PART 1 – GENERAL

1.01 Summary

B. This section outlines the requirements for the design of electrical systems.

PART 2 – PRODUCTS

A. All service entry equipment shall be UL listed for such application and an AIC rating shall be required for each component of the equipment. Series ratings for fault capabilities are not acceptable.

PART 3 – EXECUTION

3.02 Design References

A. Electrical Designs shall comply with applicable codes and standards including, but not limited to the following (or the latest version);
   - NFPA
   - OSHA
   - MOSH

3.02 Design Calculations

A. For both Normal and Emergency power a separate document of Electric Design Calculations, shall be submitted and shall include, but not be limited to;
   1. Short circuit calculation and coordination (for new panels, transformers, and switch gear)
   2. KVA by switchboard
   3. KVA by panel
   4. KVA of lighting
   5. KVA of receptacles
   6. Feeder voltage drop
   7. Peak demand (maximum)
   8. Diversity factor
   9. Lighting illumination levels (interior and exterior)
   10. Emergency power KVA
   11. Emergency Power Peak Demand
   12. Lightning protection (Risk Analysis per NFPA 780)
   13. Generator sizing
   14. UPS sizing
   15. Transformers
   16. Switchboards
   17. Grounding system
   18. OSHA 1910 ARC Flash Calculations

B. Design calculations and data sheets shall be set out in a systematic manner to enable an accurate assessment of the equipment/system proposed and submitted in a separate binder. Initial design calculations shall be submitted at the design development stage. Revised calculations shall be submitted at the 50% construction document stage. Complete final calculations shall be submitted at 95% construction document stage. All
calculations shall be presented on applicable forms and all literature used in the determination of the calculations shall be referenced.

C. On Design-Build projects, all calculations shall be submitted with the 50% Construction Documents.

D. Identify the demand factor used for each type of load for estimating the service size. Also, identify the connected load and the demand loads.

E. Load analysis shall be for all equipment connected to emergency generator. All loads connected shall be considered continuous.

3.03 Computer Calculations

A. When computer calculations are included with design calculations the following documentation shall be furnished as a minimum:
   1. A synopsis of the computer program(s) stating briefly; required input; method of solution; approximations used; second order analysis incorporated; specifications or codes used; cases considered; output generated; extent of previous usage or certification of program(s) and program(s) author.

3.04 Drawings

A. The A/E shall prepare and submit for review and approval, drawings at schematic, 50%, 95%, and 100% completion.

B. Electrical drawings shall indicate university assigned room numbers, and have column line designations.

C. Service clearances – The drawings shall indicate the manufacturers recommended service clearance requirements around all electrical equipment.

D. All elements of the Work shall be properly coordinated to insure that there are no conflicts between disciplines or between the drawings and the specifications.

E. In general, abbreviations should be avoided except those which are generally understood and accepted and listed in the legend and symbols list.

F. The power, signal, cable TV, A.V., Security, and communications layouts shall be shown on one set of drawings, and the lighting layout shall be shown on a different set of drawings. Use standard symbol conventions.

G. Drawings shall be drawn using AutoCAD 2000 or a later version and provided in electronic format with the 100% submittal.

H. Floor Plans (Scale: Not less than 1/8 inch= 1 foot 0 inches). The A/E shall:
   1. Provide a single-line electrical distribution diagram showing primary service to substations and secondary service to distribution switchboards, motor control centers, and panel board for power and lighting. This diagram shall include and show the permanent as well as temporary points of connection to external utilities such as high-voltage, telephone, and all signal systems.
   2. Electrical drawings shall include circuit #’s (PNL #, Breaker #).
I. Large-Scale Drawings (Scale: Not less than ¼ inch=1 foot 0 inches). The A/E shall provide a layout of all equipment rooms to ensure that the proposed equipment will fit in the allotted space. Large scale Drawings are required for: electric rooms, lecture halls, computer rooms, telecom closets, other rooms serving multimedia functions.

J. Electrical schedules shall be included on the drawings, with load values in KVA, and it shall include the following information:
   1. schedule name
   2. location
   3. mounting
   4. main device
   5. bussing
   6. interrupting capacity (integrated rating)
   7. voltage
   8. phase
   9. connected lighting load
   10. connected power load
   11. connected receptacle load
   12. expected demand

K. Each circuit shall include the following:
   1. circuit number
   2. description of load served
   3. wire size
   4. connected load
   5. circuit breaker size
   6. room number

L. All switchboard and panel board legend information shall be typed and shall include room numbers for locations of loads being served, as well as CB number and panel where device receives power.

M. All power, lighting, and distribution panels, switchgear, MCC’s, transformers, and switches (disconnect and transfer) shall be labeled with room number, circuit number, and panel or device number for the power source feeding the device.

N. All medium voltage manholes shall be drawn in a fold-down detail.

O. Performance data for electrical equipment shall be shown on the drawings. If the data is also included in the specification it shall be carefully edited for conflicts.

P. Demolition shall not be shown on the same drawing(s) with new work.

3.05 Design Conditions  The following information should be clearly shown on the General Information:
   Drawing. Additions and deletions may be required if package unit equipment is incorporated in the design of facilities.

A. Electrical
   Primary
   Secondary
3.05 Specifications

A. Specifications shall include the requirement for the contractor to provide Operation and Maintenance manuals. Manuals shall be supplied with each major piece of equipment. O&M manuals shall include all applicable design calculations used in sizing components. Wiring diagrams, spare parts lists, vendor contact numbers, warranty information, and certificates shall be included. Fire alarm O&M manuals shall provide a riser, wiring, annunciator diagram, and catalog cuts.

B. Campus color codes for communication, fire, security, and CCMS, junction box covers shall be as set forth below.

<table>
<thead>
<tr>
<th>SYSTEM NAME</th>
<th>COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCMS</td>
<td>Green</td>
</tr>
<tr>
<td>Communications</td>
<td>Blue</td>
</tr>
<tr>
<td>Fire Alarm</td>
<td>Red</td>
</tr>
<tr>
<td>Security</td>
<td>Yellow</td>
</tr>
</tbody>
</table>

See Division 1, Section 1.08; Division 2, Section 2.09; Division 12, Section 12.02
A. Energy

The University regards the reduction of energy consumption as an important objective in all University facilities.

To comply with the requirements of this manual, the design shall meet the Energy Performance Index, using the procedures detailed in the University Manual in order to demonstrate that the design meets the energy performance criteria.

To be fully cost effective, energy conservation measures must be given early and careful consideration during the design phase of a new construction project. To ensure that energy conservation is given priority status, an independent Energy Analyst shall be utilized. The role of this Energy Analyst shall be to:

1. Review and coordinate all disciplines within the design team to achieve the most optimal energy efficient design;

2. Review architectural, mechanical, and lighting submissions for compliance with energy guidelines developed by the University, prior to submission to the University;

3. Perform energy and life cycle analysis, to influence the building design to minimize future energy expenditures, and to achieve the University's desired energy budget;

4. Attend early design meetings to address building site, orientation, and shape as factors in energy consumption;

5. Calculate the projected energy cost of various design alternatives, as requested by the University;

6. Prepare required energy reports;
In designing for energy conservation, the entire facility shall be considered, its site and prevailing climatic conditions. Interactions among these elements as well as the facility's energy using systems must be taken into account. Design elements and sub-systems must be analyzed to arrive at the most appropriate mix of energy conservation measures.

B. Energy Analysis

Any building includes a diverse collection of spaces and functions with varying environmental requirements. Therefore, a system that is both efficient and functionally responsive shall be developed. This includes conducting a comprehensive Energy Study of the building and a cost/benefit analysis of available energy saving alternatives. The following considerations have been specifically designated for evaluation. Other such considerations shall be investigated which affect the quality of the building environment and the cost of operating its system.

1. Design variations in the fenestration, thermal resistance for the exterior surfaces, and building geometries which take advantage of passive energy conservation systems.

2. Systems selection contingent on life cycle cost and compatibility with building needs. A minimum of three different systems are to be analyzed.

3. Instrumentation of the building so that the building automatic central control systems will monitor and control the various components.

4. Functional zoning of the building by use and exposure.

At the Design Development submittal stage, provide a formal written analysis to include, but not limited to:

1. Single line, conceptualized schematic system drawings on floor plans. All HVAC duct work shall be drawn double line in plan view regardless of scale.

2. Heating, ventilating, and air conditioning block and zone load calculations.
3. Economic cost/benefit study of the system chosen and compared to alternatives chosen.

4. A computer energy analysis of the building system's energy consumption, operation, and maintainability over a period of not less than five years to compare life cycle costs for the various HVAC systems. It is desired to obtain from this analysis the projected cost of operation by varying hours of use and occupancy in the computer program. One of the following shall be used:

DOE - 2 Computer Program
Order: National Technical Information
5285 Port Royal Road
Springfield, VA 22161

Info: 1. Lawrence Berkley Lab
University of Calif.
Berkley, CA 94720
(415) 486-5711

2. TRACE Computer Program
12320 Parklawn Drive
Rockville, MD 20852
(301) 984-2400

3. E20-II Computer Program
Box 4808
Carrier Parkway
Syracuse, N.Y. 13221
(315) 432-6000

This analysis is to show the cost benefit of the systems selected by having compared selected alternative mechanical systems pre-approved by the design project manager. Analysis will be used in systems selections. ASHRAE approved or based programs such as Trane Tracer, York Yes III, Carrier OP Cost, DOE II, Trakload, or approved equal shall be used.
PART 1 – GENERAL

1.01 SUMMARY

A. This section outlines the requirements for Outdoor Power Transmission and Distribution, including but not limited to the following:
   1. High Voltage cable
   2. High Voltage Splices and Terminations
   3. High Voltage Loop Switches
   4. High Voltage Transformers
   5. Underground Ductbank
   6. Electrical Manholes

B. The high voltage (13,800 volts) distribution system on campus is operated and maintained by MEDCO through their contractor Trigen Cynergy Solutions (TCS). Any modifications, removal or new installations involving the following components shall be forwarded to MEDCO and TCS for review and approval (in addition to the normal university review process);
   1. High voltage cables or ductbank
   2. High voltage loop switches
   3. High voltage transformer
   4. Low voltage cables or ductbank from service transformer to service disconnect
   5. Main service entrance switchgear

1.02 REGULATORY REQUIREMENTS

A. All materials and installation methods shall comply with current NFPA Regulations.
B. All work in or around high voltage systems shall comply with current OSHA Safety Regulations.

1.03 QUALIFICATIONS

A. All work on the high voltage system shall be completed by technicians certified to work on high voltage systems. This includes all workers entering high voltage manholes or working in loop switches or transformers.
B. All testing of high voltage loop switches, transformers and cables shall be performed by independent testing companies, certified by nationally recognized testing agency to perform such work.

PART 2 – PRODUCTS

2.01 BASIC MATERIALS

A. All products shall be UL (Underwriters Laboratories) listed.
B. Warning Signs: Provide warning signs for electrical equipment per OSHA and NFPA.

2.02 HIGH VOLTAGE CABLE

A. The High Voltage feeder cable shall be 3-1/c, each rated 15KV, 133% level, 220 mils insulation, EPR (ethylene-propylene rubber) cable. The cable shall have a full tape shield, and be rated for 105 degrees C continuous operating temperature (MV-105), and 100 hours per year of “emergency” overload at 130 degrees C for five years of cable life. The Outside Diameter (O.D.) of the 500 kcmil cable and jacket shall be less than 1.5 inches. The cable shall be rated for 500 amps in accordance with NEC for three single conductors in one underground raceway, three feet
16.03 OUTDOOR POWER TRANSMISSION AND DISTRIBUTION (07-10-09)

deep with a conductor temperature of 105 degrees C, 100% Load Factor, an ambient earth temperature of 20 degrees C, and thermal resistance (RHO) of 90. The cable shall be either 500 kcmil or 750 kcmil cable if installed as part of the campus “Loop” Feeder system. The cable may be 4/0 AWG between the Loop Switch and the transformer.

1. Manufacturer: Okonite, Prysmian, Rome, or approved equal.
B. The ground conductor shall be 2/0 AWG stranded soft drawn bare copper conductor.

2.03 HIGH VOLTAGE SPLICE AND TERMINATION MATERIALS

A. SPLICE KITS
1. The splice kits shall match the make and type of high voltage cable provided. They shall be “cold shrink” splice kits and be rated for operation at 105 degrees C. If “cold shrink” splice kits are not manufactured for the particular cable application, then “resin filled” kits shall be provided. The kits shall include all components, including lugs and connectors, etc., needed to prepare the cables and completely install a splice. The kits shall provide water, weather, and mechanical protection, and be suitable for underground and cable tray applications.
2. All splices shall be grounded type (outdoor type).
3. Splice kits shall be manufactured by Prysmian, “3M” or approved equal.

B. TERMINATION KITS
1. The termination kits shall match the make and type of high voltage cable provided. They shall be “cold shrink” termination kits. The kits shall include all components, including lugs and connectors, etc., needed to prepare the cables and completely install a termination. The kits shall provide water, weather, and mechanical protection.
2. Termination kits shall be manufactured by “3M”, Prysmian or approved equal.

2.04 HIGH VOLTAGE LOOP SWITCHES

A. The High Voltage Loop Switches shall be S&C Electric Company “PMU-19” style low profile, pad-mounted switchgear. No substitutions will be permitted.
B. The S&C switch shall be a four compartment, three phase switch rated 14.4 Kv Nominal, 17.0 Kv max, and 95 Kv BIL. The switch shall be rated 600 amps RMS Continuous, as well as 600 amps RMS for Load interruption (Dropping and Load Splitting) (Parallel or Loop Switching)
C. The switch shall have the following Duty-Cycle Fault-Closing, Two Time ratings;
   Asymmetrical—40,000 Amps RMS
   Symmetrical—25,000 Amps RMS
   Peak—62,500 Amps RMS
D. The switch shall have a Momentary rating of 40,000 Amps RMS, and a One-Second rating of 25,000 Amps RMS.
E. The switch shall utilize SM-5S fuses and fuse holders. Three spare fuses shall be provided with switch. The fuse ratings shall match the transformer Primary protection rating.
F. Compartments #2 and #3 shall disconnect the incoming cables from the internal bus. Compart ment #4 shall disconnect the internal bus from load side fuses. Compartment #1 shall contain fuses and connect to load side cables.
G. The switch shall have physical dimensions of 72” wide x 74” deep by 63” high. The switch shall be dark green.

2.05 HIGH VOLTAGE TRANSFORMER

A. Transformers shall be outdoor, pad-mounted, oil-filled units with primary fusing via the S&C switchgear.
B. The transformer shall be three phase (unless UM approved otherwise), 65 degree C rise, 60 hertz, copper windings, rated 30 degree C average ambient.

C. The transformer shall be rated 13,800 volts delta on the primary side, with 480/277 volts (or 208/120 volts) on the secondary side. It shall be rated 95 KV BIL, and have 2-2.5% FCAN and 2-2.5% FCBN taps. Total voltage compensation shall be 5%.

D. Impedance values—2.3% min and 5.75% max up through 500kva. 750 kva and larger shall have a design impedance of 5.75%.

E. Transformers shall be equipped with externally replaceable, 8.3/14.4kV rated loadbreak bushing wells and inserts suitable for use with loadbreak elbow connectors. Bushings shall be arranged for loop feed in accordance with ANSI C5.12.26 Fig 6A.

F. Transformers shall be equipped with metal oxide, distribution class under oil lightning arresters. Arresters shall be rated 10kV.

G. Transformer shall be equipped with ground attachment points, one in the primary compartment, and one in the secondary compartment. The secondary ground point shall be a bar capable of supporting up to 12 ground cables. Grounding attachments shall be made using a “taplug” connector with ½” – 13UNC threads.

H. Transformer shall be filled with ANSI Type II mineral oil and shall have less than 1 PPM of PCB content at the time of manufacture.

I. Transformers shall be equipped with 6-hole spade type connectors. Transformers over 1500 kva shall be equipped with 10 hole spades. Spades shall be capable of accepting copper conductors up to 750 kcmil in size.

J. Transformers shall be equipped with a pressure relief device, that utilizes a pull-ring to operate the device.

K. The transformer shall have the following accessories:
   1. 5 position tap changer
   2. Dial type thermometer (measuring current and max temperature achieved)
   3. Liquid level gauge
   4. Pressure vacuum gauge
   5. Gas sample valve
   6. 1” drain valve and sampler
   7. Pressure relief valve
   8. Ground bar in the secondary compartment
   9. Standard industrial enamel paint (dark green)

2.06 UTILITY ACCESS HOLES

A. Utility access holes shall be pre-cast reinforced concrete with minimum inside dimension as indicated for each utility access hole (minimum size 6’ wide x 8’ long x 6’ high) and a centered entrance opening of 36 inches diameter (minimum).

B. The utility access hole, cover, and collar shall be capable of supporting truck loads on the cover and all other loads imposed by dry or wet earth. Provide engineering computation “sealed” by a registered professional engineer as part of the shop drawing submittals for each size of utility access hole to substantiate that the utility access hole design accommodates the criteria set forth in C. below.

C. Design Loads:
   Dead Load:
   1. Concrete at 150 PCF
   2. Earth Cover at 120 PCF
   Lateral Earth Pressure on Walls:
   1. Equivalent Fluid pressure above the water table at 32 PSF per foot of depth.
   2. Equivalent Fluid pressure below the water table at 81.4 PSF per foot of depth.
   3. Surcharge on walls equal two feet of dry earth.
16.03 OUTDOOR POWER TRANSMISSION AND DISTRIBUTION (07-10-09)

Time Load:
H20-ASHO truck loading rear wheel load of 16,000 lbs + 30% impact (20,800 lbs total)

D. Utility access holes shall be as manufactured by: Penn Cast, Easi Set, A.C. Miller Products, Inc., Smith-Midland or approved equivalent.

E. The utility access hole cover shall be cast iron to accommodate a clear opening into the utility access hole of 36 inches diameter (minimum).

F. Covers for "Electric" utility access holes shall have the word "Electric" cast as part of the cover.

G. The rim supporting the cover shall be cast iron.

H. Cover and rim shall be structurally adequate to accommodate a 20 ton truck loading (H20-ASSH) as required for each utility access hole.

I. Covers shall be solid except for openings to enable placing and removing the cover, and shall be designed to meet standard U.S. Government designs for underground electric or telephone construction.

J. A Ground rod shall be installed, and shall be copper clad steel at least 10 feet long and 3/4 inches diameter (minimum).

K. Cable support racks shall be installed on all four interior walls of the utility access hole and shall be non-metallic, adjustable arm, cable racks as manufactured by Underground Devices, Inc. Each stanchion (upright) shall be at least 36" long. Install six stanchions in the utility access holes—two on each of the long walls, and one on each of the short walls. Utilize stainless steel bolts and washers to attach the stanchions. Install a total of twelve 14" support arms on the stanchions. Each arm shall be rated to support 350 lbs. The racks shall be Underground Devices, Inc. or approved equal.

L. Each utility access hole shall have a hot dip galvanized steel ladder that reaches from the rim supporting the cover to the floor of the utility access hole. Attachments to secure the removable ladder to the steel rim shall be stainless steel.

M. Each utility access hole shall have "hot dip galvanized steel pulling eyes" for each wall. Each "pulling eye" shall be located near the floor and shall be centered in the respective wall.

N. Provide end bells for all duct penetrations.

2.07 Low Voltage Cables

A. All low voltage cables for feeders, branch circuits, and control circuits shall be copper conductor, THHN/THWN, 600 volt insulation, rated at 90 degrees C. Use of wire smaller than #12 AWG for feeder and branch circuits, and #14 AWG for control circuits shall not be acceptable. Feeder and branch circuit conductors larger than #10 AWG and all control circuit conductors shall be stranded.

2.08 Main Service Entrance Switchgear

A. Service Entrance disconnecting means for services of 400 amps or more shall be a single main breaker--fused disconnects are not acceptable.

