: 50-ohms.
  3. Must be listed for use in plenums.
- B. Coaxial Cable:
1. Size: 7/8" or 1/2"
  2. Nominal Impedance: 50-ohms.
  3. Must be listed for use in plenums.
- C. Connectors: N-Type connectors for coaxial cable.
- D. Cable Hangers: "Clic" Self Locking Hangar or approved equal.

#### 1.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, and supervise pre-testing, testing, and adjusting of equipment.
- B. Inspection: Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.

END OF SECTION 275319

## SECTION 281300 - ACCESS CONTROL

### 1.1 QUALITY ASSURANCE

- A. Installer Qualifications: 5-years minimum experience.

### 1.2 Description

- A. Security Access System: PC-based central station, one or more networked PC-based workstations, and field-installed controllers, connected by a high-speed electronic data transmission network.
- B. Network Connecting the Central Station and Workstations: LAN.
- C. Network(s) Connecting PCs and Controllers:
  - 1. Local area, Fast Ethernet, star topology network based on TCP/IP.

### 1.3 OPERATION

- A. Single database for access-control and credential-creation functions.
- B. Distributed processing.
- C. Data Capacity:
  - 1. 130 different card-reader formats.
  - 2. 999 comments.
  - 3. 16 graphic file types for importing maps.
- D. Location Capacity:
  - 1. 128 reader-controlled doors.
  - 2. 50,000 total-access credentials.
  - 3. 2048 supervised alarm inputs.
  - 4. 2048 programmable outputs.
  - 5. 32,000 custom action messages per Location to instruct operator on action required when alarm is received.
- E. Central Station: Operator interface, interaction, display, control, and dynamic and real-time monitoring.
- F. Field Equipment: Controllers, sensors, and controls.
- G. System Response to Alarms: One second(s) or less.
  - 1. Alarms annunciated at the central station within one second.
  - 2. Alarm and status changes displayed within 100 ms.

3. Graphics, including graphics-generated map displays, displayed on the console monitor within five seconds.
4. Response time maintained during system heavy load.

H. False-alarm reduction.

I. Error detection.

J. Data line supervision.

#### 1.4 APPLICATION SOFTWARE

A. System Software: Based on 32-bit, Microsoft Windows central-station and workstation operating system and application software.

1. Multiuser multitasking.
2. Graphical user interface.
3. System license for the entire system.
4. Open architecture that allows importing and exporting of data and interfacing with other systems that are compatible with Microsoft Windows.
5. Password-protected operator login and access.
6. Open-database-connectivity compliant.
7. Peer computer control software.
8. Application software.
9. Workstation software.
10. Controller software.
11. PC-to-controller communications.
12. Direct serial or TCP/IP PC-to-controller communications.
13. Dial-up modem or cable modem PC-to-controller communications.
14. Controller-to-controller communications.
15. Database downloads.
16. Operator interface.
17. Operator access control.
18. Operator commands.
19. Alarms.
20. Alarm monitoring.
21. Monitor display.
22. Report-generator software.
23. Anti-passback.
24. Visitor assignment.
25. Time and attendance.
26. Entry-control enrollment software.

#### 1.5 SYSTEM DATABASE

A. Database and Database Management Software:

1. Define and modify each point in database using operator commands.
2. Definition shall include parameters and constraints associated with each system device.

## 1.6 HARDWARE

- A. Surge and tamper protection.
- B. Central-Station Computer: Standard unmodified PC of modular design.
  - 1. Magnetic Tape System: 4-mm cartridge magnetic tape system.
  - 2. Modem: 56,600 bps, full duplex for asynchronous communications.
  - 3. CD-ROM Drive: 650 MB.
  - 4. Laser report printer.
  - 5. LAN Adapter Card: 10/100 Mbps internal network interface card.
  - 6. Redundant central computer.
- C. Workstations: Similar to the central station; with redundant workstation.
- D. UPS: Sized for four hours of operation of the central-station equipment, including two hours of alarm printer operation.
- E. Fixed Map Display: Layout of the protected facilities.
- F. Controllers: Intelligent peripheral control unit.
- G. Secondary alarm annunciator.
- H. Keypads: With unique combinations of alphanumeric and other symbols as an Identifier; includes duress codes.
- I. Card Readers: Visible status indications and user prompts.
  - 1. Touch-plate and proximity readers.
- J. Enrollment Center: Uses a dedicated workstation PC.
  - 1. Equipment to enroll selected biometric credentials.
  - 2. Card Size: Standard size, 2-1/8 by 3-3/8 inches (54 by 86 mm).
  - 3. Card Construction: Core and laminate or monolithic, with useful lifetime of at least five years or 5000 insertions or swipes. Includes holographic images as a security enhancement.
  - 4. Card-Making Equipment: Consisting of a workstation, video camera, video-imaging equipment, and a printer.
    - a. Camera: NTSC color standard with RGB video output and 470 lines minimum horizontal resolution.
    - b. Video Imaging: Live-image capture software and hardware and a digital signature capture pad.
    - c. Printer: Dye-sublimation resin thermal transfer, 300 dpi resolution. Throughput not less than 60 seconds per card.
- K. Push-Button Switches: Momentary-contact back-lighted push buttons.
- L. Door and Gate Hardware Interface:

1. Exit device with alarm.
2. Exit alarm.
3. Electric door strikes.
4. Electromagnetic locks.
5. Vehicle gate operator.

M. Field-Processing Software:

1. Monitoring of inputs.
2. Control of outputs.
3. Reporting of alarms automatically to the central station.
4. Reporting of sensor and output status to the central station upon request.
5. Maintenance of real time, automatically updated by the central station at least once a day.
6. Communication with the central station.
7. Execution of local processor resident programs.
8. Diagnostics.
9. Download and upload data to and from the central station.

N. ASCII interface.

O. Video and camera control.

P. Cables: NFPA 70, Types CM, CMP, CMG, and CMR; multiconductor, jacketed.

Q. Cable and Asset Management: Computer based, with integrated database and graphic capabilities.

## 1.7 INSTALLATION

A. Wiring Method: In raceway except within cabinets.

## 1.8 FIELD QUALITY CONTROL

A. Testing Agency: Contractor engaged.

B. Test Procedure: TIA/EIA-568-B.1.

## 1.9 STARTUP SERVICE

A. Owner's operators, management, and security personnel enrolled and badges and access cards prepared.

END OF SECTION 281300

## SECTION 281600 - INTRUSION DETECTION

### 1.1 QUALITY ASSURANCE

- A. FM Approved and labeled.

### 1.2 WARRANTY

- A. Materials and Workmanship: Two years.

### 1.3 PRODUCTS

- A. Functional Description of System: Multiplexed, modular, microprocessor-based controls.

1. Supervision: Continuously monitored for normal, alarm, supervisory, and trouble conditions.
2. System Control: Master control unit monitors intrusion detection units and connecting wiring.
3. Operator Commands:
  - a. Help with system operation.
  - b. Acknowledge alarm.
  - c. Place protected zone in access.
  - d. Place protected zone in secure.
  - e. Protected zone test.
  - f. System test.
  - g. Print reports.
4. Timed control of master control unit.
5. Automatic control for the following:
  - a. Lights.
  - b. Elevator.
  - c. Intercommunication stations.
  - d. Sound system.
  - e. Closed-circuit television cameras.
6. Printed record of events.
7. Response Time: Two seconds between actuation of any alarm and its indication at master control unit.
8. Circuit supervision.
9. Secure-Access Control: Programmable.

