CONTRACT DOCUMENTS
FOR
LOS MEDANOS COLLEGE
2700 E. Leland Rd. Pittsburg, CA 94565

L-630 New Brentwood Center

AT
1351 Pioneer Square
Brentwood, California, 94542

CONTRA COSTA COMMUNITY COLLEGE DISTRICT

Consist of the following:

DSA File #7-C1
DSA Application # 01-116287

ADDENDUM #3
Drawings & Specification

Architect: RATCLIFF
5856 Doyle Street Emeryville, CA 94608

May 3, 2018
CONTRA COSTA COMMUNITY COLLEGE DISTRICT

L-630 New Brentwood Center
Los Medanos College

ADDENDUM #3 Date: May 3, 2018

NOTICE TO ALL PRE-QUALIFIED CONTRACTORS ONLY
You are hereby notified of the following changes, clarifications and/or modifications to the original Contract Documents, Project Manual, Drawings, Specifications and/or previous Addenda. This Addendum shall supersede the original Contract Documents and previous Addenda wherein it contradicts the same, and shall take precedence over anything to the contrary therein. All other conditions remain unchanged.
This Addendum forms a part of the Contract Documents and modifies the original Contract Documents dated April 3, 2018. Acknowledge receipt of this Addendum in space provided on the Bid Proposal Form. Failure to acknowledge may subject Bidder to disqualification.

A. Pre-Bid Questions (RFIs) and Responses
Pre-Bid Requests for Information (RFIs), along with Responses, are included as an attachment to this Addendum.

B. ADDITIONS, DELETIONS, REVISIONS, REPLACE SPECIFICATIONS, DIV 0 & 1
1. Table of Contents
2. Delete / Replace: Delete SECTION 00700 General Conditions, Article 13.5.2 replace with the following: Independent Testing Laboratory. The District will select and pay an independent testing laboratory to conduct all tests and inspections required by regulatory agencies. Selection of materials required to be tested shall be made by the laboratory, and not by the Contractor. All costs for all other tests shall be included in the Bid Price and shall be paid for by the Contractor. The Contractor will be responsible to reimburse the District for the cost differential (e.g., travel expenses, subsistence expenses, higher hourly rates, premium time for overtime hours or outside of normal work day hours, swing shifts), if any, for inspection and testing services required by regulatory agencies incurred outside of a hundred (100) mile radius from the Project Site, or if the Contractor requests inspection and testing services outside normal work day hours (eight hours/day) Monday through Fridays, which are typically between 7:00 am and 3:30 pm. The District will provide the Contractor with the invoice and deduct the cost differential from the next Progress Payment.
3. REVISION: SECTION 01010 SUMMARY OF WORK
Revised Article 1.5 Contractor Personnel & Personnel Qualifications. Section included as an attachment to this Addendum.
4. Delete / Replace: Delete SECTION 01400 Quality Control Requirements, Article 1.15E.1 and replace with the following: The QA/QC Manager cannot serve in any other capacity on the project (e.g., project manager, superintendent, project engineer, etc.). The QA/QC Manager’s sole responsibility is to ensure the development and implementation of the Quality Control Program and to fulfill all other requirements of Section 01400. At a minimum, the QA/QC Manager shall visit the project site two days a week through the Contract Substantial Completion date; two work days prior to any concrete pours; erection of structural steel and when requested by the District Representative in writing to review any pertinent issues concerning the District or the Architect or Record.

5. REVISION: SECTION 01780 PROJECT RECORD DOCUMENTS
Revised Article 1.4 Project Record Drawings. Section included as an attachment to this Addendum.

C. ADDITIONS, DELETIONS, REVISIONS, REPLACE TECHNICAL SPECIFICATIONS:

1. REPLACE: Section 06 40 23 – Architectural Woodwork
Replace Section 06 40 23 – Architectural Woodwork in its entirety and replace with attached Section 06 40 23, adding Grommets and Wire Managers to Article 1.15.

2. REPLACE: Section 08 80 00 – Glazing
Replace Section 08 80 00 – Glazing in its entirety and replace with attached Section 08 80 00, revising Article 1.12(B) describing glass type “GL-2 – Insulated Glass Spandrel”, and Article 1.12(F) describing glass type “GL-6 Insulated Glass” with translucent film.

3. REPLACE: Section 10 11 00 – Visual Display Units
Replace Section 10 11 00 – Visual Display Units in its entirety and replace with attached Section 10 11 00, adding Article 1.2(A)(3) and 1.10(D) describing marker tray units for installation at PDEW walls.

4. REPLACE: Section 25 00 00 – Building Automation System
Replace Section 25 00 00 – Building Automation System in its entirety and replace with attached Section 25 00 00, clarifying the specified Automatic Logic Controls (ALC) as described in Articles 1.2(A) and 1.11(B) as the Basis of Design system.

5. REPLACE: Section 27 11 16 – Communications Cabinets, Racks, Frames and Enclosures
Replace Section 27 11 16 – Communications Cabinets, Racks, Frames and Enclosures in its entirety and replace with attached Section 27 11 16, adding Article 2.2(C): Equipment Rack, Undercounter, Pullout and Pivoting.

6. REPLACE: Section 27 41 16 – Audiovisual Systems and Equipment
Replace Section 27 41 16 – Audiovisual Systems and Equipment in its entirety and replace with attached Section 27 41 16, adding Article 2.6: Notification System describing the PTT and NS devices.
D. REVISION TO DRAWINGS SHEETS:
All drawing modifications are indicated on the drawings with a cloud graphic and a Delta 3.

1. C-600 – UTILITY PLAN
Clarified size and detail for the round SDDIs on the 6” SD lines; clarified the SDJB sizes; clarified the size and type of the blind connection between the 8” SD and the 18” SD south of Building Area A.

2. C-602 – UTILITY PLAN
Clarified the SDDI and Overflow Devices in the Rain Garden area.

3. C-700 – CONSTRUCTION DETAILS
Detail 3: Added area drain detail; revised DI sizing table.

4. C-700 – CONSTRUCTION DETAILS
Detail 5: Refer to attached CSK-002 for Recycled AC cross-section as part of Deductive Alternate 2.B.1.

5. L-204 – CONSTRUCTION DETAILS
Detail 1: Revised Monument Sign Lighting to clarify sign footing cross-section and reinforcement.

6. A-101A – FIRST FLOOR PLAN – AREA A
Revised Lobby 100 computer browsing terminals counter across from Reception/A&R 100A.

Added projection wall with marker tray location reference note each classroom.

Added projection wall with marker tray location reference note at Large Classroom 01 Room 420, Medium Classroom 02 Room 419, and Computer Lab 402.

9. A-410 – INTERIOR ELEVATIONS – AREA A
Elevation Detail A1: Revised lobby computer browsing terminals.
Elevation Details A1 and A2: Revised and clarified color pattern of acoustic wall panel.

10. A-430 – INTERIOR ELEVATIONS – AREA C
Elevation Details A1, C1, and D3: Added marker tray, including wall backing, at PDEW projection/teaching walls; added PDEW seam locations/orientation.

11. A-440 – INTERIOR ELEVATIONS – AREA D
Elevation Detail A1: Revised and clarified color pattern of acoustic wall panel.
Elevation Detail D2: Added marker tray, including wall backing, at PDEW projection/teaching walls; added PDEW seam locations/orientation.

12. A-441 – INTERIOR ELEVATIONS – AREA D
Elevation Details B2, C1, and C2: Revised and clarified color pattern of acoustic wall panel.
13. **A-442 – INTERIOR ELEVATIONS – AREA D**  
Elevation Detail C3: Added marker tray, including wall backing, at PDEW projection/teaching wall; added PDEW seam locations/orientation.

14. **A-450 – CASEWORK SCHEDULE & TYPICAL DETAILS**  
Detail B2: Revised typical countertop at computer browsing terminals.

15. **M-111 – PARTIAL LEVEL 1 MECHANICAL PLAN – AREA 1**  
Added sheet note #7.

16. **M-112 – PARTIAL LEVEL 1 MECHANICAL PLAN – AREA 2**  
Revised SAV 1-1 unit size and the inlet duct size; revised SAV 1-3 unit size and the inlet duct size; added sheet note #6.

17. **M-113 – PARTIAL LEVEL 1 MECHANICAL PLAN – AREA 3**  
Added sheet notes #16 and #17; add VOC sensor.

18. **M-114 – PARTIAL LEVEL 1 MECHANICAL PLAN – AREA 4**  
Added sheet notes #14 and #15; add VOC sensor.

19. **M-115 – PARTIAL LEVEL 1 MECHANICAL PLAN – AREA 5**  
Added sheet note #9.

20. **M-117 – PARTIAL LEVEL 1 MECHANICAL PLAN – AREA 7**  
Added sheet note #9.

21. **M-118 – PARTIAL LEVEL 1 MECHANICAL PLAN – AREA 8**  
Added sheet note #7.

22. **MP-111 – PARTIAL ROOF MECHANICAL PIPING PLAN – AREA 1**  
Revised CHWS/R piping size.

23. **MP-112 – PARTIAL ROOF MECHANICAL PIPING PLAN – AREA 2**  
Revised SAV 1-1 unit size and inlet duct size; revised SAV 1-3 unit size and inlet duct size; revised CHWS/R piping size.

24. **MP-113 – PARTIAL ROOF MECHANICAL PIPING PLAN – AREA 3**  
Revised CHWS/R and HHWS/R piping sizes.

25. **MP-114 – PARTIAL ROOF MECHANICAL PIPING PLAN – AREA 4**  
Revised CHWS/R and HHWS/R piping sizes.

26. **MP-115 – PARTIAL ROOF MECHANICAL PIPING PLAN – AREA 5**  
Revised HHWS/R piping size.

27. **MP-116 – PARTIAL ROOF MECHANICAL PIPING PLAN – AREA 6**  
Revised HHWS/R piping size.
28. MP-117 – PARTIAL ROOF MECHANICAL PIPING PLAN – AREA 7  
Revised CHWS/R piping size.

29. MP-118 – PARTIAL ROOF MECHANICAL PIPING PLAN – AREA 7  
Revised CHWS/R piping size.

30. M-122 – PARTIAL ROOF MECHANICAL PLAN – AREA 2  
Revised CHWS/R piping size.

31. M-123 – PARTIAL ROOF MECHANICAL PLAN – AREA 3  
Revised HHWS/R piping size.

32. M-124 – PARTIAL ROOF MECHANICAL PLAN – AREA 3  
Revised CHWS/R piping size.

33. M-126 – PARTIAL ROOF MECHANICAL PLAN – AREA 6  
Added new airflow measurement device; revised SA CFM in Lobby 100; revised HHWS/R piping size.

34. M-127 – PARTIAL ROOF MECHANICAL PLAN – AREA 7  
Revised CHWS/R piping size.

35. M-300 - SECTIONS  
Revised CHWS/R piping size; changed piping system from HHWS/R to CHWS/R

36. M-303 - SECTIONS  
Revised CHWS/R piping size.

37. M-400 – PARTIAL ROOF MECHANICAL PLAN – AREA 7  
Revised CHWS/R piping size.

38. M-600 – CHILLED WATER SYSTEM PIPING DIAGRAM  
Revised sheet notes #1 and #2; revised pipe size.

39. M-601 – HEATING HOT WATER SYSTEM PIPING DIAGRAM  
Revised sheet notes #1 and #2; revised pipe size.

40. M-808 – CONTROL DIAGRAMS  
Added number of door switch.

41. M-810 – CONTROL DIAGRAMS  
Added number of door switch; added VOC sensor.

42. M-811 – CONTROL DIAGRAMS  
Added number of door switch; added VOC sensor.
43. M-812 – CONTROL DIAGRAMS
Revised Diagram #2 sequence of operations.

44. E-218 – LEVEL 1 – POWER PLAN – AREA 8
Revised mounting height of receptacles at lobby computer browsing terminals to be +36" AFF and +30" AFF for ADA station; added sheet note #10.

45. P-501 – PLUMBING DETAILS – LOBBY SEISMIC COORDINATION
Revised CHWS/R piping in the lobby from 2-1/2” to 3” in all lobby details.

46. P-502 – PLUMBING DETAILS – LOBBY SEISMIC COORDINATION – WALL MOUNTING
Revised CHWS/R piping in the lobby from 2-1/2” to 3” in all lobby details.

47. P-506 – PLUMBING DETAILS – EAST TRENCH COORDINATION
Revised HHWS/R piping in trench from 2” to 2-1/2” in all trench details; revised CHWS/R pipe size in sheet notes from 4” to 3”.

48. TA-701 – AUDIOVISUAL FUNCTIONAL DIAGRAM SINGLE PROJECTOR CLASSROOM
Revised AirMedia from Owner-Furnished/Owner-Installed (OFOI) to Contractor-Furnished/Contractor-Installed (CFCI).

49. TA-702 – AUDIOVISUAL FUNCTIONAL DIAGRAM DOUBLE PROJECTOR CLASSROOM
Revised AirMedia from Owner-Furnished/Owner-Installed (OFOI) to Contractor-Furnished/Contractor-Installed (CFCI).

50. TA-703 – AUDIOVISUAL FUNCTIONAL DIAGRAM CONFERENCE ROOM
Revised AirMedia from Owner-Furnished/Owner-Installed (OFOI) to Contractor-Furnished/Contractor-Installed (CFCI).

51. TA-704 – AUDIOVISUAL FUNCTIONAL DIAGRAM CONFERENCE ROOM
Revised AirMedia from Owner-Furnished/Owner-Installed (OFOI) to Contractor-Furnished/Contractor-Installed (CFCI).

52. TN-002 – COMMUNICATIONS DEVICE – SYMBOL SCHEDULE
Revised raceway note R4.

53. TN-100 – COMMUNICATIONS DEVICE – SYMBOL SCHEDULE
Added keynotes TKN2043, TKN2046, and TKN2047.

54. TN-101A – COMMUNICATIONS DEVICE FIRST FLOOR PLAN – AREA A
Revised lobby computer browsing terminals data outlet mounting heights and orientation.

55. TN-401 – AREA A TR/MDF ROOM #138 – ENLARGED PLAN, RCP & ELEVATIONS
Added fiber management ring, lightning protectors, and 110 tel block; added rack elevation.
ADDENDUM #3

56. TN-402 – AREA B IDF ROOM #210 – ENLARGED PLAN, RCP & ELEVATIONS
   Added fiber management ring, lightning protectors, and 110 tel block; added rack elevation.

57. TN-403 – AREA C IDF ROOM #322 – ENLARGED PLAN, RCP & ELEVATIONS
   Added fiber management ring, lightning protectors, and 110 tel block; added rack elevation.

58. TN-404 – AREA D IDF ROOM #404 – ENLARGED PLAN, RCP & ELEVATIONS
   Added fiber management ring, lightning protectors, and 110 tel block; added rack elevation.

59. TN-601A – COMMUNICATIONS DEVICE FIRST FLOOR RCP – AREA A
   Removed extra WAPs.

60. TN-601C – COMMUNICATIONS DEVICE FIRST FLOOR RCP – AREA C
   Removed extra WAPs.

61. TN-701 – STRUCTURED CABLING SINGLE LINE DIAGRAM
   Revised keynote TKN1; revised fiber cable type from “FOH-OPR” to “FOH-OP”; added keynote TKN10; revised quantity of Cat 6A patch panels.

62. TN-801 – DEVICE SCHEDULES
   Revised device schedule.

63. TY-100 – ELECTRONIC SECURITY SYSTEMS – SITE PLAN
   Revised keynote TKN4002; added keynote TKN4004.

64. TY-801 – SECURITY CAMERA SCHEDULE
   Revised mounting height of the LPR cameras to 9’ above grade.

If you have any questions regarding this Addendum, please contact:

           Jovan Esprit  
           Contra Costa Community College District  
           500 Court St., Martinez, CA 94553  
           Email: jesprit@4cd.edu;  
           Facsimile: 925-229-6959

All other terms and conditions of BID are to remain the same.

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Senior Project Architect- RATCLIFF
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Emeryville, CA  94608

END OF ADDENDUM #3
L-630 New Brentwood Center PRE-BID RFIs and Responses

1. **Question:** RFI 001: Irrigation legend refers to Civil plans and the civil plans refer to Irrigation plans regarding the backflow. What is the Make, Model, and size?
   
   **Response:** Backflow device shall be per City of Brentwood Standard Plans W8 and W8a for installation and pre-approved devices as included in Addendum 2 revisions.

2. **Question:** RFI 002: RFI 002: Specification Section 23 09 01, Article 1.3(C) “Work by Others”: states “Division 23 shall: 1. Install all laboratory airflow control system air valves provided by the LACS contractor. Can you confirm that this means the LACS contractor will purchase/provide the air valves to be installed by the mechanical contractor?
   
   **Response:** The LACS contractor is the venture air valve vendor, who will provide supply air valve, exhaust air valve, fume hood exhaust air valve, fume hood face velocity controller, room differential pressure controllers, and occupancy sensor for fume hood face velocity reset. Controls contractor shall be responsible for the installation of these devices.

3. **Question:** RFI 003: Detail 2/M-506 indicates “Plumbing contractor to provide unistrut support for all trades”. This may conflict with the Project Stabilization Agreement.
   
   **Response:** Note was deleted in Addendum 2 revised drawing.

4. **Question:** RFI 004: Detail 2/M-506: shows a seismic attachment to short pieces of Unistrut which are mechanically clamped to the wide flange beams, this strut support system will be calculated by a seismic engineer for a specific load as required by the system of piping being hung from the support, how are we to provide adequate seismic restraint for all trades as noted in the detail when we are unclear of the loads that will be placed on the support system by other trades? Please provide maximum force allowed per the attachment shown in detail C of Detail #2 on M-506, so that determination can be made if this is acceptable in the instances of Duct Lateral Bracing requirements under a non-reinforced deck per detail #3 on M-506.
   
   **Response:** Note requiring “plumbing contractor to provide unistrut support for all trades” deleted in Addendum 2 revised drawing.

5. **Question:** RFI 005: Specification Section 25 00 00, Article 1.2(A), 1.11(B)(1), and 2.2(A): Please confirm Schneider Electric Ecostruxure is to be added as an acceptable manufacturer for the Building Automation System.
   
   **Response:** Section 25 00 00 revised per this addendum, clarifying the ALC system as the Basis of Design system. All “or equal” systems shall be submitted for consideration according General Condition Article 3.11.4.1.

   
   **Response:** Section 27 41 16 revised per this addendum, adding the PTT and NS device descriptions.

7. **Question:** RFI 007: Specification Section 08 80 00: Glass type GL-2 – Insulated Glass Spandrel is asking for polyester coating on #3 surface. Suppliers are not familiar with polyester coating. Glass type GL-6 is asking for translucent film on #3 surface. Any type of film is not offered by glass manufacturers. Applying film on Insulated Glass voids any warranty.
   
   **Response:** Section 08 80 00 revised per this addendum, revising glass types GL-2 and GL-6.
8. **Question:** RFI 008: Deductive Alternate 2.B.1 calls for recycled asphalt in lieu of asphalt concrete; recycle asphalt is asphalt grinding which usually comes from roadways improvements and either contractors or quarries process that and make aggregate base. There is no asphalt at this site to be recycled and none of quarries price this product since they are not sure they can supply it when we are ready to place it. In addition, please indicate the concrete curbs to be replaced per the alternative. The parking curbs in this area are asphalt, unless you are referring to the curbs around the planters and the curb and gutter along the edge of the parking lot. Please advise.

**Response:** Correct, there is no asphalt on site to recycle; recycled asphalt will need to be sourced from offsite sources. The noted quantity of curbs included in the alternate description covers all concrete curbs/gutters and asphalt curbs in the area delineated on Sheet L-100. Regarding material sourcing and available pricing, the Design Team are unable to comment on stockpile sources or available pricing. Recycled AC is becoming a commonly used product in paving work and there are a number of sources/suppliers in the SF Bay and Sacramento area region. If sources/suppliers cannot provide current market prices/estimates, we recommend bidders contact sources/suppliers and request the most recent historical unit cost pricing data to establish their deductive alternate bid.

End of RFIs and Responses
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23 05 13 Common Motor Requirements for HVAC Equipment
23 05 29 Hangers Supports and Seismic Restraint for HVAC Piping and Equipment (ADD #2)
23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment
23 05 90 Testing For HVAC
23 05 93 Balancing for HVAC
23 07 00 HVAC Insulation (ADDENDUM #2)
23 09 01 Laboratory Controls System (ADDENDUM #2)
23 21 13 Hydronic Piping and Valves (ADDENDUM #2)
23 21 14 Hydronic Systems for HVAC
23 21 15 Chemical (Water) Treatment
23 21 23 Hydronic Pumps
23 22 02 Heating Hot Water Boilers
23 22 04 Boiler Flues and Accessories
23 24 20 Air Cooled Electric Chiller
23 29 00 Variable Frequency Drives
23 30 00 HVAC Air Distribution (ADDENDUM #2)
23 34 00 HVAC Fans (ADDENDUM #2)
23 36 00 Air Terminal Units
23 73 00 Air Handling Units (ADDENDUM #2)
23 73 05 Split Air Conditioning Unit System-VRV System (ADDENDUM #2)
DIVISION 25 – INTEGRATED AUTOMATION
25 00 00 Building Automation System (ADDENDUM #3)

DIVISION 26 – ELECTRICAL
26 01 26 Field Test and Operational Test
26 05 00 Common Work for Electrical
26 05 02 Basic Materials and Methods
26 05 29 Hangers Supports Anchors & Seismic Restraints for Electrical Systems
26 05 43 Underground Electrical Construction
26 05 48 Vibration and Seismic Controls for Electrical Systems
26 05 73 Power System Study
26 05 74 Electrical Systems Firestopping
26 22 13 Dry Type Transformers - Energy Efficient Type
26 24 16 Panelboards
26 24 18 Switchboards
26 29 13 Low-Voltage Motor Controllers
26 33 23 Central Battery Inverter System
26 43 13 Surge Protection Devices
26 50 20 Lighting Controls
26 51 00 Interior Lighting

DIVISION 27 – COMMUNICATIONS
27 05 00 Common Work Results for Communications
27 05 26 Grounding and Bonding for Communications Systems
27 05 29 Hangers and Supports for Communications System
27 05 33 Conduits and Backboxes for Communications Systems
27 05 36 Cable Trays for Communications Systems
27 05 43 Underground Ducts and Raceways for Communications Systems
27 05 48 Noise and Vibration for Communications Systems
27 05 53 Identification for Communications Systems
27 10 00 Structured Cabling, Basic Materials & Methods
27 11 13 Communications Entrance Protection
27 11 16 Communications Cabinets, Racks, Frames and Enclosures (ADDENDUM #3)
27 11 19 Communications Termination Blocks and Patch Panels
27 11 23 Communications Cable Management
27 13 00 Communications Indoor Backbone Cabling
27 14 00 Communications Outside Plant Backbone Cabling
27 15 00 Communications Horizontal Cabling
27 41 16 Audiovisual Systems and Equipment (ADDENDUM #3)
27 41 23 Communications Broadband Systems

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY
28 05 00 Common Work Results for Electronic Safety and Security
28 05 13 Conductors and Cables for Electronic Safety and Security
28 05 26  Grounding and Bonding for Electronic Safety and Security
28 05 28  Pathways for Electronic Safety and Security
28 13 00  Access Control and Alarm Systems
28 23 00  Visual Surveillance
28 31 13  Fire Alarm System

DIVISION 31 – EARTHWORK
31 10 00  Site Prep & Plant Protection
31 10 10  Site Clearing and Stockpiling
31 11 00  Clearing and Grubbing
31 23 00  Excavation and Fill
31 23 33  Trenching and Backfilling
31 25 00  Erosion and Sedimentation Control

DIVISION 32 – EXTERIOR IMPROVEMENTS
32 11 00  Base Courses
32 12 00  Flexible Paving
32 13 12  Site Concrete
32 15 45  Stabilized Granular Paving
32 17 23  Pavement Markings
32 31 10  Metal Gates
32 31 13  Chain Link Fences and Gates  (New Section ADDENDUM #2)
32 33 00  Site Furnishings  (ADDENDUM #2)
32 80 00  Irrigation  (ADDENDUM #2)
32 90 00  Planting
32 91 18  Landscape Boulders

DIVISION 33 – UTILITIES
33 05 16  Utility Structures
33 10 00  Water Utilities
33 30 00  Sanitary Sewerage Utilities
33 40 00  Storm Drainage Utilities

VOLUME 03  Cutsheets
- APPENDIX A – Light Fixture Cutsheets
- APPENDIX B – Plumbing Fixture Cutsheets
- APPENDIX C – Fire Alarm Listings and Cutsheets

DRAWINGS PREPARED BY RATCLIFF

END OF SECTION 00010
13.5 TESTS AND INSPECTIONS

13.5.1 Compliance.
Tests, inspections, and approvals of portions of the Work required by the Contract Documents will comply with Title 24, and with all other laws, ordinances, rules, regulations, or orders of public authorities having jurisdiction.

13.5.2 Independent Testing Laboratory. (ADDENDUM #3)
The District will select and pay an independent testing laboratory to conduct all tests and inspections required by regulatory agencies. Selection of materials required to be tested shall be made by the laboratory, and not by the Contractor. All costs for all other tests shall be included in the Bid Price and shall be paid for by the Contractor. The Contractor will be responsible to reimburse the District for the cost differential (e.g., travel expenses, subsistence expenses, higher hourly rates, premium time for overtime hours or outside of normal work day hours, swing shifts), if any, for inspection and testing services required by regulatory agencies incurred outside of a hundred (100) mile radius from the Project Site, or if the Contractor requests inspection and testing services outside normal work day hours (eight hours/day) Monday through Fridays, which are typically between 7:00 am and 3:30 pm. The District will provide the Contractor with the invoice and deduct the cost differential from the next Progress Payment.

13.5.3 Advance Notice to Inspector.

The Contractor shall notify the Inspector a sufficient time in advance of its readiness for required observation or inspection so that the Inspector may arrange for same. The Contractor shall notify the Inspector a sufficient time in advance of the manufacture of material to be supplied under the Contract Documents which must, by terms of the Contract Documents, be tested in order that the Inspector may arrange for the testing of the material at the source of supply.

13.5.4 Testing Off-Site.

Any material shipped by the Contractor from the source of supply, prior to having satisfactorily passed such testing and inspection or prior to the receipt of notice from said Inspector that such testing and inspection will not be required, shall not be incorporated in the Work.

13.5.5 Additional Testing or Inspection.

If the Inspector, the Architect, the District, or public authority having jurisdiction determines that portions of the Work require additional testing, inspection, or approval not included under Paragraph 13.5.1, the Inspector will, upon written authorization from the District, make arrangements for such additional testing, inspection, or approval. The District shall bear such costs except as provided in Paragraph 13.5.7.

13.5.6 Costs for Retesting.
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. All Contract Documents shall be reviewed for applicable provisions related to the provisions in this document, and provisions in the General Conditions and other Division 1 Specification Sections shall apply to this Section without limitation.

1.2 RELATED REQUIREMENTS SPECIFIED IN OTHER SECTIONS
A. Section 01030 – “Alternates”
B. Section 01290 – “Payment Procedures”
C. Section 01310 – “Construction Scheduling”
D. Section 01312 – “Project Meetings”
E. Section 01330 – “Submittal Procedures”
F. Section 01400 – “Quality Control Requirements”
G. Section 01540 – “Site Security and Safety”
H. Section 01625 – “Product Options and Substitutions”
I. Section 01740 – “Warrantees and Guaranties”
J. Section 01770 – “Contract Closeout Procedures”
K. Section 01780 – “Project Record Documents”
L. Section 01820 – “Demonstration and Training”
M. Divisions 2 through 33 Sections for Summary of Work requirements for the work in those Sections.

1.3 WORK DESCRIPTIONS WITHOUT FORCE
A. All general descriptions and/or general summaries of the work noted in this section, or elsewhere within the Contract Documents, are without force and effect on the Contract Work described and indicated in detail the Construction Documents. These general descriptions and summaries are for general reference and descriptive purposes only and in no way offer the complete and concise description of all the Work required by the Contract Documents.

1.4 WORK COVERED BY CONTRACT DOCUMENTS
The intent of the Contract Documents includes but is not limited to:
The construction of one-story, 54,973 GSF, fully sprinklered educational and administration facility. The building is designed as four wings-laboratory, Classroom, Administration and Student Commons and Classrooms. Site work includes surface parking and landscaping, bio retention areas, landscaped courtyards and paths and a fire access lane.

A. CONTRACTS
   Perform the work under a single, fixed-price Contract.
1.5 CONTRACTOR PERSONNEL & PERSONNEL QUALIFICATIONS (ADDENDUM #3)

A. Qualifications: In addition to the requirements of Article 3.2 of the Contract General Conditions (Section 00700), the Contractor shall employ full time (8 hours per work day) at the Site, unless otherwise noted, the following individuals with the following minimum experience levels:

1. Sr. Project Manager (Part Time at the Site): This individual must have a minimum of 20 years of construction experience on similar public building projects, including the completion of two public projects involving similar building construction exceeding $20 million in value over the last ten years. One of these projects shall have been under the jurisdiction of DSA. Unless otherwise approved in writing by the District, the Senior Project Manager shall be on site at least two days a week to attend the weekly Owner/Architect/Contractor meeting, and to meet with the District Representative to review other pertinent issues.

2. On-Site General Superintendent (Full Time at the Site): This individual must have a minimum of 15 years of experience on similar public building projects, including the completion of two public projects involving similar building construction exceeding $15 million in value over the last ten years. One of these projects shall have been under the jurisdiction of DSA.

3. On-Site Project Engineer (Full Time at the Site): This individual must have a minimum of 3 years of construction experience on similar public building projects with completion of one public project involving similar building construction in excess of $5 million in value over the last three years.

4. On-Site QC Manager: See the qualifications and other requirements included in Section 01400, Quality Control Requirements, Article 1.15.

1.6 WORK SEQUENCE

A. Construct work as shown in the Contract Documents. Coordinate Baseline CPM Schedule activities and construction operations with District and the Architect.

B. Scheduling of Contractor’s use of the areas and times involved shall be determined in cooperation with the District. Notify the District a minimum of 10-days prior to commencement of work.

C. Construction activities shall be performed between the hours of 8AM and 5PM, Monday through Friday, unless otherwise required. No Work shall be performed outside the above hours without prior written authorization from the Construction Manager/Project Manager.

1.7 USE OF PREMISES

A. Contractor shall only use the premises for work, storage, staging areas, and vehicular parking as designated in the Contract Documents.

1.8 EXISTING AREA CONDITION SURVEY

A. Prior to commencement of work, jointly survey the existing area to be remodeled with the District and Architect, noting and recording existing damage such as cracks, sags, and other damage (on Site Plan/Floor Plans).
B. This record shall serve as a basis for determination of subsequent damage to these items due to settlement, movement, demolition, or Contractor’s operations.

C. Existing damage observed shall be marked and the official record of existing damage shall be signed by the parties making the survey.

D. Cracks, sags, and damage to the area and other items not noted in the original survey but subsequently observed shall be reported immediately to the Architect.

E. Contractor shall comply with Section 01321 for photographic and video recording of existing conditions.

1.9 PROTECTION OF EXISTING STRUCTURES AND UTILITIES

A. The Drawings may not show all existing water, gas, electrical, and hot water lines, and other items known or suspected to exist in the area of the work.

B. Contractor shall locate these installations before proceeding with demolition or other operations which may cause damage, maintain them in service where appropriate, and repair damage caused by the performance of the Work, at no increase in the Contract Sum.

C. In addition to notification, if a structure or utility is damaged, take appropriate action as specified in the General Conditions.

1.10 USE AND OCCUPANCY OF WORK PRIOR TO ACCEPTANCE BY DISTRICT

A. The District may use and occupy the building before formal acceptance under the following conditions:

1. A Certificate of Substantial Completion shall be prepared and executed as provided in the Contract Documents. See Section 01770 Contract Closeout Procedures. The Certificate of Substantial Completion shall be accompanied by a written endorsement of the Contractor’s insurance carrier and surety permitting occupancy by the District during the remaining period of the work.

2. Occupancy by the District shall not be construed as being an acceptance of that part of the Work occupied.

3. The Contractor will not be held responsible for damage to the occupied part of the Work resulting from the District’s occupancy.

4. Occupancy by the District shall not be deemed to constitute a waiver of existing claims the District or Contractor may have against each other.


6. The District will pay for utility costs associated with occupancy during construction.

1.11 NOISE CONTROL

A. See Section 01416, Special Procedures, for Noise Control requirements.

1.12 PROTECTION OF EXISTING IMPROVEMENTS

A. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing improvements indicated to remain in place.

B. Protect improvements on adjoining properties as well as those on the District’s property.
C. Protect existing trees and other vegetation indicated to remain in place, against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line.

D. Restore any improvements damaged by this work to their original condition as acceptable to the District or other parties or authorities having jurisdiction.

1.13 HAZARDOUS MATERIALS – NOT USED

1.14 MISCELLANEOUS PROVISIONS

A. Items shown or scheduled to be salvaged will remain the property of the District. Store as directed by the Project Manager.

PART 2 - PRODUCTS
Not Used.

PART 3 - EXECUTION
Not Used.

END OF SECTION 01010
a. The QA/QC program must cover on-site and off-site work and be keyed to the work sequence.
b. No construction work or testing may be performed unless the QA/QC Manager is on the work site.
c. The QA/QC Manager must report to an officer of the firm and not be subordinate to the Project Superintendent.
d. The QA/QC Manager, Project Superintendent and other Contractor and Subcontractor personnel must work together effectively. Although the QA/QC Manager is the primary individual responsible for quality control, all individuals will be held responsible for the quality of work on the job.

2. Acceptance of the QA/QC Plan is required prior to the start of construction. The District reserves the right to require changes in the QA/QC Plan and operations as necessary, including removal of personnel, to ensure the specified quality of work.

3. The District reserves the right to interview any member of the Contractor’s organization at any time in order to verify the submitted qualifications.

4. The District may require the removal of any individual for non-compliance with quality requirements specified in the Contract.

C. Preliminary Construction Work Authorized Prior to Acceptance. The only construction work that is authorized to proceed prior to the acceptance of the QA/QC Plan is mobilization of storage and office trailers, temporary utilities, and surveying.

D. Notification of Changes: Notify the District, in writing, of any proposed changes in the QA/QC Plan or changes to the Contractor organization personnel, a minimum of 10 work days prior to a proposed change. Proposed changes are subject to acceptance by the District.

E. QA/QC Manager and Duties: Provide a Full Time on site QA/QC Manager at the Work site to implement and manage the QC program.

(ADDENDUM #3)

1. The QA/QC Manager cannot serve in any other capacity on the project (e.g., project manager, superintendent, project engineer, etc.). The QA/QC Manager’s sole responsibility is to ensure the development and implementation of the Quality Control Program and to fulfill all other requirements of Section 01400. At a minimum, the QA/QC Manager shall visit the project site two days a week through the Contract Substantial Completion date; two work days prior to any concrete pours; erection of structural steel and when requested by the District Representative in writing to review any pertinent issues concerning the District or the Architect or Record.

2. The QA/QC Manager is required to attend the weekly meetings, conduct new subcontractor Pre-Work Preparatory Phase meetings, perform submittal review and certification, ensure testing is performed and provide QC certifications and documentation required in this Contract.

3. The QA/QC Manager is responsible for managing and coordinating the documentation performed by Contractor testing laboratory personnel and any other inspection and testing personnel required by this Contract not coordinated, overseen, and paid by the District.

4. Qualifications: A graduate of a four year accredited college or university program in one of the following disciplines: Engineering, Architecture, Construction Management,
1. RELATED DOCUMENTS

A. All Contract Documents shall be reviewed for applicable provisions related to the provisions in
this document, and provisions in the General Conditions and other Division 1 Specification
Sections shall apply to this Section without limitation.

1.2 RELATED REQUIREMENTS SPECIFIED IN OTHER SECTIONS

A. Section 01010 – “Summary of Work”
B. Section 01250 – “Contract Modification Procedures”
C. Section 01310 – “Construction Scheduling”
D. Section 01311 – “Project Management and Coordination”
E. Section 01330 – “Submittal Procedures”
F. Section 01740 – “Warranties and Guaranties”
G. Section 01770 – “Contract Closeout Procedures”
H. Section 01785 – “Operation and Maintenance Data”
I. Divisions 2 through 33 Sections for Project Record Documents requirements for the work in those Sections.

1.3 SUMMARY

A. This section includes administrative and procedural requirements for Project Record Documents,
including but not limited to the following:
   1. Record Drawings
   2. Record Specifications
   3. Record Product Data
   4. Record MEP & Structural coordination documents

B. Project Record Documents requirements include, but are not limited to, the following:
   1. Marked-up copies of Drawings
   2. Marked-up copies of Shop Drawings
   3. Newly prepared Drawings
   4. Marked-up Product Data submittals
   5. Field records, such as photographs, for variable and concealed conditions
   6. Record information for Work that is only schematically shown
   7. Maintenance forms for equipment

C. Other Project closeout requirements are included in Section 01770, Contract Closeout Procedures.

D. Contractor shall maintain Documents and Samples as follows:
   1. Contractor shall provide and store all required Project Record Documents and Samples in
      the Contractor field office apart from Contract Documents used for Construction. These
materials shall be available at any time upon request by the District, Architect and Project Inspector.

2. Project Record Documents shall not to be used for construction purposes.

3. Maintain Project Record Documents in good order, and in a clean, dry, legible condition.

E. Contractor shall dedicate one complete full size set of the Contract Drawings and one complete Project Manual for use in recording as-built conditions.

F. The Contractor shall update the Record Drawings and Annotated Specifications as often as necessary to keep them current, but no less often than weekly.

G. The Record Drawings and Annotated Specifications shall be kept at the Site and available for review and inspection by the District and the Architect.

1.4 PROJECT RECORD DRAWINGS

A. Mark-up Procedure: During the construction period, maintain a complete, current set of Contract Drawings and Shop Drawings uploaded and updated within the BLUEBEAM program for Project Record Documents purposes. Label each document “AS-BUILT RECORD”. Keep all record documents current.

B. On completion of the Work and prior to Application for Final Payment, the Contractor will provide one complete set of AS-BUILT RECORD Drawings in AutoCAD (drawing) file format and one complete set in Adobe PDF file format.

C. A reference by number to a Change Order, CCD, RFI, RFQ, RFP, Field Order or other such document is not acceptable as sufficient record information on any record document. Do not conceal any Work until required record information has been recorded.

1. Contractor shall mark AS-BUILT Record Drawings to indicate the actual installation where the installation varies appreciably from the installation shown originally. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later. Items required to be marked include, but are not limited to:

a. Dimensional changes to the Contract Drawings (horizontal and/or vertical)

b. Revisions or any modification to details shown on the Contract Drawings

c. Depths of various elements of foundations in relation to main floor level or survey datum.

d. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.

e. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.

f. Locations of underground work, points of connection with existing utilities, changes in direction, valves, manholes, catch basins, capped stub outs, invert elevations and similar items

g. Final, actual numbering of each electrical circuit

h. Revisions to routing of piping and conduits

i. Revisions to electrical circuitry, including legends at electrical panels

j. Actual equipment locations
k. Duct size and routing
l. Changes made by Change Order, CCD, ASI, or any other directive
m. Details not on original Contract Drawings

2. Contractor shall mark completely and accurately AS-BUILT Record Drawing prints of Contract Drawings or Shop Drawings, whichever is the most capable of showing actual physical conditions. Where Shop Drawings are marked, show cross-reference on Contract Drawings location.

3. Contractor shall mark AS-BUILT Record Drawing sets within BLUEBEAM with red markings; use other colors to distinguish between changes for different categories of the Work at the same location.

4. Contractor shall mark important additional information that was either shown schematically or omitted from original Drawings.

5. Contractor shall note Contractor Change Directive numbers; Bid Alternate numbers, if any, Change Order numbers, and similar identification.

6. Contractor shall be responsible for Mark-up: Where feasible, the individual or entity who obtained Project Record Drawing data, whether the individual or entity is the installer, Subcontractor or similar entity, is required to prepare the mark-up on AS-BUILT Record Drawings.
   a. Accurately record information in an understandable and legible drawing technique.
   b. Record data as soon as possible after it has been obtained. In the case of concealed installations, record and check the mark-up prior to concealment.
   c. The District, Architect, and Project Inspector will review all record documents each month prior to approval of Contractor’s Application for Payment.

D. Contractor shall prepare Record Drawings: Immediately prior to inspection for Certification of Substantial Completion of the Work, review completed marked-up AS-BUILT Record Drawings with District, Project Inspector and Architect to ensure accuracy of information. Once accuracy of information is confirmed, prepare and submit a full electronic set, professionally drafted in AutoCAD format, of as-built Contract Drawings and Shop Drawings.

1. Incorporate changes and additional information previously marked on print sets. Delete, redraw, and/or add details and notations where applicable. Identify and date each Drawing; include the printed designation “AS-BUILT RECORD DRAWING” and the date prepared in a prominent location on each Drawing.