PART 3 – EXECUTION

3.01 DESIGN

A. The high voltage (13,800 volts) distribution system on campus is operated and maintained by MEDCO through their contractor Trigen Cinergy Solutions (TCS), and will require their approval. Any modifications, removal or new installations involving the following components shall be forwarded to MEDCO and TCS for review and approval;
   1. High Voltage cables or ductbank
   2. High voltage Loop Switches
   3. High voltage transformer
4. Low voltage cables or ductbank from service transformer to main building switchgear
5. Main building service switchgear

B. The design concept shall first be coordinated through the University Engineer Office, to ensure the concept agrees with the campus high voltage distribution philosophy.
C. The design including the connection to the existing high voltage distribution system, through the loop switch and transformer to the first disconnecting device in the main electrical switchgear in the building shall be submitted to MEDCO for review and approval at each stage of the design.

3.02 HIGH VOLTAGE CABLES

A. All feeders in manholes shall be labeled. The labels shall be permanent and be readable with auxiliary lighting in the manhole. The labels shall indicate origination and destination locations, as well as the feeder number.
B. Install fireproof taping on all phase cables in manholes.

3.03 HIGH VOLTAGE DUCTBANKS

A. High voltage ductbanks constructed for high voltage loop feeders shall be concrete-encased, 5" diameter (minimum) PVC tubes, with a minimum of four tubes.
B. Ductbanks for feeders between the loop switch and the transformer may utilize concrete-encased, 4" diameter PVC tubes.
C. Ductbanks shall utilize "long sweep" elbows.
D. Ductbanks terminating in buildings or manholes shall have "bell ends", where the tubes penetrate the wall, or bushings if terminating in equipment.
E. Ductbanks shall have a minimum of 30" cover from the top of the ductbank to the top of grade.
F. Ductbanks shall include a minimum of 100% spare tubes.
G. Ductbanks should be graded gently sloping down toward each manhole (3" per 100' minimum).
H. If multiple loop switches are installed on a common pad, the high voltage loop ductbanks shall not go from switch to switch, but shall go back to the manhole—one 4-tube ductbank for each switch on the pad.
I. Utilize rigid PVC spacers to provide minimum duct spacing and concrete cover depths while supporting tubes during concrete pours.
J. Install reinforcement in ductbanks passing through disturbed earth and when running perpendicular across roadways.
K. Waterproof floor and wall penetrations of the duct tubes, prior to pouring concrete around the tubes
L. Provide 6" of separation in combined ductbanks between high voltage tubes and communication or low voltage tubes.
M. Provide a minimum of 18” separation when crossing steam or hot water lines. Ductbanks shall cross under steam and hot water lines, unless depth of ductbank exceeds 8’.
N. Ductbanks shall not run parallel to steam lines, unless there is at least a 5’ separation between ductbank and steam line.
O. Empty tubes shall have pull strings installed, and tied off at both ends.

3.04 HIGH VOLTAGE MANHOLES

A. Manholes shall not be greater than 400’ apart.
B. Upon completion of the feeder installation, provide "fold-down" drawings of the interior of the manhole, with the duct tubes clearly labeled, and with cables annotated.
C. Low voltage cables (less than 600 volts) shall not pass through high voltage manholes (more than 4160 volts).
3.05 LOW VOLTAGE DUCTBANKS

A. Low voltage ductbanks constructed for service entrance feeders or emergency power feeders shall be concrete-encased, 4" diameter (minimum) PVC tubes.
B. Ductbanks shall utilize "long sweep" elbows.
C. Ductbanks terminating in buildings or manholes shall have "bell ends", where the tubes penetrate the wall.
D. Ductbanks shall have a minimum of 30" cover from the top of the ductbank to the top of grade.
E. Ductbanks shall include a minimum of 50% spare tubes.

3.06 TESTING

A. All high voltage components (loop switches and transformers, etc.) shall be tested after they are placed in their final position. The applicable tests include; Megger, Contact Resistance, and Hi-Pot test.
B. All high voltage cables, terminations, and splices shall be tested prior to energizing.
C. All test results shall be submitted to MEDCO (and TCS) prior to de-energizing the campus high voltage system in preparation for splicing in the new or modified system.
PART 1 – GENERAL

1.1 SUMMARY

A. This section outlines the requirements for Basic Electrical Materials and Methods, including but not limited to the following:

1. Basic Materials
2. Connection of Utilization equipment
3. Supports
4. Identification
5. Conduit and fittings
6. Wireway
7. Surface raceway system
8. Electrical boxes, cabinets and enclosures
9. Wire and Cable
10. Wiring Devices
11. Service Fittings

1.2 REGULATORY REQUIREMENTS

A. All materials and installation methods shall comply with NFPA.

PART 2 – PRODUCTS

2.1 BASIC MATERIALS

A. All products shall be UL (Underwriters Laboratories) listed.
B. Nameplates: Engraved, Phenolic laminated plastic, 0.125 inch thick, black background with white core, with beveled edges. ALL LETTERING SHALL BE UPPERCASE. Shall be attached using self tapping screws.

1. Nameplate shall be installed on all equipment items. Use ¼” high engravings.
2. Nameplates shall be installed on all feeder circuits and all outdoor circuits.

   a. Attach nameplates to each cable or wire located in pullboxes and at each splice and termination. Use ¼” letters. Cable nameplates shall be secured in place with ¼” cable ties. Nameplates shall indicate which panel and circuit breaker the feeder or circuits is fed from.

3. Phases of all 600V wire shall be identified at all splice and termination points using colored tape. Colors shall be black, red, and blue for 208 volt phase conductors, white for neutrals, and green for ground conductors. Utilize orange, brown, and yellow for 480 volt phase conductors, gray for neutrals, and green for ground conductors.

C. Warning Signs: Provide warning signs for electrical equipment per OSHA and NFPA.
D. Label junction boxes with panel #, and circuit breaker # of where circuits originate — use permanent marker.
E. Steel – all steel products shall be galvanized or treated for corrosion.
F. Conduit and fittings.
1. Use only specified raceway in the following indoor and outdoor locations:
   a. Installation in or under concrete slab shall be: galvanized steel (EMT) or schedule 40 PVC. Stub-ups out of concrete shall be galvanized steel (EMT). Applicable for branch circuits and service entrance feeder only.
   b. Exposed outdoor locations: Only rigid galvanized steel conduit shall be used.
   c. Concealed dry interior locations: Electrical metallic tubing or MC cable as allowed below.
   d. Exposed dry interior locations: EMT or rigid steel in areas with motorized vehicles.
   e. Connections to vibration producing equipment or motors shall be liquid tight flexible metallic conduit.
   f. New Construction: raceway/conduit in finished areas shall be concealed by architectural surfaces.
   g. Electrical Feeder Distribution conduits within a building shall not be in the concrete slab or underground.

2. Use of the following types of conduits and fittings shall not be permitted in any application for this project:
   a. "Die-cast metal" conduit fittings.
   b. Aluminum Conduit, Cable Tray and fittings.
   c. PVC Type 'EB'.

G. Electrical Boxes

   1. Interior – metal only, approved for the specific location and application.
   2. Exterior – metal, NEMA approved for outdoor locations.

2.2 WIRE AND CABLE

A. Building Wire:

   1. Feeders and Branch Circuits Larger Than 10 AWG: Copper, stranded conductor, 600 volt insulation, THHN/THWN, rated at 75 degree C.
   2. Feeders and Branch Circuits 10 AWG and Smaller: Copper, 600 volt insulation, THHN/THWN solid conductor, rated at 75 degree C. No conductor smaller than #12 AWG is acceptable.

B. Forbidden Cables:

   1. Use of BX (Armored) Cable, UF, and Romex Cable is not permitted.

C. Color coding shall be a permanent part of and uniform throughout the entire length of the jacket material of the cable and shall be used throughout the building for feeder circuits. Color applied to the outer surface only is not acceptable. Taping (6" minimum) at termination points is acceptable. Color coding shall be:

<table>
<thead>
<tr>
<th>Phase</th>
<th>480/277 Volts</th>
<th>208/120 Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Orange</td>
<td>Black</td>
</tr>
<tr>
<td>B</td>
<td>Brown</td>
<td>Red</td>
</tr>
</tbody>
</table>
2.3 WIRING DEVICES AND WALL PLATES

A. Receptacle:
   1. Use specification grade receptacles and switches.
   2. GFCI Receptacle: Duplex convenience receptacle with integral ground fault current interrupter, test and reset push buttons.
   3. Device plates for interior use on flush-mounted devices shall be satin finish type 302 stainless steel.
   4. Device plates for interior use on surface-mounted devices shall be galvanized sheet metal with rounded corners.

B. Weatherproof Cover Plate: Match receptacle configuration provided for equipment connection. Gasketed cast metal with gasketed device covers.
   1. A receptacle installed in a wet location where the product intended to be plugged into is not attended while in use (e.g. sprinkler system controller, landscape lighting, holiday lights, etc.) shall have an enclosure that is weatherproof with the attachment plug cap inserted or removed.
   2. A receptacle installed in a wet location where the product intended to be plugged into is attended while in use (e.g. portable tools, etc.) shall have an enclosure that is weatherproof when the attachment is removed.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Do not drill structural steel members.
B. Install free-standing electrical equipment on 4” concrete pads.
C. Arrange conduit to maintain headroom and to present neat appearance.
   1. Route exposed raceway parallel and perpendicular to walls and adjacent piping.
   2. Maintain minimum 6 inch clearance to heat surfaces such as flues, steam pipes, and heating appliances.
   3. Maintain required fire, acoustic, and vapor barrier rating when penetrating walls, floors, and ceilings.
   4. Use conduit hangers and clamps; do not fasten with wire or perforated pipe straps.

D. Install surface metal raceway and multi-outlet assemblies in accordance with manufacturer’s instructions.
   1. Use flat-head screws or clips and straps suitable for the purpose, to fasten channel to surfaces. Mount plumb and level.
   2. Use suitable insulated bushings and inserts at connections to outlets and corner fittings in metal raceway.
3. Use fittings and accessories designed for use with raceway system.

E. Use recessed outlet boxes in finished areas or as required.
   1. Secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness.
   2. Do not install boxes back-to-back in walls; provide 6 inch separation, minimum. In acoustic-rated walls provide 24 inch separation, minimum.

F. Install floor boxes in accordance with manufacturer's instructions.
G. Minimum conduit size shall be ¾ inches.
H. Install pull strings in all spare raceways. Pull strings shall be multi-strand polypropylene monofilament, with minimum size of 3 strand 3/16 inch diameter and 800 pound breaking strength.

3.2 EXAMINATION AND PREPARATION

A. No wiring shall be installed until the building is under roof. Do not install wire in raceways until after concrete work fireproofing or plastering is completed.

3.3 WIRING DEVICES

A. Install wiring devices in accordance with manufacturer's instructions.
B. Install convenience receptacles 18" inches above finished floor with grounding pole on top.
C. Install duplex convenience receptacles in corridors at 30 foot maximum intervals.

3.4 WIRING FOR LIGHTING FIXTURES, RECEPTACLES:

A. MC cable shall be allowed for connections within a room from a junction box to the lighting fixtures.
B. Conduit home runs shall be in EMT.
C. MC cable shall be allowed from a junction box within a room to the receptacles in the same room.
D. MC cable shall not be allowed to cross one room to another room whether the wall between two rooms goes up to slab or not. If the rooms are identified as two separate rooms, MC cable shall not be used between the two rooms.
E. MC cable shall not be used, between two receptacles when they are in two separate rooms, on the same wall.

3.5 LABELING FOR LIGHTING AND POWER EQUIPMENT

A. All electrical equipment shall be labeled as set forth in this section, including but not limited to the following types;
   1. Switchgear/Switchboards
   2. Power Distribution Panels/Load Centers
   3. Lighting/Power Panels
   4. Disconnect/Safety Switches
   5. Automatic Transfer Switches (ATS)
   6. Power Distribution Units (PDU)
7. Motor Control Centers (MCC)
8. Transformer
9. Uninterruptible Power Supply (UPS)

B. The labeling shall be in the following format;

<table>
<thead>
<tr>
<th>Type</th>
<th>Vol/Sys</th>
<th>Location</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>X X</td>
<td>X X X X</td>
<td>X X X X X</td>
<td>X X</td>
</tr>
</tbody>
</table>

1. **TYPE**—First group of two characters describes the type of power equipment;
   a. "SE"—Service Entrance Equipment (Switchgear or Switchboard)
   b. "DP"—Power Distribution Panel. Panel with a significant majority of "feeder" breakers
   c. "PP"—Power Panel. Panel with a significant majority of power "branch" breakers
   d. "LP"—Lighting Panel. Panel with a significant majority of lighting "branch" breakers
   e. "DS"—Disconnect Switch. Fused or non-fused disconnect switch or circuit breaker
   f. "AT"—Automatic Transfer Switch
   g. "MC"—Motor Control Center
   h. "TX"—Transformer
   i. "PD"—Power Distribution Unit
   j. "UP"—Uninterruptible Power Supply

2. **Volt/Sys**—Second group of two to four characters describe the voltage level and the system providing power.
   a. 1st character is the "Voltage designation"
      (1). "1"—120/240 volt 1 phase
      (2). "2"—120/208 volt 3 phase
      (3). "4"—277/480 volt 3 phase
   b. 2nd and possibly the 3rd and 4th character are the system power
      (1). "N"—Normal Power
      (2). "E"—Emergency (not segregated into Life Safety, Legally Required, etc.)
      (3). "ELS"—Emergency, Life Safety Power
      (4). "ELR"—Emergency, Legally Required Power
      (5). "EOP"—Emergency, Optional Standby Power
      (6). "UPS"—Uninterruptible Power Supply
      (7). "SL"—Site Lighting (controlled by contactor)

3. **Location**—Third group of four (or five) characters describes the location (room number or nearest room number) within the building.
   a. 1st characters will indicate the floor of the building
   b. 2nd character will indicate the wing
   c. 3rd and 4th character will indicate the room number in that wing
d.  5th character may be an alpha prefix indicating a sub-basement (SB0123), basement (B0123) or mezzanine (M1123), or an alpha suffix indicating a part of a room or space (1123A)

4. ITEM—Fourth group of two characters
   a. 1st character is the sequence number for the same type equipment (same label designation) within the SAME room.
   b. 2nd character is the section number for multiple section equipment items.

C. When replacing “existing” equipment, provide two labels;
   1. The new label as defined above
   2. A second label below the first, that provides the “old” designation of the panel/equipment, with the words “old label” in front of the old designation. For instance, “old label PP-01N”

D. Label Samples
   1. “SE-4N-1201-1” is Service Entrance equipment, operating on 277/480 volt “normal” power, situated in Room 1201.
   2. “DP-4N-2301-2” is a Power Distribution Panel, operating at 77/480 volts “normal” power, situated in Room 2310. This panel is the second or two panels of this type within Room 2310.
   3. “DP-2ELS-2310-1” is a Power Distribution Panel, operating at 120/208 volt “Emergency, Life Safety” power, situated in Room 2310.
   4. “PP-2N-3224-1” is a “Branch” Power Panel, operating at 120/208 volt “normal” power, situated in Room 3224.
   5. “MC-4N-0210-1” is a motor Control Center, operating at 277/480 volt “normal” power, situated in Room 0210.
A. Emergency power for the following systems is required:

1. Fire Alarm
2. Security
3. Emergency Lighting
4. Telephone Service
5. CCMS
6. Other systems as may be needed/identified by the University.

Lighting equipment pertaining to code required illumination shall be also supported by an emergency generator. All mechanical and electrical rooms having disconnecting or air handling equipment shall have 50% of connected lighting served by an emergency circuit. All lighting shall be switchable at entry to room. Where applicable, new loads shall be connected to existing generators to maximize the use of existing equipment.

B. The size of the generator set shall be calculated by A/E base upon the connected load include any Alternate plus 20 percent spare capacity for future expansion.

C. Provide for and show a generator set with automatic transfer switch, manual by-pass, start/stop control system, remote alarm annunciator, battery charger, and other accessories for a complete working system.

D. Fuel to power the generator shall be selected on the basis of cost and availability with a preference for natural gas followed by fuel oil and propane gas.

E. Acceptable locations for Emergency Generators:

1. SCUB
2. Basement or ground floor of building,
3. A weather protected enclosure meeting noise abatement standards adjacent to building.

No other locations are acceptable.

F. Generator exhaust shall not be discharged in a fashion to cause it to enter any building's air handling system or into pedestrian walkways.
G. Generator rooms must be large enough to enable repairs. Access doors must be large enough to permit removal and replacement of the generator without having to dismantle the generator in any way.

H. The generator shall be run for several hours while the building is in use and occupied; therefore, the generator must be properly exhausted and sound-proofed so as not to interfere with the building's usage.

I. Overhead lighting, on an emergency circuit, is required in the generator room or within the weather protected enclosure while the generator is operational.
The following equipment shall be included as part of a comprehensive system for fire protection in accordance with NFPA 101, Life Safety Code and approved by DAEC.

A. A complete multiplex fire alarm system with a control panel located in a designated fire protection services room, or as specified.

B. A textually graphic annunciator in the main lobby areas and other locations as designated.

C. Standard fire alarm signals, claxon horns and flashing lights located throughout the building.

D. The connection of the system with the Central Control and Monitoring System.

E. The use of smoke detectors, magnetic door releases, manual pull stations, and HVAC controls where appropriate, and as required.

F. A complete automatic sprinkler system throughout the building with main controls in a designated fire protection services room.

G. A complete standpipe system (combined with the sprinkler system) for fire department use in areas of the building with three or more stories and as directed.

H. Fire extinguisher cabinets.

The entire system and all equipment is to be designed and/or specified in accordance with the latest addition of all applicable codes and standards.

In cases in which sensitive electronic equipment is to be located within the facility, it will be necessary to design a fire detection system capable of interrupting the power supply to the equipment. Halon or carbon dioxide type suppression systems shall not be specified.

Coordination with Facilities Management through DAEC to insure conformity of all new fire protection equipment is required.
16.07 LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment and services necessary for the furnishing and installing of a complete Lightning Protection System.

1.02 QUALITY ASSURANCE

A. Underwriter's Laboratories, Inc. Standards for Lightning Protection Systems, UL 96A.


C. The Lightning Protection System shall be designed and installed by a firm regularly engaged and experienced in installing Master Labeled Lightning Protection Systems and shall be listed with the Underwriter's Laboratories, Inc.

D. The Lightning Protection System shall conform to the requirements of the Underwriter's Laboratories Inc., Standards for Master Labeled Lightning Protection Systems, UL 96A, latest edition and the Master Label covering the existing buildings, shall be delivered to the Owner on completion of all work.

E. The Lightning Protection Installer shall issue a UL compliance certification suitable to present and satisfy any and all requirements.

1.03 SHOP DRAWINGS

A. The Contractor shall submit, for approval, shop drawings showing complete details with description of all air terminals, air terminal bases, conductors, conductor fasteners, splicers, bonding clasps, ground rods, etc. Only shop drawings bearing the stamp of approval of the Architect shall be used by the Contractor.

1.04 WORKMANSHIP

A. The Contractor shall guarantee all materials and workmanship furnished and installed under this section of
16.07 LIGHTNING PROTECTION SYSTEM

The specifications two years from date of final acceptance of the work. The Contractor also agrees that he will, at his own expense, repair and/or replace all such defective materials or effective workmanship which become defective during the term of this guarantee.

PART 2 - PRODUCTS

2.01 GENERAL

A. The system to be furnished under this specification shall be the standard product of a manufacturer regularly engaged in the production of Lightning Protection Systems and shall be the manufacturer's latest approved design. All material specified for this work shall be Underwriter's Laboratories, Inc. approved and shall be manufactured by Bonded Lightning Protection, Inc., Rockville, Maryland; Thompson Lightning Protection, Inc., St. Paul, Minnesota; Independent Protection Co., Goshen, Indiana; or Robbins Lightning Protection Co., Maryville, Missouri.

2.02 MATERIALS

A. Materials used in connection with the installation of the lightning protection system shall be approved for this system by the Underwriter's Laboratories, Inc.

2.03 CONDUCTORS

A. All conductors shall be bare stranded cable, 28 strands of 14 gauge.

2.04 AIR TERMINALS

A. Air terminals shall be aluminum, 1/2 inch in diameter with tapered points; they shall extend not less than 10" above the object they are to protect.