- B. System Component Requirements:

1. Compatibility for integration with the following:

- a. Door hardware.
  - b. Elevators.
  - c. Lighting controls.
  - d. Intercommunications and programming system.
  - e. Public address and mass notification system.
  - f. Access control system.
  - g. Fire-alarm system.
  - h. Perimeter security system.
  - i. Video surveillance system.
  - j. .
2. Surge protection.
  3. Intrusion detection units.
  4. Interference protection.
  5. Tamper protection.
  6. Self-testing devices.
  7. Antimasking devices.
  8. Addressable devices.
  9. Remote-controlled devices.
- C. Secure and Access Devices: Keypad and display module.
- D. Door and Window Switches: Balanced-magnetic type.
- E. Intrusion Detection Devices:
1. PIR sensors.
  2. Acoustic-type, glass-break sensors.
  3. Piezoelectric-type, glass-break sensors.
  4. Vibration sensors.
  5. Photoelectric sensors.
  6. Microwave-PIR dual-technology sensors.
  7. Duress-alarm switches.
  8. Video motion sensor (interior).
- F. Master Control Unit:
1. Construction: Freestanding equipment rack, modular.
  2. Alarm-Initiating Protected Zone Boards: Plug-in cards.
  3. Alarm Indication: Audible signal and plain-language identification on LED, LCD, or cathode-ray-tube display at master control unit.
  4. Timing Unit: Solid state, programmable, 365 days.
  5. Alphanumeric display and system controls.
  6. Power supply circuits.
  7. UPS for six hours of operation.
  8. Automatic signal transmission to monitoring station.
- G. Audible and Visual Alarm Devices: Bell.

1.4 INSTALLATION

- A. Wiring Method: In raceways.

1.5 FIELD QUALITY CONTROL

- A. Testing: By Contractor.

END OF SECTION 281600

## SECTION 282300 - VIDEO SURVEILLANCE

### 1.1 QUALITY ASSURANCE

- A. Quality Standard for Installation: NECA 1 and NFPA 70.
- B. Electronic Data Exchange: Comply with SIA TVAC.

### 1.2 WARRANTY

- A. Cameras and Equipment: Three years.

### 1.3 MATERIALS

- A. Black-and-White Camera: CCD interline transfer, 252,000 pixels.
- B. Color Camera: CCD interline transfer, 380,000 771(H) by 492(V) pixels.
- C. Automatic Color Dome Camera: Dome assembly with color camera, motorized pan and tilt, zoom lens, and receiver/driver.
  - 1. Pan and Tilt: Controlled by operator, with 360-degree rotation and 180-degree tilt and with preset movements at not less than 300 degrees per second.
- D. Reinforced Dome Cameras: Designed for high abuse, with weathertight surface mounting.
- E. Lenses: Optical-quality coated optics, designed specifically for video surveillance applications and matched to specified camera. Provide color-corrected lenses with color cameras.
- F. Power Supplies: Matching voltage and current requirements of cameras and accessories.
- G. Infrared Illuminators: Selectable beam pattern, rated for more than 8000 hours, and with 12-V ac/dc power supply.
- H. Camera-Supporting Equipment: Rated for load in excess of the total weight supported times a minimum safety factor of two.
  - 1. Pan-and-Tilt Units: With built-in encoders or potentiometers for position feedback, and thermostat-controlled heater.
  - 2. Protective Housings for Cameras: Steel enclosures.
- I. Monitors: Color.
  - 1. Metal cabinet units designed for continuous operation.
  - 2. Screen Size (Diagonal Dimension): TBD.
  - 3. Horizontal Resolution for Color Monitors: 300 lines.
  - 4. Horizontal Resolution for Monochrome Monitors: 600 lines.

- J. Digital Video Recorders: Digital, time-lapse type, full frame and motion and audio recorder, with removable hard drive.
- K. Network Video Recorders: External storage or internal 250-1, 500-GB hard disk drive.
- L. Digital Switchers:
  - 1. Quad Switch: For displaying images from four cameras on a single monitor.
  - 2. Manual Switch Bank: Low-loss, high-isolation, multiple-video switch to allow manual switching of multiple quad switches and cameras to a single output.
  - 3. Sequential Switchers: Automatically sequence outputs of multiple cameras to single monitor and videotape recorder.
  - 4. PTZ Controls: Arranged for multiple-camera control, with switches to select camera to be controlled.
- M. IP Video Systems: Delivery and processing of IP-based video, audio, and control data using standard Ethernet-based networks.
- N. Video Motion Sensors (Interior): Detect changes in video signal within a user-defined protected zone. Video inputs shall be composite video as defined in SMPTE 170M.
- O. Control Stations: Freestanding, modular metal furniture units.
  - 1. Equipment Mounting: Standard 19-inch (483-mm) rack.
  - 2. Power Continuity for Control Station: Rechargeable, valve-regulated, recombinant, sealed, lead-acid batteries in power supplies of central-station control units and individual system components to maintain continuous system operation during outages of both normal and backup ac system supply.
- P. Signal Transmission Components: 75-ohm coaxial cable with BNC connectors.

#### 1.4 INSTALLATION

- A. Wiring Method: In raceways.
  - 1. Except in accessible indoor ceiling spaces and attics.
  - 2. Except in hollow gypsum board partitions.

#### 1.5 FIELD QUALITY CONTROL

- A. Testing: By Contractor.

END OF SECTION 282300

## SECTION 311000 - SITE CLEARING

### 1.1 SUMMARY

- A. Protecting existing vegetation to remain.
- B. Removing existing vegetation.
- C. Clearing and grubbing obstructions, trees, shrubs, and other vegetation, including grinding stumps and removing roots and debris.
  - 1. Chipping removed tree branches and disposing of off-site.
- D. Stripping and stockpiling topsoil and disposing of surplus topsoil.
- E. Stripping and stockpiling rock and disposing of surplus rock.
- F. Removing existing above- and below-grade site improvements.
- G. Disconnecting, capping or sealing, and removing site utilities.
- H. Providing temporary erosion- and sedimentation-control measures.

END OF SECTION 311000

## SECTION 312000 - EARTH MOVING

### 1.1 SUMMARY

- A. Rough grading the Site.
- B. Preparing subgrades for slabs-on-grade walks pavements turf and grasses and plants.
- C. Excavating and backfilling for buildings and structures.
- D. Drainage course for concrete slabs-on-grade.
- E. Subbase course for concrete pavements.
- F. Subbase course and base course for asphalt paving.
- G. Subsurface drainage backfill for walls and trenches.
- H. Excavating and backfilling for utilities.
- I. Excavation: Unclassified.

### 1.2 QUALITY ASSURANCE

- A. Blasting: Seismographic monitoring provided by independent seismic survey agency.

### 1.3 MATERIALS

- A. Soil Materials: Satisfactory and unsatisfactory soil classifications..
- B. Geotextiles: Subsurface drainage geotextile and separation geotextile.
- C. Warning Tape: Detectable, polyethylene film.