2. Distribution: Whether or not changes and additional information were recorded, organize the original marked-up set of drawings that were maintained during the construction period within BLUEBEAM into manageable sets. The sets should be labeled with all appropriate identification, including titles, dates and other information on cover sheets and submit to District.

E. In addition to requirements of this Section, comply with supplemental requirements of other specification sections.

1. Section 01330, Submittal Procedures, requires the preparation of large scale, detailed layout drawings of the Work in Divisions 2 through 33. These layout drawings are not Shop Drawings as defined by Section 01330, but together with Shop Drawings or layout drawings of all other affected Sections are used to check, coordinate and integrate the work of the various Sections.
2. Contractor shall include required layout drawings as part of the Project Record Documents.

1.5 PROJECT RECORD SPECIFICATION

A. Contractor shall, during the construction period, maintain one copy of the Project Specifications, including all addenda and all other modifications issued for Project Record Documents purposes.

B. Contractor shall mark the Project Record specifications to indicate the actual installation where the installation varies substantially from that indicated in Specifications and/or modifications issued. Note related Project Record Drawing information, where applicable. Give particular attention to substitutions, selection of product options, Change Order and Construction Change Directive Work, and information on concealed installation that would be difficult to identify, measure, and record later.

1. In each Specification Section where products, materials or units of equipment are specified or scheduled, mark the Record copy with the proprietary name and model number of the product furnished.

2. Where a specification allows Contractor to elect one of several brands, makes, or types of material or equipment, the annotations shall show which of the allowable items the Contractor has furnished.

3. Record the name of the manufacturer, catalog number, supplier and installer and other information necessary to provide an accurate record of selections made, and coordinate documentation with Project Record Data submittals and maintenance manuals.

4. Note any related Project Record Product Data that was submitted in maintenance manuals instead of Product Data submittals.

5. Upon completion of mark-up, submit Project Record Specifications to District for District’s records.

1.6 ADDITIONAL REQUIREMENTS FOR FINAL PROJECT AS-BUILT RECORD DOCUMENTS

A. Using a distinct Auto CAD layer, clearly indicate at each affected plan, detail, schedule, or other drawing as necessary, a full description of changes made during construction along with the actual location of specified items.

B. “Cloud” all changes made using a distinct AutoCAD layer.

C. Submit duplicate electronic files of all drawings in both Auto CAD and Adobe PDF Format.

1.7 PROJECT RECORD PRODUCT DATA

A. Contractor shall, during the construction period, maintain one copy of each Project Record Product Data submittal for “Project Record Document” purposes.

1. Mark Project Record Product Data to indicate the actual product installation where the installation varies substantially from that indicated in Project Record Product Data submitted. Include any significant changes in the product as delivered and/or installed including any departures from the manufacturer’s instructions and/or recommendations for installation.

2. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

3. Note related Change Orders and mark-up of Project Record Drawings, where applicable.
4. Upon completion of mark-up, submit a complete set of Project Record Product Data to District for District’s records.

5. Where Project Record Product Data is required as part of maintenance manuals, submit marked-up Project Record Product Data as an insert in the manual, instead of submittal as Project Record Product Data.

6. Contractor is responsible for mark-up and submittal of Project Record Product Data for its own Work.

B. Material, Equipment and Finish Data:

1. General: Provide one (1) preliminary review copy and two (2) final copies each of a "Materials, Equipment and Finishes Manual" listing all finish materials, equipment (not provided under Divisions 15 and 16), and finishes installed in the Work.

2. Submit the preliminary manuals to the Architect a minimum of two (2) weeks prior to Substantial Completion. The preliminary copies must comply with all of the requirements, except the hardboard covers.

3. Obtain approval of preliminary copies prior to producing final copies.

4. Deliver final manuals to the Architect prior to final acceptance and final payment. Architect will deliver manuals to the District.

5. Format of Manual: Provide bound manuals with printed covers and spines. Title "Materials, Equipment and Finishes Manual". Organize data sequentially by Specification Section number on typewritten 8-1/2 by 11 inch pages. Provide each copy with a typewritten index and tabbed dividers between each separate Section. Mark each tab to indicate contents.

6. Contents of Manual: Manuals shall contain all information needed to identify, maintain, and replace/duplicate any finish materials, equipment, and finishes installed in the Work for this Project. Where materials and product information has been described and likewise indicated in the "Operation and Maintenance Manuals", cross referencing to where they can be found may be done in lieu of duplication of the information. The information provided shall include, but not be limited to, the following:

   a. Manufacturer's names and model numbers or product name; supplier's and subcontractor's name, address and phone and fax numbers; and all other pertinent information that might be required for replacement ordering or duplication at a later date.

   b. For custom fabricated products which do not have model numbers or names, reference Project shop drawing submittal number and indicate "Fabricated per shop drawing submittal Number ____.

   c. Proportions of mixes.

   d. Color formula list for each paint color used.

   e. For power operated equipment, include complete and legible wiring diagrams together with cuts of repair parts and part numbers listed and instructions relative to care, adjustment and operation of the equipment.

   f. For moisture protection and weather exposed products, include complete manufacturer's data with instructions on inspection, maintenance and repair.

   g. Where applicable, provide information on care and maintenance, including manufacturer's recommendations for types of cleaning agents to be used and
methods of cleaning. Provide information regarding cleaning agents and methods that could prove detrimental to the product.

C. Contractor shall arrange Project Record Product Data by Specification Section number, and provide names, addresses, fax numbers, emails addresses, and telephone number of Subcontractors and suppliers. Information to be provided includes:
   1. Trade Names
   2. Model or type numbers
   3. Assembly diagrams
   4. Operating instructions
   5. Cleaning instructions
   6. Maintenance instructions
   7. Recommended spare parts
   8. Product data

1.8 MISCELLANEOUS PROJECT RECORD SUBMITTALS

A. Refer to other Specification Sections for miscellaneous record keeping requirements and submittals. Immediately prior to Substantial Completion of the Work, complete all miscellaneous records and place in good order, properly identified, and readied for use and reference. Submit to the District for District’s records, in Adobe PDF format. Categories of miscellaneous records include, but are not limited to, the following:
   1. Field records on excavations and foundations
   2. Field records on underground construction and similar work
   3. Survey showing locations and elevations of underground lines
   4. Invert elevations of drainage piping
   5. Surveys establishing building lines and levels
   6. Authorized measurements utilizing unit prices or allowances
   7. Records of plant treatment
   8. Ambient and substrate condition tests
   9. Certifications received in lieu of labels on bulk products
  10. Batch mixing and bulk delivery records
  11. Testing and qualification of tradespersons
  12. Documented qualification of installation firms
  13. Load and performance testing
  14. Inspections and certifications by governing authorities
  15. Leakage and water-penetration tests
  16. Fire resistance and flame spread test results
  17. Final inspection and correction procedures
  18. Final As-Built Construction Schedule
  19. Project Record Drawing Mark-ups
20. Other

1.9 INSTALLATION, OPERATION, AND MAINTENANCE MANUALS

A. Submit Installation, Operation, and Maintenance Manuals in accordance with this Section, Section 01330, Submittal Procedures and Section 01785, Operation and Maintenance Data.

1.10 ELECTRONIC MEDIA FORMAT

A. Electronic Media Formats: Electronic media formats shall be Adobe PDF and AutoCAD.
   1. Adobe PDF files shall have chapter markers and/or bookmarks inserted in place of the equivalent hard copy section tabs. Adobe PDF copy shall include all Project Record Drawings, updated Specification Manuals, tables, charts, drawings, codes and all other matters reflected in hard copies. Adobe PDF files shall be delivered on unique CD-ROMs containing Adobe PDF files of each completed project AS-BUILT Record Drawing and the complete Specifications Manual with all changes made during the Project.
   2. In addition to the Adobe PDF file copies, professionally drafted AutoCAD project AS-BUILT Record Drawing DWG files shall be delivered showing both design and as-built information. AutoCAD layouts shall be provided allowing for the reproduction of a complete set of plans as needed.

1.11 DISTRICT’S RECURSE

A. If Contractor is not able to provide Project Record Documents in specified formats, District has the right to complete the Work using other resources. Contractor agrees that any and all costs associated with District completion of this Work shall be deducted from the Contract Price by Change Order.

PART 2 - PRODUCTS Not Used.

PART 3 - EXECUTION

3.1 RECORDING

A. Post changes and modifications to the Contract Documents as they occur. Do not wait until the end of the Project. District may periodically review Project Record Documents to assure compliance with this requirement.

3.2 SUBMITTALS

A. At completion of Project, deliver all Project Record Documents to District, per Section 01330 (Submittal Procedures.)
   B. Accompany submittal with transmittal letter containing:
      1. Date
      2. Project title and number
      3. Contractor’s name and address
      4. Number and title of each Project Record Document
      5. Certification that each document as submitted is complete and accurate and signature of Contractor or Contractor’s authorized representative.

END OF SECTION 01780
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. Plastic laminate cabinets.
   2. Veneer core cabinets.
   3. Accompanying countertops.

B. Related Requirements:
   1. Section 01 81 13 “LEED Requirements”.
   2. Section 06 20 23 “Interior Finish Carpentry.”
   3. Section 07 92 00 “Joint Sealants.”
   4. Section 09 22 16 “Non-Structural Metal Framing” for backing strips.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Shop Drawings: Meeting the requirements of Architectural Woodwork Standards. Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
   1. Show details full size.
   2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   3. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural plastic-laminate casework.
   4. Apply a WI Certified Compliance Program label to the first page of the Shop Drawings.

B. LEED Submittals: Submit in accordance with Section 01 81 13 “LEED Requirements.”
   1. For Credit MR 4, submit manufacturer’s product data that delineates % of recycled content by weight. Provide material costs for post-consumer and pre-consumer recycled content. Only include materials permanently installed on the project site.
2. For Credit MR 5, submit a list of products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site. Include the cost and percentage of each material, by weight. Provide documentation from manufacturer that confirms the address of the place of manufacture and verifies the method of transit. If a product has multiple points of assembly, provide detailed data on location and assembly.

3. For Credit MR 7, submit documentation indicating wood is certified by the Forest Stewardship Council (FSC) and that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement that indicates the cost for each certified wood product.

4. For Credit IEQ 4.1, submit product data for adhesives and sealants used inside the weatherproofing line, indicating VOCs comply with limits found in Section 01 81 13 “LEED Requirements.”

5. For Credit IEQ 4.2, submit product for paints and coatings used inside the weatherproofing line, indicating VOCs comply with limits found in Section 01 81 13 “LEED Requirements.”

6. For Credit IEQ 4.4, submit product data for composite wood products, indicating that bonding agent used contains no urea formaldehyde.

C. Samples for Verification:
1. 6 in square sample of each exposed finish.
2. Four panels, with Veneer representative of and selected from flitches to be used for transparent-finished cabinets and paneling. Samples shall be at least 8 by 10 inches, for each species and cut. Include at least one face-veneer seam. Finish each sample with the intended finish.
3. Lumber for transparent finish, not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
4. Exposed cabinet hardware and accessories, one unit for each type and finish.
5. Provide (1) 6 x 6 x 10” high mitered south corner condition of EWP-1 and SSF-2 counter interface and (1) 6 x 6 x 10” high mitered south corner condition of EWP-1, toe kick and SSF-2 base for Lobby 100 Reception Desk.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For the following:
1. Composite wood and agrifiber products.

C. Woodwork Quality Standard Compliance Certificates: WI Quality Certification Program certificates.
1.6 QUALITY ASSURANCE

   1. If there is a conflict between the requirements of the AWS and the Drawings and/or Specifications, the Drawings and specifications shall govern.

B. Woodwork Institute Certified Compliance Program (CCP)
   1. Before delivery to the job site provide a Woodwork Institute Certified Compliance Certificate indicating the millwork products to be provided, and certifying that they meet the requirements of the AWS for the Grade or Grades specified, as well as the requirements of the Contract Documents.
   2. Provide a Woodwork Institute Certified Compliance Label on each elevation of casework and on each plastic laminate top.
   3. On completion of installation provide a Woodwork Institute Certified Compliance Program certificate certifying that installation meets the requirements of the AWS and of the Plans and Specifications.
   4. All fees charged by the Woodwork Institute for their Certified Compliance Program are the responsibility of the millwork manufacturer and/or installer, and shall be included in their bid.

C. Woodwork Institute Certified Seismic Installation Program (CSIP)
   1. Before walls and ceilings are closed, provide a Woodwork Institute CSIP inspection report indicating that backing for casework attachment is installed as required, or itemizing each location where backing is missing or improperly located.
   2. All fees charged by the Woodwork Institute for their Certified Seismic Installation Program are the responsibility of the casework installer, and shall be included in their bid.

D. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is licensee of the Woodwork Institute Certified Compliance Program.

E. Installer Qualifications: A licensee of Woodwork Institute’s Certified Compliance Program and Certified Seismic Installation Program. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver casework until painting and similar operations that could damage woodwork have been completed in installation areas. If casework must be stored in
other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinetwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 43 and 70 percent during the remainder of the construction period.

B. Field Measurements: Where casework is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that Architectural Woodwork can be supported and installed as indicated.

B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 087110 "Door Hardware" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2- PRODUCTS

1.10 LEED REQUIREMENTS

A. MR 4: Provide products that contain recycled content.

B. MR 5: Provide products that are extracted, harvested, recovered, or manufactured within 500 miles of the project site, depending on its method of transportation to the project site.

C. MR 7: Provide wood that is certified by the Forest Stewardship Council (FSC).
D. IEQ 4.1: For adhesives and sealants used inside the weatherproofing line and applied on site, provide products with VOCs that comply with limits found in Section 018113 “LEED Requirements.”

E. IEQ 4.2: For paints and coatings applied inside the weatherproofing line and applied on site, provide products with VOCs that comply with limits found in Section 018113 “LEED Requirements.”

F. IEQ 4.4: For composite wood, provide products that contain no urea formaldehyde.

1.11 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS AND DOORS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate casework indicated for construction, finishes, installation, and other requirements.
   1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

B. AWS Premium Grade.

C. Core: MDF, ANSI 208.2 Grade 130. Provide marine grade MDF at sinks – minimum 3 ft. to either side of sink.
   1. Manufactured with no added urea formaldehyde.
   2. At rated corridors and where required by Local Authorities Having Jurisdiction (AHJ): Fire Retardant MDF certified to US Class 1/A (E-84) flame spread and smoke generation rating. Sierra Pine Medite FR or equal.

D. Type of Construction: Frameless.

E. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.

F. Exposed Exterior Surfaces: High-Pressure Decorative Laminate: NEMA LD 3, grades as required by woodwork quality standard.

G. Exposed Interior Surfaces: High-Pressure Decorative Laminate matching the exposed exterior surfaces.

H. Semi-Exposed Surfaces: Melamine

I. Edge Band: ABS matching the color and pattern of the exposed laminate.

J. Dust Panels: Provide 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.

K. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure laminate, NEMA LD 3, Grade BKL.
L. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
   1. Drawer Sides: Seven or nine ply hardwood plywood with no internal voids, or solid hardwood.
   2. Drawer Bottoms: Hardwood Plywood.
   3. Construction method: Dowels or dovetails.

M. Colors, Patterns, and Finishes: Refer to Finish Schedule. Laminart is the basis of design.

1.12 VENEER CORE CASEWORK

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades for construction, finishes, installation, and other requirements.
   1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. If there are any conflicts between the AWS and the Contract Documents, the Contract Documents shall govern.

B. Grade: AWS Premium Grade.

C. Laminating adhesives shall contain no added urea-formaldehyde.

D. Exposed Surfaces:
   1. Veneers within each room or area shall be selected from the same flitch.
      a. Flitches will be selected by the Architect.
   2. All grain is to run and match vertically.
   3. Sequence match veneers within each elevation, including casework, paneling, and doors.
   4. Sequence match elevations that meet.
   5. Elevations that are separated by other architectural features shall be well matched to other elevations in the same room for color and grain.
   6. Solid wood trim shall be of the same species and cut as the exposed veneer, and shall be compatible in color and grain.
   7. Edge band material shall be ABS.

E. Plywood Core: DOC PS-1, Exterior A-C.
   1. Manufactured with no added urea formaldehyde.
   2. At rated corridors and where required by Local Authorities Having Jurisdiction (AHJ): Fire Retardant MDF certified to US Class 1/A (E-84) flame spread and smoke generation rating. Koskisen, or equal.

F. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
1. Use treated materials that comply with requirements of referenced woodworking standard. Do not use materials that are warped, discolored, or otherwise defective.

2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.

3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

G. Veneer Core Finish: Match Architect’s sample.

1.13 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 8 to 13 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50%.

2. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.


1.14 SOLID SURFACE COUNTERTOP MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.

1. Type: Provide Standard type, unless Special Purpose type is indicated.
2. Colors and Patterns: As indicated on the Finish Schedule found on the Drawings.

B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

1.15 HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087001 "Door Hardware."
B. Butt Hinges: 2-3/4-inch, five-knuckle steel hinges made from 0.095-inch-thick metal, and as follows:
   1. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.
C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, self-closing.
D. Wire Pulls: Back mounted, solid metal, 6 inches long, 5/16 inch in diameter.
E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
F. Drawer Slides: BHMA A156.9.
   1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; zinc-plated steel with polymer rollers.
   2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
   3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 2.
   4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1.
   5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.
   6. For computer keyboard shelves, provide Grade 1.
   7. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-100.
G. Door Locks: BHMA A156.11, E07121.
H. Drawer Locks: BHMA A156.11, E07041.
I. Grommets: Mixed plaster grommets with star-cut, flexible rubber petals that meeting in center to allow cable pass-through, “Flex Grommet FLX1” by Doug Mockett & Co., Inc. or equal. Color: As selected by Architect from manufacturer’s full range of colors.
J. Wire Managers: Extruded plastic wire manager system to organize and conceal cords and cables from view, “J-Shape Wire Manager WM2” by Doug Mockett & Co., Inc. or equal. Color: As selected by Architect from manufacturer’s full range of colors.
K. Exposed Hardware Finishes: Satin stainless steel.
L. For concealed hardware, provide manufacturer’s standard painted finish or stainless steel finish.
1.16 MISCELLANEOUS MATERIALS

A. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

1.17 FABRICATION

A. Arrange casework in shop or other suitable space in proposed sequence for examination by Architect. Mark units with temporary sequence numbers to indicate position in proposed layout.
   1. Lay out one elevation at a time if approved by Architect.
   2. Notify Architect seven days in advance of the date and time when layout will be available for viewing.
   3. Provide lighting of similar type and level as that of final installation for viewing layout unless otherwise approved by Architect.
   4. Rearrange paneling as directed by Architect until layout is approved.
   5. Do not trim end units and other nonmodular-size units to less than modular size until after Architect's approval of layout.
   6. Obtain Architect's approval of layout before start of assembly. Mark units and Shop Drawings with assembly sequence numbers based on approved layout.

B. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
   1. Corners of Cabinets: 1/16 inch unless otherwise indicated.

C. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
   2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

D. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

E. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
   1. AWS Premium Grade.
F. Countertops: 1/2-inch-thick, solid surface material.

G. Backsplashes: 1/2-inch-thick, solid surface material. Provide where shown.

H. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
   1. Fabricate with loose backsplashes for field assembly.
   2. Install integral sink bowls in countertops in the shop.

I. Joints: Fabricate countertops without joints.

J. Cutouts and Holes:
   1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
      a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.

PART 3- EXECUTION

1.18 PREPARATION

A. Before installation, condition casework to average prevailing humidity conditions in installation areas.

B. Before installing casework, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

1.19 INSTALLATION

A. Grade: Install casework to comply with same grade as item to be installed.

B. Assemble casework and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install casework level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut casework to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
E. Casework: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install casework with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.

2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws or toggle bolts through metal backing or metal framing behind wall finish.

F. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

G. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

H. Touch up finishing work specified in this Section after installation of woodwork.

1.20 ADJUSTING AND CLEANING

A. Repair damaged and defective casework, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean casework on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION
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 glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
   1. Windows.
   2. Doors.
   4. Exterior Storefront and Entrances
   5. Interior Entrances and Storefronts.
   6. Aluminum Frames
   7. Sliding Automatic Entrances
   8. Hollow Metal Frames

B. Related Sections:
   1. Section 08 11 13 “Hollow Metal doors and Frames”
   2. Section 08 11 16 “Aluminum Frames.”
   3. Section 08 14 00 “Wood Doors”
   4. Section 08 41 13 “Interior Entrances and Storefronts”
   5. Section 08 42 29.33 “Sliding Automatic entrances”
   6. Section 08 43 13 “Glazed Aluminum Curtain Walls.”
   7. Section 08 51 13 “Exterior Storefront and Entrances.”

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit.
1.4 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:
   1. Design Wind Pressures: As required by Applicable Codes.
   2. Design Wind Pressures: Determine design wind pressures applicable to Project according to the California Building Code, based on heights above grade indicated on Drawings.
   3. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
   4. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
   5. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
   6. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
   7. Provide tempered or laminated glazing where required to meet safety glazing requirements of Local Authorities Having Jurisdiction (AHJ).

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
   1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
   2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
   3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
   4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.6 ACTION SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. LEED Submittals:
   1. For Credit MR 4, submit manufacturer’s product data that delineates % of recycled content by weight. Provide material costs for post-consumer and pre-consumer recycled content. Only include materials permanently installed on the project site.
   2. For Credit MR 5, submit a list of products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site. Include the cost and percentage of each material, by weight. Provide documentation from manufacturer that confirms the address of the place of manufacture and verifies the method of transit. If a product has multiple points of assembly, provide detailed data on location and assembly.
   3. For Credit IEQ 4.1, submit product data for adhesives and sealants used inside the weatherproofing line, indicating VOCs comply with limits found in Section 01 81 13 "LEED Requirements."

C. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
   1. Tinted glass.
   2. Patterned glass.
   3. Coated glass.
   4. Insulating glass.

D. Glazing Accessory Samples: For gaskets, sealants, and colored spacers, in 12-inch lengths. Install sealant samples between two strips of material representative in color of the adjoining framing system.

E. Glazing Schedule: List glass types and thicknesses for each size opening and location.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installers and manufacturers of insulating-glass units with sputter-coated, low-e coatings.

B. Product Certificates: For glass and glazing products, from manufacturer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for coated glass and insulating glass.
   1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
D. Preconstruction adhesion and compatibility test report.

E. Warranties: Sample of special warranties.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

E. Source Limitations for Glass: Obtain coated float glass, and insulating glass from single source from single manufacturer for each glass type.

F. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
   1. GANA Publications: GANA's "Glazing Manual."

H. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

I. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F, and the fire-resistance rating in minutes.
J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

K. Preinstallation Conference: Conduct conference at Project site.
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

1.11 WARRANTY

A. Contractor's Labor and Material Guarantee: Correct defective Work at no cost to the Owner.
1. Warranty Period: 1 year from the date of Final Completion in accordance with Document 00 65 36 – Warranty Form Contractor’s Guarantee.

B. Special Manufacturer's Warranty: Warranty all work under this section in a written document endorsed by the Manufacturer:
1. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
   a. Warranty Period: 10 years from date of Final Completion.
2. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
   a. Warranty Period: 10 years from date of Final Completion.

3. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
   a. Warranty Period: 10 years from date of Final Completion.

PART 2- PRODUCTS

1.12 GLASS TYPES

A. GL-1 – Insulated Glass, 1” nominally thick. Outer ¼” clear tempered lite with low-e coating on no. 2 surface, ½” air space, ¼” clear tempered lite at interior. Basis of design: PPG Solarban 70XL, or equal.
   1. U-value= 0.30
   2. Solar heat Gain Coefficient = 0.3
   3. Shading coefficient = 0.34
   4. Visible light Transmittance  =64%

B. GL-2 – Insulated Glass Spandrel, 1” nominally thick. Outer ¼” clear tempered with low-e coating on no. 2 surface, ½” air space, ¼” clear tempered with polyester silicone coating on no. 3 4 surface. Basis of design: PPG Solarban 70XL with ICD High Performance Coatings OPAC-COAT-300, or equal. Architect to select polyester silicone coating from manufacturer's standards.

C. GL-3: ¼” clear, laminated unit at interior: 1/8” clear lite, .060” pvb interlayer, 1/8” clear lite.

D. GL-4: ½” clear, laminated unit at interior: ¼” clear lite, .060 pvb interlayer, ¼” clear lite.

E. GL-5: 3/8” laminated: ¼ in. clear, .060 in. pvb inner layer, 1/8 in. clear.

F. GL-6 – Insulated Glass, 1” nominally thick. Outer ¼” clear tempered lite with low-e coating on no. 2 surface, ½” air space, 1/4” clear tempered lite at interior with pressure sensitive polyester transluscent film on no. 3 4 surface. Basis of design: PPG
Solarban 70XL with 3M FASARA Glass Finish, or equal. Architect to select film coating from manufacturer's standards.

1. U-value = 0.30
2. Solar heat Gain Coefficient = 0.3
3. Shading coefficient = 0.34
4. Visible light Transmittance = 64%

1.13 LEED REQUIREMENTS

A. MR 4: Provide products that contain recycled content.

B. MR 5: Provide products that are extracted, harvested, recovered, or manufactured within 500 miles of the project site, depending on its method of transportation to the project site.

C. IEQ 4.1: For adhesives and sealants used inside the weatherproofing line and applied on site, provide products with VOCs that comply with limits found in Section 018113 “LEED Requirements.”

1.14 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
   1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.

B. Strength: Provide glass products to meet local building codes. Where safety glass is required, provide tempered glass or laminated glass. Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
   1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
   2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
   3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
   4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
   5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.
1.15 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
   1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
   2. For uncoated glass, comply with requirements for Condition A.
   3. For coated vision glass, comply with requirements for Condition C (other coated glass).

1.16 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
   2. Spacer: Aluminum with grey, color anodic finish.
   3. Desiccant: Molecular sieve or silica gel, or a blend of both.

1.17 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
   1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations.
   2. Interlayer Thickness: Provide thickness not less than needed to comply with requirements.
   3. Interlayer Color: Refer to Drawings.

1.18 GLAZING SEALANTS

A. General:
   1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
   2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT. Grey color.
   1. Products: Subject to compliance with requirements, provide the following, or equal:
      a. Dow Corning Corporation; 790.
      b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
      c. Pecora Corporation; 890.
      d. Sika Corporation, Construction Products Division; SikaSil-C990.
      e. Tremco Incorporated; Spectrem 1.

1.19 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
   1. AAMA 804.3 tape, where indicated.
   2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
   3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

1.20 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated. Color to be mill finish aluminum.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

1.21 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3- EXECUTION

1.22 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
   2. Presence and functioning of weep systems.
   3. Minimum required face and edge clearances.
   4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1.23 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.
1.24 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches.
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

1.25 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

1.26 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression
gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

1.27 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

1.28 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION
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. Tackboards.
   3. Marker tray units, for installation at PDEW walls.

B. Related Requirements:
   1. Section 09 22 16 “Non-Structural Metal Framing.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.

B. Shop Drawings: For visual display units.
   1. Include plans, elevations, sections, details, and attachment to other work.
   2. Show locations of panel joints.

C. Samples: For each type of visual display unit indicated.
   1. Visual Display Panel: Not less than 8-1/2 by 11 inches, with facing, core, and backing indicated for final Work. Include one panel for each type, color, and texture required.
   2. Accessories: Full-size Sample of each type of accessory.

D. Product Schedule: For visual display units. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.
B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of tackboards.

C. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For visual display units to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Field Measurements: Verify actual dimensions of construction contiguous with visual display units by field measurements before fabrication.
   1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

PART 2- PRODUCTS

1.8 MANUFACTURERS

A. Source Limitations: Obtain each type of visual display unit from single source from single manufacturer.

1.9 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 450 or less.
1.10 VISUAL DISPLAY BOARD ASSEMBLIES


B. Tackboards: Forbo “Bulletin Board”, or equal, with 5/8 in. face trim. Provide size and configuration shown on Drawings. Architect to select cork surface from manufacturer’s standards.

C. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch-thick, extruded aluminum; slim size and standard shape.
   1. Field-Applied Trim: Manufacturer's standard, snap-on trim with no visible screws or exposed joints.

D. Marker Trays Units For Installation @ PDEW Walls: Claridge Products and Equipment, Inc. “Chalk/Maker Tray Model No. 264”, or equal. Provide size, in single units, and configuration shown on Drawings.
   1. Screw-On Trim: Exposed fasteners for surface-mount over specified projectable/dry-erase wall covering (PDEW), with end closures.

1.11 MATERIALS

A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.

B. Natural-Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish with surface-burning characteristics indicated.

C. Medium-Density Fiberboard: ANSI A208.2, Grade 130. Shall contain no added urea-formaldehyde.

D. Extruded Aluminum: ASTM B 221, Alloy 6063.

1.12 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

1.13 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3- EXECUTION

1.14 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

B. Examine walls and partitions for proper preparation and backing for visual display units.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

1.15 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.

C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.

1.16 INSTALLATION

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches o.c. Secure tops and bottoms of boards to walls.

1.17 CLEANING AND PROTECTION

A. Clean visual display units according to manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display units after installation and cleaning.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, equipment, and service necessary for a complete and operating HVAC Control System (BAS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only.

B. All labor, material, equipment and software not specifically referred to herein or on the plans, that is required to meet the functional intent of this specification, shall be provided without additional cost to the Owner.

C. The contractor performing this scope of work is referred to as the the BAS contractor.

D. The owner will provide IT access points in all buildings for use by the BAS contractor. Coordinate system requirements with the owner. The BAS contractor is responsible for all wiring from the IT switch to the BAS controller.

E. Provide a system architecture that shows all components schematically from the field devices, such as actuators and sensors to the point of connection on the owner provided IT network, with the bid documents.

1.2 SYSTEM DESCRIPTION

A. Basis-of-Design Vendor: shall be ALC to match the College District’s Contra Costa Community College’s standard, or equal. The Graphic User Interface (GUI) shall be Web based and shall provide a common operating platform for all integrated control systems.

B. The entire new Control System (BAS) shall be comprised of a network of interoperable, stand-alone digital controllers communicating via a BACnet communication protocols provided under this section.

C. Provide interface to all sub-control systems through BACnet, Modbus, or a third-party gateway as required to establish two-way communications. All points from the sub-control system(s) shall be included in the graphic interface.

D. Upgrade the WebCTRL software for the existing server located at the CCC Campus. Include all necessary software and programming efforts to upgrade existing database and software for other existing modules and controls.

1.3 SUBMITTAL

A. No work may begin on any segment of this Project until the related submittals have been reviewed for conformity with the design intent and the Contractor has responded to all comments to the satisfaction of the Owner’s Representative.
B. Prior to the start of system installation, the following shall be submitted and approved. Provide pdf copies for all items submitted:

1. Shop drawings of the entire control system and a complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions. Shop drawings shall contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings.

2. A complete written Sequence of Operation for all systems. Those sequences may be modified and altered by any of the owners consultants to incorporate the most advanced sequences possible for the equipment controlled. See also section 4 of this specification.

3. A complete points list for all connected points to the DDC system including proposed set-points and parameters available on the GUI.

4. To scale floor drawings that show the location of all controls devices including such items as building pressure sensors, duct pressure sensors, room sensors, valves, dampers and any other device monitored or controlled by the BAS system.

5. Control system Checkout, Testing and Demonstration forms developed in a format that fully documents the requirements as stated in “Checkout and Testing” and “Demonstration”. The forms shall include sections for any global or application programming performed by the Network Area Controllers.

6. The submittal shall also include a copy of each of the graphics developed for the local Graphic User Interface including a flowchart (site map) indicating how the graphics are intended to be linked to one another for system navigation. The graphics are intended to be 80% - 90% complete at this stage with the only remaining changes to be based on review comments from the A/E design team and/or Owner. See also section 3 of this document for further information about the content to be provided.

7. Provide a sample of all logs to be provided under section 3.14 to the satisfaction of the owner and its representatives.

8. The submittal shall identify all owner required IT access points to identify at least where and how many IP access points will be required.

9. Provide a spare parts submittal as defined in section 2.25.

10. Provide an alarm notification and escalation plan that includes all alarms and their notification schemes for all application and system alarms. The plan shall include all alarm points, their class, priority and their point(s) of annunciation such as email, page and visual data archive points such as printers and logs. As a minimum the following alarms shall be implemented:
a. Status alarm for all devices that have a Start/Stop and Status. The alarms shall cover any discrepancy in status for more than a specified time period. The time period shall be appropriate for the application.

b. Any Set-points not met by a selectable deviation (either in % of full range or absolute value) for more than a specified time period. The time period shall be appropriate for the application.

c. Discrete Alarm Points, shown on the points list

d. The alarms with the highest priority shall remain on top of the list.

1.4 DIVISION OF WORK

A. The controls contractor shall be responsible for all controllers, control devices, control panels, controller programming, controller programming software, controller input/output and power wiring, controller network wiring, control power transformers, and Portable Operator's Terminals. This includes the 120 VAC power to the control panels. Breakers to be provided at the closest power distribution panel by Division 26.

1.5 RELATED WORK SPECIFIED ELSEWHERE

A. Division 26, Electrical:
1. Providing motor starters and disconnect switches (unless otherwise noted).
2. Power wiring and conduit (power to the control panels by BAS contractor if not provided by Division 26).
3. Provision, installation and wiring of smoke detectors (I/O wiring to the BAS by controls contractor).

1.6 CODES AND STANDARDS

A. All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state, and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications. As a minimum, the installation shall comply with the current editions in effect 30 days prior to receipt of bids of the following codes. Systems or products not currently offering the following approvals are not acceptable.

1. Underwriters Laboratories UL-916; Energy Management Systems (Canada and the U.S.)
2. Occupational Safety and Health Act (OSHA)
3. National Fire Protection Association (NFPA) Standards
5. California Building Code (CBC)
6. California Mechanical Code (CMC)
7. California Plumbing Code (CPC)
8. Institute of Electrical and Electronic Engineers (IEEE)
10. BACnet Testing Laboratories (BTL)
11. LonMark® Interoperability Association’s LonMark® Certification
13. Underwriters Laboratories UL-864; Smoke Management Systems (If required by application, all costs to accommodate the listing requirement to be included in the scope of work).

1.7 SOFTWARE LICENSE AGREEMENT

A. The Owner shall sign a copy of the manufacturer’s standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer’s license agreement, but shall protect manufacturer’s rights to disclosure of trade secrets contained within such software. No provision in the license agreement shall prevent the Owner from using any manufacturer licensed representative regardless of geography or assigned territories.

B. The Owner shall receive ownership of all job specific configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NAC, BAS Server(s), and any related LAN / WAN / Intranet and Internet connected routers and devices.

C. Any and all required IDs and passwords or other log in credentials for access to any component or software program shall be provided to the Owner.

D. If applicable, the Owner shall determine which organizations are to be named in the SI organization ID ("orgid") of all software licenses. Owner shall be free to direct the modification of the "orgid" in any software license, regardless of supplier.

1.8 OWNERSHIP OF MATERIAL

A. The Owner shall receive ownership of all job specific software configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use within Network Area Controllers, Web server(s), and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required IDs and passwords for access to any component or software program shall be provided to the Owner.
1.9 DELIVERY, STORAGE AND HANDLING

A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.10 JOB CONDITIONS

A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly manner. It shall be the Contractor’s responsibility to check the Contract Documents for possible conflicts between his work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

1.11 QUALITY ASSURANCE

A. The manufacturer of the controllers shall provide documentation supporting compliance with ISO-9001 (Model for Quality Assurance in Design/Development, Production, Installation and Servicing). Product literature provided by the BAS digital controller manufacturer shall contain the ISO-9001 Certification Mark from the applicable registrar. The manufacturer shall make a commitment to keep the system backwards compatible for at least 20 years from the day of installation to the point of obsolescence.

B. The following manufacturers are approved providers:

   1. **Basis of Design:** Automatic Logic Controls, or equal. no exception, to match District’s LMC Campus standard.

C. Being listed still requires the manufacturer to comply with all aspects of this and related specifications.

1.12 SPECIFICATION NOMENCLATURE

A. Acronyms and other terms used in this specification are defined as follows:

   AI: Analog Input

   AO: Analog Output

   ASCII: American Standard Code for Information Interchange

   BACnet™: A data communication protocol for building automation and control networks. The rules governing this protocol are defined in ASHRAE/ANSI Standard 135.

   BAS: Building Automation System
BI: Binary Input

BMP: The standard bit-mapped graphics format used in the Windows environment. By convention, graphics files in the BMP format end with a “.BMP” extension.

BO: Binary Output

Bridge: A device that connects two local-area networks (LANs), or two segments of the same LAN that use the same protocol, such as Ethernet or Token-Ring.

Client: The client part of a client-server architecture. Typically, a client is an application that runs on a personal computer or workstation and relies on a server to perform some operations. Clients rely on servers for resources, such as files, devices, and even processing power.

Client/Server Architecture: A network architecture in which each computer or process on the network is either a client or a server. Servers are powerful computers or processes dedicated to managing disk drives (file servers), printers (print servers), or network traffic (network servers). Clients are personal computers or workstations on which users run applications. Client-server architectures are sometimes called two-tier architectures.

COV: Change of Value. The change of value is a definition used to define how much a value has to change before it get’s reported or displayed on a screen or report. The change of value can be expressed as a percentage of full range or in absolute values for analog records and for digital records it will be the change from one state to another.

DDC: Direct Digital Control. The digital algorithms and pre-defined arrangements included in the control system software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.

DDE: Dynamic Data Exchange

DMI: High Definition Multimedia Interface

DVI: Digital Visual Interface

Ethernet: A local area network (LAN) technology that is probably the most prevalent in the world today due to its common usage in standard office networks. Due to its transmission speeds (10 Mbps) or Fast Ethernet (100 Mbps), most BAS control manufacturers offer Ethernet as an option for connecting their workstations and system controllers on the LAN. Ethernet can be implemented over several different types of network media including unshielded twisted-pair (UTP), coaxial cable, and fiber optic cable. (Ethernet is also known as ISO8802-3).
**Firewall:** A system designed to prevent unauthorized access to or from a private network. Firewalls can be implemented in both hardware and software, or a combination of both. Firewalls are frequently used to prevent unauthorized Internet users from accessing private networks connected to the Internet, especially intranets. All messages entering or leaving the intranet pass through the firewall, which examines each message and blocks those that do not meet the specified security criteria.

**Furnish:** The term “Furnish” and its derivatives when used in this Division shall mean supply at the Contractor’s cost to the designated third party trade contractor for installation. The Contractor shall connect furnished items to the system, calibrate, test, verify, warrant and document.

**GIF:** Graphics Interchange Format. A bit-mapped graphics file format. GIF supports color and various resolutions. It also includes data compression, but because it is limited to 256 colors, it is more effective for scanned images such as illustrations rather than color photos. By convention, graphics files in the GIF format end with a “.GIF” extension.

**GUI:** Graphical User Interface

**HD:** High Definition

**Hub:** A common connection point for devices in a network. Hubs are commonly used to connect segments of a LAN. A hub contains multiple ports. When a packet arrives at one port, it is copied to the other ports so that all segments of the LAN can see all packets.

**HTML:** HyperText Markup Language. An internet programming language that defines the internet pages we look at and provides a common model for data representation.

**HTTP:** HyperText Transfer Protocol, the underlying protocol used by the World Wide Web. HTTP defines how messages are formatted and transmitted, and what actions Web servers and browsers should take in response to various commands.

**IBC:** Interoperable BACnet™ Controller

**IDC:** Interoperable Digital Controller

**ILC:** Interoperable LonWorks® Controller

**Install:** The term “Install” and its derivatives when used in this Division shall mean receive at the jobsite and mount.

**Integration:** The ability to link disparate control system devices into a cohesive Building Automation System.

**Interoperability:** The ability of disparate control system devices to work together toward a common objective through the exchange of information.
**Intranet**: A network based on TCP/IP protocols (an internet) belonging to an organization, accessible only by the organization’s members, employees, or others with authorization. An intranet’s Web sites look and act just like any other Web sites, but the firewall surrounding an intranet fends off unauthorized access.

**IP**: Internet Protocol. IP specifies the format of packets, also called datagrams, and the addressing scheme. Most networks combine IP with a higher-level protocol called Transmission Control Protocol (TCP), which establishes a virtual connection between a destination and a source.

**Java**: A high-level programming language developed by Sun Microsystems. Compiled Java code can run on most computers because Java interpreters and runtime environments, known as Java Virtual Machines (VMs), exist for most operating systems, including UNIX, the Macintosh OS, and Windows. Java is a general purpose programming language with a number of features that make the language well suited for use on the World Wide Web.

**Java Applet**: Small Java applications that are typically downloaded from a Web server and run on your computer by a Java-compatible Web browser, such as Google Chrome or Microsoft Internet Explorer.

**JPEG**: Joint Photographic Experts Group. JPEG is a glossy compression technique for color images. Although it can reduce file sizes to about 5% of their normal size, some detail is lost in the compression. By convention, graphics files in the JPEG format end with a “.JPG” extension.