2.05 FASTENERS, CLAMPS, ETC

A. All fasteners, clamps, and connectors shall be bolted pressure type and shall be substantial in construction, not subject to breakage, shall be of the same material as
the conductor or of such nature that there will be no serious tendency toward electrolytic corrosion in the presence of moisture.

2.06 GROUND RODS

A. Ground rods shall be 3/4 inches in diameter by 10 feet in length, made of copper-clad steel. The portion of copper on copper-clad rods shall be approximately 27% of the weight of the rod. All ground rods shall be equipped with Bonded Lightning Protection #107 ground reservoirs and shall be driven to a depth of 36 inches below finished grade and/or finished floor, minimum.

2.07 TEST WELL

A. Provide a 6 inches diameter by 24 inches terra cotta test well with steel covers for each ground rod. Test wells shall be installed flush with the finished first floor and/or finished grade. Tests wells shall be Bonded Lightning #200. Ground resistance test shall be performed on the finished system and the results submitted to the University of Maryland. Grounds resistance shall not exceed 10 ohms on completion.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The installation of the Lightning Protection System shall avoid penetrations of existing building roofs.
PART 1 - GENERAL

1.1 APPLICATION

A. This section applies to all interior and exterior lighting in “new building” designs.

B. This section applies to “renovation work” within existing buildings--if the installation of new light fixtures, or the relocation of existing light fixtures is a part of the renovation, and the lighting work involves at least 50% of the lighting within the renovated space.

C. Any deviation or exception to the requirements of this section requires the prior written approval of the Director of the Operations and Maintenance (O&M) Department in Facilities Management Electrical Systems Section, as well as notification to the Electrical Systems Section within O&M.

PART 2 - PRODUCTS

2.1 LIGHT FIXTURE COMPONENTS NOT ALLOWED

A. Lamps

1. Fluorescent T-12 lamps
2. Linear fluorescent “U-Tubes”
3. Linear fluorescent lamps in any length other than nominal 24” or 48”
4. Incandescent lamps
5. Mercury vapor lamps
6. High or low pressure sodium lamps
7. Interior horizontal mounted lamps (except linear fluorescent) in any fixture mounted higher than 10’ above the floor level

B. Ballasts

1. Magnetic
2. Ballasts containing PCB’s, DEHP, oil or hazardous substances
3. Any ballast not rated for multiple voltages (120/277 volt)

C. Occupancy Sensors

1. In hallways
2. In main mechanical or electrical rooms.

2.2 LAMP COLOR

A. Color temperature shall be 5000K or higher
B. Color Rendition Index (CRI) of 80 or higher

2.3 LAMP LIFE

A. Lamps (non-fluorescent) shall have an “average” lamp life of 5000 hours or more.
B. Lamps installed in fixtures over 12’ high, shall have a lamp life of 10,000 hours or more.
C. Lamps installed within “BSL Labs”, “Clean Rooms” or hazardous areas, shall have a lamp life of 10,000 hours or more.

2.4 BALLASTS

A. Hallways utilizing linear fluorescent fixtures shall utilize “Step-Dimming” ballasts, which have two “hot” leads, and provide lighting levels of 0%, 50%, and 100%.

B. Be rated for multiple voltage operation, at 120 volts or 277 volts.

C. Ballasts utilized in linear fluorescent fixtures with a Ballast Factor within one of the following ranges, shall be designed to meet “light level” and “power density” requirements utilizing a ballast at the lowest level within the range given. For instance, if a designer selects a fixture with a Ballast Factor of 1.2 for a particular space, then the designer shall ensure the light level and power density requirements are still met if the ballast is replaced with a 1.0 Ballast Factor ballast.

1. High--1.15 to 1.30
2. Normal—0.95 to 1.14
3. Low-- 0.70 to 0.94

2.5 LIGHT FIXTURES

A. Hallways

1. Overhead fixtures
   a. Cooper 2' x 2' fixture, 2AC-214T5-UNV-L5850-TUB228PU95S50D-UM
   b. Lithonia 2RT5 14T5 MVOLT GEB10PS LP850
   c. H.E. Williams HETG-S22-214T5S-A-EBSD2-UNV
   d. Or approved equal fixture, with “step-dimming” (0%, 50% & 100%) ballast.

2. Ballast disconnect plugs. Hallway light fixtures shall have a three wire disconnect plug.

B. Special Rooms

1. Fixtures installed in “Clean Rooms”, “BSL Labs” or hazardous areas shall have the ballasts and light switches mounted remotely--outside of the clean area.

C. Exit Signs

1. Shall be 2 watts or less LED fixtures. Exit fixtures with special features, such as “vandal resistant” fixtures, shall be 5 watts or less.

2. Shall be red exit signs, unless in an existing building, where new exit signs should match the color in the remainder of the building.

D. Outdoor

1. Outside street, walkway and parking lot lighting fixtures shall be the “Gardco” shoebox fixture utilizing metal halide lamps in 175 watt, 400 watt, and 1000 watt sizes.

2. Fixtures shall be mounted on square tapered poles.
PART 3 – EXECUTION

3.1 ENERGY CONSUMPTION

A. The power consumption level of lighting fixtures shall be determined on a “Space-by-Space” method.

B. The power consumed by lighting fixtures within a “space type”, shall not exceed a value determined by multiplying 65% times the value listed in ASHRAE 90.1-2007 “Lighting Power Densities (LPD) Using the Space-by-Space Method”.

C. All light fixtures within a space type shall be included in this calculation, including wall washer, decorative, bulletin board, cove, task, special lighting and overhead light fixtures.

D. The “input Power” rating of the light fixture shall be used in this calculation.

E. For “screw-in” type lamps, the wattage used for the above calculation shall be the highest “UL rated” lamp wattage allowed in the fixture.

3.2 LIGHT LEVELS

A. Light levels shall be as specified by the Illuminating Engineering Society of North America (IESNA) handbook (latest edition), unless modified below.

B. Light levels shall be measured by “full spectrum” light meters, or at a level of 90% of IESNA Standards using “photopic” light meters.

C. Classrooms, Offices and Labs
   1. Light levels in classrooms shall be as indicated in IESNA on at least 90% of the desks in the classrooms.
   2. Light levels in offices shall be as indicated in IESNA, with the recommended level measured on the portion of the desk used for detailed reading or paper work. The IESNA recommendation is not an average for the entire room, but is the level on the work surface.
   3. “Average Light Level” range: 30 – 50 foot-candles, calculated on the desk and table tops.

D. Hallways
   1. “Average Light Level” range: 5 to 8 foot-candles, calculated at floor level.
   2. “Max to Min” Ratio Maximum: 5

E. Restrooms
   1. Shall be designed for 5 to 8 foot-candles.

F. Stairwells
   1. Shall be designed for 10 fc on the walking surfaces.

G. Electrical and Mechanical Rooms
   1. Electrical switchgear, distribution panels, motor control centers and branch panels shall have 50 fc measured at a height of 5'-0” above the finished floor along the front of the equipment and the rear of the equipment (if there is maintenance access).
2. Provide an average level of 30 fc throughout the remainder of the room (measured at 5'-0" level).

3.3 POWER SOURCE

A. The hallway, lobby, stairwell, exit and emergency egress lighting fixtures required for emergency egress shall be powered from a 277 volt “emergency power” source originating from either an emergency generator or a central battery system such as a “Central Inverter System” (UPS System).

B. Hallway and lobby lighting that is over and above that needed for “emergency egress lighting” shall be connected to the “switched” leg of the emergency power source (see detailed description of hallway wiring below), or connected to a “non-emergency” power source utilizing occupancy sensors.

C. The “Central Inverter System”, if utilized, shall have an automatic “self-test” and “record” function, a bypass switch, the ability to communicate status via phone dialer, or similar feature. The inverter shall also include local status alarms.

D. In main Electrical and Mechanical rooms, 50% of the light fixtures throughout the room shall be on an emergency power source.

E. All overhead lighting within the building shall operate at 277 volts, if available within the building.

3.4 CONTROLS

A. In main mechanical and electrical rooms, “timer switches” with the ability to warn occupants by flashing the lights as “off-time” gets close, may be used on no more than 50% of the lighting in the room.

B. The outdoor lighting for sidewalks, parking lots and street shall be controlled via central photocell to turn the lights on, and a 7 day/24 hour time clock to turn the lights off, and a “Hand-Off-Auto” (HOA) switch to operate the lights manually. The HOA switch shall be mounted in an area not accessible to the general public.

C. Hallway, stairwell, lobby, exit, or emergency egress lighting needed to support emergency egress requirements, shall not be connected to local wall switches.

D. Locate light switch at the main entrance to the room.

3.5 WIRING CONFIGURATION

A. Hallway Wiring
   1. An “Emergency Power” conduit system shall be installed to support the hallway lighting (see Figure 1). The conduit system shall consist of an EMT conduit (appropriately sized), from the main electrical room, to the top floor of the building. The conduit shall rise from the lowest floor to the top floor near the center of the building.
2. At each floor of the building, above the suspended ceiling or in an accessible location, a junction box shall be installed in the conduit run. The junction box shall be at least 8" x 8" x 4".

3. Inside the conduit system, a series of #10 AWG wires (minimum size) shall be installed from the main electrical room to the junction box on each floor as indicated below;

   a. Two circuits (7 wires) shall be installed to each floor of the building for connection to exit, hallway, stairwell, emergency egress and lobby lighting. A three story building, would have 6 circuits (19 wires) in the Emergency Power conduit system as the conduit leaves the main electrical room.

1. The first circuit to each floor shall leave the Emergency Power Panel (generator or inverter source) and enter a “relay” or “lighting controller” box (minimum size 20” x 16” x 6”). The “hot” shall be spliced within the “relay” box, to two wires—one a “switched” wire and the other an “un-switched” wire. The “switched” wire shall be Orange. The “un-switched” wire shall be Brown. The neutral wire shall be Gray and the ground wire shall be green, and shall accompany the two “hot” wires.

2. The second circuit to each floor shall leave the Emergency Power Panel (generator or inverter source) and enter the “relay” box. The “hot” shall be spliced to two wires—one a “switched” wire and the other an “un-switched” wire. The “switched” wire shall be Yellow. The “un-switched” wire shall be Brown. The neutral wire shall be Gray and the ground wire shall be green, and shall accompany the two “hot” wires.

b. The two “hot” wires, neutral and ground wire shall continue to the junction box, be capped with wire nuts, and identified (via tags) with the “Power Panel #” and “Circuit Breaker #” where the two “hot” wires originated.

4. The “Emergency Power” conduit system from the main electric room to every floor of the building shall be installed along with the first project that installs or relocates any hallway lighting.

5. From the junction box on each floor, install two 12/3 MC cables down one direction in the hallway, and two other 12/3 MC cables down the other hallway direction. Runs greater than 750’ need to have the MC cable size re-evaluated. Down each hallway, the outer casing of one of the MC cables shall be “striped” to indicate the “Orange” interior wire, and the other MC cable may be “striped” to indicate the “Yellow” interior wire, or may have a plain exterior jacket, but it must be different than the other (striped) MC jacket.

a. Exterior “striped” MC cable shall AFC Cable Systems, Kaf-Tech or approved equal

6. Connect the two phase wires in one 12/3 MC cable which goes down one direction in the hallway, to the two “hot” wires in one of the two circuits for that floor (from the main electric room). Splice in another two phase wires from the 12/3 MC cable going down the hallway in the other direction. This provides for a single circuit from the main electric room, feeding two 12/3 MC cables leaving the junction box, going down the hall in two different directions.

7. Repeat the step above for the other two 12/3 MC cables leaving the junction box. This provides a second circuit from the main electric room, feeding two 12/3 MC cables leaving the junction box, going down the hall in two different directions.

8. The two steps above provide two different circuits to be going down each direction of the hallway. This allows a 12/3 MC cable to be connected to “every other” light fixture in the hallway—so that every other fixture is fed by a different circuit. This would permit one breaker or circuit to trip, and still have every other fixture still operating in the hallway.

9. For each light fixture in the hallway, connect a 12/3 MC cable. Connect the two phase wires in the MC cable to the two “hot” wires on the light fixture “step-
dimming” ballast. One of the wires will be a “switched” leg, and the other will be an “un-switched” leg.

B. For lighting within a room, the “home run” circuits shall be terminated in a ceiling (or above ceiling) mounted junction box, before going to the light switch.

C. Light switches in new buildings shall have EMT conduit installed from the switch to a junction box above the ceiling. This allows future wiring changes for various switch opportunities.

D. Support MC Cables from building structure as required by the NEC.

3.6 FIXTURE MOUNTING

A. Fixtures mounted in stairwells shall be mounted at no more than 12'-0" above the flat landing surface in the stairwell, or utilize an integral “fixture lift” system.

B. Fixtures mounted over 15'-0" above the finished floor level shall utilize one of the following:
   1. Be accessible from a standard stepladder (12'-0" max ladder height)
   2. Utilize an integral “fixture lift” system
   3. Be accessible from a “man lift” system, owned and stored in the building
   4. Utilize remote accessible ballasts
   5. Have an FM approved maintenance plan

C. Locate fixtures at telecommunications closets to the front and rear of data racks. Coordinate locations with UM OIT.

3.7 ABOVE CEILING LIGHTING COMPONENTS

A. Lighting system components that are mounted above a suspended ceiling, such as power supplies, controls, relays, etc., shall be located within 6'-0" of the main entrance door to the space, but to the side, out of the path of travel.

3.8 SUPPORTS

A. Lighting fixtures shall be supported in accordance with code.

B. Sprinkler piping or hangers shall not be used to support non-sprinkler system components, per NFPA 13.

3.9 LABELS

A. Junction boxes utilized for power distribution, shall be labeled on the cover plate with the following information.
   1. Circuit Number (feeding the light fixture)
   2. Power Panel Number
   3. Room Number for Panel location
NOTES:
1. PROVIDE TWO CIRCUITS ON EACH FLOOR AND IDENTIFY EACH CIRCUIT WITHIN THE JUNCTION BOX.
2. PROVIDE DEDICATED NEUTRAL (GRAY) FOR EACH CIRCUIT AND COMMON EQUIPMENT GROUND.
3. ALL RISER WIRING TO BE #10 AWG THHN COPPER.
4. PROVIDE CIRCUIT NUMBERS ON EACH JUNCTION BOX COVER.
5. SIZE JUNCTION BOXES AND CONDUITS AS REQUIRED.
6. MC CABLE OF AT LEAST ONE OF THE CIRCUITS SHALL BE STRIPED TO DIFFERENTIATE. CONNECT ALTERNATE LIGHT FIXTURE TO EACH CIRCUIT.
Section deleted. Refer to section 16.08 LIGHTING
Section deleted. Refer to section 16.08 LIGHTING
All facilities that have handicap door openers have the electronic panic bar. The handicap door opener is activated by the handicap door switch.

A. Install an electric panic bar on each door equipped with a handicap door opener.

B. Interface the door opener with the electric panic bar. See DIVISION 8, Section 8.03.
A. All security measures and systems shall be coordinated through the Office of Public Safety, Building Security Systems and incorporate the following:

1. Doors

   a. All entrances shall have an alarm/access control system connected to Building Security Systems (BSS’s) main computer. Each door shall be equipped with either an alarm, a card reader, electric locking devices, and any other necessary equipment to operate the system. Access shall be controlled by a computer coded card. Designated doors can be locked or unlocked from the main computer at BSS. (Also Reference Section 16. Security Egress System for Individuals with Disabilities.)

   b. All exterior doors to be provided with conduit and wiring for future installation of automatic door operators and a card access system.

   c. Pairs of exterior doors shall have keyed removable mullions for improved security.

   d. Any required second means of egress shall accommodate wheelchair users.

   e. All exterior doors which are designated as "EXIT ONLY" shall be installed without hardware on the exterior.

   f. Service and rear entry doors shall be as entry-proof as possible. All doors shall have non-removable hinge pins (NRP) which are not exposed to public areas/exterior.

   g. Garage, service, and rear entry doors are to be as entry-proof as possible. They should be constructed of heavy-duty construction with locking systems which provide an appropriate degree of security and wiring for future installation of a card access system.

   h. ALL MECHANICAL AND ELECTRICAL ROOMS MUST HAVE CARD READERS. (9-25-03)
2. Security Alarm System
   a. Alarm system controls shall be by DSC Products; access control equipment shall be by LENEL, no substitutions. Other devices to be by approved vendors per BSS.
   b. All security alarm equipment and access control system equipment shall be installed in an independent Security Closet. BSS shall provide exact requirements for location and required electrical service.

3. Long corridors should be avoided.

4. Rest rooms and stairwells should not be separated from areas of high usage.

5. Different units within the facility shall be separately securable without interfering with required egress routes from the building.

6. Ground floor windows are discouraged. If installed, ground windows shall be constructed to prevent easy entry into the building.

   Surface materials or windows which can be easily vandalized should be avoided. In the event other criteria dictates the requirement for operable windows, methods for securing these windows are to be provided. Methodology for securing operable windows is to be coordinated with BSS.

7. New or expanded stairwells and elevators must utilize public spaces for access and egress. Elevators or stairwells should not allow access directly into private office areas which would jeopardize security to the area. Wiring for future installation of a card access system must be provided.

   B. All departmental and administrative offices should be equipped with heavy duty locksets with anti-friction latch bolts approved by BSS.

   C. For security camera and security camera equipment specifications see the Table of Contents.
PART 1 – GENERAL

1.01 REFERENCE REQUIREMENTS

The provisions of the General Conditions, Special Conditions, Program Requirements and Division 1, General Requirements, apply to the work of this Section.

1.02 SECTION INCLUDES

A. Telecommunications service entrance.

B. Premises wiring system.

C. Broadband type cable video system.

1.03 RELATED SECTIONS

A. Shop Drawings, Product Data and Samples

B. Product Record Documents

C. Cast-In-Place Concrete

D. Painting

E. Wiring Materials and Methods

F. Outside Power Transmission and Distribution

1.04 REFERENCES


B. ANSI/TIA/EIA 568-B.1 - Commercial Building Telecommunications Cabling Standard – Part 1: General requirements, April 1, 2001

C. ANSI/TIA/EIA 568-B.1-1 - Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements - Addendum 1 - Minimum 4-Pair UTP and 4-Pair ScTP Patch Cable Bend Radius, July 1, 2001


E. ANSI/TIA/EIA 568-B.2-1 - Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Components - Addendum 1 - Transmission Performance Specifications for 4-Pair 100 Ohm Category 6 Cabling, June 1, 2002


H. ANSI/TIA/EIA 568-B.3 - Optical Fiber Cabling Components Standard, March 1, 2000
I. ANSI/TIA/EIA-568-B.3-1 - Optical Fiber Cabling Components Standard - Addendum 1 - Additional Transmission Performance Specifications for 50/125 um Optical Fiber Cables, April 1, 2002
J. ANSI/TIA/EIA 862 Building Automation Systems Cabling for Commercial Buildings, April 11, 2002
K. ANSI/TIA/EIA 569 - Commercial Building Standard for Telecommunications Pathways and Spaces.
L. ANSI/TIA/EIA 606-A – Administration Standard for Commercial Telecommunications Infrastructures, June 21, 2002
N. Underwriters Laboratories (UL®) Cable Certification and Follow Up Program.
O. National Electrical Manufacturers Association (NEMA).
Q. National Electric Code (NEC®), Latest Issue
R. Institute of Electrical and Electronic Engineers (IEEE).
T. American National Standards Institute (ANSI) X3T9.5 Requirements for UTP at 100 Mbps.
W. SYSTIMAX® SCS Generic Specifications: Fiber Optic Outside Plant Cable, Latest Issue.
X. SYSTIMAX® SCS Solutions Design & Installation Guidelines, Latest Issue.

1.05 QUALITY ASSURANCE
A. Contractor shall install work in accordance with the BISCI Telecommunications Distributions Methods Manual.
B. Contractor shall install work in accordance with the SYSTIMAX® SCS Guidelines.

1.06 SUBMITTALS
A. Before the installation of any wire or equipment, Contractor shall submit shop drawings and product data under provisions of, "Shop Drawings, Product Data and Samples" for University approval.
B. Contractor shall indicate installation details, cable routing, system configuration, and outlet numbering on all shop drawings.