### 1.4 EXCAVATION

- A. Explosives: Subject to written permission from authorities having jurisdiction.
  - 1. Scheduling time of the explosion with University.
  - 2. Blast Mat protection.
  - 3. Restrict explosion size.
- B. Hand-excavate in tree- and plant-protection zones.
- C. Disposal of Surplus and Waste Materials: Satisfactory soil to designated storage areas on Owner's property; waste materials and unsatisfactory soil off Owner's property.

1.5 FIELD QUALITY CONTROL

- A. Special Inspector and Testing Agency: Owner engaged.

END OF SECTION 312000

## SECTION 321216 - ASPHALT PAVING

### 1.1 QUALITY ASSURANCE

- A. Regulatory Requirements: University of Utah Facilities Management.

### 1.2 MATERIALS

- A. Asphalt Materials:

1. Asphalt Binder: AASHTO M 320, performance graded.
2. Prime Coat: Asphalt emulsion.
3. Tack Coat: Emulsified asphalt.
4. Fog Seal: Emulsified asphalt.

- B. Auxiliary Materials:

1. Recycled Materials: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled asphalt shingles.
2. Herbicide.
3. Paving Geotextile: Nonwoven polypropylene.

- C. Asphalt Mixes: Approved by University Facilities Management.

- D. Emulsified-Asphalt Slurry: ASTM D 3910, Type 1.

### 1.3 INSTALLATION

- A. Patching Hot-Mix Asphalt Pavement: Base mix for full thickness of patch.

- B. Hot-Mix Asphalt Paving:

1. Subgrade proof rolled.
2. Herbicide applied.
3. Prime coat over unbound-aggregate base course.
4. Base Course: 8 inches.
5. Surface Course: 4 inches.

- C. Surface Treatment: Slurry seal.

### 1.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner engaged.

END OF SECTION 321216

## SECTION 321313 - CONCRETE PAVING

### 1.1 SUMMARY

- A. Driveways.
- B. Roadways.
- C. Parking lots.
- D. Curbs and gutters.
- E. Walks.

### 1.2 QUALITY ASSURANCE

- A. Quality Standard: ACI 301.
- B. Mockups to demonstrate surface finish, texture, and color; curing; and standard of workmanship.

### 1.3 MATERIALS

- A. Reinforcement:
  - 1. Reinforcing Bars: Epoxy-coated deformed steel.
  - 2. Joint Dowel Bars: Epoxy-coated plain steel.
  - 3. Synthetic Fiber: Polypropylene multifilament.
- B. Concrete:
  - 1. Portland Cement: ASTM C 150, gray.
  - 2. Normal-weight aggregate.
  - 3. Air-entraining admixture.
  - 4. Compressive Strength: 4500 psi at 28 days.
- C. Detectable Warnings: Blockouts in concrete for detectable paving units.

### 1.4 FINISHING AND CURING

- A. Finishes: Medium-to-fine-textured broom, Slip-resistive aggregate finish.
- B. Cure concrete by moisture curing, curing compound, or a combination of these.

1.5 FIELD QUALITY CONTROL

- A. Testing: By Owner-engaged agency.

END OF SECTION 321313

## SECTION 328400 - PLANTING IRRIGATION

### 1.1 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- B. Minimum Working Pressures:
  - 1. Irrigation Main Piping: 200 psig.
  - 2. Circuit Piping: 150 psig.

### 1.2 ABOVEGROUND IRRIGATION MAIN PIPING

- A. Pipe NPS 4 and Smaller:
  - 1. Lead-free brass pipe, lead-free brass fittings, and threaded joints.
  - 2. Type L hard copper tube, wrought- or cast-copper fittings, and soldered joints.
  - 3. Schedule 80, PVC pipe; Schedule 80, threaded PVC fittings; and threaded joints.

### 1.3 UNDERGROUND IRRIGATION MAIN PIPING

- A. Pipe NPS 4 and Smaller:
  - 1. NPS 3 and NPS 4 ductile-iron, mechanical-joint pipe and fittings; and gasketed joints.
  - 2. Type L soft copper tube, wrought-copper fittings, and brazed joints.
  - 3. Schedule 40, PVC pipe and socket fittings, and solvent-cemented joints.
  - 4. Schedule 80, PVC pipe; Schedule 80, PVC fittings; and threaded joints.

### 1.4 CIRCUIT PIPING

- A. Pipe NPS 2 and Smaller:
  - 1. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
- B. Pipe NPS 2-1/2 TO NPS 4:
  - 1. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints; and thrust blocking.

### 1.5 ISOLATION VALVES

- A. NPS 2 and Smaller:

1. Brass or bronze ball valve.

B. NPS 2-1/2 and NPS 3:

1. Iron gate valve.

#### 1.6 DRAIN VALVES

A. NPS 3/4: Brass or bronze ball valve.

#### 1.7 MANUFACTURED UNITS

A. Automatic Control Valves: Plastic.

B. Pop-up, Impact-Drive Rotary Sprinklers: Plastic.

C. Surface, Pop-up Spray Sprinklers: Plastic.

D. Boxes for Automatic Control Valves: Plastic.

END OF SECTION 328400

## SECTION 329115 - SOIL PREPARATION (PERFORMANCE SPECIFICATION)

### 1.1 PRECONSTRUCTION TESTING

- A. Preconstruction testing of existing, on-site soil and/or imported soil by Contractor's testing agency.

### 1.2 MATERIALS

- A. Regional Materials: Imported soil and soil amendments and fertilizers.
- B. Planting soils produced by modifying the following soil sources:
  - 1. Existing, On-Site Surface Soil Stockpiled On-Site.
  - 2. Imported Soil.

### 1.3 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

- A. Screen soil with a 2-inch sieve to remove large materials.

### 1.4 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

- A. Till subgrade to depth of 6 inches.
- B. Spread unamended soil to total depth of 12 inches and amend in place.
- C. Compact each lift of planting soil.

### 1.5 BLENDING PLANTING SOIL IN PLACE

- A. Till unamended, existing soil to depth of 18 inches.
- B. Apply amendments and blend.
- C. Compact blended planting soil.

### 1.6 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor engaged.

END OF SECTION 329115

## SECTION 329300 - PLANTS

### 1.1 QUALITY ASSURANCE

- A. Installer's Personnel Certifications: Minimum 5 years' experience with projects of similar size and scope. Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.

### 1.2 WARRANTY

- A. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
- B. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
- C. Annuals: Three months.

### 1.3 MATERIALS

- A. Mulches: As indicated in final design.
- B. Weed-control barrier.
- C. Pesticides.
- D. Tree Stabilization: Upright staking and tying or Proprietary staking-and-guying device.
- E. Landscape Edgings: Aluminum and/or Mow strip.
- F. Root barrier.
- G. Planter drainage gravel and filter fabric.

### 1.4 INSTALLATION

- A. Pruning: Minimal; Thin and shape as directed according to standard practice.
- B. Ground Cover and Plant Planting: Space ground cover and plants other than trees, shrubs, and vines as indicated on drawings.
- C. Mulching:
  - 1. Trees in Turf Areas: Mulch ring of depth indicated on drawings, with 36-inch radius.
  - 2. Planting Areas: Depth as indicated on drawings over whole surface of planting area.