**LAN**: Local Area Network. A computer network that spans a relatively small area. Most LANs are confined to a single building or group of buildings; however, one LAN can be connected to other LANs over any distance via the Internet, telephone lines, and radio waves. A system of LANs connected in this way is called a wide-area network (WAN).

**LonMark**: A set of protocol rules and practices that has been developed and approved by a group of manufacturers that use the “Neuron” processor chip developed by the Echelon Corporation. LonMark is also the mark awarded to devices which implement the profile for their specific device type.

**LonTalk**: A local area network (LAN) technology created by the Echelon Corporation. Its speed is scaleable (32Kbps to 1.25Mbps) and is comparable to MS/TP on the low end and ARCNET on the high end. LonTalk will typically be used for application specific controller networks. LonTalk can be implemented over several different types of network media including unshielded twisted-pair (UTP) or Free Topology (FTT-10a), coaxial cable, fiber optic cable, radio frequency (RF), and infrared (IR). (LonTalk is also known as EIA-709.1)

**LonWorks**: An encompassing term that includes the LonTalk communications protocol, devices that use the LonTalk protocol (LonMark devices) and the network on which the devices reside.
**MSTP**: Master Slave Token Passing. A local area network (LAN) technology created by ASHRAE and unique to BACnet™. The communication rate, approximately 76Kbps, is slower than Ethernet and ARCNET, but it is the lowest cost LAN option for BACnet™. The maximum delay before a device is able to transmit a message can be determined. Many BAS control manufacturers utilize MSTP for their application specific controller networks. MSTP is implemented using EIA-485 signaling and can be used in a master-slave mode, a peer-to-peer token passing mode, or a combination of the two.

**Media**: The physical network wiring that is used to transmit data. Typical media includes unshielded twisted-pair (UTP) wiring, coaxial cables, and fiber optic cables.

**NAC**: Network Area Controller

**NICS**: Niagara Compatibility Statement

**ODBC**: Open DataBase Connectivity. A standard database access method developed by Microsoft Corporation. The goal of ODBC is to make it possible to access any data from any application, regardless of which database management system (DBAS) is handling the data. ODBC manages this by inserting a middle layer, called a database driver, between an application and the DBAS. The purpose of this layer is to translate the application's data queries into commands that the DBAS understands. For this to work, both the application and the DBAS must be ODBC-compliant -- that is, the application must be capable of issuing ODBC commands and the DBAS must be capable of responding to them. Since version 2.0, the standard supports SAG SQL.

**OLE**: Object Linking and Embedding. OLE is a compound document standard developed by Microsoft Corporation. It enables you to create objects with one application and then link or embed them in a second application. Embedded objects retain their original format and links to the application that created them.

**OOT**: Object Oriented Technology

**OPC**: Object Linking and Embedding (OLE) for Process Control. This is a communication protocol utilizing Microsoft Windows NT client/server technology and Component Object Module (COM) and Distributed COM software architecture. It uses Ethernet TCP/IP message transportation.

**Peer-to-Peer Architecture**: A type of network in which each workstation has equivalent capabilities and responsibilities. This differs from client/server architectures, in which some computers are dedicated to serving the others. Peer-to-peer networks are generally simpler, but they usually do not offer the same performance under heavy loads.

**PICS**: Product Interoperability Compliance Statement

**PMI**: Power Management Interface

**POT**: Portable Operator's Terminal
**Protocol:** An agreed-upon format for transmitting data between two devices. The protocol determines: 1) the type of error checking to be used, 2) data compression method, if any, 3) how the sending device will indicate that it has finished sending a message, and 4) how the receiving device will indicate that it has received a message.

**Provide:** The term “Provide” and its derivatives when used in this Division shall mean to furnish, install in place, connect, calibrate, test, verify, warrant, document and supply the associated required services ready for operation.

**Router:** A device utilized to join two or more networks together. A router has the capability of joining together networks that use different Local Area Network (LAN) technologies such as a BACnet™ Ethernet LAN with a BACnet™ MSTP LAN. The router forwards data packets along networks and use headers and forwarding tables to determine the best path for forwarding the packets.

**Server:** A computer or device on a network that manages network resources. For example, a file server is a computer and storage device dedicated to storing files. Any user on the network can store files on the server. A print server is a computer that manages one or more printers, and a network server is a computer that manages network traffic. A database server is a computer system that processes database queries.

**Switch:** On an Ethernet local area network (LAN), a switch determines from the physical device (Media Access Control or MAC) address in each incoming message frame which output port to forward it to and out of. In a wide area packet-switched network such as the Internet, a switch determines from the IP address in each packet which output port to use for the next part of its trip to the intended destination.

**SQL:** Structured Query Language. SQL is a standardized query language for requesting information from a database. Historically, SQL has been the favorite query language for database management systems running on minicomputers and mainframes. Increasingly, however, SQL is being supported by PC database systems because it supports distributed databases (databases that are spread out over several computer systems). This enables several users on a local-area network to access the same database simultaneously.

**TCP:** Transmission Control Protocol. TCP is one of the main protocols in TCP/IP networks. Whereas the IP protocol deals only with packets, TCP enables two hosts to establish a connection and exchange streams of data. TCP guarantees delivery of data and also guarantees that packets will be delivered in the same order in which they were sent.

**TCP/IP:** Transmission Control Protocol/Internet Protocol. The suite of communications protocols used to connect hosts on the Internet. TCP/IP uses several protocols, the two main ones being TCP and IP. TCP/IP is used by the Internet, making it the de facto standard for transmitting data over networks.

**TCS:** Temperature Control System
Thick Client: In a thick client/server architecture, the client does the majority of the processing.

Thin Client: In a thin client/server architecture, most of the processing is handled by the server and all the browser has to do is process the display.

UPS: Uninterruptible Power Supply.

Virtual Point: A point of information that is generated as a software value rather than the value being generated by an actual hardware device.

WAN: Wide Area Network. A computer network that spans a relatively large geographical area. Typically a WAN, consists of two or more local-area networks (LANs).

WBI: Web Browser Interface

XIF File: The external interface file created in Neuron C defining the LonMark® product’s network variables, message tags, and hardware related parameters.

XML: Extensible Markup Language. A technology for moving structured data across the internet or a corporate network. Unlike HTML, XML documents include more than just raw data by including a definition of the data structure, so the receiving computer knows what information is contained in which fields.

PART 2 - SPECIALTY MATERIALS

2.1 GENERAL

A. The Facility Management Control System (BAS) shall be comprised of a network of interoperable, stand-alone digital controllers, a computer system, graphical user interface software, printers, network devices and other devices as specified herein.

B. The installed system shall provide secure password access to all features, functions and data contained.

2.2 INTEGRATED ARCHITECTURES

A. The intent of this specification is to provide a peer-to-peer ALC WEBCTRL based networked, stand-alone, distributed control system with the capability to integrating the ANSI/ASHRAE Standard 135 BACnet™, Modbus, OPC and other open protocols into one open, interoperable system.

B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system.

C. All components and controllers supplied under this Division shall be true “peer-to-peer” communicating devices. Components or controllers requiring “polling” by a host to pass data shall not be acceptable.
D. The supplied system must incorporate the ability to access all data using standard
Microsoft® Internet Explorer Web browsers without requiring proprietary operator
interface and configuration programs. An Open DataBase Connectivity (ODBC) or
Structured Query Language (SQL) compliant server database is required for all
system database parameter storage. It shall be MS SQL Server. The data shall reside
on a supplier-installed server for all database access. Systems requiring a proprietary
database and user interface programs shall not be acceptable.

E. A hierarchical topology is required to assure reasonable system response times and to
manage the flow and sharing of data without unduly burdening the customer’s internal
Intranet network. Systems employing a “flat” single tiered architecture shall not be
acceptable.

F. Maximum acceptable response times for devices and Graphic User Interfaces
connected directly to the BAS network shall be as shown in the following table. It is the
BAS’s contractors responsibility to assess requirements for network and controller
infrastructure to maintain these performance criteria for all projects. The contractor is
responsible for complying with the requirements set in this table. The contractor
should assess the existing conditions for IT infrastructure, BAS servers, NAC’s and
local controllers before submitting the systems to ensure that these requirements can
be met when the installation under this scope is completed.

<table>
<thead>
<tr>
<th>System Function</th>
<th>Point of Origin to NAC</th>
<th>NAC to Point of Display or Control</th>
<th>Point of Origin to Point of Display, Annunciation or Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graphic display with &lt; 50 dynamic points/object and</td>
<td>5 seconds</td>
<td>3 seconds</td>
<td>8 seconds</td>
</tr>
<tr>
<td>current data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graphic display with &gt; 50 dynamic points/object and</td>
<td>5 seconds</td>
<td>5 seconds</td>
<td>10 seconds</td>
</tr>
<tr>
<td>current data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>End use device reaction to object command</td>
<td>5 seconds</td>
<td>3 seconds</td>
<td>8 seconds</td>
</tr>
<tr>
<td>End use device change of value</td>
<td>5 seconds</td>
<td>1 second</td>
<td>6 seconds</td>
</tr>
<tr>
<td>Alarm response time</td>
<td>5 seconds</td>
<td>1 second</td>
<td>6 seconds</td>
</tr>
</tbody>
</table>

2.3 NETWORK AREA CONTROLLER (NAC)

A. The contractor shall supply one or more Network Area Controllers (NAC) as part of
this contract. Number of area controllers required is dependent on the type and
quantity of devices provided under Divisions 22/23 and 26. It is the responsibility of
the BAS contractor to coordinate with Division 22/23 and 26 and to determine the
quantity and type of devices.

B. The Network Area Controller (NAC) shall provide the interface between the LAN or
WAN and the field control devices, and provide global supervisory control functions
over the control devices connected to the NAC. It shall be capable of executing
application control programs to provide:
1. Calendar functions
2. Scheduling
3. Trending
4. Alarm monitoring and routing
5. Time synchronization
6. Integration of BACnet™ controller data or any other protocol used
7. Load Shedding (Demand Response)

C. The Network Area Controller must provide the following hardware features as a minimum:
   1. One Ethernet Port 10/100 Mbps
   2. One RS-232 port
   3. Battery Backup, for more requirements see section 3.3
   4. Flash memory for long term data backup (NAC’s utilizing a hard disk drive shall not be acceptable)
   5. The NAC must be capable of operation over a temperature range of 0 to 50°C (32°F to 122°F)
   6. The NAC must be capable of withstanding storage temperatures of between 0 and 70°C (32°F and 158°F)
   7. The NAC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing

D. The NAC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it. Any database that can be stored on server shall be stored on the server based on the requirements listed under Section 2.2 D.

E. The NAC shall support standard Microsoft® Internet Explorer Web browser access via the Intranet/Internet. It shall support a minimum of 32 simultaneous users.

F. Event Alarm Notification and actions
   1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
   2. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.
3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
   a. To alarm
   b. Return to normal
   c. To fault

4. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.

5. Provide timed (schedule) routing of alarms by class, object, group, or node.

6. Provide alarm generation from binary object “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

G. Control equipment and network failures shall be treated as alarms and annunciated.

H. Alarms shall be annunciated in any of the following manners as defined by the user:
   1. Screen message text
   2. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
      a. Day of week
      b. Time of day
      c. Recipient
   3. Pagers via paging services that initiate a page on receipt of email message
   4. Graphic with flashing alarm object(s)
   5. Printed message, routed directly to a dedicated alarm printer
   6. Audio messages
   7. Text message to a phone

I. The following shall be recorded by the NAC for each alarm (at a minimum):
   1. Time and date
   2. Location (building, floor, zone, office number, etc.)
   3. Equipment (air handler #, access way, etc.)
   4. Acknowledge time, date, and user who issued acknowledgement.
   5. Number of occurrences since last acknowledgement.

J. Alarm actions may be initiated by user defined programmable objects created for that purpose.
K. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

L. A log of all alarms shall be maintained by server and shall be available for review by the user.

M. Provide a “query” feature to allow review of specific alarms by user defined parameters. This query shall allow the user to search for alarms by mechanical or electrical system, time and date, building and none application specific alarms such as system alarms or any combination thereof. This is not a description of capabilities description, this query feature is to be provided.

N. A separate log for system alarms (controller failures, network failures, etc.) shall be provided and available for review by the user. These alarms shall be clearly identified as system alarms to allow the user to differentiate application alarms from system or device alarms. This log shall be available to be run manually or based on user programmable intervals to any network printer or to a PDF file stored on the server. Each run shall create a new file with a unique file name architecture that includes the date and time. This is not a description of capabilities; a separate log for system alarms is to be provided.

O. An Error Log to record invalid property changes or commands shall be provided and available for review by the user. This is not a description of capabilities; an error log is to be provided.

2.4 DATA COLLECTION AND STORAGE

A. The NAC shall have the ability to collect data for any property of any object and store this data for future use.

B. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:

1. Designating the log as interval or deviation.

2. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.

3. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.

4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.

5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

C. All log data shall be stored in a relational database on the server.
D. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.

E. All log data shall be available to the user in the following data formats:
   1. HTML
   2. XML
   3. Plain Text
   4. Comma or tab separated values

F. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.

G. The NAC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:
   1. Archive on time of day
   2. Archive on user-defined number of data stores in the log (buffer size)
   3. Archive when log has reached it’s user-defined capacity of data stores
   4. Provide ability to clear logs once archived

2.5 AUDIT LOG

A. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:
   1. Time and date
   2. User ID
   3. Change or activity: i.e., Change set-point, add or delete objects, points in override, commands, etc.

2.6 DATABASE BACKUP AND STORAGE

A. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval, but as a minimum once a month. This is to be configured by the BAS contractor after consulting with the owner.

B. Copies of the current database and the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.
C. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

2.7 SQL DATABASE SUPPORT

A. In addition to the standard databases provided as part of the Niagara Framework, the BAS shall archive all data (such as log data, alarms, alerts and audit histories) to a Microsoft SQL Server database. This will enable the Owner with an SQL Server to utilize this resource for data archive storage as well as for other applications to have access to energy use or other data that is captured by the Network Area Controllers.

1. GRAPHICAL USER INTERFACE SOFTWARE

2.8 OPERATING SYSTEM:

A. The GUI shall run on Microsoft Windows Vista or Windows 7 and comply with the owners IT standards

B. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.

C. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:

1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.

2. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL’s, and links to other graphic screens.

3. Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.

4. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
   a. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
   b. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
5. Commands to start and stop any binary objects and all digital output points shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. Provide a timed override function, giving the user the choice to have the override expire after the set time limit (selectable between 0, indefinite or 99999 minutes at intervals of one minute). All points in override shall change their color to yellow to visualize the override state and provide that information to a “Points in Override log”

6. Adjustments to any analog object, such as set points and all analog or floating point outputs shall be done by right-clicking the selected object and using a graphical slider or “pop up menu” to adjust the value. Provide a timed override function, giving the user the choice to have the override expire after the set time limit (selectable between 0, indefinite or 99999 minutes at intervals of one minute). All points in override shall change their color to yellow to visualize the override state and provide that information to a “Points in Override log”

D. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:

1. Create, delete or modify control strategies.
2. Add/delete objects to the system.
3. Tune control loops through the adjustment of control loop parameters.
4. Enable or disable control strategies.
5. Generate hard copy records or control strategies on a printer.
6. Select points that are to be alarm able and define the alarm state.
7. Select points to be trended over a period of time and initiate the recording of values automatically.

E. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.

F. Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all operators. Each operator password shall be able to restrict the operators’ access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

G. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels,
H. Alarm Console

1. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator. There shall be at least two alarms consoles installed, one at Foothill college and one at De Anza college.

2. When the Alarm Console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

2.9 WEB BROWSER CLIENTS

A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Google Chrome™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable. “Plug Ins” are permissible as long as they are available for no additional cost and unlimited use.

B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the BAS, shall not be acceptable.

C. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

D. The Web browser client shall support at a minimum, the following functions:

1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.

3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
4. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.

5. Real-time values displayed on a Web page shall update once every minute automatically without requiring a manual “refresh” of the Web page.

6. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
   a. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
      1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
      2) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
   b. Commands to start and stop any binary objects and all digital output points shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. Provide a timed override function, giving the user the choice to have the override expire after the set time limit (selectable between 0, indefinite and up to 99999 minutes in one minute intervals) All points in override shall change their color to yellow to visualize the override state and provide that information to a “Points in Override log”
   c. Adjustments to any analog object, such as set points and all analog or floating point outputs shall be done by right-clicking the selected object and using a graphical slider or “pop-up menu” to adjust the value. Provide a timed override function, giving the user the choice to have the override expire after the set time limit (selectable between 0, indefinite and 99999 minute in one minute intervals) All points in override shall change their color to yellow to visualize the override state and provide that information to a “Points in Override log”
   d. View logs and charts
   e. View and acknowledge alarms
   f. Setup and execute SQL queries on log and archive information
   g. Users with the appropriate privileges shall be able to run any log or query or report defined in this or any other section of this document.

7. The system shall provide the capability to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to only their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

8. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.
2.10 SERVER AND LOCAL WORKSTATION FUNCTIONS AND HARDWARE

A. The existing central server(s) is located in the District’s office. The Owner shall provide LAN connectivity for connection between the project and the server.

B. Local connections shall be via an Ethernet LAN. Remote connections via ISP, provided by the BAS contractor for the duration of the project. Provide a speed appropriate for the installation.

C. It shall be possible to provide access to all Network Area Controllers via a single connection to the server or the local workstation. In this configuration, each Network Area Controller can be accessed from a remote Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the server.

D. The project shall provide a local user workstation. The local workstation shall provide the following functions, at a minimum:

1. Global Data Access: The local workstation shall provide complete access to distributed data defined anywhere in the system.

2. Distributed Control: The local workstation shall provide the ability to execute global control strategies based on control and data objects in any NAC in the network, local or remote.

E. Workstation Hardware Requirements: The workstation hardware platform shall meet or exceed the following requirements:

1. The workstation shall be an IBM compatible, Dual Core processor based computer with the following minimum configuration:
   a. 3.1 GHz Quad Blade Server
   b. 8.0 GB RAM
   c. 3 x 500-gigabyte hard drive 7200 RPM, installed on 6 port hot swap RAID controller
   d. 48X DVD-CDRW combination drive
   e. 2-parallel ports
   f. 2-asynchronous serial ports
   g. 4-USB ports
   h. 24”flat panel color monitor, 1920 x 1200 optimal preset resolution, 6 ms response time
   i. 104 key keyboard
   j. optical mouse with scroll wheel

2. Connection to the BAS network shall be via an Ethernet network interface card, 10/100 Mbps.
3. The operating system shall be Microsoft Windows MS Vista or Windows 7. Include Microsoft Internet Explorer 8.0 or later. Include Adobe Acrobat standard 9.0 or later. Include MS Office 2007 Professional or later.

4. Two system/alarm printers shall be provided, one at Foothill college and one at De Anza college. Printers shall be inkjet or laser type with a minimum 1200 x 1200-dpi resolution and rated for 18 PPM print speed minimum. The printer shall be capable of printing wide format (11”x17”) paper duplex and optimize alarm printing to use the entire page before starting a new page.

5. Provide one system/alarm printer. Printer shall be laser type with a minimum 1200 x 1200 dpi resolution and rated for 18 pnm print speed minimum. The printer shall be capable of printing 11” x 17” paper duplex and optimize alarm printing to use the entire page before starting a new page.

6. Provide one trend and application printer. The printer shall be dedicated for trends and reports provide a color laser configured to print trend logs and graphs up to 11x17.

2.11 SYSTEM PROGRAMMING

A. The Graphical User Interface software (GUI) shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the GUI shall be through password access as assigned by the system administrator.

B. A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide “real-time” data updates. Any real-time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface displays shall not be acceptable.

C. All programming tools required to configure or program any of the NAC, LonWorks or BACnet controllers connected to the BAS system shall be located on the GUI. All data files associated with those tools shall also be located on the GUI. The owner and their designated representatives shall have unlimited access as requested by the owner. No licensing agreements shall restrict the access of the owner or the designated representatives from accessing any tool or data.

D. Programming Methods

1. Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user’s application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will
support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.

2. Configuration of each object will be done through the object’s property sheet using fill-in-the-blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.

3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.

4. All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects shall not be accepted.

5. The system shall support object duplication within a customer’s database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

2.12 OBJECT LIBRARIES

A. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.

B. The objects in this library shall be capable of being copied and pasted into the user’s database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.

C. In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.

D. All control objects shall conform to the control objects specified in the BACnet™ specification.

E. The library shall include applications or objects for the following functions, at a minimum:

1. Scheduling Object. The schedule must conform to the schedule object as defined in the BACnet™ specification, providing 7-day plus holiday & temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on-off events.
2. Calendar Object. The calendar must conform to the calendar object as defined in the BACnet™ specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphical “point-and-click” selection. This object must be “linkable” to any or all scheduling objects for effective event control.

3. Duty Cycling Object. Provide a universal duty cycle object to allow repetitive on/off time control of equipment as an energy conserving measure. Any number of these objects may be created to control equipment at varying intervals.

4. Temperature Override Object. Provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling etc.) to maintain occupant comfort or for equipment freeze protection.

5. Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un-occupancy time just far enough ahead to take advantage of the building’s “flywheel” effect for energy savings. Provide automatic tuning of all start / stop time object properties based on the previous day's performance.

6. Demand Limiting Object. Provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment set points to effect the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the set point, a message shall be displayed on the users screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.

F. The library shall include control objects for the following functions. All control objects shall conform to the objects as specified in the BACnet™ specification.

1. Analog Input Object - Minimum requirement is to comply with the BACnet™ standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.
2. Analog Output Object - Minimum requirement is to comply with the BACnet™ standard for data sharing.

3. Binary Input Object - Minimum requirement is to comply with the BACnet™ standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an “on” condition. The user must be able to specify either input condition as the “on” condition.

4. Binary Output Object - Minimum requirement is to comply with the BACnet™ standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as interstart delay must be provided. The BACnet Command Prioritization priority scheme shall be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide sixteen levels of priority as a minimum. Systems not employing the BACnet method of contention resolution shall not be acceptable.

5. PID Control Loop Object - Minimum requirement is to comply with the BACnet™ standard for data sharing. Each individual property must be adjustable as well as to be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral and derivative control.

6. Comparison Object - Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.

7. Math Object - Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.

8. Custom Programming Objects - Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including math and logic functions, string manipulation, and e-mail as a minimum. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for re-use.

9. Interlock Object - Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as an Air Handler or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other
related objects within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.

10. Temperature Override Object - Provide an object whose purpose is to provide the capability of overriding a binary output to an “On” state in the event a user specified high or low limit value is exceeded. This object is to be linked to the desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be enabled. This object will execute a Start command at the Temperature Override level of start/stop command priority unless changed by the user.

11. Composite Object - Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the “contained” application that are represented on the graphical shell of this container.

2.13 MODBUS SYSTEM INTEGRATION

A. The preferred means of integrating data from a third-party product into the BAS will be either a BACnet™ or LonWorks interface. In the event that either of these two communication protocols is unavailable as an option for integration of existing legacy systems, integration of device data via Modbus may be acceptable.

B. The Network Area Controller shall support the integration of device data from Modbus RTU, ASCII, or TCP control system devices. The connection to the Modbus system shall be via an RS-232, RS-485, or Ethernet IP as required by the device.

C. Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the Modbus system data into the BAS. Objects provided shall include at a minimum:
   1. Read/Write Modbus AI Registers
   2. Read/Write Modbus AO Registers
   3. Read/Write Modbus BI Registers
   4. Read/Write Modbus BO Registers

D. All scheduling, alarming, logging and global supervisory control functions, of the Modbus system devices, shall be performed by the Network Area Controller.

E. The equipment system vendor that provided the equipment utilizing Modbus shall ensure that the existing system’s database is setup to make all data to be integrated into the BAS available at the interface. Any modifications to the existing system database to accomplish this shall be the responsibility of the equipment system vendor that provided the equipment utilizing Modbus.
F. The BAS supplier shall provide a Modbus system communications driver. The equipment system vendor that provided the equipment utilizing Modbus shall provide documentation of the system’s Modbus interface and shall provide factory support at no charge during system commissioning.

2.14 VFD DRIVE CONTROL AND MONITORING (VFD)

A. These points shall be hard wired from the new control system to the VFD’s. The control signal for the VFD shall be wired directly to the controller controlling the VFD. Do not use the BAS network to communicate the control signal from the source to the controller.

1. VFD Enable
2. Commanded Speed in either Hz or percent of full speed

B. The general alarm shall include any alarm that will cause the drive to stop running.

C. All VFD’s shall also be connected thru a serial connection and provide all available information to the BAS. For additional information see section 4. Provide a suggested point mapping list during the submittal phase. As a minimum the following points shall be available.

<table>
<thead>
<tr>
<th>Description</th>
<th>Type</th>
<th>Device</th>
<th>Trend Logging</th>
<th>Calibra-</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>tion</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Commissioning</td>
<td>Continuous</td>
</tr>
<tr>
<td>Fault reset</td>
<td>DO</td>
<td>Through network</td>
<td>COV</td>
<td>COV</td>
</tr>
<tr>
<td>On/off status</td>
<td>DI</td>
<td>Through network</td>
<td>COV</td>
<td>COV</td>
</tr>
<tr>
<td>Fault (Critical Alarm)</td>
<td>DI</td>
<td>Through network</td>
<td>COV</td>
<td>COV</td>
</tr>
<tr>
<td>Minor Alarm</td>
<td>DI</td>
<td>Through network</td>
<td>COV</td>
<td>COV</td>
</tr>
<tr>
<td>Fault Text</td>
<td>DI</td>
<td>Through network (convert code to plain English text)</td>
<td>COV</td>
<td>COV</td>
</tr>
<tr>
<td>Alarm Text</td>
<td>DI</td>
<td>Through network (convert code to plain English text)</td>
<td>COV</td>
<td>COV</td>
</tr>
<tr>
<td>Keypad in hand/auto</td>
<td>DI</td>
<td>Through network</td>
<td>COV</td>
<td>COV</td>
</tr>
<tr>
<td>Minimum frequency setpoint</td>
<td>AO</td>
<td>Through network</td>
<td>± 5%</td>
<td>± 5%</td>
</tr>
<tr>
<td>Maximum frequency setpoint</td>
<td>AO</td>
<td>Through network</td>
<td>± 5%</td>
<td>± 5%</td>
</tr>
<tr>
<td>Acceleration rate</td>
<td>AO</td>
<td>Through network</td>
<td>± 5%</td>
<td>± 5%</td>
</tr>
<tr>
<td>Deceleration rate</td>
<td>AO</td>
<td>Through network</td>
<td>± 5%</td>
<td>± 5%</td>
</tr>
<tr>
<td>Actual frequency</td>
<td>AI</td>
<td>Through network</td>
<td>1 min</td>
<td>15 min</td>
</tr>
<tr>
<td>AC output voltage</td>
<td>AI</td>
<td>Through network</td>
<td>± 10%</td>
<td>± 10%</td>
</tr>
<tr>
<td>Current</td>
<td>AI</td>
<td>Through network</td>
<td>15 min</td>
<td>60 min</td>
</tr>
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</table>
Contra Costa Community College District
Los Medanos College
L-630 New Brentwood Center
DSA Application #01-116287

<table>
<thead>
<tr>
<th>VFD temperature</th>
<th>AI Through network</th>
<th>60 min</th>
<th>60 min</th>
<th>F</th>
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</thead>
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<tr>
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<td>AI Through network</td>
<td>1 min</td>
<td>15 min</td>
<td>F</td>
</tr>
<tr>
<td>Energy, MWh</td>
<td>AI Through network</td>
<td>15 min</td>
<td>60 min</td>
<td>-</td>
</tr>
<tr>
<td>DC Bus Voltage</td>
<td>AI Through network</td>
<td>± 10%</td>
<td>± 10%</td>
<td>F</td>
</tr>
</tbody>
</table>

2.15 VALVES AND ACTUATORS

A. Electronic Actuators (By Belimo)

Electronic actuators for dampers and control valves shall be direct coupled type.

1. Actuator shall be fully modulating, floating (tri-state), two position, and/or spring return as indicated in the control sequences. Specified fail safe actuators shall require mechanical spring return.

2. Modulating valves shall be positive positioning, responding to a 2-10VDC or 4-20mA signal. There shall be a visual valve position indicator.

3. If specified or detailed on the control schematic, provide auxiliary switches, or feedback potentiometers. All analog input actuators shall have built-in feedback output providing a true position reading.

4. Actuator shall provide minimum torque required for proper valve close-off. The actuator shall be designed with a current limiting motor protection, and shall not require the use of a mechanical end stops or brakes for motor protection. A release button clutch or handle on the actuator shall be provided to allow for manual override (except when actuator is spring return type less than 133 in.lbs.).

5. Actuators shall be UL listed.

B. CHILLED WATER and HEATING HOT WATER CONTROL VALVES (By Belimo or equal)

1. 2-way and 3-way Control Valves shall be Characterized Flow Type
   a. Valve bodies shall be nickel-plated, forged brass with female NPT threads. Bodies to 1-1/4” shall be rated at 600 psi and sizes 1-1/2” to 2-1/2” at 400 psi and shall have a four bolt mounting flange to provide a 4 position, field changeable, electronic actuator mounting arrangement. A vent hole shall be provided to reduce condensation build-up. Provide a stainless steel ball and a self-aligning, blowout proof, stem with a dual EPDM O-ring packing design. Fiberglass reinforced Teflon seats shall be used.
   b. A TEFZEL, flow-characterizing disc shall be installed in the inlet of Two-way characterized control valves and in the control port of Three-way valves.

2. Actuators shall be electronic actuators directly coupled to the valve at the factory.
a. The actuator for valves shall modulate the control valve for 0 to 100% design flow while rotating a maximum of 90 degrees. Actuators shall be minimum NEMA 2 rated. Multi-turn actuators are not acceptable.

b. Actuators controlled by an analog input signal Multi-Function Technology as manufactured by Belimo or equal, shall provide adjustable DC voltage feedback capability.

c. Valve assemblies with actuators controlled by a 3-point floating control signal shall incorporate an integral manual maximum flow setting device with a visible scale.

3. On any valve assembly exposed to the weather, provide a factory engineered weather cover designed to NEMA 4 specifications.

C. VAV Damper Actuators (Belimo, or equal, unless integral to the controller)

1. Provide 24v, normally open actuators, modulating, and FAIL at Place type actuators.

2. Position feedback for dampers used in AHU economizer per contract drawings. Unit shall be Belimo MFT, 0-10v output.

2.16 SENSORS

A. RIGID DUCT MOUNTED TEMPERATURE SENSORS

1. Platinum RTD sensors: 10K Ω +/- 0.75%, Alpha : 375

2. Thermistor sensors: +/- 0.2 C interchangeability @ 77 F/ 0 C

   a. Probe Material: 1/4" / 6.3mm O.D, 0.020" / 0.5mm wall 304 Stainless Steel
   b. Flange Material: 304 Stainless Steel
   c. Bulkhead Fitting: Brass with poly compression sleeve
   d. Plastic Enclosure: Polycarbonate 30% glass filled, rated UL 94V-5-0
   e. Steel NEMA-1 / IP-30: 18 Ga. Galvanized Steel

B. FLEXIBLE DUCT MOUNTED AVERAGING TEMPERATURE SENSORS

1. Platinum RTD sensors: 10K Ω +/- 0.1% @ 0 C, Alpha : 385 per DIN 43760

2. Thermistor sensors: +/- 0.2 C interchangeability @ 77 F/ 0 C

   a. Probe Material: 3/8" aluminum
   b. Cable: plenum rated
   c. Plastic Enclosure: Polycarbonate 30% glass filled, rated UL 94V-5-0
3. The sensor probe can be of a bendable aluminum type or a multi point plenum cable sensors. The probe length shall vary from not less than 6ft to 24 ft to suit the application. For large ductwork, use multiple sensors if appropriate. Use at least 5ft length for 10sf of cross section.

C. IMMERSION TYPE TEMPERATURE SENSORS

1. Platinum RTD sensors: +/- 0.1% @ 0 C, Alpha : 385 per DIN 43760

2. Thermistor sensors: +/- 0.2 C interchangeability @ 77 F/ 0 C
   a. Probe Material: 1/4" / 6.3mm O.D, 0.020" / 0.5mm wall 304 Stainless Steel
   b. Flange Material: 304 Stainless Steel
   c. Bulkhead Fitting: Brass with poly compression sleeve
   d. Plastic Enclosure: Polycarbonate 30% glass filled, rated UL 94V-5-0
   e. Steel NEMA-1 / IP-30: 18 Ga. Galvanized Steel

3. Thermowells: 304 SS thin wall probe with a cold rolled hermetically sealed end form, a monolithic encapsulated cavity for the sensor and immune to failures caused by high humidity, contamination, thermal shock and vibration. Thread option combinations of ¾" external and ½" internal or ½" external and ¼" internal as needed by the probe selected

D. TERMINAL UNIT SPACE TEMPERATURE Thermostat

1. The BAS contractor shall use the standard DDC manufacturer specific thermostat if the thermostats are directly connected to the terminal unit controller for the purpose of controlling that unit. Any such thermostats shall have the following minimum capabilities:
   a. Network access to all networked DDC controllers in the building
   b. +/- 2% accuracy, in the range of -4 deg F to 140 deg F
   c. push button override for after hour functions
   d. Provide multifunction LCD display

2. All new building space temperature thermostats, terminal unit controller or not, shall allow for building wide BAS network access.

E. LOW PRESSURE TRANSDUCERS

1. For VDC output units provide dual outputs, either 0 to 5 or 0 to 10 VDC, and dual unregulated supply voltages 12 to 35 VAC or 12 to 40 VDC, that automatically configures for AC or DC with no field selection necessary. Fully protect the output from short circuit to ground, or if the supply voltage is applied by mistake to the output. The VDC output unit must handle low impedance circuits. The unit shall be able to drive up to 1k ohms minimum. to ensure
multiple controllers, indicators, or other devices that can be paralleled to the output without performance degradation.

2. The mA output units shall function over a wide unregulated supply voltage range: 12 to 40 VDC without any effect on calibration or performance. The unit must have reverse polarity protection built in, so as not to damage the unit by miss-wiring, and by using sophisticated low drop-out voltage regulators and CMOS integrated circuits, the mA output unit can drive very high output impedance. In fact, with only 12 VDC supply, the unit can drive 200 ohms. At 40 VDC, the unit is capable of handling up to a 1600 ohm load. In this way, the output loop can be tied in series to multiple controllers, indicators, and other devices without degrading the performance.

   a. Accuracy: ± 1% Full Scale
   b. Overpressure: 10 PSID
   c. Supply Voltage: 12 - 40 VDC, 12 - 35 VAC (VDC output units only)
   d. Supply Current: VDC units - 10 mA max.; mA units - 20 mA max.
   e. Enclosure: 18 Ga. C.R. steel NEMA-4 (IP-65) or panel mount chassis
   f. Finish: Baked on enamel PMS2GR88B
   g. Compensated Temperature Range: 25°F to 150°F
   h. T. C. Error: ± 0.0125%/°F
   i. Operating Temperature Range: 0°F to 175°F
   j. Media Compatibility: Clean dry air or any inert gas
   k. Environmental: 10 - 90% RH non-condensing
   l. Wire Size: 12 Ga. Maximum, 18 Ga. minimum
   m. Load Impedance: 1.6K ohms max. at 40 VDC (mA output units) 1K ohms min. (VDC output units)
   n. Local LCD display

3. The BAS contractor shall indicate what type of units will be used at the submittal stage. If the wiring run to the transmitter exceeds 50 ft., a mA unit will be required. As a minimum, all low pressure transmitters will have to be zero calibrated during startup with a NIST traceable device. All calibrations will have to be recorded in the sensor calibration log.

F. DUCT PRESSURE TRANSDUCERS

1. The duct pressure transducer shall be an integrated unit with the sensing element and the pressure pickup being one single unit without having to field assemble any parts of the unit. The sensor shall be available in a mA and VDC output version. The VDC version shall have an option to field select the output from 0-5VDC or 0 to 10VDC. The high end of the transducer range shall not exceed the maximum operating range by more than 10%. The maximum
operating range is defined as the maximum design pressure allowed in the system.

a. Accuracy*: ± 1% FS
b. Overpressure: 10 PSI
c. Supply Voltage: 12 - 40 VDC; 12 - 35 VAC (VDC output units only)
d. Supply Current: 10 mA maximum VDC output transducers; 20 mA maximum mA output transducers
f. Finish: Baked-on enamel PMS2GR88B
h. Compensated Temperature Range: 25°F to 150°F
i. T. C. Error: ± 0.0125%/°F
j. Media Compatibility: Clean dry air or any inert gas
k. Environmental: 10 to 90% RH non-condensing
l. Wire Size: 12 Ga. maximum
m. Load Impedance: 1.6 ohms maximum at 40 VDC (mA output units); 1,000 ohms minimum (VDC output units)
n. Local LCD display

2. The BAS contractor shall indicate what type of unit will be used at the submittal stage. If the wiring run to the transmitter exceeds 100 ft., a mA unit will be required. As a minimum, all duct pressure transmitters will have to be at zero calibrated during startup with a NIST traceable device. All calibrations will have to be recorded in the sensor calibration log.

G. DIFFERENTIAL PRESSURE TRANSDUCERS AND PRESSURE TRANSDUCERS (Wet)

1. The pressure transducer shall be an integrated unit with the sensing element and the pressure pickups being one single unit without having to field assemble any parts of the unit. The sensor shall be available in a mA and VDC output version. The VDC version shall have an option to field select the output from 0-5VDC or 0 to 10VDC. The high end of the transducer range shall not exceed the maximum operating range by more than 20%. The maximum operating range is defined as the maximum differential pressure expected in the system.

a. Accuracy: ± 1% FS
b. Overpressure: 300% of rated range
c. Burst Pressure: 500% of rated range
d. Maximum Static Pressure: 200% of DP range
e. Supply Voltage: 12-40 VDC / 12-35 VAC (VDC output units only)
f. Supply Current: VDC units - 10 mA max.; mA units - 20 mA max.
g. Enclosure: 18 Ga. C.R. steel NEMA-4 (IP-65)
i. Compensated Temperature Range: 0°F to 180°F
j. T.C. Error: ± 0.025%/°F
k. Media Compatibility: Liquid/gases compatible to 316L stainless steel
l. Port Connection: 1/8" NPT
m. Environmental: 10 - 90% RH non-condensing
n. Wire Size: 12 Ga. maximum
o. Load Impedance: 3K ohms max. at 40 VDC (mA output units); 1K ohms min. (VDC output units)
p. Local LCD display

2. The BAS contractor shall indicate what type of unit will be used at the submittal stage. If the wiring run to the transmitter exceeds 100 ft., a mA unit will be required. The pressure transmitters will have to be calibrated during startup with a NIST traceable device. All calibrations will have to be recorded in the sensor calibration log.

H. CURRENT TRANSFORMERS (for status indication and single phase power monitoring)

1. The current transformers shall be made for field installation and rated to be installed in a panel or in a MCC. The sensors shall be selected that the maximum range is no more than twice the motor rating. The BAS contractor shall setup the system that the user has tow points for each point monitored with a current transformer. The status point shall indicate “On” whenever the current sensor indicates more than 10% of rated motor draw. The second point, the kW point, shall be displaying the usage in kW calculated based on the amperage measured and the rated voltage with a power factor of 0.95 for any motor load for single phase motors. For three phase motors use three current transformers and average the amperage signal or use three inputs.

a. Output Signal 0-20mA, 4-20mA, 0-3VDC, 0-5VDC or 0-10VDC
b. Accuracy Fixed Core: 2% FS  Split-core: 1% FS
c. Repeatability 1.0% FS
d. Response Time Fixed Core: 200 ms (to 90% of step change)  Split-core: 100 ms (to 90% of step change)
e. Frequency Range DC
f. Power Supply 120VAC or 24VAC/DC, 2VA max

g. Power Consumption 2VA

h. Loading 0–20mA, 4–20mA: 650 Ω max.

i. Isolation Voltage 3kV (monitored line to output)

j. Linearity 0.75% FS

k. Current Ranges Field Selectable Ranges from 0–400A (select top range to be no more than twice motor max draw)

l. Sensing Aperture FL Case: 0.75" (19.1mm) dia. SP Case: 0.85" (21.6mm) sq.

m. Case UL 94V-0 Flammability Rated

n. Environmental –4 to 122°F, 0–95% RH, non-condensing

I. CURRENT SWITCHES (CS FOR STATUS INDICATION ONLY)

1. CS-1 (Constant Speed Motor Status Indication)
   a. Clamp-on or solid-core
   b. Range: 1.5 to 150 amps.
   c. Trip Point: Adjustable.
   d. Switch: Solid state, normally open, 1 to 135 VAC or VDC, 0.3 Amps. Zero off state leakage.
   e. Lower Frequency Limit: 6 Hz.
   f. Trip Indication: LED
   g. Approvals: UL, CSA
   h. May be combined with relay for start/stop.
   i. Where used for single-phase devices, provide the CS/CR in a self-contained unit in a housing with override switch. Kele RIBX, Veris H500, or equal.
   j. Manufacturers:
      1) Veris Industries H-708/908; Inc.
      2) RE Technologies SCS1150A-LED
      3) Or equal.