C. Contractor shall submit all appropriate product data for each component.

D. Contractor shall submit manufacturer’s installation instructions.

1.07 PROJECT RECORD DOCUMENTS

A. Contractor shall submit record documents.

B. Contractor shall accurately record location of service entrance conduit, termination backboards, outlet boxes, messenger cable raceways and cable trays, pull boxes, and equipment boxes on CD or 3.5-inch floppy diskettes using AutoCAD 14 or latest version.

C. Contractor shall document the cable plant and associated equipment installation in accordance with Parts 3.19, 3.20, and 3.21 in this Section.

1.08 QUALIFICATIONS

A. Installation of all wire, equipment, terminations and associated services shall be performed by a company that is currently a Authorized SYSTIMAX® SCS Value Added Reseller (VAR) in good standing with SYSTIMAX Solutions™; and has a minimum of (5) years of experience on similar SYSTIMAX® SCS systems. Prior to the final selection of the telecommunications sub-contractor, the main contractor shall submit its choice for telecommunications sub-contractor for the University’s approval.

B. The company specializing in supplying the products specified in this Section shall have a minimum of three (3) years experience distributing such supplies, and shall be duly authorized by the product manufacturer.

1.09 MAINTENANCE SERVICE

Contractor shall furnish warranty of SYSTIMAX® SCS products, applications, and workmanship for no less than 20 years from the date of acceptance by the University. All other non-SYSTIMAX products and workmanship shall carry warranties equal to or greater than the SYSTIMAX warranty from date of acceptance by the University.

1.10 DEFINITION—STRUCTURED CABLING SYSTEM

Structured Cabling Systems, Henceforth referred to as “SCS,” wiring is defined as all required equipment and cabling including hardware, termination blocks, cross connect wiring, patch panels, telecommunications outlets, UTP and fiber lightguide cable installed and configured to provide computer data and voice connectivity from each data or voice device to the network file server or voice network/ switch designated as the service point of the local area network.

PART 2 - PRODUCTS

2.01 TELEPHONE TERMINATION BACKBOARDS

A. The Contractor shall install 3/4-inch fire resistant plywood with Class A surface in all communications rooms (BDF and ER/TR). Equipment Room (ER) and Telecommunications Room (TR)
B. Termination backboards shall cover entirely, to a height of 8 feet, all walls within a communications room

C. Minimum backboard size shall be 4’ X 8’ unless otherwise approved by the University

2.02 STATION COPPER CABLE

A. All UTP station copper cable supporting voice and data communications requirements shall be SYSTIMAX® XX91E (where XX is either 10 or 20 depending on insulation type), and shall meet the following technical specifications:

Specifications:
The SYSTIMAX® GigaSPEED® X10D Guaranteed Performance Specifications for 4-Connection GigaSPEED X10D Channels:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion Loss</td>
<td>5%</td>
<td>2%</td>
</tr>
<tr>
<td>NEXT</td>
<td>6 dB</td>
<td>1 dB</td>
</tr>
<tr>
<td>PSNEXT</td>
<td>7.5 dB</td>
<td>2.5 dB</td>
</tr>
<tr>
<td>ELFE XT</td>
<td>6 dB</td>
<td>6 dB</td>
</tr>
<tr>
<td>PSELFEXT</td>
<td>8 dB</td>
<td>8 dB</td>
</tr>
<tr>
<td>Return Loss</td>
<td>3 dB</td>
<td>0 dB</td>
</tr>
<tr>
<td>PSANEXT</td>
<td>N/A</td>
<td>0 dB</td>
</tr>
<tr>
<td>PSAFLE XT</td>
<td>N/A</td>
<td>0 dB</td>
</tr>
</tbody>
</table>

Guaranteed Channel Performance Specifications for 4-Connection GigaSPEED X10D Solution

<table>
<thead>
<tr>
<th>Freq (MHz)</th>
<th>Insertion Loss</th>
<th>ANEXT</th>
<th>NEXT</th>
<th>ACR</th>
<th>NEXT</th>
<th>ACR</th>
<th>ELFEXT</th>
<th>ELFEXT</th>
<th>Loss</th>
<th>Delay</th>
<th>Skew</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.1</td>
<td>75.0</td>
<td>71.0</td>
<td>68.9</td>
<td>69.5</td>
<td>67.4</td>
<td>69.3</td>
<td>68.3</td>
<td>22.0</td>
<td>580</td>
<td>40</td>
</tr>
<tr>
<td>4.0</td>
<td>4.0</td>
<td>74.0</td>
<td>69.0</td>
<td>65.0</td>
<td>68.0</td>
<td>64.0</td>
<td>57.2</td>
<td>56.2</td>
<td>22.0</td>
<td>562</td>
<td>40</td>
</tr>
<tr>
<td>8.0</td>
<td>5.6</td>
<td>71.0</td>
<td>64.2</td>
<td>58.5</td>
<td>63.1</td>
<td>57.5</td>
<td>51.2</td>
<td>50.2</td>
<td>22.0</td>
<td>557</td>
<td>40</td>
</tr>
<tr>
<td>10.0</td>
<td>6.3</td>
<td>70.0</td>
<td>62.6</td>
<td>56.3</td>
<td>61.5</td>
<td>55.2</td>
<td>49.3</td>
<td>48.3</td>
<td>22.0</td>
<td>555</td>
<td>40</td>
</tr>
<tr>
<td>16.0</td>
<td>7.9</td>
<td>68.0</td>
<td>59.2</td>
<td>51.3</td>
<td>58.1</td>
<td>50.2</td>
<td>45.2</td>
<td>44.2</td>
<td>21.0</td>
<td>553</td>
<td>40</td>
</tr>
<tr>
<td>20.0</td>
<td>8.9</td>
<td>67.0</td>
<td>57.6</td>
<td>48.7</td>
<td>56.5</td>
<td>47.6</td>
<td>43.2</td>
<td>42.2</td>
<td>20.5</td>
<td>552</td>
<td>40</td>
</tr>
<tr>
<td>25.0</td>
<td>10.0</td>
<td>66.0</td>
<td>56.0</td>
<td>46.1</td>
<td>54.8</td>
<td>44.9</td>
<td>41.3</td>
<td>40.3</td>
<td>20.0</td>
<td>551</td>
<td>40</td>
</tr>
<tr>
<td>31.3</td>
<td>11.2</td>
<td>65.1</td>
<td>54.4</td>
<td>43.3</td>
<td>53.2</td>
<td>42.1</td>
<td>39.4</td>
<td>38.4</td>
<td>19.5</td>
<td>550</td>
<td>40</td>
</tr>
<tr>
<td>62.5</td>
<td>15.9</td>
<td>62.0</td>
<td>49.4</td>
<td>33.4</td>
<td>48.1</td>
<td>32.2</td>
<td>33.3</td>
<td>32.3</td>
<td>17.0</td>
<td>549</td>
<td>40</td>
</tr>
<tr>
<td>100.0</td>
<td>20.4</td>
<td>60.0</td>
<td>45.9</td>
<td>25.6</td>
<td>44.6</td>
<td>24.2</td>
<td>29.3</td>
<td>28.3</td>
<td>15.0</td>
<td>548</td>
<td>40</td>
</tr>
<tr>
<td>200.0</td>
<td>29.4</td>
<td>55.5</td>
<td>40.8</td>
<td>11.4</td>
<td>39.4</td>
<td>10.0</td>
<td>23.2</td>
<td>22.2</td>
<td>12.0</td>
<td>547</td>
<td>40</td>
</tr>
<tr>
<td>250.0</td>
<td>33.1</td>
<td>54.0</td>
<td>39.1</td>
<td>6.0</td>
<td>37.7</td>
<td>4.5</td>
<td>21.3</td>
<td>20.3</td>
<td>11.0</td>
<td>546</td>
<td>40</td>
</tr>
<tr>
<td>300.0</td>
<td>36.5</td>
<td>52.8</td>
<td>32.7</td>
<td>-3.8</td>
<td>31.3</td>
<td>-5.3</td>
<td>19.7</td>
<td>18.7</td>
<td>8.0</td>
<td>546</td>
<td>40</td>
</tr>
<tr>
<td>400.0</td>
<td>42.7</td>
<td>51.0</td>
<td>30.6</td>
<td>-12.2</td>
<td>29.1</td>
<td>-13.7</td>
<td>17.2</td>
<td>16.2</td>
<td>8.0</td>
<td>546</td>
<td>40</td>
</tr>
<tr>
<td>500.0</td>
<td>48.3</td>
<td>49.5</td>
<td>28.9</td>
<td>-19.4</td>
<td>27.3</td>
<td>-21.0</td>
<td>15.3</td>
<td>14.3</td>
<td>8.0</td>
<td>546</td>
<td>40</td>
</tr>
</tbody>
</table>

Note: The table provides reference values only. All parameters comply with the governing equations given above over the entire frequency range. All values and equations apply to worst-case channels utilizing four-pair 91A series cables with full cross-connects, consolidation points and work area outlets (4 connectors in a channel) for the length up to 100 meters.

B. All copper cable and jumpers shall conform to the REA color guide meet NEC article 125-38, 3 (B) 1, 2, and 3.
2.03 RISER COPPER CABLE

All UTP riser copper cable supporting voice communications requirements shall be standard 24 gauge, paired dual, semi-rigid PVC skin over foamed PE, Superior Essex Cable-XXX (where XXX is the number of pairs), and shall meet the following technical specifications:

COPPER VERTICAL RISER CABLES
(SPECIFIER NOTE, REMOVE FROM FINAL SPEC: SYSTIMAX WILL EXTEND ITS WARRANTY AND APPLICATION ASSURANCE TO COVER THE USE OF SUPERIOR ESSEX ARMM CABLE AS PART OF A TOTAL SYSTIMAX SCS.)

The 24 AWG multi-pair copper cables shall be used as the vertical riser cables. The cable shall support voice, data and building service applications. The bending radius and pulling strength requirements of all backbone cables shall be observed during handling and installation. The multi-pair copper cables shall be in nonplenum form and placed in conduit as required.

The Superior Essex ARMM cables are a nonplenum cable and shall consist of solid-copper conductors insulated with expanded polyethylene covered by a PVC skin, be conformance tested to meet EIA/TIA 568B for Category 3 cables, be UL® and c(UL®) Listed as CMR. The core shall be overlaid with a corrugated aluminum sheath, which is adhesively bonded to an outer jacket of PVC plastic to form an ALVYN sheath.

2.04 UNDERGROUND COPPER CABLE

The underground copper cable supporting voice communications requirements shall be 24 gauge, paired, dual-insulated with foam skin and plastic, flooded by FLEXGEL filling compound, Superior Essex ANMW, and shall meet the following technical specifications:

OUTSIDE PLANT COPPER CABLES
All voice grade wire and cable placed in the outside environment shall be solid, twisted pair, and multi-conductor. The copper twisted pairs shall have a mutual capacitance at 1kHz of 15.7 nF/1,000 ft. The cable shall be resistant to mechanical damage, lightning or damage from wildlife.

The buried or underground cable shall have an aluminum steel polyethylene (ASP) sheath and a core of solid-copper conductors, dual insulated with foam skin and plastic, surrounded by FLEXGEL III® filling compound.

2.05 CABLE PROTECTORS FOR COPPER CABLE

A. For all pairs, Contractor shall install three-element gas protector modules, SYSTIMAX® 4B1-EW, containing silicon avalanche on both ends.

B. Contractor shall supply and install SYSTIMAX® 195A1-type, multi-pair protector panels in BDF and MDF.

2.06 FIBER OPTIC CABLE

A. For single mode fiber, SYSTIMAX® TeraSPEED™ 5201 (24 – 72 strands (HFC) 301)-0XXA-WPYL (indoor applications, plenum rated) where XXX is strand count, or SYSTIMAX ® TeraSPEED™ 5022-0XXA-ZXBK dielectric (outdoor applications) cable, and shall meet the following technical specifications:
### Optical Specifications:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode Field Diameter</td>
<td>9.2 (±0.3) μm @1310 nm; 10.4 (nominal)</td>
</tr>
<tr>
<td></td>
<td>@1550 nm</td>
</tr>
<tr>
<td>Group Index of Refraction</td>
<td>1.466 @1310 nm and 1383 (±3) nm, 1.467</td>
</tr>
<tr>
<td></td>
<td>@1550 nm</td>
</tr>
<tr>
<td>Attenuation</td>
<td>Tight Buffered:</td>
</tr>
<tr>
<td></td>
<td>0.70 dB/km @1310 nm</td>
</tr>
<tr>
<td></td>
<td>0.70 dB/km @1550 nm</td>
</tr>
<tr>
<td></td>
<td>Loose:</td>
</tr>
<tr>
<td></td>
<td>0.35 dB/km @1310 nm</td>
</tr>
<tr>
<td></td>
<td>0.24 dB/km @1550 nm</td>
</tr>
<tr>
<td>Maximum Dispersion</td>
<td>2.8 ps/nm-km 1285 to 1330 nm</td>
</tr>
<tr>
<td>Zero-Dispersion Wavelength</td>
<td>1300-1322 nm</td>
</tr>
<tr>
<td>Zero-Dispersion Slope</td>
<td>0.092 ps/((nm)²) km</td>
</tr>
<tr>
<td>Polarization Mode Disp. LDV</td>
<td>0.08 ps/(km) 1/2</td>
</tr>
</tbody>
</table>

### Physical Specifications:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Diameter</td>
<td>8.3 μm nominal</td>
</tr>
<tr>
<td>Cladding Diameter</td>
<td>125.0 (±0.7) μm</td>
</tr>
<tr>
<td>Core/Clad Offset</td>
<td>&lt;=0.5 μm</td>
</tr>
<tr>
<td>Cladding Non-Circularity</td>
<td>&lt;=1%</td>
</tr>
<tr>
<td>Coated Fiber Diameter</td>
<td>245 (±10) μm</td>
</tr>
<tr>
<td>Cladding/Coating Offset</td>
<td>&lt;=12 μm</td>
</tr>
<tr>
<td>Colored Fiber Diameter</td>
<td>254 (±7) μm</td>
</tr>
<tr>
<td>Proof Test</td>
<td>0.7 Gpa</td>
</tr>
<tr>
<td>Fiber Curl</td>
<td>&gt;4 m</td>
</tr>
<tr>
<td>Dynamic Fatigue Parameter</td>
<td>&gt;=18</td>
</tr>
<tr>
<td>Macrobend 100 turns, 50mm Mandrel</td>
<td>0.10 dB @1310 nm, 0.10dB @1550 nm</td>
</tr>
<tr>
<td>Macrobend 1 turn, 32mm Mandrel</td>
<td>0.50 dB @1310 nm and @1550 nm</td>
</tr>
</tbody>
</table>

SYSTIMAX® TeraSPEED™ Loose Tube Dielectric Enhanced Singlemode Cable 5024 xxxA WXBK, Black (4 – 288 fibers) approved.

**B.** All optical fiber cable used shall have the following physical characteristics:

**Cable Core:**
- Building interior: Air core
- Building exterior: Filled core stable from -40F to +140F

**Cable Composition:**
- Building Interior:
  - (plenum): OFNP Fluoropolymer jacket
  - (non-plenum): OFNR PVC jacket
  - riser: OFNR PVC jacket
Building exterior: Non-metallic dielectric
Cable Strength: Maximum pulling tension-600 lb.
Minimum Bend Radii: (<30% max. pull tension) 10 times cable diameter
(>30% max. pull tension) 20 times cable diameter
Fiber Identification: Color coding system adequate to unambiguously identify each fiber. See paragraph 3.16 in this Section. The words “Fiber Optic Cables” shall be imprinted on cable no more than one meter apart.

2.07 OPTICAL FIBER TERMINATIONS

A. All single mode optical fiber cable installed shall be terminated utilizing a split-ferrule alignment sleeve and a precision ceramic tip. All single mode connectors shall meet the following technical specifications:

Connector Type: SC
Fiber Outside Diameter: 125 Microns
Loss Repeat: < 0.2 dB per 1000 reconnects
Axial Load, min.: 30 pounds
Temperature Stability: -40 C to 85 C

2.08 OPTICAL FIBER PATCH CORDS

The University will provide optical fiber patch cords as it relates to the University’s voice and data systems.

2.09 CONNECTING BLOCKS

A. All UTP riser copper cable shall be terminated on high-density, modular SYSTIMAX® 110AW2-XXX, where XXX indicates pair capacity, connecting blocks.

B. All UTP station copper cable shall be terminated on SYSTIMAX® GigaSPEED® X10D Universal Modular Patch (UMP) panel(s). The UMP panel accepts up to 24 GigaSPEED® X10D MGS500 information outlets that must be ordered separately. A SYSTIMAX® equivalent patch panel may be substituted with approval by the Office of Information Technology.

C. All optical fiber cable in Building Distribution Frame (BDF) rooms and Intermediate Distribution Frame (IDF) rooms shall be terminated in SYSTIMAX® 600G2-1U-MOD-SD (760028324) Fiber Optic Terminating Unit with MODG2-6SC-SM (760032201) adapters and associated equipment.

2.10 EQUIPMENT RACKS

All equipment racks will be Ortronics “Mighty Mo 6” racks with the following accessories:

<table>
<thead>
<tr>
<th>Item</th>
<th>Ortronics Part #</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.5’ channel X 7’ high rack</td>
<td>OR-MM6710</td>
</tr>
<tr>
<td>Vertical cable mgmt 10” x 13” x 7”</td>
<td>OR-MM6VMD710</td>
</tr>
<tr>
<td>Vertical cable mgmt 6” x 8” x 7”</td>
<td>OR-MM6VMD706</td>
</tr>
<tr>
<td>10.5 channel dust cover</td>
<td>OR-MM6BDC10</td>
</tr>
</tbody>
</table>
2.11 INTRABUILDING COAXIAL CABLE

All intrabuilding coaxial cable in the new facility supporting video communications requirements shall be RG-11/U Belden 89292, and shall meet the following technical specifications:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gauge:</td>
<td>14 AWG solid bare copper covered, .064 in</td>
</tr>
<tr>
<td>Outside Diameter:</td>
<td>0.348 in (8.84 mm)</td>
</tr>
<tr>
<td>Shields:</td>
<td>Duofoil + 61% tinned copper braid</td>
</tr>
<tr>
<td>Insulation:</td>
<td>Black tint Teflon jacket</td>
</tr>
<tr>
<td>Nominal DC Resistance:</td>
<td>2.5 Ohms/1000 ft</td>
</tr>
<tr>
<td>Nominal Mutual Capacitance:</td>
<td>16.5 pF/ft @ 1 kHz</td>
</tr>
<tr>
<td>Attenuation:</td>
<td>.15 dB/100 ft @ 1 MHz</td>
</tr>
<tr>
<td>Characteristic Impedance:</td>
<td>75 Ohms @ 1 MHz</td>
</tr>
</tbody>
</table>

2.12 INTERBUILDING COAXIAL CABLE

All interbuilding coaxial cable in the new facility supporting video communications requirements shall be P-3-75-500JCASS, and shall meet the following technical specifications:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gauge:</td>
<td>0.111 in. (2.82 mm) nom.</td>
</tr>
<tr>
<td>Outside Diameter:</td>
<td>0.560 in. (14.22 mm) nom.</td>
</tr>
<tr>
<td>Outer jacket of medium density polyethylene, solid aluminum sheath and Migra-Heal compound between jacket and sheath</td>
<td></td>
</tr>
<tr>
<td>Nominal DC Resistance:</td>
<td>0.37 Ohms/1000 ft</td>
</tr>
<tr>
<td>Attenuation:</td>
<td>0.66 dB/100 ft @ 83 MHz</td>
</tr>
<tr>
<td>Characteristic Impedance:</td>
<td>75 Ohms @ 1 MHz</td>
</tr>
</tbody>
</table>

2.13 VIDEO SYSTEM PARTS AND ACCESSORIES

Coaxial cable equipment: The following equipment of University approved equivalent shall be used:

- Fiber Optic Transmitter (BNI Solutions): ENI TR2100-7715
- Fiber Optic Receiver (BNI Solutions): ENI TR2200-750(38)-N17
- Line extender: CCOR LAN-100-2rv
- Pads (attenuators) for CCOR LAN-100-2rx:
  - PB-0
  - PB-3
  - PB-6
  - PB-9
- Pads for Line Extender:
  - Eq-450-3 dbmv of cable @ 450 MHz: 2.5
  - Eq-450-5 dbmv of cable @ 450 MHz: 6.2
  - Eq-450-8 dbmv of cable @ 450 MHz: 9.9
  - Eq-450-11 dbmv of cable @ 450 MHz: 13.8
  - Eq-450-13 dbmv of cable @ 450 MHz: 17.3
  - Eq-450-15 dbmv of cable @ 450 MHz: 20.9
Splitters and Directional Couplers:

<table>
<thead>
<tr>
<th>Type</th>
<th>Tap Value</th>
<th>Insertion Loss @ 450 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jerrold SSP-3</td>
<td>4.4</td>
<td></td>
</tr>
<tr>
<td>Jerrold SSP-6367.9</td>
<td>7.9</td>
<td>4.4</td>
</tr>
<tr>
<td>Jerrold SSP-7</td>
<td>7.8</td>
<td>2.5</td>
</tr>
<tr>
<td>Jerrold SSP-9</td>
<td>10.0</td>
<td>1.8</td>
</tr>
<tr>
<td>Jerrold SSP-12</td>
<td>12.8</td>
<td>1.5</td>
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<td>Jerrold SSP-16</td>
<td>16.3</td>
<td>1.2</td>
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Full Feature Taps:

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<thead>
<tr>
<th>Type</th>
<th>Tap Value</th>
<th>Insertion Loss @ 450 MHz</th>
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</thead>
<tbody>
<tr>
<td>Jerrold FFT8-14</td>
<td>14.2</td>
<td>4.3</td>
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<tr>
<td>Jerrold FFT8-17</td>
<td>17.8</td>
<td>1.8</td>
</tr>
<tr>
<td>Jerrold FFT8-20</td>
<td>20.0</td>
<td>1.2</td>
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<td>22.5</td>
<td>1.0</td>
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<td>Jerrold FFT8-26</td>
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</tr>
<tr>
<td>Jerrold FFT8-29</td>
<td>29.2</td>
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Connectors and Other Accessories:

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<th>Outside Dimension</th>
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<tr>
<td>Gilbert Parts</td>
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<tr>
<td>Pin Connector</td>
<td>GRS-500-CH-DU-03</td>
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<tr>
<td>Power Blocking Ks-F</td>
<td>GF-625-CH-DCB</td>
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<td></td>
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<tr>
<td>Chassis-Chassis Connector</td>
<td>G-KS-KS-M</td>
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<tr>
<td>Right Angle Connector</td>
<td>GP-90-S</td>
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<td>Splice Connector</td>
<td>GRS-500-SP-DU-03</td>
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<td></td>
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<td>Teflon RG-11 Connector</td>
<td>GF-11-300p-388</td>
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<td>F-type terminators</td>
<td>GTR-59-s</td>
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D-Rings for Mounting Equipment:

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<th>Outside Dimension</th>
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</thead>
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<tr>
<td>Graybar GB 13a</td>
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<td>4-7/8&quot;</td>
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<tr>
<td>Graybar GB 13b</td>
<td>3-1/8&quot;</td>
<td>6-1/8&quot;</td>
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Crimping Tool:

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Testing Equipment:

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<th>Type</th>
<th>Type</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RF Signal Strength Meter</td>
<td>Wavetek SAM III or approved equal must be used for testing,</td>
<td></td>
</tr>
</tbody>
</table>

2.14 OUTLET BOXES

A. All outlet boxes supporting voice/data communications requirements shall be double-gang, four (4) inch square, by two and one half (2.5) inch deep minimum galvanized steel boxes.

B. All outlet boxes supporting video communications requirements shall be single gang; two and one half (2.5) inch deep minimum galvanized steel boxes.
2.15 VOICE/DATA OUTLETS AND COVER PLATES

A. All outlet plates shall be SYSTIMAX® M13L-246 faceplates for voice/data applications and (SYSTIMAX M28A-246) faceplates for voice/data/fiber applications, with M20AP-246 modular covers filling unused portals.

B. The outlet assembly to support voice only or data only communications requirements shall be one (1) eight (8) position, eight (8) wire SYSTIMAX® MGS500-003 (BLACK) modular RJ45 outlets, wired per the 568B wiring standard. The faceplate will be SYSTIMAX® M10L-246.

C. The outlet assembly supporting voice/data communications requirements herein referred to as a “standard” outlet shall be three (3) eight (8) position, eight (8) wire modular RJ45 outlets, wired per the 568B wiring standard. The RJ45 receptacle (SYSTIMAX® M13L-246) shall consist of three (3) RJ45 outlets. The standard outlet is to be mounted in a vertical position with three (3) SYSTIMAX® MGS500-003 (BLACK) modular RJ45 outlets.
D. Video outlets shall be one (1) M81C-B coupler kit, video F81 coaxial video module, mounted in a separate single-gang box.

E. All fiber outlets, herein referred to as a “standard with fiber, shall be one (1) SYSTIMAX® 108 009 408 M series coupling mounting, with appropriate SC coupling per strand. Fiber outlets will be mounted in conjunction with other voice or data applications, using the (SYSTIMAX® M28A-246) faceplate.

F. The “pin-out” wiring assignment for the 4-pair UTP copper cable for both voice and data shall be consistent with the TIA/EIA T568B Commercial Building Telecommunications Wiring Standard.

2.16 HORIZONTAL DISTRIBUTION CABLE MANAGEMENT SYSTEM

A. Cable Tray Pathways

1. Cable tray is required in all areas where horizontal cabling bundle quantity (copper, optical fiber and coax) exceeds 40 wires.

2. Cable tray for telecom applications shall be Cablofil Incorporated EZTray or an approved equivalent, and shall adhere to the following dimensional guidelines:
### Dimension | EZTray Part# | Bundle Quantity
---|---|---
4”D X 12” W | CF 105/300EZ | Less than 300
4”D X 18” W | CF 105/450EZ | 300- 450
4”D X 24” W | CF 105/600EZ | In excess of 450

3. Cable tray shall be installed to the specifications of the manufacturer.

### B. J-Hook Pathways

1. J-hooks shall be utilized in all areas where bundle quantity is between 10 and 40 cables

2. All j-hook pathways shall be provided with a center hung, triple tiered, six-hook cable support system with a maximum spacing specified as not greater than four (4) feet. Contractor shall submit samples and cut sheets on proposed solutions.

### 2.17 DUCTBANK INNERLINERS

Innerliners are required. Contractor shall furnish Pi-Mar PVC conduit manufactured by Pyramid Industries Inc. Contractor will install four (4) one (1) inch innerliners in a duct. If OSP is to be installed, contractor will fill duct with OSP and inner liner as space allows.

### 2.18 CABLE LUBRICANT

Cable pulling lubricant, Ideal Yellow 77 or a University approved equal, shall be utilized when pulling all cable.

### 2.19 CASES AND SPLICES

A. All outside plant (OSP) Cable Splice Cases shall be Preformed Line Products Stainless Steel with Filling Flange and must be filled with a University Approved re-enterable encapsulant.

B. All entrance cases in the Patuxent Building; Building 010 shall be SYSTIMAX® Cable Rearrangement Facilities.

### 2.20 FIRESTOPPING

A. Contractor shall provide firestopping protection that shall meet NFPA Life Safety Code #101, 6-2.3.6, "Penetrations and Miscellaneous Openings and Fire Barriers" and the NEC 300.21 "Fire Stopping" regulations and standards.

B. All vertical penetrations consisting of conduit, sleeves, or chases shall be firestopped at the bottom of the penetration.

C. All horizontal penetrations consisting of conduit, sleeves of chases shall be firestopped on both sides of the penetration.

D. Individual cable penetrations in plenum air return areas not enclosed in conduit shall be firestopped.

E. Openings made in concrete floors shall be firestopped using a tested system. Thickness or depth of firestop materials shall be as recommended by the material manufacturer and backed by formal ASTM E-814 tests.
F. Plenum air return ceiling penetrations for conduit and cables shall be sealed with a system appropriate for the substrate and level of protection required.

G. All metal conduits designed for communications with or without wire/cable inside shall be firestopped to restrict transfer of smoke.

2.21 ELEVATOR PHONE

In the event of a new elevator installation that does not come equipped with a phone or during a retrofit, the following equipment will be installed:

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Description</th>
<th>Stock No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talk-A-Phone Co.</td>
<td>Hands-free Phone programmed to use campus circuit assurance equipment</td>
<td>EPT-100E</td>
</tr>
<tr>
<td>5013 North Kedzie Ave.</td>
<td>Chicago, IL 60625</td>
<td></td>
</tr>
<tr>
<td>312-539-1100</td>
<td>ETP-100E</td>
<td></td>
</tr>
</tbody>
</table>

2.22 OUTDOOR EMERGENCY PHONE

The Contractor shall coordinate with the General Contractor to install the following campus approved Emergency Phone:

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Description</th>
<th>Stock No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talk-A-Phone Company</td>
<td>Vandal resistant security unit with speakerphone, with keypad, blue light, strobe, with phone and camera arm.</td>
<td>ETP MTR OPT4</td>
</tr>
<tr>
<td>5013 North Kedzie Ave.</td>
<td>Chicago, Ill. 60625</td>
<td>UMCP</td>
</tr>
<tr>
<td>539-1100</td>
<td>ETP-400K Phone(773)</td>
<td></td>
</tr>
</tbody>
</table>

**** Wall Mount for Garages and other locations as specified with by the University.  ETP-400K Phone ETPWM UMCP

All outdoor emergency phones will be wired with a 6 pair OSP cable terminated in the building on a protector in the nearest BDF/TR. The University will terminate the OSP at the phone unless contractor is otherwise instructed.

Additional cabling is required by the Department of Public Safety for camera placement. Please consult the DCFS of Department of Public Safety for that information.

PART 3 - EXECUTION

3.01 SYSTEM DESIGN

A. The cabling system to support voice, data, and video requirements has been designed in accordance with BICSI, EIA/TIA, NFPA, NEC, SYSTIMAX® SCS, IEEE, and FCC communications.

B. The proposed cabling system has been designed and shall be installed in a manner that provides mechanical integrity and symmetry for the cabling media and any associated frames and racks and which also furnishes ease of access and suitability for future rearrangements and changes.
C. The transmission media shall be installed through a network of cable trays, conduit, sleeves, and chases and interconnect the various rooms and floors of the building.

D. Provide one (1) 208v, 30 amp outlet with an L6-30R receptacle from normal power and one (1) 208v, 30 amp outlet with an L6-30R receptacle from emergency power in all telecom closets. Mount these outlets to the bottom of one of the racks. Wire should be in conduit or installed per NEC requirements.

E. Provide a minimum of two (2) 120v, 20 amp dedicated outlets, wall mounted at 18” on opposite walls in all telecom closets. Locate outlets in accordance with the NEC.

F. Telecommunications Closet Design Requirements (BDFs, MDFs, IDF s and TRs)
   1. Building Distribution Frame/Main Distribution Frame (BDF/MDF)
      a. BDF/MDF shall be located on lowest level of building.
      b. BDF/MDF shall be at least 200 square feet.
      c. BDF/MDF shall have neither width nor depth less than 12 feet.
      d. BDF/MDF shall have card access through the Department of Public Safety Lenel System.
      e. BDF/MDF shall be cooled by way of the building HVAC system (to be determined by the AE during design), including dust filtering of all ventilation outlets and inlets.
      f. Wall and floor penetrations, and door assemblies shall be sealed to minimize the introduction of dust into room.

   2. Intermediate Distribution Frame/Telecom Room (IDF/TRs)
      a. Each floor with telecommunications outlets must include at least one (1) TR.
      b. IDF/TR(s) must be placed such that the longest station run is less than 90 meters from outlet termination point to the cross connect.
      c. IDF/TR(s) shall be sized as follows:
         
         | # of Stations | Minimum Closet Size | Minimum Width/Depth |
         |----------------|---------------------|---------------------|
         | 0 – 100        | 100 square feet     | 8 feet              |
         | Over 100       | 120 square feet     | 10 feet             |
      d. IDF/TR(s) shall be “stacked” one above the other.
      e. Telecom closets are for the exclusive use of telecommunications and network equipment and systems. No other equipment shall be located within the room.
      f. 4” conduits (or sleeves where appropriate) shall be installed to accommodate current needs plus 100% growth.
      g. IDF/TR(s) shall have card access through the Department of Public Safety Lenel System.
      h. Ventilation shall be provided with air drawn from the adjacent corridor through a ceiling grille. The intake grille shall be ducted to a constantly operating fan, which is ducted to the TR room ceiling where the air is supplied through a filtered grille. Relieve air through an open-ended duct which shall run from 1'-0" above the floor to the inside of the ceiling plenum.
      i. Provide a temperature sensor connected to the Campus Controls Monitoring System (CCMS), which shall send an automatic alarm to Work Control then the temperature rises above 95°F (adjustable).
      j. Wall and floor penetrations, and door assemblies shall be sealed to minimize the introduction of dust into room.

G. Determination of station quantities—quantity and placement of outlets, as well as outlet labeling assignments, shall be shown on the floor plans.
H. Determination of minimum station quantities:

General Office: (1) standard outlet every 70 sq/ft

Conference Rooms: (2) standard outlets with CCTV coax connections at opposing ends of the room, and (1) standard outlet every 70 square feet

Computer Labs/Server Rooms: (1) standard outlet with 4 strands of sm fiber (location to be determined during design), and one standard outlet every 70 sf. Internal wiring to seating to be determined during design.

Classrooms: (2) standard outlets with CCTV coax connections both in the front of the room.

Wireless Coverage: (1) single wire jack to be located every 2,000 sq. feet. Location to be determined by design.

Note: (sm = singlemode)

3.02 FORBIDDEN WORK

A. Other than the entrance splice, no cable splices shall be allowed within buildings.

B. Aerial cable construction shall not be permitted.

3.03 EXAMINATION

A. Contractor shall verify that surfaces are ready to receive work.

B. Contractor shall verify that field measurements are as shown on the CDT’s Construction Drawings approved by the University.

3.04 INSTALLATION OF BACKBOARDS

A. All termination backboards in the BDF and TR’s shall be finish painted with durable white enamel prior to installation of any communications equipment.

B. All backboards shall be supported as specified under provisions of “Wiring Materials and Methods.”

C. All backboards shall be marked with the legend “COMM” under the provisions of Section 16915.

3.05 CABLE PULLING

Contractor shall utilize cable-pulling lubricant for all pulls in conduit ducts or innerliners. Not less than three (3) gallons per kilometer shall be used.

3.06 COORDINATE WITH OTHER TRADES
A. Cable routing shall be designed and installed so that cabling and associated equipment does not interfere with the operation or maintenance of any other equipment. No wiring shall be hung, tied to, or supported from anything other than telecommunications raceway or the building structure.

B. All cable in accessible spaces shall be designed and installed for easy access. Cable paths above suspended ceilings, mechanical rooms, closets, etc. shall not be blocked or covered in any way that would impede the addition of cable in the future.

3.07 CONDUIT INSTALLATION

A. To support voice and data communications requirements, Contractor shall install one (1) inch conduit from the outlet box stubbed into the accessible ceiling for a maximum of three Category 6A cables. If additional cables are required to an outlet, conduit must be sized accordingly to meet product specifications. All telecommunications wiring shall be concealed in conduit or in the ceiling.

B. Conduit sleeves shall be four (4) inch trade size minimum. Sleeves shall be Rigid Galvanized Steel for penetrations of concrete slabs, concrete walls, and CMU walls. Sleeves for penetrations of stud walls shall be EMT. All sleeves shall be rigidly installed using appropriate fittings and all masonry penetrations shall be grouted. Sleeves shall project a minimum of six (6) inches beyond wall or floor surface. All penetrations of fire rated construction shall be firestopped with fire-stopping as specified in Part 2.16 of this Section to equal or exceed fire rating of the penetrated material. Sleeves for penetration of walls and floors shall have one hundred percent (100%) spare capacity, and shall be firestopped as per code.

C. Any section of conduit containing two (2) 90-degree bends, a reverse bend, or having length greater than one hundred (100) feet shall have an accessible pullbox. All conduits with less than a 50% fill ratio shall have a 3/32-inch polyethylene pull cord approximately secured at each end.

D. No oval or square conduit fittings shall be permitted. No screw type fittings shall be permitted.

E. All metallic conduit and raceways shall be appropriately grounded as specified in the National Electric Code.

F. Supports and fasteners shall be used to hold all cables, conduits, and trays firmly in place. Supports and fasteners shall be used such that they provide an adequate safety factor. All conduit/cable trays shall be supported from the building structure and not from any other ductwork, pipes, ceiling tiles, or equipment.

G. Where cable trays or conduit are not provided (especially between the stubbed out conduit and the nearest cable tray). Kindorf lay-in pipe hangers, or a University approved equal shall be installed. The lay-in pipe hanger shall be attachable to a floor slab through the use of a pre-threaded lead insert, which is suitable for installation of a 3/8-inch "all-thread" rod in a predrilled 1/2-inch hole. The threads of the closure bolt on the pipe hanger shall be covered by 3/8-inch copper or aluminum tubing to protect the cabling sheaths.

H. Cables placed in hangers in the plenum ceiling area shall be routed high and away from all other electrical and mechanical systems so as to avoid contact with light fixtures, ventilation ducts, sprinkler systems or plumbing piping, motors, or any other electrical devices. The cable shall not be run in parallel with any high voltage electrical wiring. The maximum separation between support points for all cabling shall be eight (8) feet. Lay-in pipe hangers shall be installed so as to accommodate these maximum distance spacing. Hangers shall
be installed at directional bend points so as to provide a maximum bend angle of 45 degrees for the supported cabling.

I. Contractor shall install 3/16-inch polyethylene pulling string in each empty conduit, and appropriately secured at each end.

3.08 COMMUNICATIONS EQUIPMENT ROOMS

A. The communications equipment rooms supporting voice, data, and video requirements are identified on the construction documents.

B. Prior to the installation of any equipment in any of the communications rooms, the Contractor shall provide room layouts, for University approval, for each of the rooms listed above showing the proposed locations of all backboards, termination blocks, distribution panels, security boxes, control boxes, power supplies, etc. required for all communications systems, which is part of this specification.

C. Cable must be installed such that station wire runs from the outlet to the cross connect do not exceed 90 meters.

D. Grounding shall be #6 AWG wire provided to each communications equipment room in accordance with ANSI/NFPA 780.

E. All walls, ceilings and floors must be made non-porous with paint or sealant to minimize dust.

F. Sleeves or conduits from outlets shall penetrate closet walls at a height above the plywood panels and extend only far enough to install bushings.

G. Hardware shall be installed plumb and level on the wall backboards. Appropriate wire management shall be installed so that jumper, cross connects, and patch cord wires can be installed in a neat and orderly fashion.

H. Equipment racks shall be installed level, to manufacturer specifications, and shall be so that jumpers and patch cords can be installed in a neat and orderly fashion. Contractor will install (1) one equipment rack installation of network infrastructure hardware. Contractor will install fiber termination shelves at the top of the rack, unless otherwise instructed. Contractor shall appropriately ground all equipment racks in accordance with the National Electric Code (NEC).

3.09 STATION CABELING AND INSTALLATION

A. All voice, data, fiber, and video outlets shall be installed in the locations that are conspicuously marked in the building floor plans. If there is a question as to the location of any outlet it shall be brought to the attention of the University prior to installation.

B. Prior to installing any cabling, drawings indicating all jack numbering shall be submitted by contractor for approval.

C. All outlets supporting voice and data communications requirements shall be wired with three (3) (SYSTIMAX® XX91) 4 pair UTP copper cables as specified in Part 2.02 of this section.

D. Data jack for wireless access: All wireless access points will be located above an accessible ceiling in areas designated by the University. (See 3.01F, Minimum Station
Requirements) If areas designated for wireless access do not have accessible ceilings, jack location is at the discretion of the University.

E. **Fiber jack:** The station fiber pairs (single mode) will be terminated at the outlet and in fiber termination shelves mounted at the top of the equipment racks.