1.5 MAINTENANCE SERVICE

- A. Trees and Shrubs: Three months.
- B. Ground Cover and Other Plants: Three months.

END OF SECTION 329300

## SECTION 330500 - COMMON WORK RESULTS FOR UTILITIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Adjust list below to suit Project.
  - 2. Piping joining materials.
  - 3. Transition fittings.
  - 4. Dielectric fittings.
  - 5. Sleeves.
  - 6. Identification devices.
  - 7. Grout.
  - 8. Flowable fill.
  - 9. Piped utility demolition.
  - 10. Piping system common requirements.
  - 11. Equipment installation common requirements.
  - 12. Painting.
  - 13. Concrete bases.
  - 14. Metal supports and anchorages.

#### 1.3 DEFINITIONS

- A. Retain terms and abbreviations that remain after this Section has been edited.
- B. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.
- C. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- D. PVC: Polyvinyl chloride plastic.
- E. DI: Ductile Iron pipe

#### 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Dielectric fittings.
  - 2. Identification devices.
- B. Welding certificates.

#### 1.5 QUALITY ASSURANCE

- A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

#### 1.7 COORDINATION

- A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.
- C. Coordinate size and location of concrete bases. Formwork, reinforcement, and concrete requirements are specified in Division 03.

### PART 2 - PRODUCTS

#### 2.1 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, unless otherwise indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
  - B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
  - C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
  - D. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
  - E. Solvent Cements for Joining Plastic Piping:
    1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - F. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.
- 2.2 TRANSITION FITTINGS
- A. Transition Fittings, General: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
  - B. Transition Couplings NPS 1-1/2 and Smaller:
    1. Underground Piping: Manufactured piping coupling or specified piping system fitting.
    2. Aboveground Piping: Specified piping system fitting.
  - C. AWWA Transition Couplings NPS 2 and Larger:
    1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Cascade Waterworks Mfg. Co.
      - b. Dresser, Inc.; DMD Div.
      - c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
      - d. JCM Industries.
      - e. Smith-Blair, Inc.
      - f. Viking Johnson.
      - g. Equal as approved by Engineer prior to bid.
    3. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.
  - D. Plastic-to-Metal Transition Fittings:
    1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Spears Manufacturing Co.
  - b. Equal as approved by Engineer prior to bid.
3. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.

E. Plastic-to-Metal Transition Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Colonial Engineering, Inc.
  - b. NIBCO INC.
  - c. Spears Manufacturing Co.
  - d. Equal as approved by Engineer prior to bid.

F. Flexible Transition Couplings for Underground Non-pressure Drainage Piping:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cascade Waterworks Mfg. Co.
  - b. Fernco, Inc.
  - c. Mission Rubber Company.
  - d. Plastic Oddities.
  - e. Equal as approved by Engineer prior to bid.

- G. Description: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

## 2.3 DIELECTRIC FITTINGS

- A. Dielectric Fittings, General: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Capitol Manufacturing Co.
  - b. Central Plastics Company.
  - c. Epcos Sales, Inc.
  - d. Hart Industries, International, Inc.
  - e. Watts Water Technologies, Inc.
  - f. Zurn Plumbing Products Group; Wilkins Div.
  - g. Equal as approved by Engineer prior to bid.
3. Description: Factory fabricated, union, NPS 2 and smaller.
  - a. Pressure Rating: 150 psig minimum.

C. Dielectric Flanges:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Capitol Manufacturing Co.
  - b. Central Plastics Company.
  - c. Epcos Sales, Inc.
  - d. Watts Water Technologies, Inc.
  - e. Equal as approved by Engineer prior to bid.
3. Description: Factory-fabricated, bolted, companion-flange assembly, NPS 2-1/2 to NPS 4 and larger.
  - a. Pressure Rating: 175 psig minimum.

D. Dielectric-Flange Kits:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Advance Products & Systems, Inc.
  - b. Calpico, Inc.
  - c. Central Plastics Company.
  - d. Pipeline Seal and Insulator, Inc.
  - e. Equal as approved by Engineer prior to bid.
3. Description: Non-conducting materials for field assembly of companion flanges, NPS 2-1/2 and larger.

- a. Pressure Rating: 150 psig minimum.
- b. Gasket: Neoprene or phenolic.
- c. Bolt Sleeves: Phenolic or polyethylene.
- d. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Calpico, Inc.
  - b. Lochinvar Corporation.
  - c. Equal as approved by Engineer prior to bid.
3. Description: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining, NPS 3 and smaller.
  - a. Pressure Rating: 300 psig at 225 deg F
  - b. End Connections: Threaded.

F. Dielectric Nipples:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Perfection Corporation.
  - b. Precision Plumbing Products, Inc.
  - c. Victaulic Company.
  - d. Equal as approved by Engineer prior to bid.
3. Description: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining.
  - a. Revise pressure rating and temperature in first subparagraph below to suit Project, or add other options for specific applications.
  - b. Pressure Rating: 300 psig at 225 deg F.
  - c. End Connections: Threaded or grooved.

2.4 SLEEVES

- A. Mechanical sleeve seals for pipe penetrations are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

- C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, plain ends.
- D. Sleeves in paragraph below are available with many end variations.
- E. Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- F. PVC sleeves in first two paragraphs below may be prohibited by fire authorities having jurisdiction.
- G. Molded PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
- H. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.
- I. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

## 2.5 IDENTIFICATION DEVICES

- A. General: Products specified are for applications referenced in other Division 33 Sections. If more than single type is specified for listed applications, selection is Installer's option.
- B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.
  - 1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
  - 2. Location: Accessible and visible.

## 2.6 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post hardening, volume adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## 2.7 FLOWABLE FILL

- A. Description: Low-strength-concrete, flowable-slurry mix.
  - 1. Cement: ASTM C 150, Type I, portland.
  - 2. Density: 115- to 145-lb/cu. ft.
  - 3. Aggregates: ASTM C 33, natural sand, fine and crushed gravel or stone, coarse.
  - 5. Aggregates: ASTM C 33, natural sand, fine.
  - 6. Admixture: ASTM C 618, fly-ash mineral.
  - 7. Water: Comply with ASTM C 94/C 94M.
  - 8. Strength: 100 to 200 psig at 28 days.

## PART 3 - EXECUTION

### 3.1 PIPED UTILITY DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.
  - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 2. Piping to Be Abandoned in Place: Drain piping. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material.
  - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.
  - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

### 3.2 DIELECTRIC FITTING APPLICATIONS

- A. Dry Piping Systems: Connect piping of dissimilar metals with the following:
  - 1. NPS 2 and Smaller: Dielectric unions.
  - 2. NPS 2-1/2 and larger: Dielectric flanges or dielectric flange kits.
- B. Wet Piping Systems: Connect piping of dissimilar metals with the following:
  - 1. NPS 2 and Smaller: Dielectric couplings or dielectric nipples or nipples.
  - 2. NPS 2-1/2 to NPS 4 : Dielectric nipples.
  - 3. NPS 2-1/2 to NPS 8: Dielectric nipples or dielectric flange kits.
  - 4. NPS 10 and larger: Dielectric flange kits.