J. THREE PHASE POWER MONITORING (Furnished by Division 26)

1. The power meter shall consist of three split-core CTs hinged at both axis with the power metering electronics embedded inside of the master CT

2. The meter shall measure true (RMS) power, instantaneous demand (kW) and consumption (kWh)
3. The meter shall report kW/kWh serially over an RS-485 network using the Modbus (RTU) protocol.

4. The consumption (kWh) variable shall be stored in non-volatile memory and retained in the event of a power outage.

5. The meter shall directly accept any voltage input from 208-480 VAC.

6. The meter shall be calibrated as a system and be accurate to +/- 1% from 7% to 100% of the rated current over a temperature range of 0-60° C.

7. The meter shall conform to ANSI C12.1 metering standards.

8. The power meter shall be internally isolated to 2000 VAC.

9. The power meter case isolation shall be 600 VAC.

10. The power meter available ordering ranges shall be 100-2400 Amps.

K. WATER FLOW METERS

1. Flow meters shall be Onicon F-3000 Series, or equal.

2. The flow meter shall use non-intrusive electromagnetic sensing to measure flow.

3. The flow meter shall maintain +/- 1% accuracy over the full range.

4. One 4-20 mA Flow Output Signal, Two programmable Pulse Outputs.

5. Use low voltage or high voltage power supply depending on application.


7. The meter shall be able to measure flow in either direction if installed in locations where flow can go either way.

8. Use the manufacturer recommended installation practices to determine the most suitable location in the pipe system.

9. Local LDC display.

L. AIR FLOW METERS

1. Air flow meters shall be Ebtron GTx116-P+, Volu-flo Electra-flow thermal measurement device, or approved equal.

2. Installed Accuracy: ±3% of reading.

4. Transmitter shall be 24v with a field selectable output (4-20mA or 0-10VDC), scalable and isolated analog output signals plus one isolated Ethernet network connection.

M. **BTU METERS**

1. **ELECTRONICS ENCLOSURE:**
   a. Standard: Steel NEMA 13, wall mount, 8"x10"x4"
   b. NEMA 4 (for outdoor applications)
   c. Alphanumeric LCD displays total energy, total flow, energy rate, flow rate, supply temperature and return temperature Alpha: 16 character, 0.2" high; Numeric: 6 digit, 0.4" high
   d. Isolated solid state dry contact for energy total Contact rating: 100 mA, 50V Contact duration: 0.5, 1, 2, or 6 sec
   e. Analog Output(s) (4-20 mA, 0-10 V or 0-5 V):
   f. Serial Communications: BACnet MS/TP or LONWORKS, coordinate with BAS system

2. **TEMPERATURE THERMOWELLS:**
   a. Hot tap stainless steel thermo wells with isolation valves
   b. Use Onicon Solid state temperature sensors custom calibrated using N.I.S.T. traceable temperature standards. Current based signal (mA) is unaffected by wire length.

3. **FLOW SENSORS:**

N. **BMS INPUT POINT FIELD DEVICES**

1. **CO₂ SENSORS** shall be Viasala GMW 20 CO₂ transmitter, or approved equal. The transmitter shall be wall mounted type, single-beam, dual-wavelength technology based. Provide local display, calibration software kit, and 4-20mA output. Guarantee for 5-years calibration interval.

O. **BMS OUTPUT POINT FIELD DEVICES**

1. Output Isolation Relays:
   a. DDC panel outputs shall not be used for directly switching motor starter control power, or voltages greater than 24 volts. Digital inputs and outputs controlling these types of points shall only switch local 24 VAC, within the panel. The intent is to protect the panels Power Supply or I/O terminals, depending upon the controller used, from damage by accidental contact with higher voltages in the field. All such outputs shall be protected by two isolation relays and one independent low voltage power supply mounted remotely from the DDC panel. Relay power for devices powered by the local DDC panels installed power supply shall be from a different source.
then the source that powers the controllers CPU and I/O modules. For motors, isolation relays and the independent power supply shall be mounted in an auxiliary panel adjacent to the DDC panel. The independent relay power supply will be provided and will either switch another low voltage relay within the starter enclosure for the motor being controlled or will switch the motor itself.

b. Output isolation relays shall be plug-in type; double pole (minimum), double throw with base, indicator light, 24 volt coil, and 10 amp rated contacts. UL Recognized (IDEC RH Series or equal).

2.17 CONTROL POWER TRANSFORMER

A. Unit shall be RIB Functional Devices, Inc., PSH100A Series, 120-24V power supplies, or approved equal.

B. The unit shall be complete with 120 VAC convenience outlet, On/Off switch and breaker, and LED indicator light.

C. The power transformer shall be mounted in a NEMA 1 enclosure with external terminal strip for control power distribution.

2.18 SPARE MATERIALS

A. Provide spare materials for the proposed system. As a minimum, provide one for each sensor type and one for each controller type used in the system. In addition, provide one actuator for each type of valve and damper actuator. Provide a list of the parts provided during the submittal phase. Not submitting the parts during the submittal phase will still require the contractor to provided them during the closeout.

2.19 RELAYS:

A. IDEC, Potter Brumfield, Square D, or Allen Bradley, or equal.

B. Equal to IDEC type RH2B-U, miniature 8 blade pilot relay with DPDT silver cadmium oxide contacts rated at 15A, 30 VDC, or 120 VAC. Coil shall match control circuit characteristics. DDC outputs shall be 24 VDC with maximum current burden of 50 milliamps. Rectangular base socket mount with blade type plug-in terminals and polycarbonate dust cover.

C. Provide DIN rail mountable (Snap type) mounting sockets equal to IDEC SH2B-05.

D. All relays are to be equipped with a status LED.

E. All relay bases to be rail mounted.

2.20 CO2 SENSOR

A. Vaisala model GMW 20, CO2 transmitter.
B. Provide local display.

C. 4-20 mA output

D. Furnish one calibration software kit, 19222GM

E. 20 to 30VDC, 24VAC supply voltage.

F. Accuracy: ± (2% of range + 2.0% of reading)

G. Measurement range: 0 to 2000 ppm

H. Operating environment:
   1. Temperature: -5 ... +45°C (+23 ... 113°F)
   2. Humidity: 0 ... 85% RH non-condensing

PART 3 - EXECUTION

3.1 GENERAL

A. The owner will provide the permanent IP connection to the workstation hosting the GUI, as long as they have been identified during the submittal phase.

B. The BAS contractor shall provide any temporary network wiring required during the startup, checkout and commissioning phase for testing of the system.

C. From the time of system startup thru the commissioning phase to the end of construction, the contractor shall provide a broadband internet connection to the system that will allow the contractor and owner representatives to access the system from any location on and off site. This connection shall be maintained by the contractor and not depend on the owners network. The contractor shall be responsible for the installation and maintenance of this temporary connection to the ISP at least until the systems is accepted or permanently connected to the owners GUI.

3.2 WIRING

A. All electrical control wiring and power wiring to the NAC and other equipment shall be provided by the BAS contractor.

B. Low voltage wiring concealed above accessible ceilings does not require raceways, however, cables run above accessible ceilings shall be run within a j-hook pathway system spaced no more than 4 ft apart. The BAS systems cabling shall use it’s own raceway. Cables run in concealed areas or within un-accessible spaces shall be installed in EMT or rigid pipe. Run pathways and cables parallel and perpendicular to the building structure.
c. All control wiring located in mechanical rooms or exposed spaces shall be run in EMT. Use of flexible conduit shall be permitted for the final connection to the field device only; length of the flex conduit shall not exceed 3 ft.

D. Flexible Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment.

E. Use 600 Volt rated wires and cables for the BAS system whenever NEC permits the mixing of low voltage and high voltage wiring in the same enclosure.

F. General: Provide copper wiring, plenum cable, and raceways as specified. All components shall be UL approved and locate for accessibility, to NEC requirements.

G. All insulated wire to be copper conductors, UL labeled for 90°C minimum service.

H. Class 2 circuits (not over 30V and 100 VA) include most temperature control wiring for programmable controllers and LAN that interconnect computers. Class 2 power sources must be durably marked and circuits must be wired with TP, CM, CMP, CL2P, CL2 or CL3 cable or THHN-THWN.

I. Class 3 power sources must be durably marked (not exceeding 150V and not over 100 VA) and circuits must be wired with CL3 or CM cable or THHN-THWN.

J. Class 1 remote control and signaling circuits shall not exceed 600 volts and require over-current protection. Class 1 circuits include motor control circuit wired from a separate power source than the circuit serving the motor. A motor control circuits tapped to the motor power wiring are not Class 1 conductors, but are motor control conductors as defined per Section 430-71 and must conform to Article 430 Part F.

K. Power Limited Class 1 Circuits include either ac or dc and must be supplied power from a power source that limits the output to 30V and 1,000 VA. An example could be power to large damper actuators. Cables shall be 600V rated. Conductor sizes no smaller than #18 to 6 amps and not smaller than #16 to 8 amps.

L. Digital signal controls conductors shall be stranded copper, meet the minimum requirements of the NEC, DDC manufacturer's requirements, and comply with the following minimum requirements:
   1. Digital Input (Low Voltage): #20, 750 feet maximum distance.
   2. Analog Input & Analog Output: #20, 750 feet maximum distance.
   3. Communications: #22 TP, CM, CMP, CL2P.
   5. Digital Output (Class 1), Size based on Load, check Table below:
### Maximum Class 1 DO Wire Run Lengths Table

<table>
<thead>
<tr>
<th>Normal Inrush</th>
<th>Starter Size</th>
<th>#18 Wire (max. 6 amps)</th>
<th>#16 Wire (max. 8 amps)</th>
<th>#14 Wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 VA</td>
<td>0 &amp; 1</td>
<td>500 ft.</td>
<td>900 ft.</td>
<td>1400 ft.</td>
</tr>
<tr>
<td>550 VA</td>
<td>2</td>
<td>200 ft.</td>
<td>300 ft.</td>
<td>500 ft.</td>
</tr>
<tr>
<td>1150 VA</td>
<td>3</td>
<td>100 ft.</td>
<td>150 ft.</td>
<td>250 ft.</td>
</tr>
<tr>
<td>1500 VA</td>
<td>4</td>
<td>70 ft.</td>
<td>100 ft.</td>
<td>200 ft.</td>
</tr>
</tbody>
</table>

Table Notes: Distances shown are to provide less than 10% voltage drop across wire

### 3.3 FIBER OPTIC CABLE SYSTEM:

A. Optical cable: Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. The sheath shall be UL Listed OFNP in accordance with NEC Article 770. The optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125mm.

B. Connectors: All optical fibers shall be field-terminated with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.

### 3.4 PANELS

A. All Control Panels shall be rated at Nema 12 for indoor applications and Nema 4 for any outdoor application. The panels shall be able to maintain ambient conditions required for the equipment installed in the panel.

1. All panels to be equipped shall be equipped with auxiliary dual 120VAC outlets for testing equipment. The panel shall have one power switch that will disconnect the power to all equipment in the panel with the exception of the auxiliary dual 120VAC outlets.

2. All controllers and network equipment for the BAS system shall be powered by a permanent UPS, sized to provide power for at least five minutes to all control equipment in the panel in case of a power failure.

3. The controllers shall be selected to provide 20% spare capacity for each input and output type. (AI, AO, TZAO, DO)

### 3.5 INSTALLATION OF SENSORS

A. Install sensors in accordance with the manufacturer’s recommendations.

B. Mount sensors rigidly and adequately for the environment within which the sensor operates.

C. Room temperature sensors shall be installed in concealed junction boxes properly supported by the wall framing. Insulating bases shall be provided for thermostats.
located on exterior walls and walls adjoining non-conditioned spaces. Locate adjustable thermostats 42 inches above the floor unless otherwise indicated on the drawings or as directed by the Architect / Engineer / Owner.

D. Provide surface mounted stainless steel perforated face enclosure for sensors in corridors, gymnasium and similar "High Probable Damage" locations. Aspirate if recommended by the manufacture.

E. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.

F. Unless otherwise noted, sensors used in mixing plenums and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.

G. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 3 m of sensing element for each 1 m² (1 ft of sensing element for each 1 ft²) of coil area.

H. All pipe-mounted temperature sensors shall be installed in stainless steel wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.

I. Install outdoor air temperature sensors on north wall, complete with sun shields at designated locations.

3.6 DIFFERENTIAL AIR STATIC PRESSURE.

A. Supply Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if applicable) or to the location of the duct high-pressure tap and leave open to the plenum.

B. Return Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the low-pressure tap tubing of the corresponding building static pressure sensor.

C. Building Static Pressure: Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe the high-pressure port to a location behind a thermostat cover. Locate such that prevailing winds will not affect readings.

D. The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.

E. All pressure transducers, other than those controlling VAV boxes, shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without use of ladders or special equipment.
F. All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shutoff valves installed before the tee.

G. Pressure sensors, gauges and control taps mounted in horizontal pipe shall be mounted above the horizontal plane of the pipe to prevent entrance of sediment into these and similar devices.

3.7 WARRANTY

A. Following acceptance testing, the Division 25 contractor shall be responsible for all initial troubleshooting when a system problem arises in the integrated control system. Upon initial checkout, if the problem cannot be determined and resolved, it may require temporary isolation of the Control System from the Network Area Controller.

B. Equipment, materials and workmanship incorporated into the work shall be warranted by the Division 25 for a period of one year from the time of system acceptance.

C. Within this period, upon notice by the Owner, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by the Division 25 contractor at no expense to the Owner.

3.8 WARRANTY ACCESS

A. The owner shall grant reasonable access to the BAS contractor during the warranty period. The owner shall also allow the contractor to access the BAS from a remote location for the purpose of diagnostics and troubleshooting, via the Internet, during this period.

B. The manufacturer shall provide help desk access for the owner during normal business hours for technical support by the factory. This help desk shall be available for at least 2 years after the warranty expires. It shall be available to all trained owner personnel.

3.9 CHECKOUT AND TESTING

A. The BAS contractor shall provide a 48 hour notice to the commissioning agent and the owner to provide both parties the opportunity to witness any or all of the work. Commissioning activities performed without notice may not be accepted by the owner.

B. The BAS contractor shall develop all the pre-functional and functional performance test sheets and submit for approval.

C. The pre-functional tests for the primary system such as the chillers, boiler AHU’s and related equipment will be an end to end point check that has to be performed with the operational GUI tested from the point of origin to the GUI graphic.

1. Valves (modulating or floating) need to be stroked fully open to fully closed. Verify that the speed of actuation is appropriate for the application and the rated
speed of the actuator is achieved. Visual inspection of the open and closed position.

2. Dampers (modulating or floating) need to be stroked fully open to fully closed. Verify that the speed of actuation is appropriate for the application and the rated speed of the actuator is achieved. Visual inspection of the open and closed position.

3. Solenoids need to be stroked open to closed. Visual inspection of the open and closed position.

4. All sensors, such as temperature, humidity pressure or other specialty sensors need to be calibrated and the offset values noted in the test. Sensors found to be outside their specified accuracy range shall be replaced. Calibration to be verified with NIST traceable instruments.

5. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.

6. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.

7. Verify that all control wiring is properly connected and free of all shorts and ground faults and verify that terminations are tight.

8. Tune all DDC loops.

D. The functional tests for the system shall be designed to verify the sequence of operation as approved by the owner. The test shall simulate at least one full cycle of operation to observe an equipment startup and shutdown cycle and a normal use period. It shall include a test for all associate safeties. For equipment operated 24 hours, the equipment shut down and start up shall be done manually via the GUI. All other control functions shall be in automatic mode. The verification shall be end to end for each piece of equipment with the operational GUI tested from the point of origin to the GUI graphic.

E. As a minimum, the systems shall trend all physical I/O’s and all set-points. Digital values shall be trended on a COV basis. Analog values shall be trended based at 1 minute intervals or based on a 1% change of full range.

F. On all trend reports and graphs each point shall be identified exactly to its use and what equipment it is associated with. For example: Discharge air temperature sensor for AHU-1 in Building 23 should be labeled as: \textit{B23 AHU\_1 Da Temp}. This will allow a user to select similar sensors to produce a report while still knowing what building and equipment to which it is associated with.

3.10 COLOR GRAPHICS

A. The Web browser GUI shall make extensive use of color in the graphic pane to communicate information related to set-points and comfort. Animated graphics controls shall be used to enhance usability. The GUI workstation software shall
graphically display in 1024 by 768 pixels 24 bit True Color or better. Graphics shall be navigated through a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the system. As a minimum, the following color graphics shall be developed:

1. **Graphics Banner**: Provide a one line banner on top of each graphics page that shows specific information as selected by the owner. This banner shall be visible from any point in the system on any graphic. As a minimum, provide a communications status indication, site humidity, site temperature and the system time. The communications status shall be organized by campus and turn from green to red whenever any of the network devices report a communications issue.

2. **WAN Graphic**: System entry screen with links to all Building Graphics for buildings connected to the BAS Wide Area Network. WAN Graphic shall show locations of controlled buildings in relation to local landmarks. (Operator sign-on and password shall be required.)

3. **Building Graphic**: Building entry screen providing links to each Floor Plan Graphic and mechanical rooms. (Operator sign-on and password into each building may be required depending upon Owner security requirements and final system network architecture.)

4. **HVAC Floor Plan Graphic**: HVAC Floor Plan Graphics shall show heating and cooling zones throughout the buildings in a range of colors, which provide a visual display of temperature relative to their respective set-points. Color floor plans shall utilize a contiguous band of colors, each corresponding to actual zone temperatures relative to the desired heating and cooling set-points. The ideal temperature shall be shown as a green color band. Temperatures that are slightly warmer than ideal shall be shown in yellow, and even warmer temperature bands shall be shown in orange. Temperatures slightly cooler than ideal shall be light blue, and even cooler temperatures shall be shown as dark blue. All alarm colors shall be in red. The colors shall be updated dynamically as a zone’s actual comfort condition changes or the set-point is changed. The operator shall be able to select a zone on the graphic with the mouse and be automatically navigated to the HVAC Zone Graphic (Single) for that zone without the operator having to select the zone from the tree navigation structure.

5. **HVAC System Graphic**: The HVAC System Graphic shall show the system mechanical components through the use of a pictorial representation. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for all rotation or moving mechanical components to enhance usability, such as fans, pumps, actuators and dampers.

6. **HVAC Zone Graphic (Single)**: The HVAC Zone Graphic (Single) shall show the zone mechanical components through the use of a pictorial representation. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability. The HVAC Zone Graphic (Single) is intended to provide data on the final HVAC
conditioning equipment for the zone whether that is a VAV box, or a piece of unitary HVAC equipment.

7. **Lab Zone Graphic:** Each lab zone may include multiple supply and exhaust valves. Include all supply and exhaust control devices and associated I/O points and setpoints. Provide a summary of total lab supply and exhaust CFM, CFM differential, room differential, pressure setpoint, and calculated air change rate per zone.

8. **HVAC Zone Graphic (Multiple):** The HVAC Zone Graphic (Multiple) shall show all of the zone I/O points being controlled or monitored for each zonal system being served by an HVAC system in a tabular format. (i.e., Data for each VAV box being served by a single air handler). The data shall be displayed with the appropriate engineering units.

9. **Central Plant Graphics:** Central Plant Graphics shall be provided for all central systems including pumping systems, plumbing equipment., etc. The Central Plant Graphics shall show the plant mechanical components through the use of a pictorial representation. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotating or moving mechanical components to enhance usability.

10. **Energy Screen:** Provide a screen for each building showing all utilities and the following data on one screen. Last week’s consumption for all meters, last month’s consumption for all meters, YTD consumption for all meters and past years consumption for all meters.

11. **Communications Screen:** Provide a screen for each building that shows all devices and their communications state from the NAC down to all BACnet, LonWorks and all other serial devices.

B. All graphics shall include a direct link to the sequence of operations, control drawings, trend logs and the submittal data such as parts, O&M and warranty information for the particular system shown on the screen. These links shall be selectable from the graphic and be located in a consistent location, identified by a symbol used on all graphics.

3.11 **DEMONSTRATION**

A. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and demonstrate compliance with this specification. The Demonstration shall occur after all work has been completed and the tests as defined under “Checkout and Testing” have been concluded. The Owner’s Representative shall be present to observe and review the Demonstration.

B. The contractors shall provide an adequate number of personnel, each equipped with two-way communication, and shall demonstrate actual field operation of each control and sensing point for all modes of operation including, but not limited to; day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure.
modes. The purpose is to demonstrate the calibration, response, and action of every point/object and system. Any test equipment required to prove the proper operation shall be provided by and operated by the Division 23, Division 25 and Division 26 contractors.

C. As each control input and output is checked, a log shall be completed showing the date, technician’s initials, and any corrective action taken or needed.

D. Demonstrate compliance with sequences of operation through all modes of operation.

E. Demonstrate that the owner approved alarm annunciation and escalation for all system and applications alarms work as submitted during the submittal phase.

F. Additionally, the following items shall be demonstrated:

1. DDC Loop Response. The contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop’s response to a change in set-point, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the set-point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the appropriate Division 23 or Division 25 contractor.

2. Demand Limiting. The contractor shall supply a trend data output showing the action of any demand-limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting set-point, and the status of shedding equipment outputs.

3. Optimum Start/Stop. The contractor shall supply a trend data output showing the capability of the algorithm. The hour-by-hour trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.

4. Operational logs for each system that indicate all set-points, operating points, valve positions, mode, and equipment status shall be submitted to the engineer and Owner’s Representative. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in a printed graphical format.

3.12 SYSTEM ACCEPTANCE

A. The Division 23,25 and 26 contractors are to coordinate the Demonstration of the system such that each Division has a representative present during the activities.

B. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and demonstrate compliance with this specification. The Demonstration shall occur after the Division 23,25 and 26 contractors have completed
their tests as defined under “Checkout and Testing”. The Owner’s Representative shall be present to observe and review the Demonstration.

C. The Demonstration process shall utilize the forms and follow the processes previously defined as part of the Division 23, 25 and 26 contractor's submittals. The approved checklists and forms shall be completed for all systems as part of the Demonstration.

D. The contractor shall provide an adequate number of personnel, each equipped with two-way communication, and shall demonstrate actual field operation of each control and sensing point for all modes of operation including, but not limited to; day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point/object and system. Any test equipment required to prove the proper operation shall be provided by and operated by the Division 23, 25 and 26 contractors.

E. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.

F. Demonstrate compliance with sequences of operation through all modes of operation.

G. Additionally, the following items shall be demonstrated:

1. DDC Loop Response. The contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop’s response to a change in set-point, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the set-point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the appropriate Division 23, 25 or Division 26 contractor.

2. Demand Limiting. The contractor shall supply a trend data output showing the action of any demand-limiting algorithm. The data shall document the action on a minute by minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting set-point, and the status of load shedding equipment outputs.

3. Optimum Start/Stop. The contractor shall supply a trend data output showing the capability of the algorithm. The hour-by-hour trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.

4. Operational logs for each system that indicate all set-points, operating points, valve positions, mode, and equipment status shall be submitted to the engineer and Owner's Representative. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in a printed graphical format.
H. Any tests that fail to demonstrate the operation of the system shall be repeated as soon as possible. The contractor shall be responsible for any necessary repairs or revisions to the hardware or software they each have provided to successfully complete all tests.

3.13 OPERATOR INSTRUCTION, TRAINING

A. During system commissioning, and at such time as the acceptable performance of the BAS hardware and software has been established, the BAS contractor and the integrations contractor shall provide on-site operator instruction to the Owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.

B. Upon the first installation of the BAS GUI, the BAS contractor shall provide 40 hours of combined instruction to the Owner's designated personnel on the operation of the BAS and describe its intended use with respect to the programmed functions specified. Operator orientation of the BAS shall include, but not be limited to; the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the system's operation.

C. The training shall be in three sessions as follows:

1. Initial Training: One day session (8 hours) after system is started up and at least one week before first acceptance test. Instruction & Operations manuals shall have been submitted at least two weeks prior to training so that the Owners' personnel can start to familiarize themselves with the system before classroom instruction begins.

2. First Follow-Up Training: Two days (16 hours total) approximately one months after conclusion of the functional performance test but before formal acceptance. These sessions will deal with more advanced topics and answer questions from the users.

3. Warranty Follow Up: Two days (16 hours total) in no less than 4 hour increments, to be scheduled at the request of the Owner during the one year warranty period. These sessions shall cover topics as requested by the Owner such as; how to add additional points, create and gather data for trends, graphic screen generation or modification of control routines.

4. The contractor shall provide an agenda and the content covered in writing and/or power point one week before the training session. Informal training sessions without detailed agenda and appropriate documentation about topics covered are not acceptable.

5. In addition to the 40 hours of training mentioned earlier in this section, the contractor shall provide factory training for at least 4 designated owners' representatives at the site by a factory representative. The training shall cover all
aspects of programming and configuration of the systems including all controllers, network management devices and GUI.

3.14 STANDARD REPORTS

A. As a minimum, the following reports shall be available to the owner:

B. A report that will run automatically at an interval chosen by the operator, listing any software or hardware point in override or disabled (separate with that distinction) at the time of the report generation. Any point in override shall be shown with the time, date and user that put the point into override and with the time remaining in override. The user shall be able to send the report to a screen, pdf file with a unique file name architecture that includes the date and time or a designated printer.

1. A report that will run automatically at an interval chosen by the owner that will list the point status. As a minimum, the status shall include the current value, the point name the point description with the related Engineering unit and the time and date stamp.

2. A report that will run automatically at an interval chosen by the owner that will list all points in alarm. At a minimum, each alarm shall include the current value, the point name the point description with the related Engineering unit and the alarm message with time and date stamp. The owner shall be able to select system alarms and application alarms separately to allow him/her to keep separate logs. System alarms are defined as alarms that are generated by the system indicating and issue with the status of the system hardware and software such as controller issue, communication issues, power issues, soft and hard reboots, and diagnostics. Application alarms are defined as alarms related to the specific nature of the equipment controlled such as status alarms, temperature or humidity levels or any other alarm that is specific to the application programmed in the controller. See materials section for additional information.

C. All time and date stamps for reports shall includes the exact time in format such as 12:02:52 AM.

3.15 RECORD DOCUMENTATION

A. Three copies of the Operation & Maintenance manuals for work provided under this Division shall be provided to the Owner upon completion of the project. These manuals shall be updated each time changes are made to the system. The entire Operation & Maintenance manual shall be furnished in three-ring binders with adequate indexing and with identical indexing and format in pdf, provided on CD or DVD media. As a minimum it shall include the following:

1. Table of contents.

2. As-built system record drawings. Record drawings in AutoCAD format shall represent the as-built condition of the system and incorporate all information supplied with the approved submittals. These shall include the sequences of operation and a complete I/O point summary.
3. Manufacturer’s products O&M sheets for all products including software.

4. System operator’s manuals. This manual shall be specific for the installation and include any information need for the operator to use the system effectively.

5. Complete network diagrams that also indicate connections to the BAS Wide Area Network on the owner provided network.

6. Wiring termination schedules.

7. Copies of all completed forms for control system Checkout and Testing and Demonstration activities including hard copies of all trend log graphs.

8. Archive copy of all controller databases, including all field controllers and NAC’s that includes the post commissioning programming at the time of system acceptance (on CD or DVD only).

B. The record documentation shall be bookmarked. Provide link to the record document in the GUI. Coordinate with the College for the requirements.

PART 4 - SEQUENCES OF OPERATION

4.1 SEE CONTRACT DRAWINGS FOR FURTHER DETAILS.

4.2 CHILLER PLANT CONTROLS

A. Chiller Start/Stop: The BAS system shall start the chiller when there is a cooling demand from the system during occupied mode or override request during unoccupied mode.

B. Not Used.

C. Chilled water supply temperature setpoint and pump differential static pressure setpoint shall be reset based on the figure below and the value CHW Plant Reset determined as described below. DPmax shall be determined under Section 23 Testing, Adjusting and Balancing. Tmin is the design chilled water temperature as scheduled on Drawings.
1. CHW Plant Reset shall be reset using Trim & Respond logic (see ASHRAE Guideline 36) based on chilled water pump status with the following parameters:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$SP_0$</td>
<td>0%</td>
</tr>
<tr>
<td>$SP_{min}$</td>
<td>0%</td>
</tr>
<tr>
<td>$SP_{max}$</td>
<td>100%</td>
</tr>
<tr>
<td>$T_d$</td>
<td>15 minutes</td>
</tr>
<tr>
<td>$T$</td>
<td>5 minutes</td>
</tr>
<tr>
<td>$I$</td>
<td>2</td>
</tr>
<tr>
<td>$R$</td>
<td>Cooling CHWST Reset Requests</td>
</tr>
<tr>
<td>$SP_{trim}$</td>
<td>-2%</td>
</tr>
<tr>
<td>$SP_{res}$</td>
<td>+3%</td>
</tr>
<tr>
<td>$SP_{res-max}$</td>
<td>+7%</td>
</tr>
</tbody>
</table>

2. CHW Plant Reset logic shall be disabled and value fixed at its last value for 15 minutes after the plant stages up or down.

D. Performance Monitoring

1. Total plant power. Calculate total plant power as the sum of chiller power and pump power. For motors with VFDs, power shall be actual power as indicated by the VFD. For fixed speed motors (e.g. CW pumps), power shall be assumed to be fixed at BHP (from equipment schedule) $\times$ 0.746 / 0.93 (approximate motor efficiency).

2. Summary Data. For each chiller and total plant, statistics shall be retained and displayed on graphic for runtime, average actual efficiency (kW/ton), and average demand (tons) and load (ton-hours). Show on chiller plant graphic:
instantaneous values, year-to-date totals/averages and previous-year totals/averages

E. Alarms - Provide alarm as follow:

1. Maintenance interval alarm when pump has operated for more than 1500 hours:
   Reset interval counter when alarm is acknowledged.

2. Maintenance interval alarm when chiller has operated for more than 1000 hours:
   Reset interval counter when alarm is acknowledged.


4. High chiller leaving chilled water temperature (more than 5°F above setpoint) for
   more than 15 minutes when chiller has been enabled for longer than 15 minutes:
   Level 3

5. Pump or tower fan alarm is indicated by the status input being different from the
   output command after a period of 15 seconds after a change in output status.
   a. Commanded on, status off.
   b. Commanded off, status on.

6. Not used.

7. Not used.

8. Not used.

9. Excess makeup flow: Average makeup water flow rate (in GPM) in any 4 hour period exceed 0.042 times the average plant load (in tons) in that same period (indicating a makeup or drain valve is stuck open). CHW System low pressure, (indicating possible leak), if CHW system gauge pressure falls below 0.9 times the scheduled expansion tanks pre-charge pressure for 1 minute.

10. Not used.

F. Chilled Water Pumps

1. Chilled water pumps shall be one operating/one stand-by alternated based on
   run hours for even-wear.

2. The lead pump shall run when plant is enabled.

3. Pump speed control
   a. Not used.
   b. Pump speed will be controlled by a PID loop maintaining the lowest differential pressure signal at a setpoint determined by the reset scheme described in Paragraph 3.15L.15. below. The maximum DP setpoint (MaxDP in figure below) shall be determined in conjunction with Work.
performed under Section 230593 Testing, Adjusting, and Balancing. All active pumps receive the same speed signal.

G. Bypass valve: When any CHW pump is proven on, the bypass valve shall be enabled, and closed otherwise. Bypass valve shall be modulated to maintain minimum flow as measured by the flow meter. Minimum flow rates are as follows (based on manufactures’ minimum flow rates plus 15% to ensure control variations do not cause flow to go below actual minimum).

H. Chilled water supply temperature setpoint and pump differential static pressure setpoint shall be reset based on the figure below the value CHW Plant Reset determined as described below. DPmax shall be determined by Testing, Adjusting and Balancing Section. Tmin is the design chilled water temperature as scheduled on Drawings.

![Diagram]

1. **CHW Plant Reset** shall be reset using Trim & Respond logic based on chilled water pump status with the following parameters:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP₀</td>
<td>0%</td>
</tr>
<tr>
<td>SPₘᵢₙ</td>
<td>0%</td>
</tr>
<tr>
<td>SPₘₐₓ</td>
<td>100%</td>
</tr>
<tr>
<td>T_d</td>
<td>15 minutes</td>
</tr>
<tr>
<td>T</td>
<td>5 minutes</td>
</tr>
<tr>
<td>I</td>
<td>2</td>
</tr>
<tr>
<td>R</td>
<td>Cooling CHWST Reset Requests</td>
</tr>
<tr>
<td>SPₚᵢₘ</td>
<td>-2%</td>
</tr>
<tr>
<td>SPᵣᵉˢ</td>
<td>+3%</td>
</tr>
<tr>
<td>SPᵣᵉˢₘᵙₓ</td>
<td>+7%</td>
</tr>
</tbody>
</table>
2. CHW Plant Reset logic shall be disabled and value fixed at its last value for 15 minutes after the plant stages up or down.

I. Performance Monitoring

J. Chiller Efficiency Check. Chiller efficiency shall be calculated as

\[
\frac{kW}{ton} = \frac{kW}{Q_E}
\]

1. where kW is the measured power to the chiller and \(Q_E\) is the calculated evaporator load in tons. For one chiller on, \(Q_E\) is the plant load.

2. Total plant power. Calculate total plant power as the sum of chiller power, pump power, and cooling tower fan power. For motors with VFDs, power shall be actual power as indicated by the VFD. For fixed speed motors, power shall be assumed to be fixed at BHP (from equipment schedule) * 0.746 / 0.93 (approx motor efficiency).

3. Summary Data. For each chiller and total plant, statistics shall retained and displayed on graphic for runtime, average actual and predicted efficiency (kW/ton), and average demand (tons) and load (ton-hours). Show on chiller plant graphic: instantaneous values, year-to-date totals/averages and previous-year totals/averages.

K. Alarms

1. Maintenance interval alarm when pump has operated for more than 1500 hours: Level 5. Reset interval counter when alarm is acknowledged.

2. Maintenance interval alarm when chiller has operated for more than 1000 hours: Level 5. Reset interval counter when alarm is acknowledged.


4. High chiller leaving chilled water temperature (more than 5°F above setpoint) for more than 15 minutes when chiller has been enabled for longer than 15 minutes.

5. Pump or tower fan alarm is indicated by the status input being different from the output command after a period of 15 seconds after a change in output status.
   a. Commanded on, status off.
   b. Commanded off, status on.

4.3 VAV REHEAT TERMINALS - NON LAB AREAS

A. Zone Priority

Each zone shall have a designated priority as follows:
1. Priority 1: VAVs terminals serving offices, break rooms, corridors, restrooms, stairs, and other non-critical spaces.

2. Priority 2: VAVs terminal serving telecom rooms, conference/meeting rooms, IDF rooms, MDF rooms, and other critical spaces.

3. Each zone shall be designated as critical or non-critical by Owner. The default setting for all zones shall be non-critical. Critical Zones shall have a value of 2, Non-Critical Zone shall have a value of 1, and Ignored Zones have a value of 0. This factor is multiplied by the demand reset and sent to the BAS.

B. Scheduled Run Conditions

Each zone shall be capable of being individually scheduled for a minimum of 4 periods per day, 365 days a year. The VAV terminal shall run according to global command from the BAS system in the following modes:

1. Zone Unoccupied Override:
   a. A local override control shall allow an occupant to override the schedule and place the zone into an occupied mode for one hour (adj.). At the expiration of this time, control of the unit shall automatically return to the schedule. Zones to have override capability are the zones of the offices and conference rooms.

2. Occupied Mode:
   The VAV terminal shall maintain:
   a. A cooling setpoint equal to the zone setpoint plus the occupied cooling offset (global), (adj.). Note: any value designated as adjustable (adj.) shall mean that a system user, with sufficient access privileges, can adjust the value from a graphic screen without the necessity of modifying source code.
   b. A heating setpoint equal to the zone setpoint minus the occupied heating offset (Global), (adj.).

3. Unoccupied Mode:
   a. AHU Off.
   b. VAV Damper shall drive closed
   c. VAV Reheat valve closed.

4. Standby Mode for Zone with Priority 1:
   The VAV terminal shall maintain:
   a. A cooling setpoint equal to the zone setpoint plus the Priority 1 standby cooling offset (Global) (adj.).
   b. A heating setpoint equal to the zone setpoint minus the Priority 1 standby heating offset (Global) (adj.).
5. Standby Mode for Zone with Priority 2:
   The VAV terminal shall maintain:
   a. A cooling setpoint equal to the zone setpoint plus the standby cooling
      offset (Global) (adj.).
   b. A heating setpoint equal to the zone setpoint minus the standby heating
      offset (Global) (adj.).

C. Zone Setpoints
   1. The default Occupied Zone Setpoint shall be as follow:
      a. 72°F (adj.)
      b. The occupant shall be able to adjust the Zone Setpoint at the thermostat
         for each zone by a maximum of ±2°F (adj.)

D. Deadband
   1. The Default Occupied Cooling Offset shall be + 2.5 (adj.).
   2. The Default Occupied Heating Offset shall be – 2.5 (adj.).
   3. The Default Standby Cooling Offset for Non-Critical Zones (Priority 1) shall be +
      5 (adj.).
   4. The Default Standby Heating Offset for Non-Critical Zones (Priority 1) shall be –
      5 (adj.).
   5. The Default Standby Cooling Offset for Critical Zones (Priority 2) shall be + 4
      (adj.).
   6. The Default Standby Heating Offset for Critical Zones (Priority 2) shall be –4
      (adj.).
   7. The Heating and Cooling Offset (Deadband) shall be set globally by the BAS
      system controller, unless Offset is overridden locally.
   8. The zone controller shall override the global controller and set the cooling offset
      to 2°F if both Condition 1 and 2 listed below occur:
      a. The zone temperature increases by greater than 2°F in a 30 minutes
         period, AND
      b. The zone temperature is between the heating and cooling setpoint.
      c. If both conditions above do not occur, then revert back to default global
         offsets.
   9. Global Offset shall be individually adjustable by Zone. Override of the global
      offsets will prevent rapid zone temperature changes, which exceed ASHRAE 55
      recommendations for space temperature rate of change.
   10. Schedule for Occupancy Modes
a. The Schedule Occupied period shall be weekdays from 6 a.m. to 9 p.m. and off weekends, unless there is a Priority 2 room served by the AHU.

b. Standby Schedule: Currently, there are no standby periods, however, contractor must program system so that Owner can add standby periods to the Occupancy Schedule.

E. Schedule VAV Minimum Airflow

1. Occupied and Standby Mode: Airflow setpoint shall be equal to Scheduled Minimum airflow setpoint as shown on Contract Documents when any of the following conditions is satisfied:
   a. The cooling demand is 0%, OR
   b. The calculated heating demand is between 0%~50%.

2. Unoccupied Mode: VAV damper shall be closed.

F. Adjusted Minimum Airflow:

1. The Adjusted Minimum Airflow shall be equal to 60% (adj.) of the Schedule Minimum Airflow when:
   a. The corresponding AHU is operated at Economizer Mode (i.e. Outside air damper is at 100% open position (Adj.) AND
   b. The cooling demand is 0%, AND
   c. The calculated heating demand is between 0%~50%, AND
   d. The CO2 level is below setpoint. (If applicable)
      Otherwise, the Schedule Minimum Airflow shall remain unadjusted.

2. The Schedule Minimum Airflow shall be increased as follows:
   a. The Schedule Minimum Airflow shall increase to satisfy zone’s CO2 setpoint of less than 1000 ppm (adj.).

G. VAV Heating Maximum Airflow

1. Airflow setpoint shall be equal to Zone Heating Maximum airflow setpoint as shown on Contract Documents when any of the following conditions is satisfied.
   a. The supply air temperature is larger than 95°F, OR
   b. The calculated heating demand is between 50%~100%.

2. Unoccupied Mode: VAV damper shall be closed

H. VAV Cooling Maximum Airflow

1. Occupied Mode: Airflow setpoint shall be equal to Zone Cooling Maximum airflow setpoint as shown on Contract Documents when cooling demand is larger than 0%.
2. Unoccupied Mode: VAV damper shall be closed

3. Economizer Mode: Airflow setpoint shall be equal to Zone Cooling Maximum airflow setpoint as shown on Contract Documents when cooling demand is larger than 0%.

I. VAV Airflow Control

1. The unit shall monitor the zone temperature and maintain the zone cooling setpoint through a PI control loop by controlling the airflow through one of the following: (Refer to Contract Documents for Control Diagram details)
   a. When zone temperature is greater than its cooling setpoint, the airflow setpoint shall modulate between the Adjusted Minimum Airflow and the Maximum Airflow (adj.) until the zone is satisfied. Heating hot water valve shall be closed.
   b. When the zone temperature is within deadband, the airflow setpoint shall be set to the Schedule Minimum Airflow.
   c. The unit shall monitor the zone temperature and discharge air temperature & maintain both zone & discharge temperature setpoints by the use of PI control loops.