F. **The terminations in the BDF and all TR's of all UTP riser copper cable shall be on 110 termination fields.**

G. **The terminations for all UTP station copper cable in the BDF and TR rooms shall be on patch panels.**

H. **All wiring supporting voice and data communications shall conform to IEEE 802.3 100BASE-T, and 100 Base-t and 1000 Base-t wiring standards.**

I. **All wiring shall meet Category 6A standards.**

### 3.10 RISER CABLING AND INSTALLATION

A. In the BDF and all TR's, connecting blocks shall be modular, high-density, SYSTIMAX® 110-type or a University approved equal, with clear protective covers. All telecommunication rooms shall be grounded by means of a #6 AWG insulated copper ground wire connected to the building ground system. The BDF shall also have gas element surge protection with sneak fuses adequate for protecting all circuits entering the building.

**NOTE:** All closet layouts shall be approved by the University before installation of any equipment or termination of any wiring.

B. Contractor shall install UTP vertical copper cabling between the BDF and each TR to support voice communications requirements. Each riser cable shall be homerun from the BDF to each TR in the conduit and sleeves provided. In both the BDF and TR, the cable pairs shall be terminated on SYSTIMAX® 110 connecting blocks and appropriately cross-connected to the UTP horizontal copper cabling (in the TR) and the UTP backbone copper cabling (in the BDF). The size of the riser cables for voice communications from the BDF to each TR can be found in the Table below.

| Number of outlets | 4 + 20% Example: 50 stations | 200 + 40(20%) = 240 |

Contractor will increase riser to the next highest available cable after utilizing the above formula.

C. **Riser Optical Fiber Cabling:** All optical fiber riser will be terminated on shelves mounted at the top of the equipment rack. Each TR will have twelve (12) tested single-mode optical fibers installed and terminated from the BDF fiber shelves to each of those TR's (see additional riser requirements below). All optical fiber, terminations, and connections shall conform to the IEEE 802.3 100BASE-F specifications.

**Additional Riser Requirements:**
In addition to the existing fiber riser, contractor will install two (2) single mode fibers to each of the TR riser counts, for each two strands installed to an outlet being serviced by that TR.

D. **Riser Coaxial Cabling:** A single RG-11 coaxial cable extending from the BDF to the top floor TR's shall be installed and used as the riser for each TR stack.

E. **"Kellums"- type basket hangers, or a University approved equal, shall be installed on all riser
cables to provide independent support of cables passing through conduit sleeves installed in floor slabs. Hangers shall have a maximum separation of twelve (12) inches.

3.11 UNDERGROUND CABBING AND INSTALLATION

A. Contractor shall install UTP underground copper cabling between the BDF and the ER (Main Distribution Frame located in Patuxent Building, Building 010) to support voice and data communications requirements (as specified in Part 2.04 of this Section). The underground cable shall run in the appropriate ductbank and manholes. The contractor shall terminate the underground cable in the cable vault of Building 010 in a SYSTIMAX® Cable Rearrangement Facility (vertical splice case). The pairs shall then be run into the frame room of building 010 and terminated on Contractor provided 195A type protector panels, and extend tails to 110 fields, as directed by the University. The Contractor shall make terminations in the BDF, utilizing SYSTIMAX® 195A type, multi-pair protector panels and extend tails to 110 fields. The Contractor shall also provide new frame racks to support the protector units. The size of the copper underground cable shall be XXXX pairs. The Contractor shall use the largest size of cable applicable.

B. Contractor shall install single mode optical fiber backbone cabling between the BDF and the ER to support data communication requirements (as specified in Part 2.06 of this Section). The underground single mode optical fiber shall run in innerliner (as specified in Part 2.17 of this Section) in the appropriate ductbank and manholes. The single mode optical fiber shall be terminated on both ends utilizing Contractor provided SYSTIMAX® 600G2-1U-MOD-SD (760028324) Fiber Optic Terminating Unit, with MODG2-6SC-SM (760032201) adapters. The size of the backbone single mode optical fiber cable shall be XX strands.

C. Contractor shall install coaxial backbone cabling between the BDF and the nearest available tap, as designated by the University, to support video communications requirements (as specified in Part 2.12 of this Section). The underground coaxial cable shall run in innerliner (as specified in Part 2.16 of this Section) in the appropriate ductbank and manholes. Cable in the manhole shall be secured to the manhole at least two (2) feet from the connection point and every four (4) feet thereafter. The connector shall be covered with a one (1) foot section of shrink tube except where the connector is located inside the building. Upon completion, the cable now shows no sign of stretches, kinks, or compressions. If damage is apparent, the contractor will pull new coaxial cable.

D. Whenever termination points for single and multi mode fiber are the same, a hybrid cable shall be utilized, when available.

E. Contractor shall install coaxial backbone cabling between the BDF and the nearest available tap, as designated by the University, to support video communications requirements (as specified in Part 2.12 of this Section). The underground coaxial cable shall run in innerliner (as specified in Part 2.16 of this Section) in the appropriate ductbank and manholes. Cable in the manhole shall be secured to the manhole at least two (2) feet from the connection point and every four (4) feet thereafter. The connector shall be covered with a one (1) foot section of shrink tube except where the connector is located inside the building. Upon completion, the cable now shows no sign of stretches, kinks, or compressions. If damage is apparent, the contractor will pull new coaxial cable.

3.12 OUTLET BOX INSTALLATION

Unless otherwise noted on the drawings, outlets shall be securely and neatly installed at the height specified in the following table:
3.13 DUCTBANK DESIGN, CONSTRUCTION, AND UTILIZATION

A. Contractor shall install XXXX pairs (specified and approved by the University) of multipair, UTP copper cable between the BDF and the Patuxent Building (Building 010). Prior to the termination of this cable in the Patuxent Building, Contractor shall verify its termination location with the University.

B. Contractor shall install a XX strand (specified and approved by the University) single mode optical fiber cable (as specified in Part 2.06 of this Section), between the BDF and the ER located in the Patuxent Building. Prior to termination of this cable in the Patuxent Building, Contractor shall verify its termination location with the University.

C. Contractor shall install one (1) coaxial cable (as specified in Part 2.12 of this Section) between the BDF and the nearest available tap. Prior to termination of this cable Contractor shall verify its termination location with the University.

D. Contractor shall install new concrete encased ductbank and manholes and/or install new concrete encased ductbank between existing manholes to accommodate the outside plant needs of the facility as directed by the University. The contractor shall submit proposed pathway for University approval.

E. Any duct supporting optical fiber, copper or coax will require installation of four (4) one-inch innerducts. In the event of a larger cable being installed, the remaining duct space shall be filled with innerduct. Optical fiber, copper and coaxial cable in the specified amounts above shall be run in separate innerducts. Ductbank shall be engineered to accommodate the required twisted pair, fiber optic, and coaxial cable needs plus one hundred percent (100%) spare capacity.

F. All ductbank shall conform to the provisions of “Outside Power Transmission and Distribution”, and shall be arranged in a rectangular fashion. Only four (4) inch PVC “type B” conduit shall be used for communication ducts. No section of ductbank shall have more than a sum of 180 degrees of bends without the installation of a manhole.

G. Ductbanks shall have a minimum of (30) thirty inches cover over encasement. There shall be twenty-four (24) inch minimum clearance between communications ductbank encasement and any other utilities.

NOTE: No exceptions will be made without prior approval of the University.

H. Concrete encased, galvanized intermediate weight rigid steel conduit shall be used instead of PVC or polypropylene wherever ductbanks cross roads, parking lots, or buried steam lines. Steel ducts shall extend ten (10) feet on either side of the crossing. At steam line crossings, encasement shall be covered with an aluminum reflector.

I. All spare ducts or those with less than twenty-five percent (25%) fill shall have a one-quarter (1/4) inch polypropylene pull wire appropriately secured at each end. All vacant innerducts or those with less than twenty-five percent (25%) fill shall have a 3/16- inch
polypropylene pull wire appropriately secured at each end.

J. All ducts shall be pneumatically rodded using a University approved slug of one-quarter (1/4) inch diameter less than the duct inner diameter.

K. All ducts, including spares, shall be sealed watertight with expandable urethane foam at both ends.

3.14 MANHOLES

A. Manholes shall have inside dimensions 6 feet Wide x 12 feet 1 inch deep x 7 feet High (6'-0"W x 12'-1"D x 7'0"H) minimum.

B. Manholes shall conform to the provisions of “Outside Power Transmission and Distribution”. All steel equipment shall be hot dipped galvanized. All manholes shall have at least one (1) 7/8-inch diameter steel-pulling eye in the wall opposite each duct entrance. Pulling eyes shall be welded to the reinforcing rods at the time of manhole fabrication. Each manhole shall be equipped with at minimum four (4) cable racks, two (2) per long side, that have adjustable hooks adequately sized to support the hardware. Manhole covers shall have the designation “COMM” cast on the cover.

C. New ductbank shall be appropriately doweled to existing manholes.

3.15 CONNECTION TO EXISTING SYSTEM

A. Splicing shall only be allowed in manholes or at building entrance locations. No splices shall be allowed in any other location in the new facility or in any ducts or innerliner. Splice cases in manholes shall be securely supported by support hooks on the cable racks not more than two (2) feet away from the splice case. Before closure, all splices shall be offered for inspection by the University and certification of workmanship by SYSTIMAX Solution™.

B. Contractor shall make all cross-connections in each TR to connect the first pair of each voice UTP horizontal copper cable to the facility copper riser system.

C. Contractor shall connect to University video network at the University’s direction.

3.16 RE-ROUTING OF EXISTING UNDERGROUND CABLES

A. Contractor shall re-route any voice, data, and video cables that are currently located in the space where the new facility is to be constructed to new or existing manholes. The re-routing and manhole locations are conspicuously identified on the site plan of the drawings.

B. Contractor shall notify the University at least two (2) weeks in advance prior to any outage, re-routing any existing voice, data, and video cables; and the outage shall be scheduled at the convenience of the University.

C. Any cable that is re-routed must be re-terminated and tested according to the termination and testing requirements as described in Part 3.19 of this Section.

3.17 VIDEO SYSTEM INSTALLATION - BUILDING INTERIOR

A. Install a BNI TR2100-7715 (Multichannel RF Fiber Optic AM Transmitter in the BDF of building 147, location to be determined by OIT/NTS. The University will make the final fiber connection to the transmitter.
B. Install a BNI TR2200-750(38)-N17 (Multichannel RF Fiber Optic AM Receiver) in the BDF of the new building. The University will make the final fiber connection to the receiver.

C. The contractor shall provide video system design with loss calculation for University approval before the beginning of installation of any video system cable or equipment.

D. Line extenders shall be mounted horizontally five (5) feet above finished floor using two (2) GB13b D-rings secured with eight (8) 1-3/16" screws. At least one (1) line extender must be provided for each TR stack. Appropriate pads and equalizers shall be installed in the forward line extender section. Return line extenders pads and equalizers may be omitted.

E. The first line extender in each TR stack shall be located in the first floor TR's. Depending on sign level requirements and the size of the building, additional line extenders in the higher floor TR's may be required.

F. All active and/ or passive devices in an individual BDF or TR shall be attached together using chassis to chassis or right angle connectors.

G. Multiport taps shall be mounted vertically to one (1) GB13a D-ring, with a hex bolt (1/4" wide x 3/4" long) and secured to plywood with four (4) 1-3/16" screws. This does not apply to multiports attached to line extenders.

H. The multiport tap, excluding those attached to line extenders shall face either left or right, but not outward into the BDF/TR. All unused ports shall be terminated.

I. An FFT8-29 multiport shall be the first device attached to the output side of the line extender and is to be used to read the signal levels and measure forward tilt. F-Type right angle connectors may be used for multiport wiring.

J. Directional couplers and splitters shall only be used to connect the first amplifiers in the BDF/TR stacks.

K. All BDF/TR's shall have at least one (1) multiport tap connected to the riser regardless if that IDF/BDF, services any outlets. At every TR/BDF, a minimum of three (3) spare ports is required.

L. In each TR, the RG-11 coaxial station cable shall be secured to the existing plywood every two (2) feet with screw-type cable tie connectors. Station cable ends in the TR/BDF shall clearly indicate the outlet and room number of the station end in indelible ink written on plastic cable tags.

M. Connectors shall be chosen and installed so they can withstand (30) thirty pounds of pulling force without separating from the cable.

3.18 VIDEO SYSTEM ADJUSTING

Contractor shall adjust amplifier gain and make other system adjustments to achieve specified output levels at each outlet.

3.19 CABLE PLANT LABELING

A. All labeling shall be clear, securely affixed, and consistent on both ends of each installed cable. The University shall approve all labeling in advance.

B. The labeling of outlets and TR hardware shall be permanently engraved in the field by the Contractor according to the following numbering system:
1. Each outlet identification code shall consist of five (5) characters.

2. The first character shall indicate the floor of the building where the communications room serving the outlet is located. The number 0 (zero) shall be used for the ground floor, 1 (one) for the first floor, etc. The letter B shall be used for basements, S for sub-basements, and M, N, and P for mezzanines.

3. The second character shall be used for the communications room identifier. The letters A through Z (except I and O) shall be used and the University will specify the character to be used for each communications room.

4. The last three (3) characters shall denote the number of the outlet. All outlet numbering will begin at 001.

Example: An outlet labeled 1A006 means first floor, TR “A”, outlet number 006.

5. Outlets containing fiber shall be labeled with a separate 5-digit number. These numbers do not have to correspond to the UTP numbers that share the faceplate. All outlet numbering for fiber will begin at 001.

Following is an example of a three UTP cable outlet with SM fiber:

C. The (5)-five character code for each outlet shall be permanently marked on the outlet, as well as on the corresponding IDF blocks. In addition, each outlet shall be labeled in advance on all telecommunications drawings.

D. All coaxial cable shall be labeled with an outlet number consistent with the closest communications outlet.

E. All UTP copper riser and underground cable termination blocks shall be labeled with white 110 label strips and shall indicate pair count and destination closet. Voice riser shall be labeled separately.

F. Underground cable protector units shall be labeled with green 110 label strips reflecting cable pair count and cable number. Underground cable in manholes shall be labeled with engraved brass tag showing cable number where entering and exiting manhole.

G. All optical fiber riser and underground cable termination panels shall be labeled with fiber strand count, destination closet, and “SMOF,” to indicate cable type. The underground frame shall be labeled with the fiber strand count, fiber number, and fiber optic hub.
building number. Underground cable in manholes shall be labeled with engraved brass tag showing cable number where entering and exiting manhole.

H. All underground coaxial cable shall be labeled on each end with brass tag marked with the building number and designated as a coaxial feed cable.

3.20 TESTING AND ACCEPTANCE

A. Prior to acceptance, all "As-Built" and technical documentation shall be received and approved by the University. As-built documentation shall include the completed and notarized original copy of the Avaya SYSTIMAX® Structured Cabling System Registration Document. All intrabuilding and interbuilding wiring and equipment, and all site restoration shall be installed and completed in accordance with University and industry standards. All wiring and equipment provided and/or installed under this Contract shall be tested as described under the terms of this Contract and shall be fully operational. After all work is complete, the Contractor shall also provide the University with SYSTIMAX® SCS Certification for all communications work completed on the project and Avaya Distribution Technologies certification for all outside plant splices.

B. All copper cable plant testing shall diagnose, at a minimum, the presence of all open-loop conductors, noisy lines and distortion, low-loop current, high-loop current, ringer failures, grounded, shorted or crossed conductors, dB loss, and split connections. Contractor shall perform a continuity test on all pairs installed in the cable plant, both inside and outside the new facility. The testing shall cover end-to-end, from the outlet to the TR and the BDF to the Patuxent Building (Building 010). In addition, all tests described above shall be performed on a randomly selected pair per twenty-five (25) pair binder group of the copper riser cable. If this random selection is bad, additional testing shall be done to ensure that ninety-nine percent (99%) good pairs exist. The Contractor shall supply complete testing and correction reports to the university for review prior to acceptance of the system. For copper pairs used for any voice/data outlets, the Contractor shall perform such additional testing as required to verify that pairs meet the transmission parameters required for 100BASE-T and Category 6A wiring specifications. The University shall have final approval on the format used for recording and reporting of test results prior to the start of testing activities.

C. Optical fiber cable testing shall, at a minimum, quantify the attenuation range, optical loss, bandwidth, and misalignment. The cable completion tests shall be performed after all optical fiber cable has been placed and all splicing completed. All optical fibers shall be tested at both 850nm and 1300nm. For outside plant fiber, testing shall include two-way testing using an Optical Time Domain Reflector (OTDR), and one-way testing using a Multimode Optical Loss Test Set (MOLTS). For optical fiber installation between the BDF and an TR, the contractor shall provide two-way loss testing through the use of MOLTS. Two-way MOLTS testing shall also be performed on station fiber terminated for testing purposes. All traces and results shall be provided to the University for approval. Protective covers shall be in place on all connectors when they are not in use to protest against contamination by dirt or dust. Any fiber found to be defective a result of installation, physical inspection, or operational test shall be replaced at the Contractor’s expense.

D. Coaxial cable and video signal testing shall be performed in the following manner to verify correct installation of coaxial cable and video system electronics:

<table>
<thead>
<tr>
<th>Input Signal @ 450 MHz (after pad &amp; equalizer)</th>
<th>Output @ 450 MHz</th>
<th>Output@ch. 7 (175.2 MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 dbmv (+ 1 dbmv)</td>
<td>43 dbmv</td>
<td>40 dbmv</td>
</tr>
</tbody>
</table>
FFT8s Located in TR’s:
15 dbmv at 450 MHz at the output of all eight (8) ports of all FFT8s located in the building.

3.21 AS-BUILT DOCUMENTATION

A. The contractor shall provide the following outside plant wiring information, prior to acceptance of the building by the University, for each of the specified media:

1. Cable identification number (Copper, Fiber, Coax).
2. Cable design makeup (Copper, Fiber, Coax).
3. Cable lengths between splice points, terminations, amplifiers, or line extenders (Copper, Fiber, Coax)
4. Exact routing of cable (Copper, Fiber, Coax).
5. Splice location and identification (Copper, Fiber, Coax).
6. Strand count, mode of installed fiber, loss per splice in dB, and total amount of optical fibers installed (Fiber).
7. Frequency rating, location and identification of amplifiers and splitters (Coax).
8. Bonding and grounding (Copper, Fiber, Coax).
9. Location and description of all associated equipment (Copper, Fiber, Coax).
10. Location and description of all associated structures and obstructions (Copper, Fiber, and Coax).
11. Signal level readings at all line extenders, FFT8s, and all video jacks using frequencies 175.2 MHz (CH. 7) and 450 MHz.

B. The Contractor shall provide the following intrabuilding wiring information for each specified media prior to acceptance of the building by the University:

1. Cable entrance locations and penetration details (Copper, Fiber, Coax).
2. Location and identification of all distribution closets and of all equipment located inside distribution closets (Copper, Fiber, Coax).
3. Terminal information, outlet numbering, and pair count information at each distribution frame (Copper).
4. Schematic drawings of riser (Copper, Fiber, Coax).
5. Routing of cable and termination information (Copper, Fiber, Coax).

C. The Contractor shall provide the following MDF wiring information prior to acceptance of the building by the University:

1. Cable pair assignments per connector block.
2. Identification of cable routing to MDF.

D. The Contractor shall provide a complete listing of pair assignment records for copper wiring, optical fiber cabling, and coaxial cabling. Copper cable records shall include the status of each copper pair. Optical fiber cable records shall include strand allocation, test results, and identification of media and protocol used.

E. The Contractor shall provide the University with the operational and maintenance documentation of all telecommunications equipment installed under this contract.

F. As-Built drawings shall include actual locations of installed ductbank and manholes, including elevations, and shall indicate location, elevation and type of service for all utilities crossed by the new ductbank.

G. Contractor shall submit all drawings on compact disc in AutoCAD, latest edition.
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Uninterruptible power system (UPS).

1.02 SYSTEM DESCRIPTION

A. Components: The UPS shall consist of the following major equipment.

1. Rectifier/Charger, Invertor, input and output transformers, static bypass switch, input and output circuit breakers located in a single cabinet or group of cabinets.

2. External maintenance bypass circuit breakers.

3. Battery and battery cabinet.

B. Modes of Operation: The UPS shall be designed to operate as an on-line, fully automatic reverse transfer system in the following modes.