### 3.3 PIPING INSTALLATION

- A. Install piping according to the following requirements and Division 33 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings.

- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping to permit valve servicing.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Select system components with pressure rating equal to or greater than system operating pressure.
- I. Retain paragraph below if sleeves are not required for core-drilled holes.
- J. Sleeves are not required for core-drilled holes.
- K. Retain first paragraph below if permanent sleeves are not required for holes formed by removable PE sleeves.
- L. Permanent sleeves are not required for holes formed by removable PE sleeves.
- M. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
    - a. PVC or Steel Pipe Sleeves: For pipes smaller than NPS 6.
- N. Verify final equipment locations for roughing-in.
- O. Refer to equipment specifications in other Sections for roughing-in requirements.

### 3.4 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 33 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- G. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- H. Soldered Joints: Apply ASTM B 813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.
- I. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- J. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.
- K. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
  3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  5. PVC Non-pressure Piping: Join according to ASTM D 2855.
  6. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- L. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- M. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.
- N. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End PE Pipe and Fittings: Use butt fusion.
  2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.
- O. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

### 3.5 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Install dielectric fittings at connections of dissimilar metal pipes.

### 3.6 EQUIPMENT INSTALLATION

- A. Install equipment level and plumb, unless otherwise indicated.
- B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.
- C. Install equipment to allow right of way to piping systems installed at required slope.

### 3.7 PAINTING

- A. Painting of piped utility systems, equipment, and components is specified in Division 09 painting Sections.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.8 IDENTIFICATION

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
  - 1. Plastic markers, with application systems. Install on insulation segment if required for hot non-insulated piping. Place direct bury marker 12-18 inches above top of pipe but not less than 12-inches below finish grade.

### 3.9 GROUTING

- A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.

- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 330500

## SECTION 332300 – COMPACTION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. ASTM D 698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
- C. ASTM D 1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
- D. ASTM D 2216 Laboratory Determination of Water (Moisture) Content of Soil and Rock.
- E. ASTM D 2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- F. ASTM D 3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- G. ASTM D 3282 Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposed.
- H. ASTM D 3740 Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

#### 1.2 SUMMARY

- A. Compaction of granular fill materials.

#### 1.3 DEFINITIONS

- A. A-1 Soil: Defined in ASTM D 3282.
- B. Modified Proctor Density: The maximum laboratory density, as defined in and determined by ASTM D 1557 using procedure A, B or C as applicable.
- C. Relative Density (or Relative Compaction): The ratio of field dry density to the maximum laboratory density expressed as a percentage.
- D. Standard Proctor Density: The maximum laboratory density, as defined in and determined by ASTM D 698 using procedure A, B or C as applicable.

#### 1.4 QUALITY ASSURANCE

- A. Use a soil and rock laboratory that complies with ASTM D 3740.

#### PART 2 - PRODUCTS

NOT USED

#### PART 3 - EXECUTION

##### 3.1 COMPACTION

- A. Moisten or dewater backfill material to obtain optimum moisture for compaction.
- B. When no density compactive effort is specified, compact the entire area to 95 percent and eliminate unstable zones.
- C. Correct deficient compaction conditions. Replace or repair materials and damaged facilities.

##### 3.2 FIELD QUALITY CONTROL

- A. Testing: Perform control testing of materials. Perform additional testing at no additional cost to OWNER, for
  - 1. Changes in source of materials or proportions requested by CONTRACTOR, or
  - 2. Failure of materials to meet specification requirements, or
  - 3. Other testing serviced needed or required by CONTRACTOR.
- B. Optimum Soil Density: Use ASTM D 2216 and the following industry standards.
  - 1. For A-1 Soils: Method C of ASTM D 1557 (Modified Proctor)
  - 2. For All Other Soils: Method C of ASTM D 698 (Standard Proctor).
- C. Field Density:
  - 1. Use ASTM D 3017 and test method C of ASTM D 2922 for shallow depth nuclear testing.
  - 2. No density determinations are required on any material containing more than 65 percent material retained on the number 10 sieve or more than 60 percent material retained on the number 4 sieve. In lieu of reporting densities in such cases, report the sieve analysis to document the material type.

##### 3.3 REPORT

- A. For each material tested, document the following:
  - 1. Vertical and horizontal location of the test.
  - 2. Optimum laboratory moisture content.
  - 3. Field moisture content.

4. Maximum laboratory dry density.
5. Field density.
6. Percent compaction results.
7. Certification of test results by Independent Testing Agency.

END OF SECTION 332326

## SECTION 334100 - STORM DRAINAGE UTILITY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Codes and Standards:
  - 1. Plumbing Code Compliance: Comply with applicable portions of International Plumbing Code pertaining to selection and installation of storm drain system materials and products.
  - 2. DFCM Compliance: Comply with applicable portions of "State of Utah, Department of Administrative Services, Division of Facilities Construction and Management, Design Requirements" dated June 11, 2009 including highlighted updates.
  - 3. University of Utah Compliance: Comply with applicable portions of "DFCM Design Manual, University of Utah Supplement, 3.2 Civil" dated November 1, 2013.
  - 4. University of Utah Compliance: Comply with applicable portions of "DFCM Design Manual, University of Utah Supplement, 3.5 Mechanical" dated November 1, 2013.

#### 1.2 SUMMARY

- A. This Section includes gravity-flow, non-pressure storm drainage outside the building, with the following components:
  - 1. Cleanouts.
  - 2. Precast concrete manholes.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Non-pressure, Drainage-Piping Pressure Rating: 10-foot head of water.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For manholes and drain inlet. Include plans, elevations, sections, details, and manhole frames and covers and drain inlet frames and grates.
- C. Retain first paragraph below if Drawings do not include detailed plans.
- D. Coordination Drawings: Show pipe sizes, locations, and elevations.
- E. Field quality-control test reports. Product Data: For each type of product indicated.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
  - 2. Stormwater Systems:
    - a. ADS (Advanced Drainage Systems) Inc.
    - b. Cultec Inc.
    - c. Hancor Inc.
    - d. Infiltrator Systems Inc.
    - e. Equal as approved by Engineer prior to bid.

### 2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

### 2.3 PE PIPE AND FITTINGS

- A. Corrugated PE Drainage Pipe and Fittings NPS 10 and Smaller: AASHTO M 252M, Type S, with smooth waterway for coupling joints.
  - 1. Soiltight Couplings: AASHTO M 252M, corrugated, matching tube and fittings
- B. Corrugated PE Pipe and Fittings NPS 12 and larger: AASHTO M 294M, Type S, with smooth waterway for coupling joints.
  - 1. Soiltight Couplings: AASHTO M 294M, corrugated, matching pipe and fittings.

### 2.4 PVC PIPE AND FITTINGS

- A. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.
- B. PVC Sewer Pipe and Fittings, NPS 18 and Larger: ASTM F 679, T-1 wall thickness, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

### 2.5 NONPRESSURE-TYPE PIPE COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non-pressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.