2. The unit shall monitor the zone temperature and maintain the zone heating setpoint through a PI control loop by controlling the heating hot water valve position and airflow through one of the following: (Refer to Contract Documents for Control Diagram details)
   a. While in the 1st third of zone heating (between 0%~50% of calculated heating demand), reset the discharge air setpoint from 55°F to 95°F by controlling heating hot water valve position.
   b. While in the 2nd third of zone heating, (between 50%~100% of calculated heating demand), reset the airflow setpoint from the Schedule Minimum Airflow to the Maximum Airflow by controlling VAV damper position.
   c. While in the 3rd third of zone heating, (exceeds 100% of calculated heating demand), reset the setpoint from 95°F to space heating setpoint plus 35°F.

J. VAV Airflow Control with CO2 Sensor.

The CO2 concentration at ambient level shall be set at 400 ppm. Ventilation rate for rooms equipped with CO2 sensors shall be controlled to maintain a CO2 concentration range between the ambient level (400 ppm) and 1,000 ppm. The VAV airflow shall be controlled based on a calculated CO2 concentration percentage, which is set at 0% when concentration is measured at 400 ppm and 100% when that is measured at 1,000 ppm. Refer to Contract Documents for Control Diagram detail. The percentage basics control output shall reset zone airflow setpoint as follow:

1. Occupied Mode:
   a. Between 0%~50%, reset VAV airflow setpoint from Zone Minimum airflow setpoint to Zone Cooling Maximum airflow setpoint.
b. Between 50%~100%, send request to AHU controller to increase the minimum outside airflow setpoint by sequencing the outside air damper.

2. Unoccupied Mode:
   a. Set control output to 0%, damper shall be closed.

K. Testing and Commissioning
   1. Provide software points per Specification to all VAV terminals for testing and commissioning overrides.

4.4 VAV COOLING-ONLY TERMINALS

A. Zone Priority

Each zone shall have a designated priority as follows:

1. Priority 1: VAVs terminals serving offices, break rooms, corridors, restrooms, stairs, and other non-critical spaces.
2. Priority 2: VAVs terminal serving telecom rooms, conference/meeting rooms, computer rooms, IDF rooms, MDF rooms, and other critical spaces.
3. Each zone shall be designated as critical or non-critical by Owner. The default setting for all zones shall be non-critical. Critical Zones shall have a value of 2, Non-Critical Zone shall have a value of 1, and Ignored Zones have a value of 0. This factor is multiplied by the demand reset and sent to the BAS.

B. Scheduled Run Conditions

Each zone shall be capable of being individually scheduled for a minimum of 4 periods per day, 365 days a year. The VAV terminal shall run according to global command from the BAS system in the following modes:

1. Zone Unoccupied Override:
   a. A local override control shall allow an occupant to override the schedule and place the zone into an occupied mode for one hour (adj.). At the expiration of this time, control of the unit shall automatically return to the schedule. Zones to have override capability are the zones of the 3rd floor, board rooms, conference rooms, and VP area.

2. Occupied Mode:
   The VAV terminal shall maintain:
   a. A cooling setpoint equal to the zone setpoint plus the occupied cooling offset (global), (adj.). Note: any value designated as adjustable (adj.) shall mean that a system user, with sufficient access privileges, can adjust the value from a graphic screen without the necessity of modifying source code.

3. Unoccupied Mode:
a. AHU Off.
b. VAV Damper shall drive closed

4. Standby Mode for Zone with Priority 1:
The VAV terminal shall maintain:
   a. A cooling setpoint equal to the zone setpoint plus the Priority 1 standby cooling offset (Global) (adj.).

5. Standby Mode for Zone with Priority 2:
The VAV terminal shall maintain:
   a. A cooling setpoint equal to the zone setpoint plus the standby cooling offset (Global) (adj.).

C. Offsets
1. The Default Occupied Cooling Offset shall be +2.5 (adj.).
2. The Default Standby Cooling Offset for non-critical zones (Priority 1) shall be +5 (adj.).
3. The Default Standby Cooling Offset for critical zones (Priority 2) shall be +4 (adj.).
4. The Cooling Offset (Deadband) shall be set globally by the BAS system controller, unless Offset is overridden locally.
5. The zone controller shall override the global controller and set the cooling offset to 2°F when both Condition 1 and 2 listed below occur:
   a. The zone temperature increases by greater than 2°F in a 30 minutes period, AND
   b. The zone temperature is between the heating and cooling setpoint.
   c. If both conditions above do not occur, then revert back to default global offsets.
6. Global Offset shall be individually adjustable by Zone. Override of the global offsets will prevent rapid changes in zone temperature which exceed ASHRAE 55 recommendations for space temperature rate of change.
7. Schedule for Occupancy Modes
   a. The Schedule Occupied period shall be weekdays from 6 a.m. to 9 p.m. and off weekends, unless there is a priority 2 room served by the AHU
   b. Standby Schedule: Currently, there are no standby periods, however, contractor must program system so that Owner can add standby periods to the Occupancy Schedule.

D. Schedule VAV Minimum Airflow
1. Occupied and Standby Mode: Airflow setpoint shall be equal to Schedule Minimum airflow setpoint as shown on Contract Documents when the following condition is satisfied:
   a. The cooling demand is 0%.

2. Unoccupied Mode: VAV damper shall be closed.

E. Adjusted Minimum Airflow:

1. The Adjusted Minimum Airflow shall be equal to 60% (adj.) of the Schedule Minimum Airflow when:
   a. The corresponding AHU is operated at Economizer Mode (i.e. Outside air damper is at 100% open position (Adj.) AND
   b. The cooling demand is 0%, AND
   c. The CO2 level is below setpoint. (If applicable)
      Otherwise, the Schedule Minimum Airflow shall remain unadjusted.

2. The Schedule Minimum Airflow shall be increased as follows:
   a. The Schedule Minimum Airflow shall increase to satisfy zone’s CO2 setpoint of less than 1000 ppm (adj.).

F. VAV Cooling Maximum Airflow

1. Occupied Mode: Airflow setpoint shall be equal to Zone Cooling Maximum airflow setpoint as shown on Contract Documents when cooling demand is larger than 0%.

2. Unoccupied Mode: VAV damper shall be closed

3. Economizer Mode: Airflow setpoint shall be equal to Zone Cooling Maximum airflow setpoint as shown on Contract Documents when cooling demand is larger than 0%.

G. VAV Airflow Control

1. The unit shall monitor the zone temperature and maintain the zone cooling setpoint through a PI control loop by controlling the airflow through one of the following: (Refer to Contract Documents for Control Diagram details)
   a. When zone temperature is greater than its cooling setpoint, the airflow setpoint shall modulate between the Adjusted Minimum Airflow and the Maximum Airflow (adj.) until the zone is satisfied. Heating hot water valve shall be closed.
   b. When the zone temperature is within deadband, the airflow setpoint shall be set to the Schedule Minimum Airflow.
   c. The unit shall monitor the zone temperature and discharge air temperature & maintain both zone & discharge temperature setpoints by the use of PI control loops.
H. Testing and Commissioning

1. Provide software points per Design Build Specification to all VAV terminals for testing and commissioning overrides

END OF SECTION 250000
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the contract, including conditions and Division 1 specification sections, apply to this section.
B. Related Work Under Other Sections:
   1. Section 27 05 00 – Common Work Results for Communications
   2. Section 27 05 26 – Grounding and Bonding for Communications Systems
   3. Section 27 10 00 – Structured Cabling, Basic Materials and Methods
   4. Section 27 11 13 – Communications Entrance Protection
   5. Section 27 11 23 – Communications Cable Management
   6. Section 27 13 00 – Communications Interior Backbone Cabling
   7. Section 27 14 00 – Communications Outside Plant Backbone Cabling
   8. Section 27 15 00 – Communications Horizontal Cabling

1.2 SCOPE OF WORK
A. Provision of Communications Cabinets, Racks and related

1.3 RELATED WORK BY OTHERS
A. By the Owner
   1. Data switching equipment.
   2. Rack mounted power strips/PDU’s

1.4 RELATED WORK IN OTHER SECTIONS
A. Division 26
   1. Power at equipment racks, mounted to cable tray above floor mounted racks and internal to wall mounted racks unless otherwise noted.
B. Section 27 05 26 – Grounding and Bonding for Communications Systems
   1. Bonds racks and cabinets.
C. Section 27 05 33 – Conduits and Backboxes for Communications Systems
   1. Signal systems raceways at communications rooms
D. Section 27 05 36 – Cable Trays for Communications Systems
1. Signal systems cable tray at communications rooms

E. Section 27 15 00 Communications Horizontal Cabling
   1. Rack mounted horizontal patch panels.

1.5 REFERENCES
   A. American National Standards Institute (ANSI)
      1. EIA-310-D (1992) Cabinets, Racks, Panels, and Associated Equipment
         (ANSI/EIA/310-D)
         (Earthing) for Customer Premises

1.6 SUBMITTALS
   A. Conform with the requirements of Division 1 and Section 27 05 00 - Common Work
      Results for Communications.

1.7 DELIVERY, STORAGE AND HANDLING
   A. Procedures: In accordance with Division 1 and Section 27 10 00 – Structured Cabling,
      Basic Materials and Methods.

1.8 SEQUENCING
   A. Not Used.

PART 2 - PRODUCTS

2.1 GENERAL
   A. Keys
      1. Key all boxes, cabinets, enclosures, panels, controls, doors and related provided
         for similar usage within a system identically.

2.2 EQUIPMENT ENCLOSURE SYSTEMS
   A. General:
      1. Provide enclosure systems including, but not limited to enclosures, cabinets,
         cases and related panels and accessories as specified herein. Provide size and
         quantity as shown on drawings or scheduled.
      2. Provide color as shown on drawings. If no color is shown on drawings, submit
         manufacturer's standard color chips for selection.
      3. Provide enclosure systems conforming to the IBC, latest edition, for bracing
         design.

B. Relay Rack, Seismic Rated

1. Drawing Reference: R15

2. Construction, Rack
   a. Seismically qualified assembly meets California legacy Zone 4, CBC, ASCE 7-10 (2010 Edition) and 2009 editions of NFPA 5000 for use in areas of high seismicity – Zone 4 or Seismic Design Category (SDC) "D" seismic requirements with a least a 500 pound uniformly distributed load.
   b. Two wide vertical side channels tapped with EIA mounting holes on both sides, 6" deep section construction minimum.
   c. Full 19" wide EIA Frame fits standard equipment forms – assemblies with non-standard opening widths not permitted.
   d. Maximum width of relay rack frame (not including vertical wire managers): 25.5 inches.
   e. Floor mount plates
   f. Top angle or plate
   g. 44 EIA Rack Units minimum

3. Construction, Vertical Wire Managers
   a. Front and back vertical wire management troughs on both sides of rack, unless otherwise indicated on plans - 6" wide and x 9" minimum depth vertical cross-section, each trough (18.75" max depth overall depth). Coordinate depth with rack and horizontal wire managers to maintain unrestricted full cross-sectional area cable passage from horizontal wire managers to vertical wire managers.
   b. Double-sided cable managers with closely spaced fingers provides cable support for each rack mounting space (EIA RU).
   c. Access doors and gates on front and rear.
   d. Front and rear vertical sections can be spaced apart when mounting on racks deeper than 3” allowing cables to be routed out through side openings created between vertical sections.
   e. One-piece full length doors, with quarter-turn locking hinges, allow for quick opening from either side or complete removal.
   f. Six snap-on gates retain cables when doors are opened or removed. Gates can be placed at any location.
   g. Open back design allows unrestricted routing of cables between front and rear cables managers.
h. 1/4" accessory mounting holes run the full height on both sides of cable manager to accommodate the attachment of cable management accessories.

i. UL Listed as a Communication Circuit Accessory. File No. E171936.

j. Material: Aluminum with UL 94V-0 black plastic components.

k. Provide two each vertical wire managers at each frame, unless otherwise noted on the plans. Provide one between adjacent R15 frames, unless otherwise indicated on plans.

4. Manufacturers, Seismic Relay rack assembly - subject to minimum panel opening criteria scheduled above:
   a. B-Line Advantage Seismic Relay Rack SB-852-19-084 FB.
   b. Telect/Hendry GS Global Seismic Frame, 19" with Hendry Anchor Kit.
   c. Ortronics Mighty Mo 6 Seismic Cable Management Rack
   d. Chatsworth Products Company Seismic Frame Two-Post Rack with manufacturer’s offset brackets to accommodate mounting of vertical wire managers without impairing fill capacity of wire managers due to perimeter flange of this rack.
   e. Or equal.

5. Vertical Wire Manager:
   a. B-Line SB86086D084FB 6" Double sided Vertical Manager 6" Wide x 18-5/8" Deep x 84" High.
   b. CPI
   c. Ortronics
   d. Panduit
   e. Or equal.

C. Equipment Rack, Undercounter, Pullout and Pivoting
   1. Drawing Reference: R18
   2. Features/Construction:
      a. EIA compliant 19” rotating slide-out equipment rack intended for permanent installation and integration into a millwork or cabinet opening.
      b. Overall dimensions of rack shall be not more than 19.25” wide x 20” deep.
      c. Rackspace:
         1) Provide 16 RU rack spaces, 30”H max.
         2) Rack shall support up to a 300 pound loading, in closed and pull-out operation.
3) Rack shall pull out 19" on integrated ball bearing slides and rotate 90° for equipment servicing. When rotating rack, allows rack to lock in place at 0, 60 and 90 degrees of rotation.

4) Rackrail shall be 11-gauge steel with tapped 10-32 holes in universal EIA spacing. Rackrail shall be finished in black e-coat with marked rackspaces.

5) Rough-in pan shall be 14-gauge steel.

6) Finish on assembly shall be durable flat black powder coat.

7) Trim/locking panel shall lock rack in closed position and be 11-gauge aluminum with brushed black anodized finish.

8) Unless otherwise noted, completely enclose interior of enclosure, or ensembles of enclosures with equipment, blank or vent panels.

d. Blower panel.
   1) Exhausts hot air from rear to front of rack.
   2) Minimum 100 CFM free air rating.
   3) iQuiet, maximum 35 dB sound level.
   4) 1 rackspace high.

e. Half-height power receptacle strip(s)
   1) Vertical power strip, no higher than rack height.
   2) Not less than ten (10) 20A receptacles; Provide multiple strips if required
   3) Integral circuit breaker
   4) NEMA 5-20 plug on a minimum 6' cord.
   5) UL Listed Assembly
   6) Provide mounting hardware as necessary to attach vertically to rack interior.

3. Manufacturers:
   a. Middle Atlantic SRSR-4-XX; where XX indicated quantity of rack units, Middle Atlantic QBP-2 blower, and power strip(s).
   b. Or equal (no known equal).

D. Equipment Rack, Zone 4, Front, Rear and Side Access, with Vertical Wire Management. 36" Depth
   1. Drawing References: R27
   2. Minimum Features, Function & Construction:

b. Fully welded construction provides:
   1) Static load capacity: 10,000 lbs.
   2) UL Listed load capacity: 2,500lbs.
   3) Seismic Certified load capacity: 755 lbs.

c. Seismic certified to the following codes and standards: 2007 & 2010 CBC; 2006, 2009 & 2012 IBC; ASCE 7-05 (2005 Edition) & ASCE 7-10 (2010 Edition) and the 2006 & 2009 editions of NFPA 5000 for use in areas of high seismicity – Zone 4 or Seismic Design Category (SDC) “D”. Intended for use in Mission Critical and/or High-Importance Installations in locations with the highest level of seismicity and top floor or rooftop installations including those within UBC and CBC Essential facilities or IBC, ASCE 7, and NFPA 5000 Seismic Use Group III facilities. For all codes, the Importance factor (Ip) is 1.5.

d. Vertical Height (Min): 44 RU

e. Outside depth: 36 inches maximum.

f. Width: Not to exceed 30 inches

g. Lockable, 70% open area perforated mesh full height front and rear doors:
   1) Front door with wire mesh insert covers rack contents - swing shall be field adjustable to swing from either right or left.
   2) Rear doors to be a pair of half width doors, each with a wire mesh to cover rack contents.
   3) Wire mesh, vertical center split rear door pair.

h. Front and rear 19” mounting rail pairs DIN square holes on EIA spacing standard are fully adjustable in depth of setback from front to rear.

i. Vertical cable management rings, continuous, full height cable management system shall be installed:
   1) fully inside of the rack enclosure, with 2” minimum clearance behind front and rear rack frame.
   2) fully outside (to left of left rail and to right of right rail, and out of conflict with EIA Rails. Cable management system mounting shall not occupy rail screw openings.
   3) Front managers shall be accessible from front in fully loaded equipment rack.
   4) Rear managers shall be accessible from rear in fully loaded equipment rack.
j. 60% or greater perforated top panel occupying at least 50% of the stop surface of the cabinet allows passive heat radiation from rack interior to the exterior.

k. Cutouts and removable covers in cabinet top accommodates vertical transition of cabling from tray above into rack interior.

l. Gangable. Racks have been designed such that they are suitable for installation either as a single, standalone unit, or in a row of identical racks (gangable).
   1) Single rack installation. Provide side panels at both sides.
   2) Multirack installation in a row. Bolt racks together using means provided by manufacturer. Omit side panels except at ends of row of racks – provide at ends of rows of racks.

3. Manufacturers. Provide manufacturer’s accessories or 3rd party accessories as specified elsewhere in this Section for other specified elements. Coordinate selected shelves, fans and similar with rack submitted for finish and mounting means:
   a. Middle Atlantic DRK19-44-36PRO with DLVFD-44 front door, DCLVRD-44 rear doors, MRK-Z4 Base angles, 2 pair DRK-44DUCT (front and rear, 4 total vertical ducts), MW-LVT 64% open area top insert. Keylocked side panels SPN-44-36 at ends of rows.
   b. APC Infrastructure
   c. Hoffmann
   d. or equal.

E. Equipment Rack, Zone 4, Front, Rear and Side Access, with Vertical Wire Management.
   1. Drawing References: R28
   2. Minimum Features, Function & Construction:
       b. Fully welded construction provides:
          1) Static load capacity: 10,000 lbs.
          2) UL Listed load capacity: 2,500 lbs.
          3) Seismic Certified load capacity: 755 lbs.
c. Seismic certified to the following codes and standards: 2007 & 2010 CBC; 2006, 2009 & 2012 IBC; ASCE 7-05 (2005 Edition) & ASCE 7-10 (2010 Edition) and the 2006 & 2009 editions of NFPA 5000 for use in areas of high seismicity – Zone 4 or Seismic Design Category (SDC) "D". Intended for use in Mission Critical and/or High-Importance Installations in locations with the highest level of seismicity and top floor or rooftop installations including those within UBC and CBC Essential facilities or IBC, ASCE 7, and NFPA 5000 Seismic Use Group III facilities. For all codes, the Importance factor (Ip) is 1.5.

d. Vertical Height (Min): 44 RU

e. Outside depth: 40” minimum - 42 inches maximum.

f. Width: Not to exceed 30 inches

g. Lockable, 70% open area perforated mesh full height front and rear doors:
   1) Front door with wire mesh insert covers rack contents - swing shall be field adjustable to swing from either right or left.
   2) Rear doors to be a pair of half width doors, each with a wire mesh to cover rack contents.
   3) Wire mesh, vertical center split rear door pair.

h. Front and rear 19” mounting rail pairs DIN square holes on EIA spacing standard are fully adjustable in depth of setback from front to rear.

i. Vertical cable management rings, continuous, full height cable management system shall be installed:
   1) fully inside of the rack enclosure, with 2” minimum clearance behind front and rear rack frame.
   2) fully outside (to left of left rail and to right of right rail, and out of conflict with EIA Rails. Cable management system mounting shall not occupy rail screw openings.
   3) Front managers shall be accessible from front in fully loaded equipment rack.
   4) Rear managers shall be accessible from rear in fully loaded equipment rack

j. 60% or greater perforated top panel occupying at least 50% of the stop surface of the cabinet allows passive heat radiation from rack interior to the exterior.

k. Cutouts and removable covers in cabinet top accommodates vertical transition of cabling from tray above into rack interior.

l. Gangable. Racks have been designed such that they are suitable for installation either as a single, standalone unit, or in a row of identical racks (gangable).
   1) Single rack installation. Provide side panels at both sides.
2) Multirack installation in a row. Bolt racks together using means provided by manufacturer. Omit side panels except at ends of row of racks – provide at ends of rows of racks.

3. Manufacturers. Provide manufacturer’s accessories or 3rd party accessories as specified elsewhere in this Section for other specified elements. Coordinate selected shelves, fans and similar with rack submitted for finish and mounting means:

a. Middle Atlantic DRK19-44-42PRO with DLVFD-44 front door, DCLVRD-44 rear doors, MRK-Z4 Base angles, 2 pair DRK-44DUCT (front and rear, 4 total vertical ducts), MW-LVT 64% open area top insert. Keylocked side panels SPN-44-36 at ends of rows.

b. APC Infrastructure

c. Hoffmann

d. Liebert/Knurr

e. Wrightline Paramount, Vantage or Vantage 2.

f. or equal.

2.3 RACK PANELS AND ACCESSORIES

A. Rack Mounting Screws:

1. Screws 10-32; length as required for at least 1/4" excess when fully seated; oval head with black plastic non marerring cup washer or equivalent ornamental head; nickel, cadmium or black plated; Phillips, Allen Hex, Square-Tip or Torx drive. Slotted screws are not acceptable.

B. Blank Panels:

1. Construction

a. 16 gauge minimum cold rolled steel

b. Powder coat finish to match rack color, unless otherwise noted

2. Manufacturers

a. Middle Atlantic Products EB or FEB Series.

b. Ortronics Filler Panels.

c. CPI Snap-In Filler Panel


e. BGW Systems Inc. Flanged Steel Blank Panels

f. Dukane

g. Elkay

h. Lowell Series L3

i. Zero ZP112000 Series.
C. Vent Panels:
   1. Construction
      a. 20 gauge minimum cold rolled steel
      b. 1/8" minimum holes, at least 70% open total panel cross-section.
      c. Powder coat finish to match rack color, unless otherwise noted
   2. Manufacturers
      b. BGW Systems Inc. Perforated Vent Panels
      c. House of Metal Enclosures (HOME) Series PRP.
      d. Lowell Series L5
      e. Middle Atlantic Products VT Series.
      f. Zero.
      g. or equal.

D. Vertical Lacer Strips
   1. 44RU high vertical steel strips with points for attachment of velco cable ties at at least 6” o.c.
   2. Manufacturer:
      a. Middle Atlantic LACE-44LP
      b. APW
      c. or equal.

E. Horizontal Lacer Bars
   1. EIA 19" Width steel strips or bars suitable to provide support to large cable dressed horizontally through racks
   2. Size to suit load and mounting width.
   3. Manufacturer:
      a. Middle Atlantic LBP-1R4, LBP-1.5 and LBP-1S.
      b. APW
      c. or equal.

F. Seismic Hold-down Equipment Straps
   1. Drawing Reference: None - Provide as required to secure equipment that can not be screw fastened to mounting shelves.
2. Manufacturers:
   a. BGW Systems
   b. Everest Electronic Equipment Lock Down Kit
   c. Ergotron
   d. Chatsworth Products
   e. Middle Atlantic Products
   f. Q-Safety, Inc.
   g. or equal.

PART 3 - EXECUTION

3.1 MOUNTING

A. Unless otherwise noted, all floor supported equipment racks shall be bolted to the structure in accordance with the requirements of the CBC and the contractor's approved structural engineering submittal demonstrating the method to be used to conform to these requirements.

B. Rows of identical racks shall be bolted together, in addition to being bolted to the floor, and bonded to form a single electrical ground plane.

C. Wall mounted equipment racks and cabinets shall similarly be bolted to structural members in accordance with the requirements of the CBC and the contractor's approved structural engineering submittal demonstrating the method to be used to conform to these requirements.

3.2 EQUIPMENT ENCLOSURE (RACK) AND EQUIPMENT BACKBOARD FABRICATION

A. Combustible material, other than incidental trim of indicated equipment, is prohibited within equipment racks.

B. Provide permanent labels for all equipment and devices.

C. Floor racks to be bolted floor unless otherwise indicated.

D. Access shall not require demounting or de-energizing of equipment. Install access covers, hinged panels, or pull-out drawers to insure complete access to terminals and interior components.

E. Provide a permanent label on the front of each equipment rack including the rack designation, and the circuit breaker number and associated electrical distribution panel designation servicing same.

F. Where wiring of mixed types are called for on the plans, maintain separation of wiring classifications as specified in the individual sections of Division 27.
G. Provide vertical wire management of cabling within the rack independent of the adjustable EIA mounting rails. Vertical wiring management provided by the contractor within the rack shall not prevent such rails from being moved as required by the Owner.

H. Dress and support cabling at a minimum of 24 inch on center.

I. Access shall not require demounting or de-energizing of equipment or cabling. Install access covers, hinged panels, or pull-out drawers to insure complete access to terminals and interior components.

J. Fasten removable covers containing any wired component with a continuous hinge along one side, with associated wiring secured and dressed to provide an adequate service loop. Provide an appropriate stop locks to hold all hinged panels and drawers in a serviceable position.

K. Provide permanent labels for all equipment and devices. Where possible, fasten such labels to the rack frame or to blank or vent panels which will remain in place when active equipment is removed for possible service.

L. Coordinate the design and execution of wire harnessing of multi-bay audio and video rack ensembles with conditions of delivery to installation locations at Project Site, and with the requirement herein for test of the completely wired system in the shop prior to delivery to the Project Site. Organize the wiring harnesses such that they will fold within one shippable unit without risk of damage, or provide polarized multipin connectors and related interconnect systems as specified elsewhere herein.

3.3 SIGNAL GROUNDING & BONDING PROCEDURES

A. Comply with the California Electrical Code. Bond equipment racks to ground in accordance with the California Electric Code, ANSI-J-STD-607-B-2011 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises and Section 27 05 26

B. Equipment enclosures shall not be permitted to touch each other unless bolted together and electrically bonded.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Provide all labor, materials, transportation and equipment to complete the furnishing, installation, assembly, set up, and testing of the Sound and Audiovisual System work indicated on the drawings and specified herein. Notwithstanding any detailed information in this Section, provide complete, working systems.

B. Design, engineer and provide complete, all means of support, suspension, attachment, fastening, bracing, and restraint (hereinafter "support") of the Work of this Section. Provide engineering of such support by parties licensed to perform work of this type in the Project jurisdiction.

1.2 REFERENCE STANDARDS

A. Conform to the applicable portions of the current standards published by these organizations:

1. SMPTE Society of Motion Picture and Television Engineers.
2. NAB National Association of Broadcasters.
3. EIA Electrical Industries Association of America.
4. UL Underwriters Laboratories.
5. AES Audio Engineering Society.
6. NEC National Electrical Code.
9. EIAJ Electrical Industries Association of Japan.
11. FCC Federal Communications Commission.
12. NTC Network Transmission Committee of the Video Transmission
   (a) Engineering Advisory Committee.
14. BTSC Broadcast Television Stereo Committee.
15. TASO Television Allocation Study Organization.

B. Conform additionally to the following specific standards:

1. American National Standards Institute (ANSI)


2. Audio Engineering Society Incorporated (AES)
   a. AES2-1984 (r1997) AES Recommended Practice Specification of Loudspeaker Components Used in Professional Audio and Sound Reinforcement
   b. AES5-1998 (Revision of AES5-1984) AER recommended practice for professional digital audio – Preferred sampling frequencies for applications employing pulse-code modulation
   c. AES14-1992 (r1998) AES standard for professional audio equipment – Application of connectors, part 1, XLR-type polarity and gender
   d. AES20-1996 AES recommended practice for professional audio – Subjective evaluation of loudspeakers
   e. AES26-2001 Revision of AES26-1995 AES recommended practice for professional audio interconnections – Conservation of the polarity of audio signals
   f. AES-R2-1998 AES project report for articles on professional audio and for equipment specifications – Notations for expressing levels

3. Electronic Industries Association of America (EIA)
   a. EIA-160 Sound Systems
   b. EIA-310-E Racks, Panels and Associated Equipment
   c. EIA-101-A Amplifiers for Sound Equipment
   d. SE-103 Speakers for Sound Equipment
   e. SE-104 Engineering Specifications for Amplifiers for Sound Equipment

4. International Electrotechnical Commission (IEC)
   c. IEC 268-12 (1987) Sound system equipment – Part 12: Application of Connectors for Broadcast and Similar Use
   d. IEC 651 (1979) Sound level meters

5. International Organization for Standardization (ISO)
   a. ISO 1996-1 Acoustics – Description and measurement of environmental noise – Part 1: Basic quantities and – Composite Analog Video Signal – NTSC for Studio Applications

6. Federal Specifications (FS)
   a. GG-S-00172D Screen, Projection. Federal Supply Classification (FSC) 670.

7. Federal Standards (Fed-Std)
   a. 191A Textile Test Methods.
      i. 5760 Mildew Resistance of Textile Materials; Mixed Culture Method.
      ii. 5903.1 Flame Resistance of Cloth; Vertical.

8. NFPA
b. 701  Methods of Fire Tests for Flame-Resistant Textiles and Films.

9. Society of Motion Picture Engineers (SMPTE).
   a. SMPT 196M-86 Motion Picture - Screen Luminance and Viewing Conditions - Indoor Theater Projection Guide.
   b. SMPTE 202M-1998 Motion Pictures – B Chain Electroacoustic Response – Dubbing Theaters, Review Rooms and Indoor Theaters
   c. SMPTE RP167-1995 Alignment of NTSC Color Picture Monitors
   d. SMPTE EG1-1990 Alignment Color Bar Test Signal for Television Picture Monitors
   f. RP 94 Recommended Practice for Gain Determination of Front Projection Screens.
   g. SMPTE RP 95 Recommended Practice for Installation of Gain Screens.
   h. SMPTE RP 98 Recommended Practice for Measurement of Screen Luminance in Theatres.

10. Underwriters Laboratories Incorporated (UL)
    a. UL 813 Commercial Audio Equipment 1996
    b. UL 1419 Professional Video and Audio Equipment 1997
    c. UL 1492 Audio-Video products and Accessories 1996
    d. UL 6500 Audio/Video and Musical Instrument Apparatus for Household, Commercial and Similar General Use 1999

1.3 RELATED WORK IN OTHER SECTIONS

A. Division 26 – Power for all equipment
B. Section 27 05 00 – Common Work Results for Communications Systems
C. Section 27 05 26 – Grounding and Bonding for Communications Systems
D. Section 27 05 29 – Hangers and Supports for Communications Systems
E. Section 27 05 33 – Conduits and Backboxes for Communications Systems
F. Section 27 05 36 – Cable Trays for Communications Systems
G. Section 27 05 43 – Underground Duct and Raceways for Communications Systems
H. Section 27 05 48 – Noise and Vibration Control for Communications Systems
I. Section 27 05 53 – Identification for Communications Systems
J. Section 27 10 00 – Structured Cabling for Communications Systems
K. Section 27 11 13 – Communication Entrance Protection
L. Section 27 05 00 – Common Work Results for Communications Systems
M. Section 27 11 16 – Communications Racks, Frames and Enclosures

N. Section 27 11 19 – Communication Termination Blocks

O. Section 27 11 23 – Communications Cable Management

P. Section 27 11 26 – Communication Rack Mounted Power

Q. Section 27 13 00 – Communications Indoor Backbone Cabling

R. Section 27 14 00 – Communications Outside Plant Backbone Cabling

S. Section 27 15 00 – Communications Horizontal Cabling

1.4 RELATED WORK BY OTHERS

A. By Owner:
   1. Refer to Drawings for identification of Owner-furnished audiovisual equipment items.

1.5 QUALITY ASSURANCE

A. Test Equipment. Provide in conformance with the applicable requirements of Section 27 05 00 – Common Work Results for Audiovisual Systems. Test systems using at least one (1) each of the following test measurement devices or their functional equivalents:

   1. Sound Systems:
      a. Wide band oscilloscope, 50 MHz, analog. (Example: NTI Audio Minilyzer ML1).
      b. True RMS audio digital volt-ohm-millimeter (Example: Fluke 8060A).
      c. Integrated audio test set (Example: Audio Precision or NTI Audio Minilyzer ML1).
      d. Acoustic polarity tester (Example: NTI Audio Minilyzer ML1).
      e. Pink Noise generator (Example: NTI Audio Digital Audio Signal Generator, Extron VTG 300R).
      f. Calibrated microphone and pre-amplifier assembly (Example: 1/2” ANSI Type 1 ACCO, Larson Davis, Bruel & Kjaer free field incidence capsule, preamplifier/power supply).
      g. Real time audio spectrum analyzer, one-third octave (Example: NTI Audio Acoustilyzer AL1 or Minilyzer ML1, Ivie IE-30A or Rational Acoustics Smaart system).
      h. Frequency/time audio analyzer (Example: Goldline TEF system or Rational Acoustics Smaart system).

   2. Baseband Video Systems:
      a. Wide band oscilloscope, 50 MHz, analog. (Example: Tektronix TDS3000C).
      b. Analog composite test generator (Example: Tektronix SPG300).
      c. Analog composite waveform/vector monitor (Example: Tektronix WFM series.)

   3. RGBHV Wideband Component Analog Video Systems:
      a. Wide band oscilloscope, 500 MHz, analog. (Example: Tektronix TDS3000C).
b. RGBHV test generator (Dot clock 200 MHz, Pixel clock accuracy 100 ppm, Horizontal frequency range 15 kHz to 131 kHz, Vertical frequency range 20 Hz to 120 Hz. (Example: Extron VTG 400D).

4. HD/SDI Video Systems
   a. Pattern & Test Signal Generator (Example: Extron VTG 400D, Tektronix SPG300).
   b. Portable Waveform Monitor/Rasterizer (Examples: Tektronix WFM series, Leader LV5750 with HD/SDI Options)

5. HDMI Video Systems
   a. HDMI EDID Diagnostic (Example: Kramer VA-2H).

6. Projection Systems:
   a. Luminance meter. (Example: Tektronix J17/J18 with J1803 8 degree luminance head.).
   b. Grey scale chart.
   c. Precision optical comparator. (Example: Phillips or Tektronix J17/J18 with J1810/J1820 chromaticity head.).

7. Structured Cabling used for Audiovisual Systems
   a. Level III field testers as defined in ANSI/TIA-1152 - Fluke, Agilent or equal.
      i. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table 4 of ANSI/TIA-1152
      ii. The RJ45 test plug shall fall within the values specified in ANSI/TIA-568-C Annex C for NEXT, FEXT and Return Loss.
      iii. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.
   b. Tone Test Sets.

8. Any other items of equipment or materials required to demonstrate conformance with the Contract Documents.

1.6 SUBMITTALS
   A. Conform with Section 27 05 00 - Common Work Results for Communications Systems

1.7 CONFLICTS
   A. Present any conflicts between codes, regulations, specifications and/or requirements at least thirty (30) days prior to the commencement of the scheduled work.
1.8 SYSTEM PERFORMANCE REQUIREMENTS, AUDIO-VISUAL SYSTEM

A. Using the listed test equipment, document that the installed systems meet or exceed the performance standards below.

1. Audio Playback and Sound Reinforcement Systems:
   a. Electrical Performance; Source Input to Power Amplifier Output:
      i. Frequency Response (Equalizer flat): +0.5 dB 30 Hz to 15 kHz.
      ii. Total Harmonic Distortion (THD): Less than 0.5%, 30 Hz to 15 kHz, +4 dBm line level.
      iii. Signal to Noise: At least 70 dB, 30 Hz to 15 kHz, referenced to input of +4 dBm.
      iv. Crosstalk: At least -60 dB, 30 Hz to 15 kHz.
   b. Electro/Acoustic Performance:
      i. Standard Classrooms, Coaching Spaces and Conference Rooms
         (1) Uniformity of Coverage:
            (a) Consistent with installed device, location in room and geometric dispersion of sound level.
         (2) Minimum Sound Pressure Level, Pink Noise Input measured on axis to device under test, center of room, at 4 feet above the floor using a freestanding Type 1, microphone:
            (a) Program Audio 80 dB flat weighting, in each octave from 125 Hz to 8 kHz, without clipping.
      c. Equipment: Specified individually.
      d. Audio Signal Path: Shall not degrade performance of connected equipment.

2. Video Systems
   a. Digital performance concurrent with SMPTE 292M HDTV requirements at 1.5 Gigabits.
   b. Analog Composite Video Frequency Response: 100 KHz to 20 MHz within 0.5 dB
   c. Analog Component/RGBHV Video Frequency Response: 100 KHz to 350 MHz within 3.0 dB
   d. Analog NTSC Video Signal to Noise Ratio: at least 65 dB.
   e. Analog RGBHV Video Signal to Noise Ratio: at least 58 dB.
   f. Analog Video Differential Phase and Gain: no more than 0.5 degrees and 0.5 percent, respectively.
   g. Analog and Digital Video Signal to Crosstalk Ratio: at least 50 dB.
   h. Analog Video Timing; no more than .25 degrees variation at 3.58 MHz between any two parallel lines to the same location.

3. Projection Systems:
   a. Consistent with performance of specified projectors and screens.
   b. Brightness, convergence per ANSI standard procedures for device.

B. System Gain/Levels
1. Maintain consistent signal levels throughout the project for each type of signal carried. Patch points shall be unity gain, "flat" equalization, unless specifically noted otherwise herein or on the drawings. The reference signal levels shall be:

a. Analog Video; 1.0 Volt peak to peak composite signal, sync tip to peak white, defined as "100 IRE", or "100% signal".

b. TV RF; 1000 microVolts, defined as "0 dBmV"

c. Digital Audio, Line Level; -20 dbfs, defined as "0 VU"

d. Analog Audio, Line Level; +4 dBu, defined as "0 VU"

e. Analog Audio, Microphone Level; -50 dBm, 150 ohms

f. Analog Audio, Speaker Level; Greater than +20 dBm

g. Data and Control; As defined by the specification for the signal carried, e.g., RS-232, RS-422 or any other such appropriate standard

C. Measurements

1. Contractor to submit quantitative test reports substantiating conformance with the technical performance standards outlined herein above for each cable run, component, subsystem and overall system installed under the work of this Section, concurrent with or prior to identifying to the Owner’s Representative that the work is Substantially Complete.

2. Conform with the requirements of Section 27 05 00 – Common Work Results for Audiovisual Systems as to means and method of submittal.

1.9 TRAINING

A. Conduct training on completed system at reasonable convenience of the Owner during normal business hours.

1. Operator Training: 10 hours, including classroom format and hands-on training. Document training using the systems installed under the work of this project. Transmit a copy of the training recordings to the Owner on DVD for subsequent retraining and reference by Owner staff.

2. Initial Use Support: Provide standby trainer/system engineer during one (1) system use, not to exceed 4 hours of supplemental support training.

1.10 DEFINITIONS

A. Definitions of Terms: The following definitions and conditions apply to each of the respective parameters and the measurements of those parameters, unless specifically stated otherwise:

1. Frequency Response: The minimum acceptable frequency band over which the amplitude response is within 3 dB (or any specified range), or the specified limits of the response relative to the reference frequency (1 kHz for audio, 1.0 MHz for video) under design load conditions, at any operating level up to and including the specified maximum output while fully in compliance with all other performance specifications.

2. Maximum Output Level: The minimum acceptable maximum signal output level
(voltage, current or power) attained under design load conditions attained while fully in compliance with all other performance specifications.

3. Harmonic Distortion: The maximum acceptable harmonic distortion measured at any operating level, up to and including the specified maximum output, with an applied sine wave signal of any frequency in the range of the specified frequency response.

4. Audio Intermodulation Distortion: The maximum acceptable intermodulation distortion resulting from the introduction of 60 Hz and 7 kHz signals in a ratio of 4:1 under design load conditions at any operating level up to and including the specified maximum output level.

5. Signal to Noise Ratio: The minimum acceptable ratio of signal to noise levels derived from broadband measurements under design load at maximum output over the entire range of the specified frequency response.

6. Clipping Level: The minimum acceptable maximum level of signal applied to the device under design load conditions while fully in compliance with all other performance specifications.

7. Sensitivity: The maximum acceptable level of input signal applied to the device that is necessary to provide the maximum output under design load conditions.

8. Design Load: The load (in ohms) specified by usage of the particular device input or output.


10. Cross Modulation Ratio: The ratio of visual carrier level to coherent spurious signal level (i.e. intermodulation products).

11. Carrier to Noise Ratio: The ratio of visual carrier to noise levels derived from broadband measurements under design load at maximum output over the entire range of the specified frequency response.

B. Signal Levels: The following voltage levels shall be considered the standard operating levels for the particular circuitry, unless specifically noted otherwise (0.775 Volt = 0 dBu = 0 dbm for a 600 ohms terminated circuit):

1. Microphone Circuits: -30 dBu or less.

2. Audio Line Level Circuits: -30 dBu to +24 dBu; equivalent to -30 dBm to +24 dBm for a 600 ohms terminated circuit.

3. Loudspeaker Level Circuits: More than +24 dBu.

4. Video Line Level Circuits: 1.0 Volt, peak to peak composite signal.

5. Radio Frequency (RF), Television (MATV) Circuits: +6 to +72 dBmV (0 dBmV = 1,000 microvolts).

C. Characteristic Impedances: The following operating impedances shall be considered to be the standard operating impedances for the particular circuitry, unless specifically noted otherwise:
1. Microphone Circuits: 50-250 ohms source, 150-1500 ohms terminating, electrostatically and electromagnetically balanced to ground.
2. Audio Line Level Circuits: 600 ohms maximum source, 600 ohms minimum terminating, line to line, electrostatically and electromagnetically balanced to ground.
3. Video Line Level Circuits: 75 ohms maximum source, 75 ohms minimum terminating to shield and signal ground, with Vertical Standing Wave Ratio (VSWR) not to exceed 1.2.
4. Radio Frequency (RF) Television Circuits: 75 ohms nominal to shield and signal ground, with Vertical Standing Wave Ratio (VSWR) not to exceed 1.2.