1. Normal: The rectifier/battery charger shall derive power from the commercial AC source and supply DC power to the invertor while simultaneously float charging the battery. The critical load shall be continuously supplied by the invertor.

2. Emergency: Upon failure of the commercial AC power, the critical load shall continue to be supplied by the invertor which without any switching, obtains its power from the storage battery. There shall be no interruption of power to the critical load upon failure or restoration of the commercial AC source.

3. Recharge: Upon restoration of the commercial AC source, the rectifier/charger shall power the invertor and simultaneously recharge the battery. This shall be an automatic function and shall cause no interruption of power to the load.
4. **Bypass Mode:** If the UPS must be taken out of service for overload or internal failures, the static bypass switch shall automatically transfer the load without interruption, to the commercial AC power. Retransfer of the load to the normal mode shall be automatic after the overload or failure has been cleared and reset. Transfer to bypass shall also be initiated manually for maintenance or repair.

5. **Downgrade:** If the battery needs to be taken out of service for maintenance, the battery shall be disconnected from the UPS module by means of an internal battery circuit breaker. The UPS shall continue to function and meet all performance criteria specified herein, except for the reserve time capability.

C. **Design Requirements:** The UPS system shall be field-upgradable to 50 KVA.

### 1.03 APPLICABLE STANDARDS

A. The UPS shall meet the requirements of the following standards (latest edition):

1. ANSI C84.1 - Voltage ratings for Electric Power Systems and equipment.
2. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 volts maximum).
3. NEMA PE1 - Uninterruptible power systems.
5. FCC Part 15, Subpart J, Class A.

B. The UPS shall be UL listed under UL 1012.
1.04 SUBMITTALS

A. **Shop Drawings:** Submit system configurations with single line diagrams, detailed layouts of power and control connections, ladder diagrams for the maintenance bypass scheme, and detailed installation drawings including all terminal locations.

B. **Product Data:** Provide product data for UPS and battery including catalog sheets and technical data sheets to indicate electrical performance, UPS type, battery type, detailed equipment outlines, weight, dimensions, control and external wiring requirements, heat rejection and air flow requirements.

C. Submit manufacturer's installation instructions under provisions of Division 1.

D. Submit manufacturer's certificate showing that the system meets or exceeds the specified requirements.

E. Submit a copy of factory test reports to the University, before shipment of the equipment.

1.05 ENVIRONMENT CONDITIONS

The UPS shall be able to withstand the following environmental conditions without damage, derating or degradation of operating characteristics:

A. **Operating Ambient Temperature**

   **UPS:** +10°C to +40°C  
   **Battery:** +10°C to +40°C

B. **Storage/Transport Ambient Temperatures**

   **UPS:** -20°C to +60°C  
   **Battery:** -20°C to +60°C

C. **Relative Humidity** (operating and storage) 0 to 95%, non-condensing.

D. **Elevation:** 5,000 feet
E. Acoustical noise: 65 dBA to one meter from any operator surface, measured at full load on inverter, at 25°C.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in UPS equipment with a minimum of three years experience in the design, manufacture, and testing of solid-state UPS systems.

B. Factory Testing: The manufacturer shall fully and completely test the system to assure compliance with the specifications, before shipment.

1.07 WARRANTY

The manufacturer shall warrant the complete Uninterruptible Power System against defective material and workmanship for a period of five (5) years and shall provide a minimum of two (2) preventative maintenance service calls per year by qualified factory service technicians during this period. This warranty period shall commence with the date that the University takes over the building.

PART 2 - PRODUCTS

2.01 SYSTEM REQUIREMENTS

A. System Efficiency: The overall system AC to AC efficiency shall be determined by dividing the output power by the input power. The battery shall be fully charged and connected. The rectifier/battery charger shall be in the normal float mode. The inverter shall be operating in the normal mode.

The minimum acceptable efficiency values are 83% at 50% rated load, 84% at 75% rated load, 86% at 100% rated load.

B. Components: All active electronic devices shall be solid-state and shall not exceed manufacturer recommended tolerances for maximum reliability. All semiconductor
devices shall be sealed. Vacuum tubes shall not be used. All relays shall be provided with dust covers.

C. **Grounding:** The UPS output AC neutral shall be electrically isolated from the UPS chassis, battery, and main ac input.

D. **Conductors:** All wiring, including transformers and inductors, and all other conductive components shall be copper for maximum safety and reliability. All exposed copper surfaces shall be treated with a suitable permanent protective coating electrically equivalent to tin. Aluminum wiring, foil or bus work shall not be used. Aluminum shall not be used as a current carrying media. Aluminum heat sinks may be used provided that no electrical current passes through the part.

E. **Power Transformers:** Input and output power transformers shall be designed and manufactured for maximum safety, reliability, and efficiency. All input and output transformers shall be of the isolated winding type. All windings shall be copper. Input transformer(s) shall have an electrostatic shield between primary and secondary windings for noise isolation and suppression. Insulation type shall have a temperature rating that is greater than the highest winding temperature during worst case UPS operation. All transformer connections shall be accessible from the front of the enclosure to facilitate periodic inspection and maintenance.

F. **Materials:** All materials and parts comprising the UPS shall be new, of current manufacture, and shall not have been in prior service, except as required during factory testing. All metal surfaces shall be treated with a corrosion inhibiting permanent protective coating.

G. **Sag/Surge/Impulse Protection:** The UPS shall have built-in protection against sag/surge/impulse disturbances on both the main and bypass ac input sources. These disturbances shall include, but not limited to, the effects of load transfer between the inverter and bypass ac source as well as low energy induced transients resulting from the proper operation of correctly applied lightning protection systems.

H. **Reliability:** The UPS Module shall have an internal Mean
Time Between Failure (MTBF) of not less than 50,000 hours. This requirement shall be based upon actual field experience using representative data from all installed UPS models of the specified series and/or rating. For the purpose of determining specified reliability, the bypass AC input source shall not be used as an enhancement method.

I. Overtemperature Protection: The rectifier/charger heat sink and the invertor heat sinks shall be protected by temperature sensors so that the UPS will shut down before any semiconductor devices are damaged by over temperature. When a sensor is activated, the UPS shall transfer the critical load to bypass.

2.02 MANUFACTURER

The UPS system shall be as manufactured by Exide Electronics, Powerware System 50, Model 20 or approved equal.

2.03 ELECTRICAL CHARACTERISTICS

The UPS shall have the following electrical characteristics:

A. Input

1. Input voltage: 480 volts, 3 phase, 4 wire.

2. Voltage range: +10%, -20% without battery discharge.

3. Frequency: 60 Hertz, ± 5%.

4. Input power factors: 0.95 lag minimum.

5. Input current total harmonic distortion (THD): 10% maximum.

B. Output

1. Nominal output voltage 208/120 volts, 3 phase, 4 wire plus ground.

2. Frequency: 60 hertz ± 0.1%
3. Rating: 20 KVA, 16 KW at 0.8 p.f lagging.

2.04 COMPONENTS

A. Rectifier/Charger: Incoming AC power shall be converted to regulated DC by the rectifier/charger. The rectifier/charger shall be a phase controlled, solid-state type with constant voltage and constant current control circuitry. The rectifier shall be provided with a timed walk-in circuit, with loading over a period of 15 seconds.

B. Invertor: The invertor shall be transistorized, pulse-width-modulation design.

C. Static Transfer Switch and Bypass: The static transfer switch and bypass shall be provided as an integral part of the UPS. The control unit shall include transfer circuitry that senses the status of the invertor logic signals and alarm conditions to provide an uninterrupted transfer of the load to bypass. Return to normal mode of operation shall be automatic, upon restoration of normal operating conditions, except for invertor failure or overload.

D. Input and Bypass Protection: Thermal-magnetic molded case breakers and transient suppression circuitry shall be provided for input and bypass protection.

E. Battery and Battery Cabinet: The stationary storage battery system shall be sized to meet or exceed the 100% UPS output requirement for a minimum of ten (10) minutes. The individual battery shall be sealed, maintenance free, non-gassing absorbed electrolyte type with automatic/self sealing safety vents, heavy duty integral copper terminals, heavy duty lead plated copper connectors, and stainless steel bolts and lockwashers. The battery shall be housed in a separate cabinet(s) to match UPS cabinets, with casters and leveling feet. Battery shall have minimum 10 years expected life covered by warranty through the manufacturer. Battery short circuit protection shall be provided by a molded case circuit breaker located in the battery cabinet.
F. Control and Monitoring Panel: The UPS shall be equipped with control and monitoring panel that provides metering, monitoring, and control functions. An Emergency Power Off (EPO) pushbutton shall be located on the control and monitoring panel.

G. Remote Monitor Panel: A remote monitor panel shall be provided and shall be connected to the UPS via the RMP interface. A panel shall have a local audible alarm horn and three user selectable alarm indicators.

H. Input Filter: An input filter with power factor correction shall be provided in a matching cabinet.

I. External Maintenance Bypass Circuit Breakers and Enclosure: A separate maintenance bypass shall be provided to allow complete isolation of the load from the UPS. The bypass scheme shall consist of two non-automatic, molded case circuit breakers provided in a separate NEMA 1 enclosure. The operation of the external bypass breakers shall be enabled only when the UPS is in bypass mode. The closing of the inverter output contractor or breaker shall be inhibited during the transfer or retransfer operation. Kirk Key interlocks with two sets of keys shall be provided such that only one breaker can be in the open position at all times and power supply to the load is never interrupted.

J. Remote Alarm Panel: A remote alarm panel shall be provided, and shall be connected to the UPS. A summary alarm dry contact shall be provided on the UPS for indicating any alarm condition at the new alarm panel to be located in the telecommunication switch room in the existing building. The sequence of operations in the alarm panel shall be as follows: One green indicating light shall display the systems normal; the alarm condition shall flash the red indicating light and sound the local alarm horn; the acknowledge pushbutton shall stop the horn and the light shall be steady on until the panel is reset; the reset button shall return the panel to normal only after the alarm condition on the UPS has
PART 3 - EXECUTION

3.01 INSTALLATION

A. The UPS system shall be installed in the UPS room. The remote monitor panel and the remote alarm panel shall be provided as per University requirement.

3.02 TESTING

A. Before application of primary power, all connections shall be verified for correct phase rotation.

B. The Contractor shall provide all equipment necessary for load testing including a load bank equivalent to the full capacity of the UPS. Any additional ventilation required shall be provided by the contractor.

1. Pre-Start-Up Tests: All manufacturer required or suggested "Prestart-up Tests" shall be performed.

2. Primary Power Application: Primary power shall be applied only after the successful completion of the "Pre-start-up Tests". Primary power shall be applied for a minimum of seventy-two (72) hours with the dummy load operating, prior to the initiation of additional required tests. During this period of operation, all functions of the UPS shall be continuously monitored. The load testing of the system with load bank shall be conducted only once. Run down time and battery back-up shall be monitored and verified as well as the recharge time of the batteries as specified or as listed by manufacturer as minimum.

3. Operational Tests: After the initial seventy-two (72) hours of operation, the Contractor, under the direction of a skilled and qualified technical representative of the manufacturer, shall non-harmfully induce conditions necessary to
successfully test and assure the proper operation of all alarms, overrides, transfers and/or bypasses.

4. **Final Acceptance Test:** The UPS shall have been in service for at least thirty (30) days prior to the final inspection. The Contractor shall notify the Construction Manager in writing within five (5) working days prior to the date of the final acceptance tests. The UPS shall be considered ready for such testing only after all necessary preliminary tests have been made and all defects and deficiencies found have been corrected to the satisfaction of the equipment manufacturer's technical representative. The UPS shall be acceptance tested in the presence of representatives of the manufacturer, the Construction Manager, the University of Maryland, College Park. The Contractor shall furnish all instruments, labor and materials required for the tests; and the technician who supervised the installation shall conduct the tests. Any deficiencies found shall be corrected and the UPS retested at no cost to the University. All tests shall be repeated as directed by the Construction Manager during final acceptance testing period to his satisfaction at no additional cost.

5. **Additional Tests:** When deficiencies, defects normal functions develop during required testing, all further testing of the UPS shall be suspended until proper adjustments, repairs, corrections or revisions have been made to assure proper performance of the system. If these adjustments, repairs, corrections or revisions require more than a nominal delay, the observers as herein before indicated shall be notified when the additional work has been completed to arrange a time for a new final inspection and test of the equipment involved. All tests required shall be repeated prior to final acceptance, unless directed otherwise.
6. Maintenance Instructions: Submit to the Construction Manager with the initial notification of final acceptance testing, a complete set of reproducible as-built, approved wiring and interconnection wiring diagrams with four (4) sets of copies, and four (4) complete sets of maintenance manuals. This is in addition to the requirements of Division 1.

7. Instruction of Owner's Personnel: Upon completion of the work and at a time designated by the Construction Manager, designated personnel at the activity shall receive a complete training session of 20 hours, comparable to the equipment manufacturer's factory training procedure. The training shall include an explanation and review of the theory of operation, the function, description, analysis, and the trouble-shooting of all equipment provided. Training shall include a review of manuals, drawings, and lists supplied, together with any clarifications required. At least one period of eight hours shall be spent demonstrating routine maintenance procedures and trouble-shooting equipment with actual faults being introduced for training purposes. The instruction personnel shall be factory certified by the related equipment manufacturer to provide instruction services. The training shall take placed at the site.
A. All utilities serving a building shall be metered.

B. Temporary utility meters are required during construction and shall be included in the specifications.

C. Water, electric, and steam utilities shall be remotely metered.

D. Water meters shall incorporate flange meters at all locations. For 2" meters or smaller, rotating disk type shall be used. For 2 ¼" or greater, turbine type shall be used. Pulse weighing shall be not less than 1 closure/100 gallon on 2" or smaller and 1 closure/1000 gallons on 2 ¼" or greater. A Trican "S" head shall provide dry contact operation for DPP use.

E. All sub-metering opportunities will be identified. When sub-metering is appropriate, the specified meter and installation shall be inspected and certified by the appropriate governing agency.

F. Steam utility shall be metered via turbine type condensate meters. Pulse output shall be made available via dry contacts for CCMS use.

G. Condensate shall exit to a condensate return system. Condensate shall not be discharged to sanitary sewer.

H. All service conductors entering a building shall be metered. All electrical metering at service entry shall utilize campus standard Time of Use electronic registration with remote communication via Sangamo's ST-MT100 register (or its current replacement), T3000 meter interface unit (or current production model), induction disk meter body, and polycarbonate cover with Optocom port.

I. Where building service provides power to computer systems requiring three phase, uninterruptable power supply, the electrical load shall have electrical monitoring for on-line alarming and documentation. The hardware used shall conform to existing campus locations and the software used to interrogate these installations.
J. Service entry locations and critical load distribution locations shall be served by a standard telephone service. This service shall be a hard wire bridge to an analog service existing in the building. If an analog courtesy phone is applied anywhere in the building a bridge shall be provided via a jack at the BDF. One analog bridge will be required per meter interface unit, MIU, (T3000). If no line exists a separate line should be provided to serve the MIU.
A. Control Frequency Drives shall be manufactured by a single contractor utilizing a sine coded pulse width modulated inverter control. The variable speed drive units applied to various HVAC systems shall be provided with designs utilizing the following basic criteria/specifications:

1. Converter shall consist of a modular assembly consisting of a diode rectifier and capacitor assembly which will first convert, then filter and maintain a fixed DC voltage source from the fixed voltage and frequency input.

2. Inverter shall be Insulated Gate Bipolar Transistor (IGBT) with a minimum rating of 1000 VDC on 460 VAC controls to invert the converter fixed DC voltage into a sine-coded pulse with modulated output.

3. Control Logic to consist of a single printed circuit board for all horsepower sizes and incorporates an 8 bit, or larger, microcomputer central processing unit to control all inverter, converter, base drive, and external interface functions.

B. The VFD unit shall allow application onto systems which employ any NEMA-B induction squirrel cage motor.

C. The selected VFDs shall provide user friendly diagnostics clearly displayed at a front display.

D. The following identifies the minimum features to be noted in a design:

1. Standard line input voltage 460 VAC.

2. Shall not induce voltage line notching into the utility line.

3. The VFD units shall be controlled automatically a 4-20 mA control signal.

4. The VFD shall be UL approved.

5. The VFD shall be designed to meet power line transient conditions defined within IEEE-587.

6. The VFD shall comply with 1990 NEC.
7. The VFD shall contain the following general features:

   a. Automatic restart after power outage and fault occurrences of over current or over voltage.

   b. Control follower circuit board to utilize 4-20 mA control signal.

   c. Electronic overload protection.

   d. Hand/Off/Auto operator switch.

   e. Instantaneous electronic trip when 180% FLA sensed, phase to phase output short or phase to ground output short circuit occurs.

   f. Interface for time clock control.

   g. Line circuit breaker.

   h. Manual bypass (door interlocked) for fixed 60 Hz operation in emergency.

   i. Manual speed potentiometer.

   j. Minimum/Maximum adjustable speeds.

   k. Over-temperature protection.

   l. Panel mounted display of status, frequency, service diagnostics.

   m. Run/Stop command switch.

   n. Shall provide for 100% current limit.

   o. Thermal overload relay.

   p. Timed acceleration and deceleration for soft starting and stopping.
PART 1 - GENERAL

A. The inspection and testing of medium voltage components shall be performed by an independent testing agency. The inspection and testing shall be applied for, coordinated and paid by the construction contractor.

1.01 SCOPE OF WORK

A. The testing agency shall furnish all labor, materials, equipment, supervision, and insurance necessary to provide electrical acceptance testing including load surveys, power line disturbance studies, calibration and adjustment of relays, PCB sampling, ground resistance tests, transformer tap adjustments and testing on high voltage apparatus such as cables, switchgear, and transformers at the University of Maryland installations on demand.

1.02 SUBMITTALS

The construction contractor shall submit the following to the Department of Architecture, Engineering & Construction and get approval in writing prior to entering into a contract with the testing agency or initiating any testing.

A. Documentation supporting the testing agency qualifications (per article 4 of this specification).

B. The name(s) and certifications of the members of the testing teams.

C. The name and State of Maryland registration number of the registered electrical engineer responsible for testing and evaluation of the test data.

D. Certificate of the testing firm's insurance containing evidence of the "Hold Harmless" clause protecting the University of Maryland from all, suits, actions or claims.

1.03 QUALIFICATIONS OF TESTING AGENCY

A. Requirements

1. Testing Agency shall be limited to any firm, company, or corporation in the electrical testing industry providing the following qualifications are met:
a. They shall be regularly engaged in the technical testing, maintenance, and repair of electrical materials, devices, appliance, electrical installation, and systems for the purpose of preventing injury to persons or damage to property and other equipment. This type of business shall constitute the firm's principal source of revenue. Equipment installation and/or services normally performed by manufacturers, contractors, consulting firms, producers, suppliers, vendors or installer shall constitute less than twenty-five percent (25%) of total revenue.

b. The testing firm shall meet federal OSHA criteria for Accreditation of testing laboratories, Title 29, PARTS 1907, 1910, and 1936.

c. They shall be engaged in such practice for a minimum of two (2) years and must have a minimum of one (1) registered professional electrical engineer, licensed in the State of Maryland who has been regularly engaged in over 600 volt acceptance testing for a periods of not less than five (5) years and shall be responsible for all phases of testing and maintaining electrical power systems including short circuit analysis, protection coordination studies, and the evaluation of test and maintenance data. The engineer shall review and evaluate all results and issue a certified test report.

1. Any company with fewer than twelve (12) test technicians may meet the professional Engineer requirement by contracting with a State of Maryland registered Professional Engineer for review of all short circuit studies, overcurrent coordination studies, and other engineering reports, who meets the above 4.A.1. criteria.
2. Any company which employs twelve (12) or more test technicians for twelve (12) consecutive months must employ a full time State of Maryland registered Professional Engineer who meets the above 4.A.1 criteria.

d. The testing firm must have in their employee a minimum of two (2) two-person test teams who are employed full time by the firm for testing services.