- B. Sleeve Materials:
1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
  2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
  3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- C. Unshielded Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
1. Manufacturers:
    - a. Dallas Specialty & Mfg. Co.
    - b. Fernco Inc.
    - c. Logan Clay Products Company (The).
    - d. Mission Rubber Company; a division of MCP Industries, Inc.
    - e. NDS Inc.
    - f. Plastic Oddities, Inc.
    - g. Equal as approved by Engineer prior to bid.
- D. Shielded Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
1. Manufacturers:
    - a. Cascade Waterworks Mfg.
    - b. Dallas Specialty & Mfg. Co.
    - c. Mission Rubber Company; a division of MCP Industries, Inc.
    - d. Equal as approved by Engineer prior to bid.
- E. Ring-Type Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.
1. Manufacturers:
    - a. Fernco Inc.
    - b. Logan Clay Products Company (The).
    - c. Mission Rubber Company; a division of MCP Industries, Inc.
    - d. Equal as approved by Engineer prior to bid.

## 2.6 MANHOLES

- A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
1. Diameter: 48 inches minimum, unless otherwise indicated.
  2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
  3. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.

4. Riser Sections: 4-inch minimum thickness, and of length to provide depth indicated.
5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
6. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
9. Steps: Individual FRP steps, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
11. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
12. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
13. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange and 26-inch diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
  - a. Material: ASTM A 536, Grade 60-40-18 ductile iron, unless otherwise indicated.

## 2.7 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
  1. Cement: ASTM C 150, Type II.
  2. Fine Aggregate: ASTM C 33, sand.
  3. Coarse Aggregate: ASTM C 33, crushed gravel.
  4. Water: Potable.
- B. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious materials ratio.
  1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
  2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

## 2.8 DRAIN INLETS

- A. Standard Precast Concrete Drain Inlets: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
  1. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
  2. Top Section: Eccentric-cone type unless flat-slab-top type is indicated.
  3. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
- B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch diameter flat grate with small square or short-slotted drainage openings.
  1. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Pipe couplings and fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
  - 1. Use non-pressure-type flexible couplings where required to join gravity-flow, non-pressure sewer piping, unless otherwise indicated.
    - a. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
    - b. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
- B. Gravity-Flow, Non-pressure Sewer Piping: Use the following pipe materials for each size range:
  - 1. NPS 3 to NPS 6 (DN 80 to DN 150): Hub-and-spigot, Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. NPS 3 to NPS 6 (DN 80 to DN 150): Corrugated PE drainage pipe and fittings, soiltight couplings, and coupled joints.
  - 3. NPS 3 to NPS 6 (DN 80 to DN 150): PVC sewer pipe and fittings, gaskets, and gasketed joints.
  - 4. NPS 8 to NPS 15 (DN 200 to DN 375): Hub-and-spigot, Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 5. NPS 8 to NPS 15 (DN 200 to DN 375): Corrugated PE drainage pipe and fittings, soiltight couplings, and coupled joints.
  - 6. NPS 8 to NPS 15 (DN 200 to DN 375): PVC sewer pipe and fittings, gaskets, and gasketed joints.
  - 7. NPS 18 to NPS 30 (DN 450 to DN 750): Corrugated PE pipe and fittings, soiltight couplings, and coupled joints.
  - 8. NPS 18 to NPS 30 (DN 450 to DN 750): PVC sewer pipe and fittings, gaskets, and gasketed joints.

### 3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Install gravity-flow, non-pressure drainage piping according to the following:
  - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
  - 2. Install piping NPS 6 (DN 150) and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
  - 3. Install piping with 36-inch (915-mm) minimum cover.
  - 4. Install piping below frost line.
  - 5. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
  - 6. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
- F. Clear interior of piping and manholes of dirt and superfluous material as work progresses.

### 3.3 PIPE JOINT CONSTRUCTION

- A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. Join gravity-flow, non-pressure drainage piping according to the following:
  - 1. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
  - 2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
  - 3. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-gasket joints.
  - 4. Join dissimilar pipe materials with non-pressure-type flexible couplings.

### 3.4 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
  - 1. Use light-duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
  - 2. Use medium-duty, top-loading classification cleanouts in paved foot-traffic areas.
  - 3. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
  - 4. Use extra-heavy-duty, top-loading classification cleanouts in roads.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

### 3.5 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches (76 mm) above finished surface elsewhere, unless otherwise indicated.

### 3.6 DRAIN INLET INSTALLATION

- A. Set frames and grates to elevations indicated.

### 3.7 CONNECTIONS

- A. Connect non-pressure, gravity-flow drainage piping to building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."
- B. Make connections to existing piping and underground manholes.
  - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

### 3.8 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
  - 1. Submit separate report for each system inspection.
  - 2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Crushed, broken, cracked, or otherwise damaged piping.
    - d. Infiltration: Water leakage into piping.
    - e. Exfiltration: Water leakage from or around piping.
  - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  - 4. Re-inspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
  - 1. Do not enclose, cover, or put into service before inspection and approval.
  - 2. Test completed piping systems according to requirements of authorities having jurisdiction.

3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Air Tests: Test storm drainage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
  - a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 334100

## SECTION 334600 - SUBDRAINAGE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Perforated-wall pipe and fittings.
  - 2. Drainage conduits.
  - 3. Drainage panels.
  - 4. Geotextile filter fabrics.

#### 1.3 ACTION SUBMITTALS

- A. Product Data:
  - 1. Drainage conduits, including rated capacities.
  - 2. Drainage panels, including rated capacities.
  - 3. Geotextile filter fabrics.

### PART 2 - PRODUCTS

#### 2.1 PERFORATED-WALL PIPES AND FITTINGS

- A. Perforated PE Pipe and Fittings:
  - 1. NPS 6 and Smaller: ASTM F 405 or AASHTO M 252, Type CP; corrugated, for coupled joints.
  - 2. NPS 8 and Larger: ASTM F 667; AASHTO M 252, Type CP; or AASHTO M 294, Type CP; corrugated; for coupled joints.
  - 3. Couplings: Manufacturer's standard, band type.
- B. Perforated PVC Sewer Pipe and Fittings: ASTM D 2729, bell-and-spigot ends, for loose joints.

## 2.2 DRAINAGE CONDUITS

- A. Molded-Sheet Drainage Conduits: Prefabricated geocomposite with cusped, molded-plastic drainage core wrapped in geotextile filter fabric.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. American Wick Drain.
    - b. JDR Enterprises, Inc.
    - c. TenCate Geosynthetics.
  2. Nominal Size: 12 inches high by approximately 1 inch thick.
    - a. Minimum In-Plane Flow: 30 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.
  3. Nominal Size: 18 inches high by approximately 1 inch thick.
    - a. Minimum In-Plane Flow: 45 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.
  4. Filter Fabric: PP geotextile.
  5. Fittings: HDPE with combination NPS 4 and NPS 6 outlet connection.
- B. Multipipe Drainage Conduits: Prefabricated geocomposite with interconnected, corrugated, perforated-pipe core molded from HDPE complying with ASTM D 1248 and wrapped in geotextile filter fabric.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Varicore Technologies, Inc.
  2. Nominal Size: 6 inches high by approximately 1-1/4 inches thick.
    - a. Minimum In-Plane Flow: 15 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.
  3. Nominal Size: 12 inches high by approximately 1-1/4 inches thick.
    - a. Minimum In-Plane Flow: 30 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.
  4. Nominal Size: 18 inches high by approximately 1-1/4 inches thick.
    - a. Minimum In-Plane Flow: 45 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.