1.11 SOFTWARE LICENSING

A. Provide licensing for project specific software programming at programmable devices.

B. Provide licensing and original software copies for each device provided under Work of this Section that uses software for operation, configuration or control.

1. Provide licensing for required workstation operating systems, and required third party software.

2. For the Control System, provide a complete copy of the source code, including the device interface driver code modules.

C. Upgrade each software package to the release in effect at the end of the Warranty Period.

PART 2 - PRODUCTS

2.1 POWER AMPLIFIERS AND RELATED

A. Power Amplifiers, General

1. Drawing Symbol: PA[number].

2. Provide the following functions and/or features
   a. Employ solid state devices (integrated circuits and/or transistors) throughout and employ positive protection of circuit components.
   b. With amplifier input driven 10 dB beyond input level required to produce full rated output, amplifier shall withstand for at least 15 seconds any of the following load conditions without instability or operation of main over current protection (i.e. no blown fuses or circuit breakers).
      i. "Short" circuit of 0.1 ohm.
      ii. Open circuit (no load).
      iii. Standard Reactive Load: 5.4 ohms in series with the parallel combination of 12.5 microhenrys; 800 microfarads and 18.3 ohms resistive.
   c. Peak voltage of turn-on and/or turn-off transients not greater than 20 dB below maximum rated amplifier output.
      i. Time duration of transients not to exceed 3 seconds.
d. Input level controls for each output channel to be calibrated, stepped attenuators with at least 50 dB range.
   i. For 0 to 34 dB of attenuation, steps not to be greater than 2.0 dB.
   ii. Attenuators to track calibration within 0.5 dB.
   iii. Stepped attenuators are not required at Power Amplifiers where the connected driving source device includes a precision attenuator under digital control with precision not less than that specified herein.

e. Input Connectors: XLR connector or tip sleeve (standard) phone jack or barrier strip.

f. Output Connectors: Standard 0.75 inch spacing "5-way" binding posts, or barrier strip.

g. Where integral cooling fans are provided, such fans shall have a minimum life rating of 50,000 hours at 25 degree Centigrade ambient temperature.

h. Where indicated, provide balanced input, differential or transformer. Provide matching accessory to implement if not a standard feature of the product provided.

i. Listed by a Nationally Recognized Testing Laboratory.

3. Minimum performance requirements with all channels driven

a. Power Output Per Channel: As scheduled on Drawings as Minimum Amplifier (Min Amp) and specified below; continuous average sine wave power into 70 Volt line over a bandwidth of 40 Hz to 20 kHz.
   i. Frequency Response: plus 0 dB, minus 0.5 dB, 40 Hz to 20 kHz at rated output.
   ii. Total Harmonic Distortion: Less than 0.25 percent at rated output, 40 Hz to 20 kHz.
   iii. Intermodulation Distortion: Less than 0.04 percent at rated output using frequencies of 60 Hz and 7 kHz, mixed in a ratio of 4:1.
   iv. Input Impedance: 15,000 ohms minimum; unbalanced, or balanced as shown on drawings.
   vi. Channel Separation: At least 75 dB at 1 kHz.
   vii. Phase Shift: Less than plus20 degrees from 20 Hz to 20 kHz.

B. Power Amplifiers, 2 Channel, Low Impedance

1. Drawing Symbols
   a. PA 25
   b. PA100
   c. PA200
   d. PA300
   e. PA400
   f. PA800

2. Comply with Power Amplifiers, General, in this Section.

3. Power Output Per Channel, continuous average sine wave power into 8 ohm voice
coil impedance, not less than:

a. PA25, 25 Watts
b. PA40, 40 Watts
c. PA100, 100 Watts
d. PA200, 200 Watts
e. PA300, 275 Watts
f. PA400, 400 Watts
g. PA800, 650 Watts

4. Dimensions

a. PA 25 and PA40 not to exceed 1 rack unit for 2 channels.
b. PA100, PA200 and PA300, not to exceed 2 rack units for 2 channels.

5. Manufacturer, PA25

a. Crown D-45
b. Stewart Electronics
c. Or equal

6. Manufacturer, PA 40

a. Creston MP-AMP40
   i. Input Volume Range : -60 dB to +15 dB
   ii. Bass Gain Range : ±10 dB @ 100 Hz
   iii. Treble Gain Range : ±12 dB @ 10 kHz
   iv. Frequency Response : 80 Hz to 20 kHz ±2.5 dB
   v. S/N Ratio : 75 dB @ 80 Hz to 20 kHz A-weighted
   vi. THD+N : 0.5% @ 1 kHz
   vii. Output Power (MP-AMP40-70V) : 40 watts at 70 volts (Transformer isolated)
   viii. Output Power (MP-AMP40-100V) : 40 watts at 100 volts (Transformer isolated)
   ix. Amplifier Protection : Electronic short-circuit and overload protection
   x. Input Detection Threshold : <30 mVrms @ 1 kHz
   xi. Power Pack : 2.0 amps @ 24 volts dc 100-240 volts ac, 50/60 Hz power pack, included
   xii. Power Consumption : 14 watts @ 1/8 output power - 6.2 watts @ Idle - 750 mW standby

7. Manufacturer, PA100

a. Crown CL1
b. Crown Cd1 1000 in low impedance mode.
c. Stewart Electronics
d. Electro-Voice
e. Peavey
f. Or equal

8. Manufacturer, PA200
9. Manufacturer, PA300
   a. Crown CL1
   b. Crown CDi 1000 in low impedance mode.
   c. Stewart Electronics
   d. Electro-Voice
   e. Peavey
   f. Or equal

10. Manufacturer, PA400
    a. Crown CDi 2000
    b. Crest CKV800
    c. QSC CX702
    d. Electro-Voice
    e. or equal

11. Manufacturer, PA800
    a. Two each PA400 as specified herein above.
    b. Crown CDi 4000
    c. QSC CX1102
    d. or equal

2.2 LOUDSPEAKER

   A. Loudspeaker wall mounted

    1. Drawing Symbol(s) : SP
    2. Function/Features:
       a. Woofer: 8 inch (203 mm) polypropylene w/ring mode decoupled cloth
       b. surround & steel basket
       c. Tweeter: 0.98 inch (25 mm) titanium dome, 90° conical horn loaded
       d. Crossover Frequency: 2 kHz
       e. Impedance: 8 Ohms nominal with transformer set to “8Ω”
       f. Transformer Taps: 3.75W/7.5W/15W/30W/60W at 70V;
       g. 7.5W/15W/30W/60W at 100V
       h. Frequency Response: 80 Hz to 16 kHz (±3 dB)
       i. Frequency Range: 60 Hz to 18 kHz (-10 dB)
       j. Power Handling: 200 Watts prog
       k. Sensitivity: 91.5 dB @ 1W/1m
3. Manufacturer
   i. SAROS_SR8T-B-T-EACH
   ii. or equal

B. Loudspeaker ceiling mounted
   1. Drawing Symbol(s): SA
   2. Function/Features:
      a. Woofer: 6.5 inch (165 mm) polypropylene w/ring mode decoupled cloth
      b. surround & steel basket
      c. Tweeter: 0.98 inch (25 mm) titanium dome, horn loaded
      d. Crossover Frequency: 2.5 kHz
      e. Impedance: 8 Ohms nominal with transformer set to “8Ω”
      f. Transformer Taps: 3.75W/7.5W/15W/30W/60W at 70V;
         7.5W/15W/30W/60W at 100V
      g. Frequency Response: 50 Hz to 20 kHz (±3 dB)
      h. Frequency Range: 40 Hz to 20 kHz (-10 dB)
      i. Power Handling: 125 Watts program (8 Ohms)
      j. Sensitivity: 88.5 dB @ 1W/1m
      k. Coverage: 100° conical (nominal)

3. Manufacturer
   i. SAROS_ICI6T
   ii. Or equal

2.3 ASSISTIVE LISTENING SYSTEM (ALS):

A. General
   1. Provide Radio Frequency Type, Frequency Modulated
   2. 72 MHz Assistive Listening band.
   3. Quantity of Devices:

B. ALS Transmitter
   1. Drawing Symbol: ALS TX
   2. Features
      a. Balanced bridging line input.
      b. Rack mounted.
      c. Connector for remote-mounted antenna.
      d. Selectable transmitting frequency.
   3. Manufacturer
      a. Listen Technologies LT-800-072 Stationary Transmitter with LA-326 Rack Mounting Kit
      b. Phonic Ear
c. Williams Sound Corp
d. Or equal.

C. ALS Remote Transmitting Antenna

1. Drawing Symbol: A
2. Features
   a. Antenna system with mounting hardware, matching specified ALS TX.
3. Manufacturer
   a. Listen Technologies LA-123
   b. Phonic Ear
   c. Williams Sound Corp
   d. Or equal.

D. Receivers and Accessories

1. Receiver
   a. Battery powered, rechargeable.
   b. Volume control.
   c. Receptacle for earphone/accessory.
   d. Rechargeable battery.
   e. Tuneable to channel in use by the user.
   f. Quantity: As Scheduled on the plans
2. Earphone
   a. Ear hung, not inserted in the ear canal.
   b. Hearing-Aid Compatible - For hearing-aid compatible receivers:
   c. Wireless neck loop compatible with “T” coil hearing aids.
   d. Built-in antenna
   e. Operates with provided receivers
3. Manufacturer
   a. Listen Technologies LR-500-072-0-M-C, LA-164 earphones, and LA-166 neck loops
   b. Phonic Ear
   c. Williams Sound Corp
   d. Or equal.

E. Battery Charger/Storage/Carry Case

1. Features
   a. Store and charge up to 16 Receivers and related accessories.
   b. Cover, latches and carrying handles.
   c. Removable lid.
2. Quantity: To simultaneously recharge each received as scheduled on the plans
2.4 CONTROL SYSTEM, SWITCHING AND RELATED

A. General

1. Products provide under this Section shall be made by manufacturers regularly engaged in the production of programmable commercial audio-visual control systems. Such manufacturers shall have at least 5 years prior production experience in the manufacture of such goods.

2. Provide control system to perform functions scheduled on drawings and herein.
   a. System to be field programmable.
   b. Provide programming allowance to implement system as required to provide the functionality indicated herein and as defined by the Owner during design and construction phase meetings, including closely matching the user interface of the existing control panels used elsewhere at the Owner in style, color and organization to the extent directed by the Owner’s Representative.

3. In addition to providing programming to meet the requirements outlined in part one of this specification section and as outlined by the Owner during the reconstruction programming meetings, contractor to provide an allowance of up to $6000 to implement new functions in the audiovisual systems programming identified by the Owner after the substantial completion of this project. Allowance may not be expended by the Contractor in completing the base bid scope of work including warranty defect items.

B. Control Panels, Touch, 7” Diagonal

1. Drawing Reference: CTP7

2. Features/Functions
   a. Display Type: TFT Active matrix color LCD
   b. Size: 7 inch (178 mm) diagonal
   c. Aspect Ratio: 15:9 WVGA
   d. Resolution: 800 x 480 pixels
   e. Brightness: 300 nits (cd/m²)
   f. Contrast: 350:1
   g. Color Depth: 18-bit, 262k colors
   h. Illumination: Edgelit LED
   i. Viewing Angle: ±70° horizontal, ±65° vertical
   j. Touch Screen: Projected capacitive, 2-point multi-touch capable

3. Manufacturers:
a. Crestron TSW-752-B-S  
b. Extron  
c. AMX  
d. Or equal.

C. Gigabit PoE Network Switch

1. Drawing References: NSW

2. Features/Functions:
   a. 100 Mb Latency : < 5 µs
   b. 1000 Mb Latency : < 5 µs
   c. Throughput 14.8 Mpps (64-byte packets)
   d. Routing/Switching capacity : 20 Gbps
   e. Routing table size : 32 entries (IPv4), 32 entries (IPv6)
   f. MAC address table size : 8192 entries
   g. MTBF (years) : 76.33
   h. Operating temperature : 32°F to 104°F (0°C to 40°C)
   i. Operating relative humidity : 10% to 90%, noncondensing
   j. Nonoperating/Storage temperature : -40°F to 158°F (-40°C to 70°C)
   k. Nonoperating/Storage relative humidity : 10% to 95%, noncondensing
   l. Altitude up to 16,404 ft (5 km)
   m. Acoustic Pressure: 0 dB No Fan
   n. Electrical characteristics Frequency 50/60 Hz
   o. AC voltage : 100 - 240 VAC
   p. Maximum power rating : 94 W
   q. PoE power : 65 W PoE+

3. Manufacturers:
   a. HP 1920-8G-PoE+
   b. DLink
   c. Cisco Systems
   d. Or equal.

2.5 VIDEO PROCESSING

A. Digital Media Presentation Switch

1. Drawing Reference: AVSW

2. Functions/Features:
   a. Operating System:
      i. Crestron 3-Series; real-time, preemptive, multi-threaded/multitasking kernel; Transaction-Safe Extended FAT file system; supports up to 10 simultaneously running programs; preloaded DMPS3 .AV Framework Base Program.
   b. Memory:
i. SDRAM 512 MB
ii. Flash 4 GB

c. Communications:
i. Ethernet 10/100/1000 Mbps, auto-switching, auto-negotiating, auto-discovery, full/half duplex, industry-standard TCP/IP stack, UDP/IP, CIP, DHCP, SSL, TLS, SSH, SFTP (SSH File Transfer Protocol), FIPS 140-2 compliant encryption, IEEE 802.1X, SNMP, BACnet™/IP [10], IPv4 or IPv6, Active Directory authentication, IIS v.6.0 Web Server, SMTP e-mail client, RSTP, Private Network Mode

ii. Control Subnet 10/100/1000 Mbps Ethernet, auto-switching, auto-negotiating, full/half duplex, DHCP server, DNS Server, port forwarding, Isolation Mode, IEEE 802.3at Type 1 compliant PoE PSE

iii. AirMedia [1] (Via Ethernet) 10/100 Mbps, IPv4, DHCP, TLS, AES, mDNS, HTTPS web server

iv. Streaming (Via Ethernet) 10/100 Mbps, DHCP, H.264 decoding, MJPEG decoding, HDCP 2.2, RTP, RTSP, SDP

v. Cresnet Cresnet master mode

vi. USB USB signal routing via select DM transmitters and receivers, or via USB-EXT-DM series extenders [9]; USB device port for computer console (setup)

vii. RS-232 2-way device control and monitoring up to 115.2k baud with hardware and software handshaking

viii. IR/Serial 1-way device control via infrared up to 1.2 MHz or serial TTL/RS-232 (0-5 Volts) up to 115.2k baud; supports CNXRMIRD IR Receiver [6]

ix. DigitalMedia DM 8G+, HDCP 2.2, EDID, CEC, PoDM+ [8], Ethernet

x. HDBaseT HDCP 2.2, EDID, CEC, RS-232, PoE+ [8], Ethernet

xi. HDMI HDCP 2.2, EDID, CEC. Supports management of HDCP and EDID; supports management of CEC between the connected HDMI and HDBaseT devices and the control system.

d. Video:
i. Switcher 9x4 matrix, Crestron QuickSwitch HD technology

ii. Scalers (HDMI outputs) (2) 4K video scalers with motion-adaptive deinterlacing, intelligent frame rate conversion, Deep Color support, 3D to 2D conversion [5], content-adaptive noise reduction, and widescreen format selection (zoom, stretch, maintain aspect-ratio, or 1:1).

iii. Input Signal Types HDMI w/Deep Color, 3D [5], & 4K (DVI & Dual-Mode DisplayPort compatible [4]) on Inputs 1-6; DM 8G+ & HDBaseT w/Deep Color, 3D [5], & 4K on Inputs 7 & 8; streaming & AirMedia on Input 9 (LAN).

iv. Output Signal Types HDMI w/Deep Color & 4K (DVI compatible [4]) on Outputs 1 & 2; DM 8G+ & HDBaseT w/Deep Color, 3D, & 4K on Outputs 3 & 4.

e. Maximum Resolutions:
i. Progressive 4096x2160 DCI 4K & 3840x2160 4K UHD 24 Hz 4:4:4 30 bit.

ii. 30 Hz 4:4:4 24 bit.
iii. 30 Hz  4:2:2  36 bit.
iv. 60 Hz  4:2:0  24 bit.
v. 2560x1600 WQXGA  60 Hz  4:4:4  36 bit
vi. 1920x1080 HD 1080i  30 Hz  4:4:4  36 bit
vii. Interlaced (excluded on HDMI outputs)  1920x1080 HD 1080i  30 Hz  4:4:4  36 bit.
viii. NOTE: Common resolutions are shown; other custom resolutions are supported at pixel clock rates up to 300 MHz. Interlaced video is not supported on the HDMI outputs.

f. Streaming Decoder
i. Video Formats H.264 (MPEG-4 part 10 AVC), MJPEG.
ii. Audio Format AAC stereo.
iii. Bitrates up to 25 Mbps.
iv. Resolutions Up to 1080p60.

g. Air Media
i. Users Supports up to 32 users (presentation device connections)
ii. Client Software OS Support Windows 7, Windows 8, Window 10, Mac® OS X® (versions 10.10 through 10.13)
iii. Client Software Video Frame Rate 30 fps, audio supported
iv. Mobile App OS Support Apple® iOS, Android
v. Full Screen Device Mirroring Shares the screen image and audio from an Apple iOS, Android, Mac OS X, or Windows device
vi. Resolutions  800x600@60Hz, 1024x768@60Hz, 1280x720@60Hz (720p60), 1280x768@60Hz, 1280x800@60Hz, 1280x1024@60Hz, 1360x768@60Hz, 1400x1050@60Hz, 1440x900@60Hz, 1600x1200@60Hz, 1920x1080@60Hz (1080p60), 1920x1200@60Hz.

h. Audio – General
i. Switcher/Mixer 14x5 stereo source matrix switcher, digital & analog source inputs, streaming & AirMedia source input, 6-channel gated mic mixer w/DSP, independent mixer per analog output (6-ch mic + 1 stereo source), independent stereo DSP per analog output, integrated power amplifier, two independent digital output mixers (6-ch mic + 1 stereo source), 2x1 digital output mix selector per digital output.
ii. Analog-To-Digital Conversion 24-bit 48 kHz
iii. Digital-To-Analog Conversion 24-bit 48 kHz
iv. Frequency Response, Digital & Analog Line Outputs 20 Hz to 20 kHz ±0.5 dB (digital source); 20 Hz to 20 kHz ±0.5 dB (analog line source); 20 Hz to 20 kHz ±0.7 dB (microphone source)
v. Frequency Response, Speaker Output 20 Hz to 20 kHz ±1 dB @ 25 Watts into 8 Ohms; 100 Hz to 20 kHz ±2.5 dB @ 70 or 100 Volts.
vi. S/N Ratio, Digital & Analog Line Outputs >108 dB, 1 kHz, A-weighted (digital source); >103 dB, 1 kHz, A-weighted (analog line source)
vii. S/N Ratio, Speaker Output 98 dB @ 25 Watts into 8 Ohms, 1 kHz, A-weighted; 96 dB @ 25 Watts into 4 Ohms, 1 kHz, A-weighted.
viii. THD+N, Digital & Analog Line Outputs <0.002%, 20 Hz to 20 kHz (digital source); <0.005%, 20 Hz to 20 kHz (analog line source); <0.05%, 20 Hz to 20 kHz (microphone source).
ix. THD+N, Speaker Output <0.1%, 1 kHz @ 25 Watts into 4 or 8 Ohms; <0.7%, 20 Hz to 20 kHz @ 25 Watts into 4 or 8 Ohms.

x. Stereo Separation, Digital & Analog Line Outputs >108 dB (digital source); >103 dB (analog source).

xi. Stereo Separation, Speaker Output >65 dB @ 25 Watts, 1 kHz

xii. Channel Separation, Digital Outputs >108 dB (digital source); >103 dB (analog source).

xiii. Channel Separation, Analog Line Outputs >103 dB.

xiv. Speaker Output Modes 4Ω/8Ω stereo, 70V mono, or 100V mono.

xv. Speaker Amplifier Output Power 25 Watts RMS per channel @ 8 Ohms, 4 Ohms tolerant; 50 Watts RMS @ 70 or 100 Volts.

Audio – Microphone Inputs
i. Typical of 6 microphone input channels (Mic/Line 1 – 6).

ii. Input Signal Types Mono analog mic or line level.

iii. Phantom Power Enable/Disable per channel.

iv. Gain 0 to +60 dB Gain adjustment in 3 dB increments, plus Mute.

v. Delay 0.0 to 85.0 ms.

vi. EQ Center Frequencies 50 to 200 Hz (Band 1), 200 to 800 Hz (Band 2), 800 to 3.2k Hz (Band 3), 3.2k to 12.8k Hz (Band 4).

vii. EQ Gain ±12.0 dB per band.

viii. High-Pass Filter On or Off.

ix. Gating Threshold -80 to 0 dB.

x. Gating Depth (Attenuation) -80 to 0 dB.

xi. Gating Attack 1 to 250 ms.

xii. Gating Release 1 to 1000 ms.

xiii. Compression Threshold -80 to 0 dB.


xv. Compression Attack 1 to 250 ms.

xvi. Compression Release 1 to 1000 ms.

xvii. Compression Curve: hard or soft knee.

Audio – Source Inputs
i. Input Signal Types HDMI (Dual-Mode DisplayPort compatible [4]) on Inputs 1-6, DM 8G+ & HDBaseT on Inputs 7 & 8, streaming & AirMedia on Input 9 (LAN), analog 2-channel on Aud In 1-5.

ii. Analog Formats Stereo 2-channel.

iii. Digital Formats 2-channel LPCM.

iv. Input Compensation ±10.0 dB, adjustable per input.

Audio – Analog Line & Speaker Outputs
i. Typical of 1 analog line/speaker output (Program Out & Speaker Outputs) and 2 analog line outputs (Aux Out 1 – 2).

ii. Output Signal Type/Format Stereo 2-channel.

iii. Mic 1 – 6 -80 to +10 dB Level adjustment range, plus Mute and Pan.

iv. Mics Master -80 to +10 dB Level adjustment range, plus Mute.

v. Source -80 to +10 dB Level adjustment range, plus Mute and Balance.

vi. Master Volume -80 to +10 dB Level adjustment range, plus Mute and Mono.

vii. Mixer Presets 1 through 5.

viii. Bass ±12.0 dB.
ix. Treble ±12.0 dB.

x. Equalization 10-band graphic + 4-band parametric.

xi. GEQ Center Frequencies 31.5, 63, 125, 250, 500, 1k, 2k, 4k, 8k, 16k Hz.

xii. GEQ Gain ±12.0 dB per band.

xiii. PEQ Center Frequencies 10 to 22000 Hz per band.

xiv. PEQ Gain -36.0 to +24.0 dB per band.

xv. PEQ Bandwidth 0.02 to 3.50 octaves per band.

xvi. PEQ Types Peaking EQ, High Pass, Low Pass, High Shelf, Low Shelf, Notch.

xvii. Delay 0.0 to 85.0 ms.

xviii. Limiter Threshold -80 to 0 dB.

xix. Limiter Ratio 1:1 to 10:1.

xx. Limiter Attack 1 to 250 ms.

xxi. Limiter Hold 1 to 200 ms.

xxii. Limiter Release 1 to 1000 ms.

xxiii. Limiter Curve Hard or soft knee.

xxiv. EQ Presets 1 through 10 (includes Delay and Limiter settings).

l. Audio – Digital Outputs

i. Typical of 4 digital outputs (HDMI Output 1 – 2 & DM Output 3 – 4).

ii. Output Signal Types  HDMI (DVI compatible [4]) on Outputs 1 & 2, DM 8G+ & HDBaseT on Outputs 3 & 4.

iii. Formats  2-channel LPCM.

iv. Digital Output Mix Select 1 – 2  Selects which mix is routed to the corresponding output.

m. Typical of 2 digital output mixers:

i. Mic 1 – 6 -80 to +10 dB Level adjustment range, plus Mute and Pan.

ii. Mics Master -80 to +10 dB Level adjustment range, plus Mute.

iii. Source -80 to +10 dB Level adjustment range, plus Mute and Balance.

iv. Master Volume -80 to +10 dB Level adjustment range, plus Mute.

v. Mixer Presets 1 through 5.

n. Connectors – Audio/Video Inputs

i. AUD IN 1 – 5 (5) 5-pin 3.5 mm detachable terminal blocks.

ii. Balanced/unbalanced stereo line-level analog audio inputs; Input Impedance: 24k Ohms balanced/unbalanced; Maximum Input Level: 4 Vrms balanced, 2 Vrms unbalanced.

iii. MC1/LN1 – MC6/LN6  (6) 5-pin 3.5 mm detachable terminal blocks; Comprises (6) balanced microphone/line audio inputs; Balanced Mic Input Level: -60 to 0 dBV, 1 Vrms maximum; Balanced Line Input Level: -31 to +11 dBV, 3.7 Vrms maximum; Unbalanced Line Input Level: -37 to +5 dBV, 1.85 Vrms maximum; Mic Input Impedance: 3.9k Ohms balanced; Line Input Impedance: 19k Ohms balanced, 9.5k Ohms unbalanced; Phantom Power: 48 Volts DC, software enabled/disabled per channel.

iv. HDMI 1 – 6 INPUTS (6) HDMI Type A connectors, female; Digital video/audio inputs; (DVI and Dual-Mode DisplayPort compatible [4]).
v. DM INPUT 7 – 8 (2) 8-pin RJ45 connectors, female, shielded; DM 8G+ inputs, HDBaseT compliant; PoDM+ PSE ports (HDBaseT PoE compatible) [8]; Each connects to the DM 8G+ output of a DM transmitter or other DM device, or to an HDBaseT device, via CAT5e, Crestron DM-CBL-8G, or Crestron DM-CBL-ULTRA cable [7].

o. Connectors – Audio/Video Outputs
i. SPEAKER OUTPUT 4Ω/8Ω L – R (2) 2-pin 7.62 mm 15A detachable terminal blocks; 4-8 Ohm stereo speaker-level audio output; Wire Size: Terminals accept up to 14 AWG (2.5 mm²); Output Power: 25W RMS per channel stereo at 8 Ohms, 4 Ohms tolerant.

ii. SPEAKER OUTPUT 70/100V (1) 2-pin 7.62 mm 15A detachable terminal block; Transformer-isolated 70 or 100 Volt mono speaker-level audio output; Wire Size: Terminals accept up to 14 AWG (2.5 mm²); Output Power: 50W RMS mono at 70 or 100 Volts; Note: 4Ω/8Ω and 70/100V outputs are mutually exclusive.

iii. PROG OUT (1) 5-pin 3.5 mm detachable terminal block; Balanced/unbalanced stereo line-level audio output; Output Impedance: 200 Ohms balanced, 100 Ohms unbalanced; Maximum Output Level: 4 Vrms balanced, 2 Vrms unbalanced.

iv. AUX OUT 1 – 2 (2) 5-pin 3.5 mm detachable terminal blocks; Balanced/unbalanced stereo line-level audio outputs; Output Impedance: 200 Ohms balanced, 100 Ohms unbalanced; Maximum Output Level: 4 Vrms balanced, 2 Vrms unbalanced.

v. HDMI 1 – 2 OUTPUTS (2) HDMI Type A connectors, female; Digital video/audio outputs; (DVI compatible [4]).

vi. DM OUTPUT 3 – 4 (2) 8-pin RJ45 connectors, female, shielded; DM 8G+ outputs, HDBaseT compliant; PoDM+ PSE ports (HDBaseT PoE compatible) [8]; Each connects to the DM 8G+ input of a DM receiver or other DM device, or to an HDBaseT device, via CAT5e, Crestron DM-CBL-8G, or Crestron DM-CBL-ULTRA cable [7].

p. Connectors – Networking, Control, & Power
i. IR/SERIAL OUT 1 – 4 (4) 2-pin 3.5 mm detachable terminal blocks; IR/Serial output ports; IR output up to 1.2 MHz; 1-way serial TTL/RS-232 (0-5 Volts) up to 115.2k baud.

ii. IR IN (1) 3-pin 3.5 mm detachable terminal block; For connection of the CNXRMIRD IR Receiver [6]; Allows control from IR wireless remotes using RC-5 command set.

iii. INPUT 1 – 4 (1) 5-pin 3.5 mm detachable terminal block; Comprises (4) programmable digital inputs; Input Voltage Range: 0 to 24 Volts DC, referenced to GND; Logic Threshold: 2.5 Volts DC nominal with 1 Volt hysteresis band; Input Impedance: 10k Ohms at >5 Volts, 1M Ohms at <5 Volts; Pull-up Resistor: 2.2k Ohms per input.

iv. RELAY 1 – 4 (1) 8-pin 3.5 mm detachable terminal block; Comprises (4) normally open, isolated relays; Rated 1 Amp, 30 Volts AC/DC;

v. MOV arc suppression across contacts.

vi. COM A – B (2) DB9 connectors, male; Bidirectional RS-232 ports; Up to 115.2k baud, hardware and software handshaking support.
vii. NET (4) 4-pin 3.5 mm detachable terminal blocks; Cresnet Master ports, paralleled; Available Cresnet Power: 10 Watts.
viii. PoDM+ INPUT PWR (1) Combo D-Sub 7w2 connector, male; 48 Volt DC power input for PoDM power supply [8]; Enables PoDM+ power sourcing on each DM INPUT/OUTPUT port; Enables PoE power sourcing on the CONTROL SUBNET port.
ix. SERVICE (1) USB Type B connector, female; For factory use only.
x. 100-240V~ 6.0A 50/60Hz (1) IEC 60320 C14 main power inlet; Mates with removable power cord, included.
xi. G (1) 6-32 screw; Chassis ground lug.
xii. CONTENT LAN IN 9 (1) 8-pin RJ45 connector, female; 10Base-T/100Base-TX Ethernet port; Provides a dedicated LAN connection for streaming input & AirMedia.
xiii. CONTROL SUBNET (1) 8-pin RJ45 connector, female; 10Base-T/100Base-TX/1000Base-T Ethernet port; PoE PSE (Power Sourcing Equipment) port [8]; Provides a dedicated local network for Crestron devices.
xiv. LAN (1) 8-pin RJ45 connector, female; 10Base-T/100Base-TX/1000Base-T Ethernet port.
xv. COMPUTER (front) (1) USB Type B connector, female; USB computer console port (for setup only).

q. Controls & Indicators
i. PWR (1) Green LED, indicates operating power supplied from AC power line.
ii. NET (1) Yellow LED, indicates Cresnet bus activity.
iii. LAN (1) Yellow LED, indicates Ethernet activity.
iv. HW-R (1) Recessed pushbutton for hardware reset, reboots the control system.
v. SW-R (1) Recessed pushbutton for software reset, restarts the software program.
vi. LCD Display (1) Green LCD alphanumeric; adjustable backlight; 2 lines x 20 characters per line; displays input/outputs by name, volume levels, setup menus, signal routing, device info, and other system information.
vii. SOFTKEYS (4) Pushbuttons for activation of LCD driven functions and passcode entry.
viii. MENU (1) Pushbutton, steps menu back one level.
ix. Λ, V (2) Pushbuttons, for scrolling up or down through the menu and adjusting menu parameters.
x. ENTER (1) Pushbutton, executes the highlighted menu or value.
xi. VOLUME (1) Continuous turn rotary encoder, adjusts menu parameters, defaults to Program audio volume.
xii. MUTE (1) Pushbutton and red LED, mutes the Program audio output.
xiii. INFO (1) Pushbutton and red LED, selects INFO mode to view AV and device info.
xiv. ROUTE (1) Pushbutton and red LED, selects ROUTE mode to allow routing changes.
xv. VIEW (1) Pushbutton and red LED, selects VIEW mode to view current routing.
xvi. INPUT 1 – 9 (9) Pushbuttons and red LEDs, each selects the corresponding video input for routing.

xvii. OUTPUT 1 – 4, PROG, AUX 1 – 2 (7) Pushbuttons and red LEDs, each selects the corresponding video or audio output for routing.

xviii. SPEAKER OUTPUT (rear) (1) 3-position slide switch, selects the amplifier output configuration.

xix. DM INPUT 7 – 8 (rear) (4) LEDs, green LEDs indicate DM link status, amber LEDs indicate video and HDCP signal presence, for each corresponding port.

xx. DM OUTPUT 3 – 4 (rear) (4) LEDs, green LEDs indicate DM link status, amber LEDs indicate video and HDCP signal presence, for each corresponding port.

xxi. CONTENT LAN IN 9 (rear) (2) LEDs, (1) green and (1) amber, for indication of Ethernet speed, activity, and link status.

xxii. CONTROL SUBNET (rear) (2) LEDs, (1) green and (1) amber, for indication of Ethernet speed, activity, and link status.

xxiii. LAN (rear) (2) LEDs, (1) green and (1) amber, for indication of Ethernet speed, activity, and link status.

r. Power

i. Main Power 6 Amps @ 100-240 Volts AC, 50/60 Hz

ii. Power Consumption 93 Watts typical; 72 Watts idle.


iv. Power over DM (PoDM) IEEE 802.3at compliant PoDM+ PSE (Power Sourcing Equipment), each DM INPUT/OUTPUT port supplies up to 30 Watts to power one PoDM (Class 0-3) or PoDM+ (Class 4) PD (Powered Device).

v. Power over HDBaseT IEEE 802.3at PoE+ compliant PSE (Power Sourcing Equipment), each DM INPUT/OUTPUT port supplies up to 30 Watts to power one HDBaseT PoE or PoE+ PD (Powered Device).

vi. Power over Ethernet (PoE) IEEE 802.3at compliant PoPSE (Power Sourcing Equipment), the CONTROL SUBNET port supplies up to 15.4 Watts to power one PoE (Class 0-3) PD (Powered Device).

vii. PoDM Power Supply Compatible with model PW-4830DUS or DM-PSU-3X8-RPS.

s. Environmental

i. Temperature 41° to 104° F (5° to 40° C).

ii. Humidity 10% to 90% RH (non-condensing).

iii. Heat Dissipation 317 BTU/hr typical; 246 BTU/hr idle.

t. Enclosure

u. Chassis Metal, black finish, fan-cooled, vented sides

v. Front Panel Metal, black finish with polycarbonate label overlay

w. Mounting Freestanding or 3 RU 19-inch rack-mountable (adhesive feet and rack ears included)

x. Dimensions

y. Height 5.20 in (133 mm) without feet

z. Width 17.28 in (439 mm);

aa. 19.00 in (483 mm) with rack ears

bb. Depth 15.75 in (400 mm)
cc. Weight  
dd. 15.5 lb (7.1 kg)  
ee. Compliance  
ff. UL Listed for US & Canada, IC, CE, FCC Part 15 Class A digital device  
gg. Maximum DM 8G+ Cable Lengths  

3. Manufacturer:  
   a. Crestron DMPS3-4K-350-C  
   b. Or equal.  

B. Wireless HD presentation  

1. Drawing References: AIRMEDIA  

2. Features & Functions  
   a. Users: Supports up to 32 users (presentation device connections)  
   b. Quad View: Allows simultaneous display of up to four presentation sources in a quad window  
   c. Moderator Mode (Layout Control): Enables a single moderator to control the presentation via a Web browser or control system touch screen  
   d. Remote View: Allows up to 40 remote users to connect via a Web browser to view and save images of the presentation  
   e. Display Control: Controls the display device over IP as part of the presentation [2]  
   f. Control System Integration: Allows communication over IP with a Crestron Control System® for remote control and integration with other equipment  
   g. Network Management: Supports enterprise management and monitoring using SNMP or Crestron Fusion® software  
   h. Output Signal Types: HDMI® (DVI compatible [3]), VGA/RGBHV  
   i. Output Resolutions, Progressive: 800x600@60Hz, 1024x768@60Hz, 1280x720@60Hz (720p60), 1280x800@60Hz, 1280x1024@60Hz, 1360x768@60Hz, 1400x1050@60Hz, 1440x900@60Hz, 1600x1200@60Hz, 1920x1080@60Hz (1080p60), 1920x1200@60Hz  
   j. Output Resolutions, Interlaced: 1920x1080@30Hz (1080i30)  
   k. Underscan: Up to 7.5%  
   l. Output Signal Types: HDMI, analog stereo  
   m. Formats, HDMI: PCM 2-channel  
   n. Formats, Analog: Stereo 2-channel  
   o. Ethernet: 10/100 Mbps, auto-switching, auto-negotiating, full/half duplex, TCP/IP, UDP/IP, CIP, DHCP, SSL, TLS, SSH, SNMP, IPv4, Web server  
   p. 5VDC 2.6A: (1) 2.0 x 3.0 mm DC power connector, 5 Volt DC power input, Universal power pack included  
   q. AUDIO: (1) 3.5 mm TRS mini phone jack, unbalanced stereo line-level audio output  
   r. HDMI: (1) 19-pin Type A HDMI female, HDMI digital video/audio output (DVI compatible [3])  
   s. VGA: (1) HD15 female, RGBHV (VGA) video output
t. LAN: (1) 8-wire RJ45, female; 10Base-T/100Base-TX Ethernet port
u. SERVICE: (1) USB Type A female, for factory use only
v. PWR: (1) Bi-color LED, red indicates booting, flashing red indicates updating firmware, green indicates operating normally
w. LAN (rear): (2) LEDs, green LED indicates Ethernet link status, amber LED indicates Ethernet activity
x. Reset (bottom): (1) Pushbutton, resets the AM-101 to its factory settings
y. Power Pack: 2.6 Amps @ 5 Volts DC; 0.3 Amps (maximum) @ 100-240 Volts AC, 50/60 Hz power pack included

3. Manufacturer:
   a. AirMedia (AM 101)

2.6 NOTIFICATION SYSTEM

A. 2-WAY NOTIFICATION SYSTEM LOUDSPEAKER

1. Drawing Reference: NS
2. Features/Functions:
   a. IP flush mount loudspeaker w/ powder-coated metal grille.
   b. 12”W x 12”H x 4”D
   c. 8” High efficiency PA speaker
   d. Built-in Sound Masking
   e. Built-in Microphone for 2-way communication
   f. Manufacturer’s back-box included
3. Manufacturer:
   a. Advanced Network Systems IPSWS-FM
   b. Or equal.

B. PUSH-TO-TALK 2-WAY NOTIFICATION SYSTEM

1. Drawing Reference: PTT
2. Features/Functions:
   a. Faceplate dimensions 4.5”H x 2.75” W for installation with any standard single-gang junction box.
   b. Includes call button, faceplate (16 ga. Polished stainless steel), vandal resistant screws and peripheral interface adaptor board.
3. Manufacturer:
   b. Or equal.

2.7 SOURCE DEVICES

A. High Definition A/V Transmitter
1. Drawing Reference: DMTX
2. Functions/Features:
   a. Provides HDMI, RGBHV and mini stereo audio inputs
   b. Provides USB extension
   c. Provides LAN connectivity
   d. Transmits audio, video and control signaling to specified receiver over a single UTP6-4P cable.
   e. HDCP compatible.
   f. Can be remotely powered by specified control system.
   g. Mounts to underside of table.
   h. Nominal dimensions: 6.5” x 7” x 1.5”

3. Manufacturer
   a. Crestron DM-TX-201-C
   b. Or equal.

B. HDMI and RGBHV w/ Stereo Audio Input Plate
   1. Drawing Reference: MP1
   2. Features/Functions
      a. Inputs
         i. HDMI
         ii. RGBHV
         iii. Stereo Audio
         iv. USB
      b. 2x1 combination digital/analog switch
      c. Supports resolutions up to 2048x1080 @ 24Hz
      d. Analog-To-Digital Conversion 10-bit 165 MHz per each of 3 channels
      e. Communications
         i. Audio, video and control 330 feet over a single UTP Cat 6 cable.
         ii. HDCP management, EDID format management, CEC
      f. USB Supports USB HID class devices
      g. Compatible with specified switcher.
      h. Remotely powered from switcher/headend equipment location.
         i. 2 gang.
   3. Manufacturers
      a. Crestron DM-TX-200-C-2G w/ required remote power accessories.
      b. Extron
      c. Or equal.

C. Multimedia Receiver w/ Scaler
   1. Drawing Reference: DMRX
   2. Features/Functions
a. Receives audio, video and control over a single UTP Cat 6 cable.
b. Outputs
   i. HDMI, DVI
   ii. RS-232
   iii. IR
   iv. USB
   v. LAN
c. Communications: HDCP management, EDID format management, CEC
d. Supports resolutions up to 2048x1080 @ 24Hz
e. Compatible with specified switcher.
f. Enclosure
   i. Metal, black finish, vented sides and front
   ii. 8” x 8” x 2”
g. Built-in video scaler: HD video scaler, motion-adaptive deinterlacer, interlacer, intelligent frame rate conversion, Deep Color support, 3D to 2D conversion, content-adaptive noise reduction

3. Manufacturers
   a. Crestron DM-RMC-SCALER-C
   b. Crestron 4K Digital media receiver from controller (DM-RMC-4k-100-C)
   c. Or equal.

2.8 VIDEO TERMINAL EQUIPMENT

A. 55” Flat Panel Display
   1. Drawing Reference: LCD55
   2. Features/Functions
      a. Panel Type: LCD, LED backlighting
      b. Professional/commercial grade display warrantied by the manufacturer for continuous operation for not less than two (2) years.
      c. Minimum viewable panel size: 55” diagonal, 16:9 aspect ratio
      d. Maximum pixel pitch: 0.923 x 0.923 mm
      e. Native Resolution: 1920 x 1280
      f. Viewing angle (H/V): 176-degrees/176-degrees
      g. Brightness: 450 cd/m²
      h. Maximum response time: 6ms
      i. Contrast Ratio: 5000:1
      j. Inputs
         i. VGA (D-sub 15 pin)
         ii. HDMI
         iii. Stereo Mini Jack
      k. Control
i. RS-232C
ii. RJ45
iii. IR, included IR remote
l. Power consumption in accordance with California Code of Regulations, Title 20: Division 2, Chapter 4, Article 4, Sections 1601-1608: Appliance Efficiency Regulations.
m. Weight: 175 lbs.

3. Manufacturer:
a. NEC
b. Samsung
c. Or equal.

B. 80" Flat Panel Display

1. Drawing Reference: LCD80

2. Features/Functions
   a. Panel Type: LCD, LED backlighting
   b. Professional/commercial grade display warranted by the manufacturer for continuous operation for not less than two (2) years.
   c. Minimum viewable panel size: 80" diagonal, 16:9 aspect ratio
   d. Maximum pixel pitch: 0.923 x 0.923 mm
   e. Native Resolution: 1920 x 1280
   f. Viewing angle (H/V): 176-degrees/176-degrees
   g. Brightness: 450 cd/m²
   h. Maximum response time: 6ms
   i. Contrast Ratio: 5000:1
   j. Inputs
      i. VGA (D-sub 15 pin)
      ii. HDMI
      iii. Stereo Mini Jack
   k. Control
      i. RS-232C
      ii. RJ45
      iii. IR, included IR remote
   l. Power consumption in accordance with California Code of Regulations, Title 20: Division 2, Chapter 4, Article 4, Sections 1601-1608: Appliance Efficiency Regulations.
m. Weight: 175 lbs.

3. Manufacturer
   a. NEC
   b. Samsung
   c. Or equal.
C. Interactive display
   1. Drawing Reference: LCD70i
   2. Features/Functions
      a. Native Aspect Ratio 16:9
      b. Technology: E-LED LCD
      c. Resolution: 1080p(1920x1080)
      d. Diagonal Size: 70"
      e. Touchscreen: Edge-to-edge IR 4-point multi-touch system with support for
         Windows 7/8 gestures (PC only). Glass protection overlay for LCD surface.
      f. Refresh Rate: 200 Hz
      g. Speakers: Integrated: Stereo 20W (2 x 10W)
      h. Connections: HDMI x 2, HDMI (ARC) x 1, VGA (HD15 VESA), USB Type A x 2,
         SPDIF Optical, Component, RCA stereo audio (L/R) in, 3.5mm stereo audio in,
         3.5mm stereo audio out, LAN, USB Type-A cable to touch system panel board
   3. Manufacturer
      a. InFocus JTouch 70"
      b. Or equal.

D. Lay-in Ceiling Projector Mount Kit
   1. Drawing Reference: refer to VPROJ, where occurs
   2. Features/Functions:
      a. UL Listed
      b. Color: white
      c. 9 mounting hole positions and threaded ends for accepting 1.5” NPT extention
         columns.
      d. Weight Capacity: 250 lbs. (center hole), 125 lbs. (side and corner holes).
   3. Manufacturer:
      a. Chief CMA450 Above Suspended Ceiling Kit with Chief CMS Extention Column(s)
         as required to align projector lens level with top of viewable area of projection
         surface.
      b. No known equal.

E. Projector
   1. Drawing Reference: VPROJ3
   2. Manufacturer:
      a. Epson PRO G7200W or PRO G7200 WNL
      b. Brightlink PRO697UI
      c. Or equal

F. Document camera
2.9 SOUND CABLES AND RELATED

A. General

1. Provide cable with electrical conductors of soft drawn annealed copper, bare or tinned, solid or concentric stranded as applies, conductivity not less than 98 percent of pure copper.

2. Comply with applicable Code for insulation, jacket, marking and listing for applicable use.
   a. Refer to California Electrical Code, Table 725-61. Cable Uses and Permitted Substitutions.

3. Manufacturer part number specified is for a Listed Type CM construction to indicate intended cable construction and quality.
   a. Code requirements take precedence.
   b. Provide type required by Code at no additional cost to the Owner.

B. Cable, Microphone and Line Level, General Purpose

1. Drawing Symbol(s): SP, 2A.

2. Description: Shielded, single twisted pair, with #20 AWG color coded stranded conductors and foil shield with drain wire.

3. Performance/Construction
   a. Conductors AWG #20.
   c. D.C. Resistance Per 1000 feet 15 ohms maximum.
   d. Shield: Aluminum polyester foil with #20 AWG stranded tinned copper drain wire.
   e. Diameter 0.24 inch maximum.

4. Where 2A indicated, provide 2 each SP

5. Manufacturer
   a. Belden 8762
   b. West Penn.
   c. Or equal.

C. Cable, Microphone and Line Level, Miniature

1. Drawing Symbol: SP, 2A

2. Restriction: For use within fixed equipment racks only.

3. Description: Shielded, single twisted pair, with #22 AWG color coded stranded conductors and foil shield with drain wire.

4. Performance/Construction:
   a. Conductors AWG #22.
c. D.C. Resistance Per 1000 feet: 20 ohms maximum.
d. Shield: Aluminum polyester foil with #24 stranded tinned copper drain wire.
e. Diameter 0.15 inch maximum.

5. Where 2A indicated, provide 2 each SP

6. Manufacturer
   a. Belden 8451, 9451, 1266A.
   b. Alpha.
   c. West Penn.
   d. Or equal.

D. Cable, Antenna, Assistive Listening System

1. Description
   a. Nominal 50 ohms (actual 51 or 52 ohms) coaxial cable.

2. Minimum 97 percent shield coverage.

3. Joint Army Navy (JAN) or Military (MIL) Construction
   a. RG-8/U to JAN-C-17A
   b. RG-8 A/U to MIL-C-17D
   c. RG-9/U to JAN-C-17A.

4. Manufacturer
   a. Belden 8237, 9251 or 8242.
   b. CommScope.
   c. Or equal.

E. Cable, Loudspeaker and D.C. Power

1. Drawing Symbol(s)
   a. #18TP
   b. #16TP
   c. #14TP
   d. #12TP

2. Description
   a. Twisted pair, jacketed, unshielded cables, #12, #14, #16, or #18, as shown on Drawings.

3. Plenum rated where installed in open plenum return voids.

4. Performance/Construction
   a. Conductor, AWG: #12, #14, #16, and #18, as noted.
   b. Maximum diameter
      i. 0.384 inch (#12)
      ii. 0.332 inch (#14)
      iii. 0.256 inch (#16)
iv. 0.224 inch (#18).

5. Manufacturer
   a. Belden.
      i. #12TP, Belden 8477
      ii. #14TP, Belden 8473
      iii. #16TP, Belden 8471
      iv. #18TP, Belden 9740
   v. West Penn.
   vi. Or equal.

F. Audio & Control Cabling, Underground, in ducts
   1. As specified for the applications above with waterblocking construction consisting of two
      ply tape designed to swell on exposure to water.
   2. Jacket is sunlight and moisture resistant
   3. NEC CM or CL3 listed or better. Transition to listed cabling type within 50 feet of
      entering building.
   4. Manufacturer listed for underground application subject to extended exposure to standing
      water.
   5. Manufacturer:
      a. West Penn (aquaseal)
      b. Alpha
      c. Belden
      d. Commscope/Isotec
      e. or equal.

2.10 VIDEO CABLES, COPPER COAX AND RELATED

A. General
   1. Provide cable with electrical conductors of soft drawn annealed copper, bare or tinned,
      solid or concentric stranded as applies, conductivity not less than 98 percent of pure
      copper.
   2. Comply with applicable Code for insulation, jacket, marking and listing for applicable
      use.
      a. Refer to California Electrical Code, Table 725-61. Cable Uses and Permitted
         Substitutions.
      b. Manufacturer part number specified is for a Listed Type CM construction to indicate
         intended cable construction and quality.
   3. Code requirements take precedence.
      a. Provide type required by Code at no additional cost to the Owner.

B. Cable, Precision Video
   1. Drawing Symbol(s): P-VID, V.
2. Description: 100 percent sweep tested from 0.01 to 100 MHz, double braided shield solid center conductor 75 ohms coaxial precision video cable.

3. Performance
   a. Cable Type: Coaxial precision video.
   b. Center Conductor AWG: Twenty (20) bare copper.
   c. Insulation: Polyethylene.
   d. Shield: Tinned copper double braid, minimum 98 percent coverage.
   e. Nominal Impedance: 75 ohms.
   g. Attenuation Per 100 feet:
      i. 1.0 MHz: 0.25 dB
      ii. 4.5 MHz: 0.45 dB
      iii. 10.0 MHz: 0.78 dB.
   h. Jacket: Polyethylene.
   i. Diameter: 0.305 inch maximum.

4. Manufacturer
   a. Belden 8281A or 8281B.
   b. Canare
   c. Gepco
   d. Or equal.

C. Cable, Miniature Precision Video

1. Drawing Symbol: Miniature Precision Video.

2. Description: 100 percent sweep tested from 0.01 to 100 MHz, braided shield plus foil shield, stranded center conductor 75 ohms coaxial miniature precision video cable.

3. Performance
   a. Cable Type: Coaxial precision video.
   b. Center Conductor AWG: 22 or 23 bare copper.
   c. Center Conductor Stranding: 7 by 30 or 7 by 32.
   d. D.C. Resistance Per 1000 feet: 15 ohms maximum.
   e. Insulation: Cellular Polyethylene.
   f. Shield: 100 percent foil plus trimmed copper braid, 95 percent coverage.
   g. Nominal Impedance: 75 ohms.
   h. Velocity of Propagation: 66 percent.
   i. Attenuation Per 100 feet:
      i. 1.0 MHz: 0.15 dB
      ii. 10.0 MHz: 1.3 dB
      iii. 100 MHz: 5.0 dB.
   k. Diameter: 0.240 inch maximum.
4. Manufacturer
   a. Belden 9209A.
   b. Canare LV-61S.
   c. Or equal.

D. Cable Set, Audio Video, Manufactured
1. Provide signal type as indicated on Drawings.
2. Manufacturer
   a. Liberty Wire & Cable Interflex Z-200 and Z-300 Series
   b. Markertek
   c. Or equal.

E. Cable, Data Monitor Precision Video
1. Plan Reference(s):
   a. D5
   b. 5DVideo
2. Construction
   a. 5 miniature high resolution coax cables in an overall shielded overall jacket to
      transmit analog component video based on the Red-Green-Blue-Horizontal Sync-
      Vertical Sync (RGBHV) transmission method.
   b. Sub cables are color coded Red, Green, Blue, Black, Grey; or approved alternate
      color coding scheme.
   d. Overall five sub cable assembly diameter: 0.56" maximum in raceway applications.
   e. Center Conductor AWG: Twenty two (22) ga Silver Plated Copper.
   f. Insulation: Foamed Teflon.
   g. Shield:
      i. Each subcable is double shielded
      ii. Overall cable has 100% tape shield.
3. Approval/Rating:
   a. UL: Recognized Type CL2P (Article 725 of NEC) for plenum application, riser rated
      elsewhere.
4. Performance - each sub-cable:
   a. Resistance: 0.0162 ohms/ft nominal @ 20C
   b. Impedance: 75 ohm nominal
   c. Capacitance: 17.5 pf/ft nominal
   d. Velocity of Propagation: 80% nominal
   e. Time Delay: 1.19ns/ft nominal
   f. Maximum Attenuation Per 100':
      i. 10 MHz: 0.8 dB/100 ft.
ii. 50 MHz: 2.5 dB/100 ft.
iii. 100 MHz: 3.5 dB/100 ft.
iv. 200 MHz: 4.6 dB/100 ft.
v. 300 MHz: 5.0 dB/100 ft.
vi. 400 MHz: 7.2 dB/100 ft.
vii. 1000 MHz: 14.6 dB/100 ft.

5. Manufacturers:
   a. Altinex CB5100PL in plenum spaces, riser rated elsewhere.
   b. Extron
   c. Belden
   d. Gepco.
   e. or equal.

F. DVI Cabling
   1. Drawing Reference: DVI
   2. Features/Functions
      a. Supports single link DVI-D signals up to 1920 x 1200 @ 60 Hz and 1080p/60:
      b. Data rates to 4.95 Gbps
      c. Color depth to 24 bits - 8 bits per color
      d. For cable lengths up to 12 feet: 24 AWG copper wire construction
      e. For cable lengths 25 feet and longer: 22 AWG copper wire construction
      f. NEC CM rated
   3. Manufacturers, copper cabling and extenders:
      a. Extron
      b. or equal.

G. USB over Ethernet Extender Host Module
   1. Drawing Symbol(s) : USB XTD H?
   2. Features/Functions
      a. Ethernet: 100Base-T or 1000Base-T, Layer 2
      b. Link Speed: Up to 480 Mbps, dependent upon network speed and quality
      c. USB Device Support: USB 1.1 and 2.0 compatible including isochronous devices
         [2]
      d. USB: (1) USB Type B female (cable included);
      e. USB 2.0 device port for connection to the USB host computer, media
      f. server, game console, annotator, codec, etc.
      g. Link: (1) 8-pin RJ45 female;
      h. Connects to an Ethernet network or directly to a USB-EXT-DM-REMOTE [3]
      i. Power: (1) Blue LED, indicates operating power supplied via the USB host
      j. Link: (1) Green LED, indicates a valid link connection to a USB-EXT-DM-REMOTE
k. Host: (1) Green LED, indicates a valid connection to the USB host
l. Activity: (1) Amber LED, indicates data activity over the link connection
m. USB-EXT-DM USB over Ethernet Extender with Routing
n. Pair: (1) Pushbutton, used to establish a connection with a USB-EXT-DM-REMOTE
o. USB-EXT-DM-LOCAL: USB powered via the USB host interface

3. Manufacturer
   a. With routing, Host Module, 2 each (USB-EXT-DM-LOCAL)

H. USB over Ethernet Extender Device Module
   1. Drawing Symbol(s): USB XTD D?
   2. Features/Functions
      a. Ethernet: 100Base-T or 1000Base-T, Layer 2
      b. Link Speed: Up to 480 Mbps, dependent upon network speed and quality
      c. USB Device Support: USB 1.1 and 2.0 compatible including isochronous devices [2]
      d. USB: (4) USB Type A female;
      e. USB 2.0 host ports for connection of USB mice, keyboards, whiteboards, game controllers, cameras, mobile devices, printers, flash drives, hard drives, hubs, and other USB devices [2];
      f. Available Power: 500 mA @ 5 Volts DC per port
      g. 24V DC: (1) 2.1 x 5.5 mm DC power connector; 24 Volt DC power input; PW-2407WU power pack included
      h. Link: (1) 8-pin RJ45 female; Connects to an Ethernet network or directly to a USB-EXT-DM-LOCAL
      i. Power: (1) Blue LED, indicates operating power supplied via the power pack
      j. Link: (1) Green LED, indicates a valid link connection to a USB-EXT-DM-LOCAL
      k. Host: (1) Green LED, indicates a valid connection to the USB host at the USB-EXT-DM-LOCAL
      l. Activity: (1) Amber LED, indicates data activity over the link connection
      m. Pair: (1) Pushbutton, used to establish a connection with a USB-EXT-DM-LOCAL
      n. USB-EXT-DM-REMOTE: 0.75 Amps @ 24 Volts DC; 100-240 Volts AC, 50/60 Hz power pack, model PW-2407WU included

3. Manufacturer
   a. With routing, 4 port Device Module, 2 each (USB-EXT-DM-Remote)

I. Extender set
   1. Drawing Symbol(s): XTD Set?
   2. Features/Functions
      a. Input Signal Types: HDMI (DisplayPort Multimode compatible [2])
      b. Output Signal Types: HDMI
      c. Formats: Dolby Digital®, Dolby Digital EX, Dolby Digital Plus, Dolby® TrueHD,
DTS®, DTS-ES, DTS HD High Res, DTS-HD Master Audio™, LPCM up to 8 channels

d. RS-232: Extends 2-way serial device control signals up to 115.2k baud
e. IR: Extends 1-way IR device control signals up to 455 kHz
f. HDMI: Passes HDCP 2.2, EDID, & CEC
g. HDMI IN: (1) 19-pin Type A HDMI female; HDMI digital video/audio input; Also supports DVI or Displayport Multimode [2]
h. IR IN: (1) 2-pin 3.5mm detachable terminal block; IR repeater input port; IR signal input up to 455 kHz
i. COM: (1) 3-pin 3.5mm detachable terminal block; Bidirectional RS-232 port; Up to 115.2k baud, software handshaking support
j. 24VDC 0.75A (rear): (1) 2.1 x 5.5 mm DC power connector; 24 Volt DC power input (PW-2407WU power pack included) [3]
k. Ground (rear): (1) Flying lead, chassis ground connection
l. HDBaseT OUT (rear): (1) 8-pin RJ45 female, shielded; Connects to the HDBaseT IN port of the HD-RX3-C receiver via CAT5e, Crestron DM-CBL-8G, or Crestron DM-CBL-ULTRA cable [1]
m. IR OUT: (1) 2-pin 3.5mm detachable terminal block; IR repeater output port; IR output up to 455 kHz
n. COM: (1) 3-pin 3.5mm detachable terminal block; Bidirectional RS-232 port; Up to 115.2k baud, software handshaking support
o. G: (1) 6-32 screw, chassis ground lug
p. HDMI OUT: (1) 19-pin Type A HDMI female; HDMI digital video/audio output; Also supports DVI[2]
q. HDBaseT IN: (1) 8-pin RJ45 female, shielded; Connects to the HDBaseT OUT port of the HD-TX3-C transmitter via CAT5e, Crestron DM-CBL-8G, or Crestron DM-CBL-ULTRA cable [1]
r. PWR 24VDC 0.75A: (1) 2.1 x 5.5 mm DC power connector; 24 Volt DC power input (PW-2407WU power pack included) [3]
s. PWR/LINK: (1) dual-color amber/green LED, indicates operating power supplied via local power pack or HD-RX3-C[3], and indicates HDBaseT link status and HDMI input signal presence
t. HDBaseT OUT (rear): (2) LEDs, green LED indicates link status, amber LED indicates video and HDCP signal presence
u. SW1 (side): (1) slide switch, enables hot plug detect
v. PWR: (1) green LED, indicates operating power supplied via local power pack or HD-TX3-C [3]
w. HDBaseT IN: (2) LEDs, green LED indicates link status, amber LED indicates video and HDCP signal presence
x. Power Pack: 0.75 Amp @ 24 Volts DC; 100-240 Volts AC, 50/60 Hz power pack, model PW-2407WU, included [3]

3. Manufacturer
a. HDBaseT (HD-EXT3-C)

2.11 CONTROL AND CONTROL MEDIA CABLING

A. General

1. Provide cable with electrical conductors of soft drawn annealed copper, bare or tinned, solid or concentric stranded as applies, conductivity not less than 98 percent of pure copper.

2. Comply with applicable Code for insulation, jacket, marking and listing for applicable use.
   a. Refer to California Electrical Code, Table 725-61. Cable Uses and Permitted Substitutions.
   b. Manufacturer part number specified is for a Listed Type CM construction to indicate intended cable construction and quality.

3. Code requirements take precedence.
   a. Provide type required by Code at no additional cost to the Owner.

B. High Speed, TIA/TIA Category Cabling

1. Drawing Reference:** UTP6-4, where ** denotes cable count

2. Construction:
   a. Provide horizontal copper cable in accordance with:
      i. EIA ANSI/TIA/EIA-568-B.2
      ii. UL 444,
      iii. NEMA WC 66 (Performance Standard for Category 6 and Category 7 100 Ohm Shielded and Unshielded Twisted Pair)
      iv. ICEA S-90-661
   b. UTP (unshielded twisted pair),
   c. 100 ohm impedance
   d. Four each individually twisted pair, 22 or 24 AWG conductors,
      i. Color code
         (1) Pair 1 White/Blue Blue
         (2) Pair 2 White/Orange Orange
         (3) Pair 3 White/Green Green
         (4) Pair 4 White/Brown Brown
      e. No shield in the sheath.
   f. Jacket
      i. Thermoplastic jacket
      ii. Color: Blue unless otherwise indicated.
      iii. Cable imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating (category designation) at regular intervals not to exceed 2 feet.
iv. The word "FEET" or the abbreviation "FT" shall appear after each length marking.

v. Provide communications general purpose (CM or CMG), communications plenum (CMP) or communications riser (CMR) rated cabling in accordance with NFPA 70.

vi. Type CMP and CMR may be substituted for type CM or CMG and type CMP may be substituted for type CMR in accordance with NFPA 70.

3. Certification

   a. Warrantied by the manufacturer to provide Category 6 performance when installed in accordance with applicable EIA/TIA standards and when terminated with the jacks supplied by the Contractor for this Project.

4. Performance

   a. Assembly electrically meets or exceeds EIA ANSI/TIA/EIA-568-B.2 Category 6 performance standards

5. Manufacturers:

   a. Berk-Tek LANmark-6
   b. Belden/CDT
   c. Berk-Tek
   d. Commscope/Systimax
   e. Commscope/Uniprise
   f. General Cable
   g. Mohawk/CDT
   h. Superior/Essex
   i. or equal
   j.

2.12 CONTROL MEDIA CABLING

A. General

   1. Provide cable with electrical conductors of soft drawn annealed copper, bare or tinned, solid or concentric stranded as applies, conductivity not less than 98 percent of pure copper.

   2. Comply with applicable Code for insulation, jacket, marking and listing for applicable use.

   a. Refer to National Electrical Code, Table 725-61. Cable Uses and Permitted Substitutions.

   b. Manufacturer part number specified is for a Listed Type CM construction to indicate intended cable construction and quality.

   3. Code requirements take precedence.

   a. Provide type required by CEC at no additional cost to the Owner.

B. Low Speed Audiovisual Cabling
1. Drawing Reference: AVNet
2. 1 cable equivalent to a 1 pair, 18 gauge cable suitable for RS-485 (A/V Net) signaling and remote device powering.
3. Manufacturers:
   a. Crestron
   b. Liberty Wire & Cabling
   c. AMX
   d. Extron
   e. or equal.

C. Shielded High Definition Category Media Cabling
   1. Drawing Reference(s):
      a. HCAT MEDIA
   2. Features/Functions:
      a. Proprietary 4 twisted-pair cable in overall shield designed to transmit manufacturer's proprietary implementation of HDBaseT
   3. Manufacturers:
      a. Crestron DigitalMedia 8G Cable
      b. Liberty Wire & Cabling
      c. AMX
      d. Extron
      e. or equal.

2.13 MISCELLANEOUS PRODUCTS

A. Cable Termination Devices and Related:
   1. Screw-type or Tubular Clamp Barrier Blocks:
      a. Buchanan 125, 0625 Series.
      b. Electrovert
      c. TRW-Cinch 140, 141, 142 Series.
      d. Weidmuller.
      e. Pass & Seymour/Legrand.
      f. Phoenix
      g. Or equal.
   2. Tubular Clamp Barrier Blocks, High Density, Switch Block Section
      b. Features/Functions
         i. Paired screw terminals on opposite sides of insulating base.
         ii. TB15 Base mounts to DIN rail, providing space beneath TB15 to dress field and source cabling.
         iii. Terminates range of wire gages used by project – at least 30 gage to 10 gage.
iv. High density:
   (1) At least 33 pairs of connections per foot for 12 and smaller gage terminations,
   (2) At least 16 pairs of connections per foot for 10 gage terminations.

v. Switch Block Section permits load, such as field devices, to be separated from
monitoring panel for testing independent of source then restored without
disturbing field wiring terminations.

vi. Rated at least fifteen (15) amperes at 300V AC/DC

c. Approvals
i. UL

d. Manufacturers:
   i. Allen Bradley Isolation Switch Blocks,
      (1) 1492-H7 for 30 to 12 gage
      (2) 1492-CE9 for 10 gage.
   ii. Tyco Buchanan 0135 Series.
   iii. WECO Electrical Connectors
   iv. Altech
   v. Curtis Industries
   vi. Electrovert
   vii. Weidmuller
   viii. Pass & Seymour/Legrand
   ix. Phoenix
   x. or equal.

3. Low Level Audio Cable Termination, Insulation Displacement Products
a. Coordinate with wire size, type and insulation
b. Manufacturer
   i. ADC "Dense Patch".
   ii. Siemon Model S66M450 with D10 Designation Strip.
   iii. Any meeting 110TB under Section 17119 – Communications Termination Blocks
        and Patch Panels of the Base Building Project
   iv. Or equal.

B. Audio and Control Connectors and Related:
   1. Circular Audio Connector, Cord, 3 through 5 contacts, gold plated contacts, captive
      cable clamp strain relief, matte black chrome finish over nickel metal shell
      a. Neutrik C-Series, X-Series.
      b. Switchcraft.
      c. Or equal.
   2. Circular Audio Connector, Panel mount, male and female devices to fit same panel
      cutout including fasteners, 3 through 5 contacts, gold plated contacts, matte black
      chrome finish over nickel metal shell, female receptacles locking type:
      a. Neutrik D Series Version L.
b. Switchcraft
c. Or equal.

3. Loudspeaker Connector, Panel mount, female devices to fit same panel cutout including fasteners as other panel mount receptacles, 4 contacts, matte black finish Polyamide/graphite shell, female receptacles locking type. UL Component Recognized:
   a. Neutrik NL4MP.
   b. Switchcraft
c. Or equal.

C. Video Connectors and Related

1. Video Connector, BNC type, 75 ohms, Panel, recessed, flush with panel face, insulated from panel, double female
   a. Manufacturer
      i. Canare BCJ-JRU.
      ii. Tec Nec
      iii. Liberty Wire & Cable/Panelcraft
      iv. or equal.

2. Video Connector, BNC type, 75 ohms, Panel, recessed, flush with panel face, insulated from panel, single female to solder pin
   a. Manufacturer
      i. Canare BCJ-RU.
      ii. Tec Nec
      iii. Liberty Wire & Cable/Panelcraft
      iv. or equal.

3. Video connector, BNC type, 75 ohms, cord, crimp applied. Coordinate with cable.
   a. Manufacturer
      i. Amp.
      ii. Amphenol.
      iii. Augat/LRC Products
      iv. Canare.
v. Kings.
vi. Liberty Wire & Cable/Panelcraft
vii. RFI/Celltronics.
viii. Trompeter.
ix. or equal.

4. Video Precision 75 ohms Terminator, BNC:
   a. Manufacturer
      i. Canare BCP-TA
      ii. Trompeter TNAI-1-75.
      iii. or equal.
5. XGA Connectors, DB15
   a. Drawing Reference HD15
   b. Manufacturer
      i. Amp.
      ii. Amphenol.
      iii. Canare.
      iv. Kings.
      v. Liberty Wire & Cable/Panelcraft
      vi. RFI/Celltronics.
      vii. or equal.

D. Custom Facility Panels and Rackmount Auxiliary Panels

1. Drawing Reference(s):
   a. MP* - Media Panels, where * is a number indicating the panel type.
   b. FP* - Facility Panels, where * is a number indicating the panel type.
   c. Aux Panel

2. Provide connector types and plate finish as shown. If none shown, provide:
   a. Rack mount panels:
      i. 16 gauge minimum, cold rolled steel or 1/8" minimum aluminum, finish to match rack finish.
      ii. At contractor's option, fabricate using rack mount panels with Decora/Decorator openings and steel plates with specified connectors. Match insert color to panel color provided. Refer to Rack Panel with Decora Openings below.
   b. Wall Panels: 16 gauge minimum cold rolled steel, finish to match surrounding electrical and other low voltage panels.

3. Manufacturers, Rack Mount Panels
   a. BGW Systems Inc.
   b. Conquest
   c. Middle Atlantic Products Universal Connector Panel
   d. Middle Atlantic Products Universal Connector Panel, Modular Custom Connector Panel Systems
   e. ProCo Sound, Inc.
   f. Ultimate Plates and Panels
   g. or equal.

4. Manufacturers, Wall Panels
   a. PanelCrafters Division of Liberty Wire & Cable, Classic Series
   b. FSR
   c. RCI Systems
   d. Middle Atlantic
   e. Ultimate Plates and Panels
   f. Whirlwind
5. Manufacturers, Decora/Decorator connector inserts:
   a. Connector Plates by Radio Design Labs. Provide specified connectors rear mounted in D-Blank insert for connector combinations not available from RDL.
   b. Grey by Pathway Connectivity Solutions. Provide specified connectors rear mounted in 5100 insert for connector combinations not available from Pathway Connectivity Solutions.

6. Manufacturers, Rack Mount Decora Panel Openings
   a. Lowell Manufacturing LD8-RMP with Lowell DBB-4 blank Decora plates at openings not fitted with equipment.
   b. Middle Atlantic DECP Series
   c. or equal.

2.14 POWER DISTRIBUTION EQUIPMENT:

A. Comply with applicable Codes. Provide UL Listed devices suitable for commercial use. Provide all junction boxes, raceway, fittings, wire, supports and fastenings as required for complete installation. Contractor to coordinate plug end of selected strip with rack power receptacles installed under the work of Division 16. Unless otherwise noted, provide receptacles of NEMA 5-15R configuration.

B. Power Sequencer System
   1. Drawing References
      a. Power Sequencer
      b. Fire Alarm Interface – provide where required to shunt system operation on receipt of closure from Fire Alarm system.
      c. Sold State Relay (SSR) SSR1 through SSR7
   2. Features
      a. Power sequencing system.
      b. Solid state switching, zero crossing.
      c. Sequencing on power up and power down.
      d. Front panel button and external closure activation.
      e. Alarm terminal to sequence the system down when tripped.
      f. UL Listed.
   3. Manufacturer
      a. FSR Inc. Power Products Group SPC-20 Power Sequencer and SPC-20X Solid State Relay
      b. Furman
      c. Or equal.

C. UPS, Rack Mounted, 1400 VA
   1. Drawing Reference: UPS10
2. Features/Functions/Performance:
   a. Provide continuous, no-break power with sine wave output.
   b. Size to carry connected load at least 10 minutes following loss of power, after at least two hours of charge time.
   c. Provide Transient Over-Voltage (TOV) Surge Suppression; comply with ANSI/IEEE C62.41-1980, Category A and Category B.
   d. Provide complete isolation from Line.
   e. Provide output voltage regulation to ANSI C84.1 for computing equipment.
   f. SNMP manageable and status reporting to Owner's Management console. Provide output KVA, switch-mode power supply rated, not less than 150% of connected load indicated.
   g. Rack Mounted

3. Manufacturer:
   a. SmartUPS 1400 RM series by American Power Conversion (APC)
   b. Trip-Lite
   c. Or equal.

D. Power Supplies and Related:
   2. Relay and Lamp Power Supply:
   3. 24 VDC, regulated within 5%. Ripple not greater than 1.5%. Output current rating at least 150% of maximum possible load. Circuit breaker or intrinsic over current protection. UL Recognized or UL Listed.

E. Full Height Receptacle Strip, One (1) Circuit, 15A
   1. Features/Construction:
      a. Not less than 60" Long
      b. Not less than eleven (11) 15A receptacles
      c. Integral circuit breaker
      d. NEMA 5-15P plug on 6' cord.
      e. UL Listed Assembly
      f. Provide mounting hardware as necessary to attach to rack interior.
      a. Wiremold Series 7011ULBC.
      b. Lowell ACS 1524
      c. Geist NSVB200-101S15
      d. Hubbell PR206
      e. Leviton
      f. Middle Atlantic
      g. Chatsworth 12848-701
      h. Or equal.
F. Full Height Receptacle Strip, One (1) Circuit, 20A

1. Features/Construction:
   a. Not less than 70" Long
   b. Not less than eleven (11) 15A receptacles
   c. Integral circuit breaker
   d. NEMA 5-20P plug on 6' cord.
   e. UL Listed Assembly
   f. Provide mounting hardware as necessary to attach to rack interior.

2. Manufacturers. Contractor to coordinate selected strip with rack power receptacles installed under the work of Division 26.
   a. Geist NSVB200-102S20
   b. Hubbell PR20820DRTL
   c. Leviton P104x series
   d. Lowell ACS-2024
   e. Midde Atlantic PD-1020C-NS
   f. Wiremold Series 7011ULBC20.
   g. Chatsworth 12848-705
   h. or equal.

G. Rackmount Power Panel, Horizontal Mount, User Aux device use:

1. Drawing Reference: POWER.

2. Functions/Features:
   a. Front face of panel shall provide two electrical power outlets and a switch. An indicator lamp shall show the presence of AC power when on. The front face of panel shall have a black finish. The rear face shall provide a minimum of at least four receptacles. The panel shall be racked mounted in a maximum of two rack units. The panel shall be Code approved and UL rated for this application.

3. Manufacturers:
   a. Hubbell MCCPSS19TS
   b. Leviton 4515
   c. Geist SP124-1020
   d. Or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Perform the Work of this Section in accordance with acknowledged industry and professional standards and practices, and the procedures specified herein.

B. Furnish and install (herein, "provide") all materials, devices, components, and equipment required for complete, operational systems.
3.2 PRECONSTRUCTION PROGRAMMING MEETING

A. Not less than 30 days prior to the scheduled completion of the project, Contractor to initiate a request of the Owner's Representative to schedule an Audiovisual Systems programming meeting.

1. The Owner's Representative will schedule the meeting at the reasonable mutual convenience of the Contractor and the Owner's technical systems representatives.

2. The purpose of the meeting is for the Owner's Representative to indicate to the contractor how the programmable interfaces of the audiovisual systems are to be implemented, including:
   a. Button assignments and labels for physical button panels
   b. Touchscreen menu hierarchy, scene arrangement, button and background colors, text size, logos
   c. Whether authorization codes or passwords will be required to access special functions/menus.

3. Contractor to document the information received from the Owner's Representatives at this meeting.

4. Contractor to submit the documentation of the requirements meeting, along with their proposed response to the Owner's programming requirements in the form of screen shots and system menu flow diagrams as required under Section 27 41 00 – Common Work Results for Audiovisual Systems, 1.4 D Submittals.

3.3 WIRING CLASSIFICATION AND RELATED

A. Audio Signal Wiring Classification:

1. Type A-I: Microphone level wiring less than -30 dBµ, 20 Hz to 20 kHz.
2. Type A-2: Line level wiring -30 dBµ to +24 dBµ, 20 Hz to 20 kHz.
3. Type A-3: Loudspeaker level or circuit wiring greater than +24 dBµ, from 20 Hz to 20 kHz.

B. Video and Related Signal Wiring Classification:

1. Type V-1: Baseband and composite video wiring 1 volt peak-to-peak into 75 ohms, 0 to 10.0 MHz.
2. Type V-2: Synchronization and switching pulse wiring 4 volts peak-to-peak into 75 ohms, 15.62 to 15.75 kHz.
3. Type V-3: Color subcarrier wiring 0 to 4 volts peak-to-peak into 75 ohms, 3.57 to 4.43 MHz.
4. Type V-4: MATV system wiring 0.1 to 1000 uV peak-to-peak into 50 or 75 ohms, 47 to 890 MHz.

C. Control Signal Wiring Classifications:

1. Type C-1: DC control wiring 0 to 50 volts.
2. Type C-2: Synchronous control or data wiring 0 to 40 volts, peak-to-peak.
3. Type C-3: AC control wiring 0 to 48 volts, 60 Hz.

D. Additional Wiring Classifications:
1. Type M-1: DC power wiring 0 to 48 volts.
2. Type M-2: AC power wiring greater than 50 volts, 60 Hz.

E. Wiring Combinations:
1. Except as indicated herein, conduit, wireways and cable bundles shall contain only wiring of a single classification. The following combinations are acceptable in conduit, or cable harnesses. Additional acceptable combinations may be indicated on the Contract Drawings.
   a. Types A-1, C-1, and M-1.
   b. Types A-2, C-1, C-2, and M-1, runs less than twenty (20) feet.
   c. Types A-2, C-1, and M-1.
   d. Types A-3, C-1, C-2, and M-1.
   e. Types A-2, V-1, and V-3.
   f. Types V-1, V-2, V-3, and C-1.
   g. Types M-2 and C-3.

3.4 WIRE AND CABLE INSTALLATION

A. Provide permanent identification of run destination at all raceway terminations.

B. All wire and cable shall be continuous and splice-free for the entire length of run between designated connections or terminations.

C. All shielded cables shall be insulated. Do not permit shields to contact conduit, raceway, boxes, panels or equipment enclosures.

D. Within buildings, make splices only in designated terminal cabinets and/or on designated equipment backboards. Outside buildings, make splices only in designated manholes and/or handholes. Protect splices outside of buildings with splicing kits equivalent to Scotchcast Re-enterable. Make splices only with connectors or terminal devices specified herein. Document all splices on Record Drawings.

E. Verify that all raceway has been de-burred and properly joined, coupled, and terminated prior to installation of cables. Verify that all raceway is clear of foreign matter and substances prior to installation of wire or cable.

F. Inspect all conduit bends to verify proper radius. Comply with Code for minimum permissible radius and maximum permissible deformation.
G. Apply a chemically inert lubricant to all wire and cable prior to pulling in conduit. Do not subject wire and cable to tension greater than that recommended by the manufacturer. Use multi-spool rollers where cable is pulled in place around bends. Do not pull reverse bends.

H. Provide a box loop for all wire and cable routed through junction boxes or distribution panels. Provide tool formed thermal expansion loops at cable at manholes, handholes and at both sides of all fixed mounted equipment. Cable loops and bends shall not be bent at a radius greater than that recommended by the manufacturer.

I. Secure all wire and cable run vertically for continuous distances greater than thirty (30) feet. Secure robust non-coaxial cables with screw-flange nylon cable ties or similar devices appropriate to weight of cable. For all other cables, provide symmetrical conforming nonmetallic bushings or woven cable grips appropriate to weight of cable.

3.5 SIGNAL POLARITY CONVENTION

A. Maintain consistent absolute signal polarity at all connectors, patch points and connection points accessible in the system. Comply with AES26-2001. Where applicable, a positive polarity electrical signal shall yield positive acoustic pressure from the loudspeakers.

B. Audio signal connector convention: Comply with AES 14-1992 (r1998)

<table>
<thead>
<tr>
<th>Signal</th>
<th>Connector</th>
<th>Wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal Phase</td>
<td>Pin 2</td>
<td>Red or White</td>
</tr>
<tr>
<td>Signal Anti-Phase</td>
<td>Pin 3</td>
<td>Black</td>
</tr>
<tr>
<td>Signal Ground</td>
<td>Pin 1</td>
<td>Drain Wire</td>
</tr>
</tbody>
</table>

C. Video and RF/MATV Connector Convention:

<table>
<thead>
<tr>
<th>Signal</th>
<th>Connector</th>
<th>Wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal Phase</td>
<td>Center Pin</td>
<td>Center conductor</td>
</tr>
<tr>
<td>Signal Anti-Phase</td>
<td>Shell</td>
<td>Shield</td>
</tr>
<tr>
<td>Signal Ground</td>
<td>Shell</td>
<td>Shield</td>
</tr>
</tbody>
</table>

3.6 WIRING PRACTICE

A. Land all non-coaxial field wiring entering each equipment rack at specified terminal devices prior to connection to any equipment or devices within racks. At Contractor's option, such terminals may be located in the equipment racks or in the terminal cabinets provided. Coordinate such selection with Project construction sequence and test procedures specified herein.
B. Identify all wire and cable clearly with permanent labels wrapped about the full circumference within one (1) inch of each connection. Indicate the number designated on the associated field or shop drawing or run sheet, as applies. Assign wire or cable designations consistently throughout a given system. Each wire or cable shall carry the same labeled designation over its entire run, regardless of intermediate terminations. Conform with the requirements of Section 27 41 00.

C. Apply all crimp connectors only with manufacturer's recommended ratchet type tooling and correct crimp dies for connector and wire size. Plier type crimp tooling shall not be acceptable.

D. Coordinate insulation displacement (quick connect) terminal devices with wire size and type. Comply with manufacturer's recommendations. Make connections with automatic impact type tooling set to recommended force.