5. Filter Fabric: Nonwoven, needle-punched geotextile.
  6. Fittings: HDPE with combination NPS 4 and NPS 6 outlet connection.
  7. Couplings: HDPE.
- C. Single-Pipe Drainage Conduits: Prefabricated geocomposite with perforated corrugated core molded from HDPE complying with ASTM D 3350 and wrapped in geotextile filter fabric.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Advanced Drainage Systems, Inc.
  2. Nominal Size: 12 inches high by approximately 1 inch thick.
    - a. Minimum In-Plane Flow: 30 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.
  3. Nominal Size: 18 inches high by approximately 1 inch thick.
    - a. Minimum In-Plane Flow: 45 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.
  4. Filter Fabric: PP geotextile.
  5. Fittings: HDPE with combination NPS 4 and NPS 6 outlet connection.
  6. Couplings: Corrugated HDPE band.
- D. Mesh Fabric Drainage Conduits: Prefabricated geocomposite with plastic-filament drainage core wrapped in geotextile filter fabric. Include fittings for bends and connection to drainage piping.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Bonar Inc.; a Low & Bonar company.
  2. Nominal Size: 6 inches high by approximately 0.9 inch thick.
    - a. Minimum In-Plane Flow: 2.4 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.
  3. Filter Fabric: Nonwoven geotextile made of PP or polyester fibers or combination of both. Flow rates range from 120 to 200 gpm/sq. ft. when tested according to ASTM D 4491.
- E. Ring Fabric Drainage Conduits: Drainage conduit with HDPE rings-in-grid pattern drainage core, for field-applied geotextile filter fabric. Include fittings for bends and connection to drainage piping.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Invisible Structures, Inc.
2. Nominal Size: 18 inches high by 1 inch thick.
  - a. Minimum In-Plane Flow: 82 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.
3. Nominal Size: 36 inches high by 1 inch thick.
  - a. Minimum In-Plane Flow: 164 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.
4. Filter Fabric: Comply with requirements for flat geotextile filter fabric specified in Part 2 "Geotextile Filter Fabrics" Article.

### 2.3 DRAINAGE PANELS

- A. Molded-Sheet Drainage Panels: Prefabricated geocomposite, 36 to 60 inches wide with drainage core faced with geotextile filter fabric.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. American Wick Drain.
    - b. Cosella-Dorken Products, Inc.
    - c. Eljen Corporation.
    - d. JDR Enterprises, Inc.
    - e. Midwest Diversified Technologies Incorporated.
    - f. Sika Greenstreak.
    - g. TenCate Geosynthetics.
    - h. Trace-LINQ Inc.
  2. Drainage Core: Three-dimensional, nonbiodegradable, molded PP.
    - a. Minimum Compressive Strength: 15,000 lbf/sq. ft. when tested according to ASTM D 1621.
    - b. Minimum In-Plane Flow Rate: 7 gpm/ft. of unit width at hydraulic gradient of 1.0 and compressive stress of 25 psig when tested according to ASTM D 4716.

3. Filter Fabric: Nonwoven needle-punched geotextile, manufactured for subsurface drainage, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with the following properties determined according to AASHTO M 288:
    - a. Survivability: Class 2.
    - b. Apparent Opening Size: No. 60 sieve, maximum.
    - c. Permittivity: 0.2 per second, minimum.
  4. Filter Fabric: Woven geotextile fabric, manufactured for subsurface drainage, made from polyolefins or polyesters; with elongation less than 50 percent; complying with the following properties determined according to AASHTO M 288:
    - a. Survivability: Class 2.
    - b. Apparent Opening Size: No. 60 sieve, maximum.
    - c. Permittivity: 0.2 per second, minimum.
  5. Film Backing: Polymeric film bonded to drainage core surface.
- B. Mesh Fabric Drainage Panels: Prefabricated geocomposite with drainage core faced with geotextile filter fabric.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Bonar Inc.; a Low & Bonar company.
  2. Drainage Core: Open-construction, resilient, plastic-filament mesh, approximately 0.4 inches thick.
    - a. Minimum In-Plane Flow Rate: 2.4 gpm/ft. of unit width at hydraulic gradient of 1.0 and normal pressure of 25 psig when tested according to ASTM D 4716.
  3. Filter Fabric: Nonwoven geotextile of PP or polyester fibers or combination of both. Flow rates range from 120 to 200 gpm/sq. ft. when tested according to ASTM D 4491.
- C. Net Fabric Drainage Panels: Prefabricated geocomposite with drainage core faced with geotextile filter fabric.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. GSE Lining Technology, Inc.
    - b. JDR Enterprises, Inc.
    - c. Strata Systems, Inc.
  2. Drainage Core: Three-dimensional, PE nonwoven-strand geonet, approximately 0.25 inches thick.

- a. Minimum In-Plane Flow Rate: 5 gpm/ft. of unit width at hydraulic gradient of 1.0 and normal pressure of 25 psig when tested according to ASTM D 4716.
3. Filter Fabric: Nonwoven geotextile of PP or polyester fibers or combination of both. Flow rates range from 120 to 200 gpm/sq. ft. when tested according to ASTM D 4491.
- D. Ring Fabric Drainage Panels: Drainage-core panel for field application of geotextile filter fabric.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Invisible Structures, Inc.
    2. Drainage Core: Three-dimensional, HDPE rings-in-grid pattern, approximately 1 inch thick.
      - a. Minimum In-Plane Flow Rate: 40 gpm/ft. of unit width at hydraulic gradient of 1.0 and normal pressure of 25 psig when tested according to ASTM D 4716.

## 2.4 SOIL MATERIALS

- A. Soil materials are specified in Section 312000 "Earth Moving."

## 2.5 WATERPROOFING FELTS

- A. Material: Comply with ASTM D 226, Type I, asphalt or ASTM D 227, coal-tar-saturated organic felt.

## 2.6 GEOTEXTILE FILTER FABRICS

- A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. when tested according to ASTM D 4491.
- B. Structure Type: Nonwoven, needle-punched continuous filament.
  1. Survivability: AASHTO M 288 Class 2.
  2. Styles: Flat and sock.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.

- B. If subdrainage is required for landscaping, locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and damage of services.
- C. Verify that drainage panels installed as part of foundation wall waterproofing is properly positioned to drain into subdrainage system.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

### 3.3 FOUNDATION DRAINAGE INSTALLATION

- A. Place impervious fill material on subgrade adjacent to bottom of footing after concrete footing forms have been removed. Place and compact impervious fill to dimensions indicated, but not less than 6 inches deep and 12 inches wide.
- B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.
- C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.
- D. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive or tape.
- E. Install drainage piping as indicated in Part 3 "Piping Installation" Article for foundation subdrainage.
- F. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.
- G. After satisfactory testing, cover drainage piping to width of at least 6 inches on side away from footing and above top of pipe to within 12 inches of finish grade.
- H. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.
- I. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.
- J. Install drainage panels on foundation walls as follows:
  - 1. Coordinate placement with other drainage materials.
  - 2. Lay perforated drainage pipe at base of footing. Install as indicated in Part 3 "Piping Installation" Article.
  - 3. Separate 4 inches of fabric at beginning of roll and cut away 4 inches of core. Wrap fabric around end of remaining core.