E. Make all connections to screw-type barrier blocks with insulated crimp-type spade lugs. Lugs are not required at captive compression terminal type blocks. Provide permanent designation strips designed for use with the terminal blocks provided. Make neat, intelligible markings with indelible markers equivalent to "Sharpie".

F. Tin terminated shield drain wires and insulate with heat shrinkable tubing.

G. Use only rosin core 60/40 tin/lead solder for all solder connections.

H. Dress, lace or harness all wire and cable to prevent mechanical stress on electrical connections. No wire or cable shall be supported by a connection point. Provide service loops where harnesses of different classes cross, or where hinged panels are to be interconnected.

I. Termination and buildout resistors and related circuit correction components shall be visible. Do not install in connector shells or internally modify equipment. Show locations on Record Drawings.

J. Correct any and all of the following unacceptable wiring conditions:
   1. Deformed, brittle or cracked insulation.
   2. Insulation shrunken or stripped further than 1/8" away from the actual point of connection within a connector, or on a punch block.
   3. Cold solder joints.
   4. Flux joints.
   5. Solder splatter.
   6. Ungrommeted, unbushed, or uninsulated wire or cable entries.
   7. Deformation or improper radius of wire or cable.

3.7 FINISHES
A. Finishes and materials for contractor fabricated assemblies such as racks, custom control panels, brackets, blank panels, equipment mounting in furniture or casework, speaker baffles, speaker grille material and in general any item or component herein which is visible shall adhere to the following:

1. Finish shall be as directed by the Owner's Representative.
2. In the event that the Owner's Representative provides no direction as to finish, finish shall match exactly the surrounding and adjacent surfaces.
3. Wooden speaker back boxes and baffles shall be painted flat black if not otherwise finished or stained.

3.8 EQUIPMENT ENCLOSURE (RACK) AND EQUIPMENT FABRICATION

A. Combustible material, other than incidental trim of indicated equipment, is prohibited within equipment racks.

B. Within each equipment enclosure, provide a full-height multi-circuit ground outlet strip with branch circuit count as shown on drawings; locate on the left side of the equipment enclosure, as viewed from the rear. In each enclosure provide number of receptacles required by present and future equipment indicated on drawings, plus at least two spare receptacles. Provide flexible steel raceway and junction box for connection of power service. Bond internal raceway to rack frame.

C. Provide a permanent label on the front of each equipment rack including the rack designation, and the circuit breaker number and associated electrical distribution panel designation servicing same.

D. Maintain separation of wiring classifications as specified herein. Separately dress, route and land microphone and line level cables and related on the right side of the equipment enclosure, as viewed from the rear; dress, route, and land loudspeaker level and control cables on the left side of the equipment enclosure, as viewed from the rear.

E. Access shall not require demounting or de-energizing of equipment. Install access covers, hinged panels, or pull-out drawers to insure complete access to terminals and interior components.

F. Fasten removable covers containing any wired component with a continuous hinge along one side, with associated wiring secured and dressed to provide an adequate service loop. Provide an appropriate stop locks to hold all hinged panels and drawers in a serviceable position.

G. Provide permanent labels for all equipment and devices. Where possible, fasten such labels to the rack frame or to blank or vent panels which will remain in place when active equipment is removed for possible service.
H. At jackfields, provide service loop to permit removal of jackfields from rack sufficient to conveniently access all jack contacts for routine cleaning and maintenance. Organize the service loop and harness such that reasonable reconnection of jacks and jack normals is possible without cutting apart the harness.

I. Coordinate the design and execution of wire harnessing of multi-bay rack ensembles with conditions of delivery to installation locations at Project Site, and with the requirement herein for test of the completely wired system in the shop prior to delivery to the Project Site. Organize the wiring harnesses such that they will fold within one shippable unit without risk of damage, or provide polarized multipin connectors and related interconnect systems as specified elsewhere herein.

J. At each equipment backboard, provide UL Listed surge suppressing multi-outlet assembly with at least six (6) receptacles.

3.9 EQUIPMENT RACK AND EQUIPMENT TESTING AND ADJUSTING PROCEDURES

A. Conduct procedures in fabrication shop. Verify safe and proper operation of all components, devices, or equipment, establish nominal signal levels within the systems and verify the absence of extraneous or degrading signals. Make all preliminary adjustments and document the setting of all controls, parameters of all corrective networks, voltages at key system interconnection points, gains and losses, as applicable. Submit test report. Request and coordinate verification of submitted test data by the Owner's Representative. Correct all non-conforming conditions prior to shipment to Project Site. Perform at least the following procedures:

B. Preliminary: Verify:

1. Grounding of devices and equipment. Integrity of signal and electrical system ground connections.
2. Proper provision of power to devices and equipment.
3. Integrity of all insulation, shield terminations and connections.
5. Absence of debris of any kind, tools, etc.
6. Routing and dressing of wire and cable.
7. All wiring, including polarity and continuity, including conformance with wire designations on running sheets, field and shop drawings.
8. Mechanical integrity of all support provisions.

C. Rig temporary power and grounding. Comply with all applicable Codes, regulations and ordinances.

D. Determine the proper sequence of energizing systems to minimize the risk of damage. Energize. Burn in for at least 168 hours.

E. Sound Systems:
1. Gain control settings: Establish tentative normal settings for all gain controls. Set all equalizers flat. Set all automatic gain control devices to bypass. Terminate power amplifier outputs with power load resistors with resistance value within 10% the nominal output impedance of the respective amplifier. Adjust all gain controls on equipment for optimum signal-to-noise ratio and signal balance and, unless they are sub-panel mounted, cap them to prevent tampering. Unless specified or directed otherwise, adjust gains such that in a given system the "front end" operates at unity gain and maintains 10 dB of clip margin referenced to the first onset of clipping of the associated power amplifier(s). Measure and document system gains at 1 kHz. Settings may require further adjustment by the Contractor, a result of testing by the Owner’s Representative.

2. Freedom from parasitic oscillation and radio frequency pickup: Maintain previous setup. Set up for each mode of operation specified in the functional requirements; verify that all systems are free from spurious oscillation and radio-frequency pickup using broadband oscilloscope. Correct any such defects.

3. Hum and noise level/signal to noise level/signal to crosstalk level: Maintain previous setup. Terminate microphone and line-level inputs with shielded resistors of 150 and 600 ohms, respectively. Set available variable gain controls such that full power amplifier output would be achieved with -40 dBm input level at a microphone input and +12 dBm at a line-level input. Measure and document the specified parameters of the system overall for each microphone input channel and line-level input channel. Compare with nominal signal level.

4. Total Harmonic Distortion: Maintain previous setup. Measure at reference operating level at least at 63 Hz, 125 Hz, 1 kHz, 10 kHz.

F. Baseband Video Systems:

1. Picture Monitors:
   a. Apply crosshatch. Verify linearity.
   b. Apply red field. Adjust purity.
   c. Apply SMPTE bars and PLUGE. Adjust to standards.

2. Video Path Test: Use manufacturer's procedures. Use full field or line signals.

G. Data/Graphics Systems:

1. Projector:
   b. Apply red, green and blue field. Adjust purity.

2. Wideband Component Analog Video Path Test: Use manufacturer's procedures.

H. Control System:

1. Demonstrate complete operation.
3.10 LOUDSPEAKER ASSEMBLY INSTALLATION

A. Loudspeakers:
   1. Verify proper installation of loudspeaker enclosures and related support.
   2. Verify that no loudspeaker assembly is subjected to stresses or loading effects in any way contributing to possible extraordinary failure.

3.11 VIDEO PROJECTOR ASSEMBLY INSTALLATION

A. Design, engineer and provide complete, all means of support, suspension, attachment, fastening, bracing, and restraint (hereinafter "support") of such equipment. Provide engineering of such support by parties licensed to perform work of this type in the Project jurisdiction. Submit in timely manner.

B. Comply with applicable Code and the requirements of the Authorities having jurisdiction.

C. Provide safety factor greater than six (6) or as required by Code, whichever is greater.

D. Mountings shall:
   1. Permit projector lens to align with top of projection screen.
   2. Permit Video Projector to be re-oriented at least plus or minus 30° from angles shown on the Contract Drawings for optimum picture.
   3. Maintain precise location and orientation of Video Projector after such adjustment when subject to normal building motion and Code defined seismic induced building motion.

E. Do not apply any load to building structure without first obtaining written approval of the Owner's Representative. Obtain per Project procedures.

F. During Acceptance Testing, adjust orientation of Video Projector as directed to achieve optimum picture. Provide workers and ladders as required. Perform such adjustment with no claim for additional cost or time.

3.12 PERMANENTLY INSTALLED MICROPHONES

A. General
   1. Orient generally as shown in the plans with respect to area of intended pickup.

B. Ceiling Mount Microphones
   1. Review indicated mounting location in the field prior to installation. Verify that location is not associated with excessive levels of vibration or background noise (due to HVAC, Projector fans and loudspeakers installed under the work of this or other projects, audible occupancy sensors. Report such conditions to the Owner's Representative.
and obtain direction prior to proceeding.

2. Coordinate installation location of boundary microphones with final floor plan for maximum uniformity of coverage, and maintainance of unobstructed line-of-site between the projector(s) and the screen(s).

3.13 PERMANENTLY INSTALLED PROGRAM AUDIO SPEAKERS

A. At projection screen conditions,
   1. Coordinate the installation location with the projector screen to maintain symmetry.
   2. Place speakers indicated for mounting at underside of ceiling oriented to place their long dimension parallel to the ceiling plane.

B. Provide resilient mounting vibration isolation at all wall and roof deck supported loudspeakers to minimize coupling of program audio sound into other building spaces. This requirement does not apply to ceiling supported distributed ceiling speakers.

C. Dress cabling neatly and out of side of audience.

D. Orient on adjustable speaker mounts for maximum uniformity of coverage for audience area and maximum gain before feedback at presenter microphones.

3.14 SYSTEMS PERFORMANCE TESTING AND ADJUSTING PROCEDURES

A. Upon completion of the installation of all equipment in an area, perform the following tests and record results. Verify safe and proper operation of all components, devices, or equipment, establish nominal signal levels within the systems and verify the absence of extraneous or degrading signals. Make all preliminary adjustments and document the setting of all controls, parameters of all corrective networks, voltages at key system interconnection points, gains and losses, as applicable. Submit test report. Correct all non-conforming conditions prior to requesting Acceptance Review and Testing. Perform at least the following procedures:

1. Mechanical: Verify:
   a. Integrity of all support provisions.
   b. Absence of debris of any kind, tools, etc.

2. Power and Isolated Ground: Verify:
   a. Isolation of Isolated Ground system from raceway and related ground.
   b. Grounding of devices and equipment. Integrity of signal and technical power system ground connections.
   c. Proper provision of power to devices and equipment.

3. Signal Wiring: Verify:
   a. Integrity of all insulation, shield terminations and connections.
   b. Integrity of soldered connections. Absence of solder splatter, solder bridges.
   c. Routing and dressing of wire and cable.
   d. Continuity, including conformance with wire designations on running sheets, field
and shop drawings.

e. Absence of ground faults.
f. Polarity.

4. Use the proper sequence of energizing systems to minimize the risk of damage. Energize.

5. Sound Systems, Electronic Tests; confirm:
   a. Gain at 1 kHz.
   b. Maximum output.
   c. Input clipping level.
   d. Frequency response.
   e. Total harmonic distortion.
   f. Signal to noise ration.
   g. Signal to crosstalk ratio.

6. Electro/Acoustic Tests:
   a. Uniformity of coverage.
   c. Maximum continuous sound pressure level (in the reverberant field). Drive systems with broadband pink noise. Sustain for at least five (5) minutes with no system damage. Measure for "A" and "C" weightings at ear level on loudspeaker axis. Turn off noise.
   d. Acoustic signal-to-noise ratio referenced to the specified maximum continuous sound pressure level in the reverberant field. Measure for "A" and "C" weightings at ear level on loudspeaker axis with mechanical systems operating. Present comparison with previous measurement.

7. Video Systems:
   a. Picture Monitors:
      i. Apply crosshatch. Verify linearity.
      ii. Apply red field. Adjust purity.
      iii. Apply SMPTE bars and PLUGE. Adjust to standards.
   b. Video Path Test: Use NTC Report No. 7 procedures. Use full field or line signals.
      i. Insertion Gain.
      ii. Gain/Frequency Distortion.

8. Control System: Demonstrate complete operation.

3.15 LABELING

A. Conform with the requirements of Section 27 41 07 – Identification for Audiovisual Systems.
B. Provide permanent "wedge" type labels on all controls, as applies, to indicate correct settings after systems performance testing and adjustment procedures have been successfully completed.

END OF SECTION
NOTE:
REFER TO SHEET L-100 FOR DEDUCTIVE ALTERNATE 2.B.1 EXTENTS.

ASPHALT PAVEMENT SECTION - (DEDUCTIVE ALTERNATE 2.B.1)

NO SCALE
ADDENDUM NO. 3
PROJECT
NORTH TRUE
PROJECT NUMBER:
SHEET NUMBER:
SCALE:
SHEET TITLE:
5856 Doyle Street
Emeryville, CA 94608
Tel  510 899 6400
www.ratcliffarch.com
SEALS AND SIGNATURES
DSA APPROVAL 03/21/18
ADDENDUM NO. 3 05/03/18
As indicated
1. **MONUMENT SIGN LIGHTING**

2. **METAL LANDSCAPE EDGING IN PLANTING**

3. **GRAVEL EDGE AT BUILDING**
MATCH CONNECTING ACTIVE SLOT.

BLANK

SEE ARCH. DWGS FOR EXACT SLOT LOCATION.

CONTINUOUS LINEAR SLOT DIFFUSER TO ALIGN WITH WALL.

120V TO 24V CONTROL POWER TRANSFORMER PANEL, TYP.

BOOT, TYP.

CONNECTIONS.

SEE DRAWING 2/M

MODEL TITUS DESV, WITH REHEAT COILS. SIZE AS NOTED.

PRESSURE INDEPENDENT SUPPLY AIR TERMINAL UNIT,

DUCT MOUNTED SMOKE DETECTOR FURNISH BY FIRE

1/2" GALVANIZED STEEL WIRE

SHEET NOTES:

- OFF UNUSED PORTION OF SLOT. SLOT WIDTH SHALL

- 504 FOR TYPICAL REHEAT COIL

- MECH.
SHEET NOTES:

5856 Doyle Street
Emeryville, CA 94608
Tel 510 899 6400

SEE DRAWING 1/M-502 FOR TYPICAL VAV BOX WITH HEATING HOT WATER AND CHILLED WATER COIL CONNECTIONS.

SEE DRAWING 2/M-502 FOR TYPICAL VENTURI AIR VALVE WITH HEATING HOT WATER AND CHILLED WATER COIL CONNECTIONS.

www.ratcliffarch.com

PROVIDE 3/4" TAILPIECE AND INSTALL BY PLUMBING CONTRACTOR.

TECH. OFFICE
CONNECT 2"Ø CHWS/R PIPING TO COLD ROOM CONDENSING UNIT.

GENERAL NOTES:

1. SEALS AND SIGNATURES

2. ROUTING SHOWN IS SUGGESTED ROUTING ONLY. CONTRACTOR SHALL DETERMINE ACTUAL ROUTING DURING COORDINATION.

3/4"Ø CD DN
MATCH LINE SEE MP-114

SAN FRANCISCO, CA 94109
TELEPHONE (415) 474-9500
FAX (415) 474-1363

GENERAL NOTES:

1. PROVIDE A TEMERATURE CONTROLLED SYSTEM FOR ALL ROOMS.

2. PROVIDE ALL PIPING AND FITTINGS FOR ALL CONDENSATION COLLECTOR SYSTEMS.

3. PROVIDE ALL PIPING AND FITTINGS FOR ALL CHILLED WATER PIPING.

4. PROVIDE ALL PIPING AND FITTINGS FOR ALL POTABLE WATER PIPING.

PHYSICS PREP
CHEM. STORAGE
CHEM. PREP
GAYNER
3/4"Ø CD DN

EXP. DATE: JUNE 30, 2019

ADDENDUM NO.2 04/26/18 ADDENDUM NO.3 05/03/18

1 1/4"Ø CHWR
3/4"Ø HHWS
3/4"Ø HHWR
1"Ø CHWS
1"Ø CHWR
2-6
3/4"Ø HHWS
3/4"Ø HHWR
3/4"Ø CHWR
3/4"Ø CHWS
1 1/4" Ø CHWR
1 1/4" Ø CHWS
3/8"Ø RL
PARTIAL LEVEL 1 MECHANICAL PIPING - AREA 5

SHEET NOTES:
1. PROVIDE MEANS AND METHODS FOR TYPICAL CONSTRUCTION NOT SHOWN. TYP.
2. PROVIDE SHEET NUMBER ON ALL SHEETS TO BE NUMERED ONE-TWO-SIX.

GENERAL NOTES:
1. PROVIDE MIN. 3/4" PRIMARY CONDENSATE DRAIN FOR EACH COOLING COIL MODULE DRAIN PAN. SLOPE 1/8" PER FOOT TOWARDS NEAREST PLUMBING WASTE RECEPTOR, MOP SINK, OR OTHER APPROVED MEANS. PIPING SHALL BE 3/4" OR LESS OTHERWISE NOTED.
2. ROUTING SHOWN IS SUGGESTED Routing ONLY. CONTRACTOR SHALL DETERMINE ACTUAL ROUTING DURING COORDINATION PROCESS.

SCALE: 1/4" = 1'-0"

DRAWN BY: [Name]
CHECKED BY: [Name]

PARTIAL LEVEL 1 MECHANICAL PIPING PLAN - AREA 5

MP-115

L-630 NEW BRENWOOD CENTER

LOS MEDANOS COLLEGE

EXP. DATE: JUNE 30, 2019

ISSUE SCHEDULE NO. DATE
SAV-02 04/27/2018
DSA APPROVAL 03/21/18
ADDENDUM NO.3 3 05/03/18

3/4"Ø   HHWR
3/4"Ø   HHWS
2 1/2"Ø   HHWR
2 1/2"Ø   HHWS
3"Ø   CHWR
3"Ø   CHWS
3/8"Ø   RL
3/8"RG
1 1/4"Ø   CD
1 1/4"Ø   CD
1/4"Ø   RL
1/4"Ø   CD
3/4"Ø   CD
3/4"Ø   CD
3/4"RG
3/4"RG

PLANT SD NO. DATE 11/17/2017
SEAL AND SIGNATURES

LARGE CLASSROOM
LARGE CLASSROOM
LARGE CLASSROOM

GAYNER ENGINEERS
1133 POST STREET
SAN FRANCISCO, CA  94109
TELEPHONE  (415) 474-9500
FAX             (415) 474-1363
PARTIAL ROOF MECHANICAL PLAN - AREA 3

SEALS AND SIGNATURES

sheet notes:

see level 1 plan for continuation to building distribution.

duct mounted smoke detector furnished by fire alarm and

installed by mechanical.

walking platform over ductwork. s.a.d.

vfd furnished by mechanical and installed by electrical.

coordinate with structural to seal diagonal support

through ductwork. f.

FILE NO:

IDENTIFICATION STAMP

DIVISION OF STATE ARCHITECT

APPL NO:

DATE

ISSUE SCHEDULE NO. DATE

DSA APPROVAL 03/21/18

ADDENDUM NO.3 3 05/03/18
12" DIA. BOILER FLUE
W/ WIND RESISTANT WEATHER CAP

3" DIA. WATER HEATER FLUE
W/ WIND RESISTANT WEATHER CAP

INSTALL CHILLER WITH 2" DEFLECTION
SEISMIC VIBRATION ISOLATORS ON A
21" TALL ROOF PAD

4" CHWS/R,
2-1/2" HHWS/R

1/4"Ø RG &
3/8"Ø RL DN
6" CHWR DN
6" CHWS DN

12" DIA. BOILER INTAKE AIR
W/ GOOSE NECK W/ 1/4" S.S. WIREMESH

3" DIA. WATER HEATER INTAKE AIR
W/ GOOSE NECK W/ 1/4" S.S. WIREMESH

MATCH LINE
SEE M-122

MATCH LINE
SEE M-123

EXP. DATE: JUNE 30, 2019

M-124
RELIEF AIR PLENUM WITH LOUVER OF FREE AREA APPROXIMATELY 28 S.F., S.A.D.

OSA PLENUM WITH LOUVER OF FREE AREA APPROXIMATELY 28 S.F., S.A.D.

DUCT MOUNTED SMOKE DETECTOR FURNISH BY FIRE ALARM AND INSTALLED BY MECHANICAL.

MEDANOS COLLEGE

PARTIAL ROOF MECHANICAL PLAN - AREA 6

L-630 NEW BRENTWOOD CENTER

1/4" = 1'-0"
INSTALL AHU ON A 18" TALL CONCRETE CURB.

1. 1/4"Ø CONDENSATE DRAIN PIPE TO WASTE RECEPTOR WITH MIN. 3" P-TRAP, TYP.

SEE PLUMBING DRAWINGS FOR RECEPTOR LOCATIONS, TYP.
Fume hood controllers shall be on a separate BACnet network loop. The BACnet loop shall interface with the rest of the BAS system through the BAS network. BACnet network points from the fume hood may be manually by the user.

Lab air flow and temperature controls are via the BACnet interface between the lighting control system BAC and the HVAC control’s BACnet network. Upon receipt of the notification from the lighting control system, the exhaust only mode will be engaged. The fume hood controller maintains air flow CFM to maintain a face velocity set point of 100 FPM. The fume hood face velocity controller shall issue an audible and visual alarm if the face velocity is out of setpoint for more than 1 minute (adjustable). All fume hood controllers shall be connected to a local BACnet network to the lab controller.

General notes:

- Overflow monitoring and alarm are linked to the suction system. If the suction system is drawing too much air, the suction fan will be shut down. The suction fan will only be shut down if the suction system is drawing more than 50% of the supply air.

- Heating setpoint: 63°F, adjustable
- Cooling setpoint: 80°F, adjustable

- Transition between modes is as follows:
  1. Reset room temperature setpoint as follows:
     a. Occupancy mode (50°F, adjustable)
     b. Unoccupied mode (63°F, adjustable) and the VOC level limit is maintained. The setback sequence shall be as follows:
     1) Monitors via hardwired to room controller shall be airflow, general alarm and mode (bidirectional) and via BACnet for sash height, velocity, alarms/modes and airflow.

- General notes:
  - The ventilation to the zone’s maximum setpoint. The DDC system shall resume normal operation after if the VOC level is below the high limit for more than 30 minutes (adjustable).
  - The fume hood controller shall maintain the face velocity through the sash at setpoint (100 FPM, +10% adj) by modulating the fume hood exhaust control valve. The fume hood controller monitors the sash position. The airflow to the fume hood shall be maintained at a constant CFM reading.
  - The airflow to the fume hood shall be maintained at a constant CFM reading.
  - The airflow to the fume hood shall be maintained at a constant CFM reading.
  - The airflow to the fume hood shall be maintained at a constant CFM reading.
Room 213 (Chem. Prep) Control Diagram

Room 218 (Biology Health Science Lab) Control Diagram

Sequence of Operations

1. Provide individual room summary, including I/O points, calculated values, such as discharge air temperature.
2. Provide calculated HVAC room load - BTU/h by the following equation:
   \[ \text{Load} = \text{Room Load} \times \left( \frac{\text{Room Temp}}{\text{Air Temp Difference}} \right) \]
3. Reset room temperature setpoint as follows:
   - Heating setpoint: 63°F, adjustable
   - Cooling setpoint: 75°F, adjustable

Sequence of Operations

1. Provide individual room summary, including I/O points, calculated values, such as discharge air temperature.
2. Provide calculated HVAC room load - BTU/h by the following equation:
   \[ \text{Load} = \text{Room Load} \times \left( \frac{\text{Room Temp}}{\text{Air Temp Difference}} \right) \]
3. Reset room temperature setpoint as follows:
   - Heating setpoint: 63°F, adjustable
   - Cooling setpoint: 75°F, adjustable

General Exhaust Damper to meet the room temperature setpoint. If the room setpoint cannot be maintained when the damper is 95% open, then the lab controller shall open the chilled water valve to maintain the room temperature.
SEQUENCE OF OPERATIONS

ROOM 214 (CHEM. STORAGE) CONTROL DIAGRAM

1. **Supply Air Temperature**
   - The supply air temperature is controlled by the building automation system (BAS).
   - The BAS setpoint is based on the room's setpoint and the current humidity level.

2. **Room Ventilation Rate**
   - The ventilation rate is adjusted based on the room's occupancy and the current air quality.
   - The BAS setpoint is adjusted by the BAS controller.

3. **General Room Controls**
   - The general room controls are monitored by the BAS.
   - The BAS setpoint is adjusted by the BAS controller.

4. **Building Lighting Controls**
   - The building lighting controls are monitored by the BAS.
   - The BAS setpoint is adjusted by the BAS controller.

5. **Alarm Detection**
   - When an alarm is detected, the BAS controller will send a signal to the BAS system.
   - The BAS system will then activate the alarm and take appropriate action.

6. **Emergency Shut-Down**
   - In case of an emergency, the BAS controller will send a signal to the BAS system.
   - The BAS system will then activate the emergency shut-down sequence.

ROOM 223 (AUTOCLAVE) CONTROL DIAGRAM

1. **Supply Air Temperature**
   - The supply air temperature is controlled by the BAS.
   - The BAS setpoint is based on the room's setpoint and the current humidity level.

2. **Room Ventilation Rate**
   - The ventilation rate is adjusted based on the room's occupancy and the current air quality.
   - The BAS setpoint is adjusted by the BAS controller.

3. **General Room Controls**
   - The general room controls are monitored by the BAS.
   - The BAS setpoint is adjusted by the BAS controller.

4. **Building Lighting Controls**
   - The building lighting controls are monitored by the BAS.
   - The BAS setpoint is adjusted by the BAS controller.

5. **Alarm Detection**
   - When an alarm is detected, the BAS controller will send a signal to the BAS system.
   - The BAS system will then activate the alarm and take appropriate action.

6. **Emergency Shut-Down**
   - In case of an emergency, the BAS controller will send a signal to the BAS system.
   - The BAS system will then activate the emergency shut-down sequence.

**Notes:**
- All control hardware and software shall be furnished and installed by the building automation contractor.
- In case of an alarm, the BAS controller shall issue an alarm and close the chilled water valve.
- The BAS system shall monitor the overflow status at the coil module continuously.
- Upon an alarm, the BAS controller shall adjust the total supply air flow to maintain the CFM reading.
- The BAS system shall provide temperature and airflow setpoint controls when no occupancy is detected by the BAS controller.
- The BAS system shall provide temperature and airflow setpoint controls when an occupant is detected by the BAS controller.
- The BAS system shall provide temperature and airflow setpoint controls when the BAS controller is not in operation.
- The BAS system shall provide temperature and airflow setpoint controls when the BAS controller is in operation.
- The BAS system shall provide temperature and airflow setpoint controls when the BAS controller is not in operation.
Q.4
J.2
N.3
A
B
C
D

FLOOR PLAN - AREA A

COMMUNICATIONS DEVICE FIRST

EMER. LIGHTING

CONFERENCE-TR/MDF ROOM

STORAGE

POWER

LARGE

127

137

126

139A

136

135

129A

113

142

171

133

140

124

138

122

120A

128

129

119

118

116

117

114

115

112

111

109

108

107

106

105

104

103

100

102

101A

COUNS. OFFICE

DSPS TESTING LG

FACULTY 01

FACULTY 02

FACULTY 03

FACULTY 04

FACULTY 05

FACULTY 06

FACULTY 07

FACULTY 08

FACULTY 09

FACULTY 10

FACULTY 11

FACULTY 12

FACULTY 13

FACULTY 14

FACULTY 15

MAILROOM/MAIL DISTRIBUTION

CORRIDOR

RECEPT. / A&R

RECEP. 100A

RECEP. 100B

A & R OFFICE

LOBBY

RECEPT. 100C

CORRIDOR

RECEPT. 100D

RECEPT. 100E

CORRIDOR

RECEPT. 100F

CORRIDOR

RECEPT. 100G

CORRIDOR

RECEPT. 100H

CORRIDOR

RECEPT. 100I

CORRIDOR

RECEPT. 100J

CORRIDOR

RECEPT. 100K

CORRIDOR

RECEPT. 100L

CORRIDOR

RECEPT. 100M

CORRIDOR

RECEPT. 100N

CORRIDOR

RECEPT. 100O

CORRIDOR

RECEPT. 100P

CORRIDOR

RECEPT. 100Q

CORRIDOR

RECEPT. 100R

CORRIDOR

RECEPT. 100S

CORRIDOR

RECEPT. 100T

RECEPT. 100U

RECEPT. 100V

CORRIDOR

RECEPT. 100W

RECEPT. 100X

CORRIDOR

RECEPT. 100Y

CORRIDOR

RECEPT. 100Z

CORRIDOR
AKN0001 PROVIDE 8'HIGH X 3/4" THICK FIRE-RESISTANT TREATED PLYWOOD BACKBOARD IN THE PERIMETER WALLS PAINTED WHITE. MOUNT BOTTOM OF BACKBOARD AT 6" AFF.

EKN0003 GROUND THE RACKS AND CABLE TRAY WITH #6 AWG TO THE GROUNDING BUS BAR.

EKN0004 GROUNDING BUS BAR BY DIV. 26. MOUNT AT 7' A.F.F. HOMERUN SOLID #6 AWG GROUNDING CONDUCTOR TO MAIN ELECTRICAL GROUNDING BUS BAR.

TKN0029 (3) 4" C.

TKN1008 PROVIDE 18" WIDE X 4" HIGH CABLE TRAY.

TKN2022 PROVIDE (1) 4" C. SLEEVE THROUGH THE ROOF WITH WEATHERHEAD. REFER TO ARCHITECTURAL PLANS FOR ROOF PENETRATION DETAILS.

TKN2027 PROVIDE (1) 4" C. (U.G), (1) 2" C. (U.G).

TKN2028 PROVIDE (2) 4" C. (U.G).

TKN2029 PROVIDE (4) 4" C. (U.G).

TKN2038 ACCESS CONTROL PANELS (DGP). SEE DETAIL 6/TY-901.

TKN2039 FIRESTOP CONDUIT PENETRATIONS AND THE GAP INSIDE THE CONDUITS AFTER CABLE INSTALLATION. SEE TN-905. IN LIEU OF THE CONDUIT SLEEVE AND FIRESTOPPING MATERIAL, PROVIDE EZ-PATH SERIES 44+. MATCH THE QUANTITY OF CONDUIT SLEEVES SHOWN.

TKN2045 PROVIDE SEPARATE CAT 6A PATCH PANELS FOR DATA, VOICE AND SECURITY.

TKN2048 PROVIDE FIBER MANAGEMENT RING (FMR) AND INSTALL FIBER SLACK IN IT. SEE TN-701.

TKN2049 PROVIDE LIGHTNING PROTECTOR AS SHOWN ON TN-701.

TKN2050 PROVIDE 110 TEL BLOCKS AS SHOWN ON TN-701.
KEYNOTES

PROVIDE 8' HIGH X 3/4" THICK FIRE-RESISTANT TREATED PLYWOOD BACKBOARD IN THE PERIMETER WALLS PAINTED WHITE. MOUNT BOTTOM OF BACKBOARD AT 6" AFF.

GROUND THE RACKS AND CABLE TRAY WITH #6 AWG TO THE GROUNDING BUS BAR.

GROUNDING BUS BAR BY DIV. 26. MOUNT AT 7' A.F.F. HOMERUN SOLID #6 AWG GROUNDING CONDUCTOR TO MAIN ELECTRICAL GROUNDING BUS BAR.

(3) 4" C.

PROVIDE 18" WIDE X 4" HIGH CABLE TRAY.

PROVIDE (2) 4" C.(U.G).

ACCESS CONTROL PANELS (DGP). SEE DETAIL 6/TY-901.

FIRESTOP CONDUIT PENETRATIONS AND THE GAP INSIDE THE CONDUITS AFTER CABLE INSTALLATION. SEE TN-905. IN LIEU OF THE CONDUIT SLEEVE AND FIRESTOPPING MATERIAL, PROVIDE EZ-PATH SERIES 44+.

MATCH THE QUANTITY OF CONDUIT SLEEVES SHOWN.

PROVIDE SEPARATE CAT 6A PATCH PANELS FOR DATA, VOICE AND SECURITY.

PROVIDE FIBER MANAGEMENT RING (FMR) AND INSTALL FIBER SLACK IN IT. SEE TN-701.

PROVIDE LIGHTNING PROTECTOR AS SHOWN ON TN-701.

PROVIDE 110 TEL BLOCKS AS SHOWN ON TN-701.

1/2" = 1'-0" 3 AREA B IDF #210 - NORTH ELEVATION

1/2" = 1'-0" 4 AREA B IDF #210 - EAST ELEVATION

1/2" = 1'-0" 5 AREA B IDF #210 - SOUTH ELEVATION

1/2" = 1'-0" 6 AREA B IDF #210 - WEST ELEVATION

7 AREA B IDF #210 - 3D VIEW

1" = 1'-0" 8 AREA B IDF #210 - RACK ELEVATION
AKN0001 PROVIDE 8'HIGH X 3/4" THICK FIRE-RESISTANT TREATED PLYWOOD BACKBOARD IN THE PERIMETER WALLS PAINTED WHITE. MOUNT BOTTOM OF BACKBOARD AT 6" AFF.

EKN0003 GROUND THE RACKS AND CABLE TRAY WITH #6 AWG TO THE GROUNDING BUS BAR.

EKN0004 GROUNDING BUS BAR BY DIV. 26. MOUNT AT 7' A.F.F. HOMERUN SOLID #6 AWG GROUNDING CONDUCTOR TO MAIN ELECTRICAL GROUNDING BUS BAR.

TKN0029 (3) 4" C.

TKN1008 PROVIDE 18" WIDE X 4" HIGH CABLE TRAY.

TKN2028 PROVIDE (2) 4" C.(U.G).

TKN2038 ACCESS CONTROL PANELS (DGP). SEE DETAIL 6/TY-901.

TKN2039 FIRESTOP CONDUIT PENETRATIONS AND THE GAP INSIDE THE CONDUITS AFTER CABLE INSTALLATION. SEE TN-905. IN LIEU OF THE CONDUIT SLEEVE AND FIRESTOPPING MATERIAL, PROVIDE EZ-PATH SERIES 44+. MATCH THE QUANTITY OF CONDUIT SLEEVES SHOWN.

TKN2045 PROVIDE SEPARATE CAT 6A PATCH PANELS FOR DATA, VOICE AND SECURITY.

TKN2048 PROVIDE FIBER MANAGEMENT RING (FMR) AND INSTALL FIBER SLACK IN IT. SEE TN-701.

TKN2049 PROVIDE LIGHTNING PROTECTOR AS SHOWN ON TN-701.

TKN2050 PROVIDE 110 TEL BLOCKS AS SHOWN ON TN-701.
PROVIDE 8’ HIGH X 3/4” THICK FIRE-RESISTANT TREATED PLYWOOD BACKBOARD IN THE PERIMETER WALLS PAINTED WHITE. MOUNT BOTTOM OF BACKBOARD AT 6” AFF.

GROUND THE RACKS AND CABLE TRAY WITH #6 AWG TO THE GROUNDING BUS BAR.

GROUNDING BUS BAR BY DIV. 26. MOUNT AT 7’ A.F.F. HOMERUN SOLID #6 AWG GROUNDING CONDUCTOR TO MAIN ELECTRICAL GROUNDING BUS BAR.

(3) 4” C.

PROVIDE 18” WIDE X 4” HIGH CABLE TRAY.

PROVIDE (1)4” C. SLEEVE THROUGH THE ROOF WITH WEATHERHEAD. REFER TO ARCHITECTURAL PLANS FOR ROOF PENETRATION DETAILS.

PROVIDE (2) 4”C.(U.G).

ACCESS CONTROL PANELS (DGP). SEE DETAIL 6/TY-901.

FIRESTOP CONDUIT PENETRATIONS AND THE GAP INSIDE THE CONDUITS AFTER CABLE INSTALLATION. SEE TN-905. IN LIEU OF THE CONDUIT SLEEVE AND FIRESTOPPING MATERIAL, PROVIDE EZ-PATH SERIES 44+. MATCH THE QUANTITY OF CONDUIT SLEEVES SHOWN.

PROVIDE SEPARATE CAT 6A PATCH PANELS FOR DATA, VOICE AND SECURITY.

PROVIDE FIBER MANAGEMENT RING (FMR) AND INSTALL FIBER SLACK IN IT. SEE TN-701.

PROVIDE LIGHTNING PROTECTOR AS SHOWN ON TN-701.

PROVIDE 110 TEL BLOCKS AS SHOWN ON TN-701.
KEYNOTES

TKN0029 (3) 4" C.

TKN0404 PROVIDE 12"W x 4"H BASKET CABLE TRAY (12-4 CTW). SEE SHEET TN-906 FOR SUPPORT.

TKN2011 PROVIDE WAO WITH TWO JACKS ADJACENT TO ROUGH-IN FOR PERMANENTLY INSTALLED PROJECTOR.

TKN2012 PROVIDE WAO WITH TWO JACKS AT 12" BELOW THE CEILING FOR EMERGENCY BROADCAST USE.

TKN2013 PROVIDE WAO WITH TWO JACKS FLUSHED IN THE CEILING FOR WAP.

TKN2040 IN NON FIRE RATED WALLS, PROVIDE ACOUSTICAL SEALANT IN ALL CONDUIT PENETRATIONS. PROVIDE AS SPECIFIED ON SECTION 26 05 48, 2.9.A.3.

1. REFER TO TY PLANS FOR CCTV CAMERAS WHICH WILL REQUIRE 2 CAT 6A CABLING FOR EACH CAMERA. SEE ALSO CCTV DETAIL SHEET TY-902.

ISSUE SCHEDULE NO DATE

DSA APPROVAL 03/21/18

ADDENDUM NO. 3 05/03/18

PROJECT NUMBER:

SHEET NUMBER:

SCALE:

SHEET TITLE:

KEY PLAN

COMMUNICATIONS DEVICE FIRST FLOOR RCP - AREA C

FILE NO:

IDENTIFICATION STAMP

DIVISION OF STATE ARCHITECT

APPL NO:

DATE

AC

FLS SS

01-116287

L-630 NEW BRENTWOOD CENTER

LOS MEDANOS COLLEGE

COMMUNICATIONS DEVICE FIRST FLOOR RCP - AREA C

I-VII-02

TN-601C

4/27/2018 3:56:20 PM
1 STRUCTURED CABBING SINGLE LINE DIAGRAM

2 T568A Wiring
### AREA A DEVICE SCHEDULE

<table>
<thead>
<tr>
<th>Room Name</th>
<th>Room No.</th>
<th>Voice Cat 6A Jack</th>
<th>Data Cat 6A Jack</th>
<th>Security Cat 6A Jack</th>
<th>Data Cat 6A Plenum Cable</th>
<th>Security Cat 6A Plenum Cable</th>
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### AREA B DEVICE SCHEDULE

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<th>Security Cat 6A Jack</th>
<th>Data Cat 6A Plenum Cable</th>
<th>Security Cat 6A Plenum Cable</th>
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### AREA C DEVICE SCHEDULE

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### AREA D DEVICE SCHEDULE

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<th>Security Cat 6A Jack</th>
<th>Data Cat 6A Plenum Cable</th>
<th>Security Cat 6A Plenum Cable</th>
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### AREA A - CAMERA SCHEDULE

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<th>CAMERA NO.</th>
<th>DRAWING NUMBER</th>
<th>CAMERA SENSOR</th>
<th>QTY</th>
<th>HORIZONTAL ANGLE</th>
<th>CAMERA HEIGHT</th>
<th>INSTALLATION</th>
<th>MOUNTING</th>
<th>ENCLOSURE</th>
<th>MOUNTING LOCATION</th>
<th>MOUNTING DETAIL</th>
<th>HOME RUN LOCATION</th>
<th>CAT 6A</th>
<th>FILL</th>
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<tbody>
<tr>
<td>CI-A-09</td>
<td>TY-601A</td>
<td>4</td>
<td>180°</td>
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<td>CEILING DOME</td>
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### AREA B - CAMERA SCHEDULE

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<th>CAMERA HEIGHT</th>
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<th>MOUNTING</th>
<th>ENCLOSURE</th>
<th>MOUNTING LOCATION</th>
<th>MOUNTING DETAIL</th>
<th>HOME RUN LOCATION</th>
<th>CAT 6A</th>
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<tr>
<td>CE-B-01</td>
<td>TY-100, TY-601B</td>
<td>3</td>
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### AREA C - CAMERA SCHEDULE

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<th>ENCLOSURE</th>
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<th>HOME RUN LOCATION</th>
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<tr>
<td>CE-C-01</td>
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### AREA D - CAMERA SCHEDULE

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### POLES - CAMERA SCHEDULE

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<tr>
<td>CE-P-01</td>
<td>(LPR) TY-100</td>
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<td>AS SPECIFIED</td>
<td>POLE 4/TY-902</td>
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