4. Attach panels to wall beginning at subdrainage pipe. Place and secure molded-sheet drainage panels, with geotextile facing away from wall.
- K. Place backfill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

### 3.4 UNDERSLAB DRAINAGE INSTALLATION

- A. Excavate for underslab drainage system after subgrade material has been compacted but before drainage course has been placed. Include horizontal distance of at least 6 inches between drainage pipe and trench walls. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.
- B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.
- C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.
- D. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive or tape.
- E. Install drainage piping as indicated in Part 3 "Piping Installation" Article for underslab subdrainage.
- F. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.
- G. After satisfactory testing, cover drainage piping with drainage course to elevation of bottom of slab, and compact and wrap top of drainage course with flat-style geotextile filter fabric.
- H. Install horizontal drainage panels as follows:
  1. Coordinate placement with other drainage materials.
  2. Lay perforated drainage pipe at inside edge of footing.
  3. Place drainage panel over drainage pipe with core side up. Peel back fabric and wrap fabric around pipe. Locate top of core at bottom elevation of floor slab.
  4. Butt additional panels against other installed panels. If panels have plastic flanges, overlap installed panel with flange.

### 3.5 RETAINING-WALL DRAINAGE INSTALLATION

- A. Lay flat-style geotextile filter fabric in trench and overlap trench sides.
- B. Place supporting layer of drainage course over compacted subgrade to compacted depth of not less than 4 inches.
- C. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive or tape.

- D. Install drainage piping as indicated in Part 3 "Piping Installation" Article for retaining-wall subdrainage.
- E. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.
- F. After satisfactory testing, cover drainage piping to width of at least 6 inches on side away from footing and above top of pipe to within 12 inches of finish grade.
- G. Place drainage course in layers not exceeding 3 inches in loose depth; compact each layer placed and wrap top of drainage course with flat-style geotextile filter fabric.
- H. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.
- I. Install drainage panels on wall as follows:
  - 1. Coordinate placement with other drainage materials.
  - 2. Lay perforated drainage pipe at base of footing as described elsewhere in this Specification. Do not install aggregate.
  - 3. If weep holes are used instead of drainage pipe, cut 1/2-inch- diameter holes on core side at weep-hole locations. Do not cut fabric.
  - 4. Mark horizontal calk line on wall at a point 6 inches less than panel width above footing bottom. Before marking wall, subtract footing width.
  - 5. Separate 4 inches of fabric at beginning of roll and cut away 4 inches of core. Wrap fabric around end of remaining core.
  - 6. Attach panel to wall at horizontal mark and at beginning of wall corner. Place core side of panel against wall. Use concrete nails with washers through product. Place nails from 2 to 6 inches below top of panel, approximately 48 inches apart. Construction adhesives, metal stick pins, or double-sided tape may be used instead of nails. Do not penetrate waterproofing. Before using adhesives, discuss with waterproofing manufacturer.
  - 7. If another panel is required on same row, cut away 4 inches of installed panel core and wrap fabric over new panel.
  - 8. If additional rows of panel are required, overlap lower panel with 4 inches of fabric.
  - 9. Cut panel as necessary to keep top 12 inches below finish grade.
  - 10. For inside corners, bend panel. For outside corners, cut core to provide 3 inches for overlap.
- J. Fill to Grade: Place satisfactory soil fill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Fill to finish grade.

### 3.6 LANDSCAPING DRAINAGE INSTALLATION

- A. Provide trench width to allow installation of drainage conduit. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.
- B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

- C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.
- D. Install drainage conduits as indicated in Part 3 "Piping Installation" Article for landscaping subdrainage with horizontal distance of at least 6 inches between conduit and trench walls. Wrap drainage conduits without integral geotextile filter fabric with flat-style geotextile filter fabric before installation. Connect fabric sections with adhesive or tape.
- E. Add drainage course to top of drainage conduits.
- F. After satisfactory testing, cover drainage conduit to within 12 inches of finish grade.
- G. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.
- H. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.
- I. Fill to Grade: Place satisfactory soil fill material over drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Fill to finish grade.

### 3.7 PIPING INSTALLATION

- A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.
  - 1. Foundation Subdrainage: Install piping level and with a minimum cover of 36 inches unless otherwise indicated.
  - 2. Underslab Subdrainage: Install piping level.
  - 3. Plaza Deck Subdrainage: Install piping level.
  - 4. Retaining-Wall Subdrainage: When water discharges at end of wall into stormwater piping system, install piping level and with a minimum cover of 36 inches unless otherwise indicated.
  - 5. Landscaping Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 36 inches unless otherwise indicated.
  - 6. Lay perforated pipe with perforations down.
  - 7. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.
- B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.
- C. Install thermoplastic piping according to ASTM D 2321.

### 3.8 PIPE JOINT CONSTRUCTION

- A. Join perforated PE pipe and fittings with couplings according to ASTM D 3212 with loose banded, coupled, or push-on joints.

- B. Join perforated PVC sewer pipe and fittings according to ASTM D 3212 with loose bell-and-spigot, push-on joints.
- C. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

### 3.9 BACKWATER VALVE INSTALLATION

- A. Comply with requirements for backwater valves specified in Section 334100 "Storm Utility Drainage Piping."
- B. Install horizontal backwater valves in header piping downstream from perforated subdrainage piping.
- C. Install horizontal backwater valves in piping in manholes or pits where indicated.

### 3.10 CLEANOUT INSTALLATION

- A. Comply with requirements for cleanouts specified in Section 334100 "Storm Utility Drainage Piping."
- B. Cleanouts for Foundation, Retaining-Wall and Landscaping Subdrainage:
  - 1. Install cleanouts from piping to grade. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.
  - 2. In vehicular-traffic areas, use NPS 4 cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 18 by 18 by 12 inches deep. Set top of cleanout flush with grade.
  - 3. In nonvehicular-traffic areas, use NPS 4 PVC pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 12 by 12 by 4 inches deep. Set top of cleanout 2 inches above grade.
  - 4. Comply with requirements for concrete specified in Section 033000 "Cast-in-Place Concrete."
- C. Cleanouts for Underslab Subdrainage:
  - 1. Install cleanouts and riser extensions from piping to top of slab. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.
  - 2. Use NPS 4 cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout flush with top of slab.

### 3.11 CONNECTIONS

- A. Comply with requirements for piping specified in Section 334100 "Storm Utility Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Connect low elevations of subdrainage system to building's solid-wall-piping storm drainage system.
- C. Where required, connect low elevations of foundation or underslab subdrainage to stormwater sump pumps. Comply with requirements for sump pumps specified in Section 221429 "Sump Pumps."

### 3.12 IDENTIFICATION

- A. Arrange for installation of green warning tapes directly over piping. Comply with requirements for underground warning tapes specified in specified in Section 312000 "Earth Moving."
  - 1. Install PE warning tape or detectable warning tape over ferrous piping.
  - 2. Install detectable warning tape over nonferrous piping and over edges of underground structures.

### 3.13 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling.
  - 2. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.
- B. Drain piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.14 CLEANING

- A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION 334600