1. The members of the testing teams shall be currently certified by the International Electrical Testing Association (NETA) in Electrical Power Distribution System Testing, or certified as an Engineering Technician in Electrical Testing Engineering Technology by the National Institute for Certification in Engineering Technologies (NICET).

e. They must agree to perform all work according to the guidelines of the approved testing standards for equipment of their class and type. However, job specifications shall take precedence over approved testing standards for equipment of their class and type guidelines.

f. They shall be corporately and financially independent testing organizations which can function as unbiased testing authorities, professionally independent of the manufacturers, contractors, counseling firms, producers, suppliers, vendors or installer of equipment or systems of a type evaluated by the design organization. Such a testing organization or laboratory is defined as follows:

The testing organization or laboratory is legally constituted to perform testing and is independent of manufacturers, contractors, consulting firms, producers, suppliers, vendors and installers. "Independent" as used herein shall be defined as an organization or laboratory which meets all of the following criteria:
1. Such individual group, organization or laboratory shall be free of common ownership or control of manufacturers, contractors, consulting firms, producers, suppliers, vendors, or installers of equipment. As used herein, the following terms shall have the following means:

a. To own means to own, control or influence a majority of the voting rights in the testing organization or laboratory.

b. To control means to be able to formulate, determine, or veto basic business policy decisions of the testing organization or laboratory. It is not necessary for another company to own the testing organization or laboratory to control it; it may exercise control through use of dominant minority voting rights, proxy voting, contractual arrangements or otherwise.

c. A manufacturer means an individual, group or organization whose primary business is to design or assemble, or cause to be assembled, products which would customarily be tested and evaluated for conforming to the manufacturer's specified performance criteria by a member of the International Electrical Testing Association or distribution of electrical power.

d. A contractor means an individual, group or organization whose primary business is the construction and/or installation of electrical power distribution equipment, systems or facilities.

e. A consulting firm means an individual, group or organization whose primary business is the concept, design, supervision, and/or
16.15 MEDIUM VOLTAGE ELECTRICAL TESTING SERVICES

management of projects that include electrical power distribution equipment, systems or facilities.

2. It has no managerial affiliation with manufacturers, contractors, consulting firms, producers, suppliers, vendors or installers.

3. It has sufficient breadth of interest or activity so that the loss or award of a specific contract to determine the compliance of a product with the applicable test standard would not be a substantial factor in the financial well-being of the organization or laboratory.

4. The employment security status of the personnel of the organization or laboratory is free of influence or control of manufacturers, suppliers, vendors, and installers.

5. The organization of laboratory is not engaged in the promotion of the product.

g. The testing organization or laboratory shall have a minimum of four (4) or twenty-five percent (25%) of their field testing personnel (whichever is greater) approved as NETA Certified Test Technicians or NICET Certified.

1.04 SAFETY AND PRECAUTIONS

A. All work shall be performed in accordance with applicable regulations of the Occupational Safety and Health Administration (OSHA), the Maryland Occupational Safety and Health Administration, the National Fire Protection Association - NFPA 70E, ANSI-C2 National Electrical Safety Code and the American National Standards for Personnel Protection.

B. No work involving reaching into or dismantling of equipment, work in the immediate vicinity of exposed electrical connections, or work involving the handling of hazardous materials shall be performed by any employee of the test agency except in the immediate presence of another employee of the test agency who is capable of rendering assistance in case of an emergency.
C. It is the intent of this contract that all test procedures shall be provided by a two-person team of the testing agency.

1.05 LOCAL CONDITIONS COVERING WORK

A. The testing firm shall cooperate with those in authority on the premises in bringing, storing, or removal of all materials and equipment, to observe all rules and regulations in force on the premises, avoid unnecessary dust or accumulated debris, or the undue interference with the convenience, sanitation or routine of the University of Maryland, and to prevent the loss of, or damage to the property of the University of Maryland and/or its employees.

The testing firm shall repair any and all damage he/she may cause to the building or property, to the full satisfaction of the staff of the Department of Architecture, Engineering & Construction.

B. Special precautions shall be exercised in accordance with the regulations of the particular institution when testing at some hospital centers.

1.06 RESPONSE TIME

A. The testing agency shall respond to routine test requests by the Contractor or the University of Maryland within 72 hours of request.

B. Response time for location/identification of equipment failures shall be within three (3) hours of receipt of request.

1.07 TECHNICAL STANDARDS AND LIBRARY

A. The testing procedures to be performed under this contract shall be in accordance with the latest applicable requirements of ANSI, ASTM, IEEE, ICEA, NFPA, OSHA, EPA, NETA, and the Doble Engineering Company. The testing agency shall maintain in-house the latest copies of these standards, codes, and recommended practices.

1. In particular, copies of standards and codes pertaining to the following electrical equipment and testing practices must be available in-house for ready reference upon demand:
a. Power cables of all types and of all distribution voltage ratings.  
b. Medium voltage switchgear of all types.  
c. Medium voltage circuit breakers and switches of all types.  
d. Dry-type and liquid-filled power and distribution transformers.  
e. Protective relaying and protection system requirements.  
f. Current transformer and potential transformers.  
g. Voltage regulators.  
h. Surge arresters and capacitors.  
i. Metering apparatus.  
j. Motors.  
k. Generators and Motor Generator sets.  
l. Grounding systems.  

B. The testing company must have in its in-house technical library the following reference electrical manuals of the latest edition:

* OSHA CFR 29  
* IEEE Color Book Series  
* Electrical Engineering Handbook  
* applies Protective Relaying Handbook  
* NETA Acceptance Testing Specifications  
* Electrician's and Technician's Handbooks  
* NFPA-70E  
* ANSI-C2  
* ANSI-C39  

1. Furthermore, reference library of various electrical equipment manufacturer's technical pamphlets or manuals for the variety of electrical equipment commonly in use must be maintained in-house. The manuals and
reference technical data must be published by the manufacturers of switchgear, circuit breakers, transformers, protective relays, cables, bus ducts, motors, metering and other power and control equipment being tested regularly.

1.08 UNIVERSITY OF MARYLAND RIGHTS OF INSPECTION AND TEST

A. The University of Maryland reserves the right to make or cause to be made such inspections and tests as deemed advisable to ascertain that the requirements of these specifications are being fulfilled. Should it be found that the standards herein specified are not being satisfactorily maintained, the University of Maryland may, by written notice to the Contractor, terminate this testing agency services. In such event, the University of Maryland may take over the work and prosecute it to completion, by contract or otherwise, and the contractor and his sureties shall be liable to the University of Maryland for any additional costs occasioned by the University of Maryland.

1.09 TESTING AND INSPECTION PROCEDURES

A. Prior to the energization of any new and/or relocated high voltage apparatus (above 600 volts) such as cables, transformers, and switchgear, the following field inspections and tests shall be performed. It shall be the responsibility of the electrical contractor doing the construction to advise and coordinate the test procedures including cable preparation with the testing agency.

B. In Power Company service entrance applications, unless otherwise required by the Power Company, it shall be the responsibility of other than the testing agency to deliver draw-out elements of overcurrent relays to the Power Company's Laboratory for inspecting, testing, and setting prior to the equipment being placed in service.

C. The scope of inspection and testing services for medium voltage electrical equipment includes but is not limited to the following:

1. Switchgear and switchboard assemblies

2. Transformers
   a. Dry-Type
   b. Liquid Filled
c. Small Dry-Type

3. Cables - Medium Voltage

4. Metal Enclosed Bus

5. Air Switches
   a. Medium Voltage - Metal Enclosed
   b. Medium voltage - Open

6. Circuit Breakers - Medium Voltage
   a. Air Filled
   b. Oil Filled
   c. Vacuum

7. Protective Relays

8. Instrument Transformer

9. Metering and Instrumentation

10. Grounding System

11. Motor Control - Medium Voltage

12. Surge Arrester - Medium Voltage

13. Capacitors

14. Automatic Circuit Reclosers - Medium Voltage - Oil and Vacuum

15. Automatic Line Sectionalizers - Medium Voltage - Oil

D. The testing scope and procedures for those items noted in paragraph 10C above shall be in accordance with Section 7 of the latest edition of NETA Acceptance Testing Specifications for electrical Power Distribution Equipment and Systems. Optional test procedures noted in Section 7 are not required to be accomplished except as follows:

1. Section 7.3.2.2. - Cable insulation resistance testing utilizing a megohm-meter shall be provided.

2. Section 7 of the latest NETA Acceptance Testing specifications for Electrical Power Distribution Equipment and Systems is made inclusive of this
1.10 TEST EQUIPMENT AND TEST EQUIPMENT CALIBRATION

A. All test equipment required to price the services outlined in this specification shall be in the testing agency's inventory or shall be procured by the testing agency, if required, at no additional cost to the University of Maryland.

B. The testing firm shall have a calibration program which assure that all applicable test instruments are maintained within rated accuracy.

   1. The accuracy shall be directly traceable to the National Institute of Standards and Technology.

1.11 PCB ANALYSIS UNIT PRICES

A. Upon request by staff engineers of the Department of Architecture, Engineering & Construction, the testing firm shall obtain the following suspected PCB contaminate, analyze same for degree of contamination, and report the results. These services shall be billed at the contractual hourly rate for labor plus the contractual unit price for the PCB laboratory analysis noted in the Bid Form. All testing shall be in accordance with EPA prescribed methods.

   1. Provide unit price for laboratory analysis for PCB contamination of a suspected oil sample.

   2. Provide a unit price for a wipe sample of suspected contaminated surfaces.

   3. Provide a unit price for concrete core samples. Core samples shall be one (1) inch diameter by three (3) inches deep.

   a. The samples shall be obtained with a diamond bit and water coolant system. The core samples shall be pulverized and dried for a 24 hour period. The PCB shall then be extracted from each sample for a period of two (2) hours using EPA recommended techniques. The analysis is completed by injection into a gas chromatographic system with subsequent computation and report in PPM.
b. Though there are no present EPA specifications or standards for this criteria, laboratory analysis shows a 1:2 extraction ratio for this process.

c. The holes shall be patched with Super Por-Rok, or approved equal, non-shrink grout.

1.12 DEMAND VISITS

A. In addition to the acceptance testing of medium voltage electrical equipment the testing agency shall also provide fault identification services for cable, transformer, switchgear, etc., failures on demand. Additional services such as load surveys and device testing for over and under 600 volt applications may be required.

1.13 TEST RESULTS

A. All test data shall be recorded on standard National electrical Testing Association (NETA) forms or forms developed by a manufacturer for use with specific test equipment and approved by the University of Maryland.

B. All test results shall be typewritten when submitted in their final forms and shall include the assigned University of Maryland project number, job name and location.

C. Under "Remarks" Column, an analysis of the test data shall be given indicating whether data recorded is or is not within accepted limits.

D. Normally five (5) copies of final report shall be submitted with copies going to each of the following:

1. Department of Architecture, Engineering & Construction Project Manager (2 copies).

2. Consulting Engineer responsible for the particular project (1 copy).

3. In Power Company service entrance application, all test results and applicable field inspection reports shall be forwarded to the applicable Power Company (1 copy).

Test result reports shall be submitted with copies
as noted within five (5) working days of the date of the test.

Immediately upon the completion of the testing of each high voltage system component (cables, transformers, switches, etc.), the testing agency technician shall provide written certification to the contractor and University of Maryland that the tested component is or is not suitable to be energized. This document shall be the Contractor's authorization to/or not to energize the equipment.

The above noted document shall be on a standard NETA form or approved substitution.

E. All test results shall be certified by an electrical engineer registered in the State of Maryland. Each test report shall bear the signature and seal of the professional engineer who shall certify the data and conclusions presented therein. The stamp and seal shall be affixed to the first page of the body of the Report, not a cover or title sheet.

1.14 EST FIRM'S LIABILITY INSURANCE

A. Responsibility for Damage Claims

The testing firm shall indemnify and hold harmless and defend the University of Maryland and all its representatives from all suites, actions, or claims of any character brought on account of any injuries or damages sustained by any person or property including State property and State employees, agents or representatives in consequence of any work performed under this testing contract, either by the testing firm or any Sub-Contractor, or their employees, agents, or representatives.

B. Liability Insurance

1. The testing firm and/or any Sub-Contractor shall maintain such insurance as will protect him/her from claim under Workmen's Compensation Acts, by coverage with Insurance Companies acceptable to the State Insurance Commissioner for damages which may arise, from operations under this testing contract, whether such operations be by himself/herself or by any sub-contractor or anyone directly or indirectly employed by the testing firm.
2. He/she shall protect himself/herself and the state from any other claims.

3. The limits for Bodily Injury Liability shall not be less than $500,000/$1,000,000; that is, $500,000 is the limit for injury per occurrence and $1,000,000 in the aggregate. The minimum limit for Property Damage Liability shall be $500,000 per occurrence and $1,000,000 aggregate.

4. The above policies for Bodily Injury and Property Damage Liability Insurance shall be so written as to include Contingent Bodily Injury against claims from the operations of the Sub-Contractors.

5. Certificates of the testing firm's insurance containing evidence of the Hold Harmless Clause protecting the University of Maryland shall be filed with the Department of Architecture, Engineering & construction and shall be subject to their approval for adequacy of protection.

1.15 CHARGES

A. The charges for this testing contract shall be submitted on a monthly basis and shall be payable by the construction contractor on a monthly basis. Invoices shall be separate, by project identification.

B. The hourly rate quoted for a two-person testing crew per hour shall include charge for administrative expenses, overhead expenses, vehicle mileage and profits.

1. The maximum allowable round trip travel time for any testing procedure anywhere in the state, shall be five (5) hours.

C. Site visits by the testing company shall be certified by either the on-job electrical contractor's foreman or by a responsible staff member of the using agency. This certification on an approved form, shall be submitted with each job invoice and shall state the number of hours at the job site, travel time, and the names of the individuals doing the work.
PART 1 - GENERAL

1.01 SECTIONS INCLUDES

A. Control switches and stations.
B. Photocells.
C. Relays.
D. Time switches.
E. Control device enclosures.

1.02 SUBMITTALS

A. Shop Drawings: Indicate control device enclosure wiring diagrams and panel layout drawings.
B. Product Data: Provide data on each control device specified.
C. Operating and Maintenance Instructions: Include instructions on adjusting, repairing, cleaning, and lubricating each control device specified.

PART 2 - PRODUCTS

2.01 CONTROL SWITCHES AND STATIONS

A. Description: Heavy duty, oil-tight control switches and stations manufactured to NEMA ICS 2.
B. Contact Ratings: Class A150.

2.02 PHOTOCELL SWITCH

A. Description: Photocell switch manufactured to NEMA ICS 2.
B. Ratings: Contact Ratings: Class A150.
C. Enclosure: Gasketed, cast feralloy box with conduit hub.

2.03 RELAYS

A. Description: Relays manufactured to NEMA ICS 2.
1. Magnetic Control Relay: Class A300.

2. Time-Delay Relay: Class A600.

B. Ratings:

1. Contact Ratings: Class A150.

2. Coil Voltage: 120 volts, 60 Hz., Single Phase.

C. Enclosure: NEMA Type 1 for interior and NEMA type 4 for exterior use.

2.04 TIME SWITCH

A. Description: Clock timer manufactured to NEMA ICS 2, with astronomical dial.

B. Ratings:

1. Contact Ratings: Class A150; SPST.

2. Coil Voltage: 120 volts, 60 Hz., Single Phase.

3. Dial Time: 24 hours, 7 days.

C. Enclosure: NEMA Type 1 for indoor applications, and NEMA Type 4 for outdoor applications.

2.05 CONTROL DEVICE ENCLOSURES

A. Description: Shop fabricate and wire control device enclosures to NEMA ICS 1, for groupings of more than one device.

B. Use hinged cover enclosures under provisions of Section 16110.


D. Fabrication: Shop assemble to NEMA ICS 6. Use plastic wiring through to route internal wiring.

PART 3 - EXECUTION
3.01 INSTALLATION

A. Install control devices in accordance with manufactures instructions.

B. Install individual components in enclosures.

C. Connect control devices to systems controlled, to achieve proper system operation.

3.02 ADJUSTING

A. Adjust time delay relays and clock timers to achieve specified system operation.
PART 1—GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes furnishing of equipment and installation of a CCTV System for the University of Maryland. The new camera system shall interface with the existing Pelco CCTV system and all cameras shall connect to the existing Pelco Video CM9760 Matrix Switcher. Contractor shall be responsible for installation and programming of any cameras to this system. Contractor is responsible for the supply and installation of any video input/output cards, switching bay boxes, or any other head end equipment required to expand the existing system and provide the university with a fully operational CCTV system. The contractor shall provide all wiring, fiber and electrical power, to provide control of pan/tilt/zoom cameras and all CCTV equipment.

1.03 SUBMITTALS

A. Product Data: Include detailed manufacturer’s specifications for each component specified. Include data sheets reflecting the model numbers, features, ratings, performance, power requirements, and dimensions.

B. Shop Drawings: For CCTV equipment to include plans, elevations, sections, details, and attachments to other Work.

1. Include dimensioned plan and elevation views of components and enclosures. Show access and workspace requirements. Shop drawings shall include mounting details for all wall and pole mounted equipment. Such details shall include all mounting brackets, hardware, and connections to the building and pole structures.

2. Wiring Diagrams: Power, signal, and control wiring point-to-point diagrams. Differentiate between manufacturer-installed and field-installed wiring.

3. It is the Contractors responsibility to submit for approval the complete designed system configuration and layout showing all devices, wiring, conduit, and locations along with other required information as specified herein for the completely integrated system proposed for installation.
C. Coordination Drawings: Plans drawn to scale and coordinating locations of CCTV equipment. Show the following:
   1. Method of attaching hangers to building structure.
   2. Location of items requiring installation coordination including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and other architectural features.

D. Samples: Provide full size samples of each outlet; finish plate, for colors and textures required.

E. Product Certificates: Signed by manufacturer of CCTV equipment and components certifying that products furnished to the Contractor comply with requirements.

F. Installer Certificates: Signed by manufacturer certifying that installers comply with manufacturers requirements.

G. Field Test Reports: Indicate and interpret test results for compliance with performance requirements of installed systems.

H. Maintenance Data: Maintenance Data for CCTV equipment and components shall be a part of the maintenance manuals specified in Division 1. In addition to requirements specified, to be provided include the following:
   1. Detailed operating instructions covering operation under both normal and abnormal conditions.
   2. Routine maintenance requirements for system components.
   3. Lists of spare parts and replacement components recommended are to be stored at the site for ready access.

I. Warranties: Special warranties specified in this Section.

J. Calculations and Parameters; Contractor shall submit for approval by University of Maryland, Building Security Systems, the calculations used and plans and diagrams for the Field of View calculations for the CCTV system. Submission as a minimum shall include and address Low Level Lighting. Backlight compensation, and Lens conformance with this Specification.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: This project requires an experienced installer with a minimum of five (5) years experience installing CCTV equipment and possess manufacturers certification, for both installation and maintenance of equipment required for this Project.

B. Product Options: Drawings shall indicate size, profiles, and dimensional requirements of surveillance equipment and are based on the specific system indicated. Other manufacturers’ products complying with requirements may be considered. Refer to Division I Section “Substitutions.”
C. Electrical Components: Devices, and Accessories; Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70.

E. Comply with 47 CFR 15, 17, and 76.

F. UL Compliance. Comply with applicable requirements of UL safety standards pertaining to television equipment and accessories. Provide TV equipment and accessories, which are UL-listed and labeled.

1.05 PROJECT CONDITIONS

A. Environmental Limitations: System components shall be equipped and rated for the environments where installed

1. Service Conditions for Outdoor Equipment: Rate equipment for continuous operation under the following environmental conditions, unless otherwise indicated:

   a. Temperature: Minus 15 deg F to plus 122 deg F.
   b. Relative Humidity: 5 to 100 percent.
   c. Weather: Enclosure housings to prevent entry of moisture due to melting ice build-up or driven rain or snow.

2. Service Conditions for Indoor Equipment: Rate equipment for continuous operation under the following environmental conditions, unless otherwise indicated:

   a. Temperature: 32 deg F to 140 deg F.
   b. Relative Humidity: 0 to 95 percent.

1.06 COORDINATION

A. Coordinate layout and installation of CCTV surveillance equipment and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

1.07 WARRANTY

A. Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1. Special Warranty for Surveillance System and Components: Written warranty, signed by manufacturer and Installer agreeing to correct system deficiencies and replace components that fail in materials or
workmanship within specified warranty period when installed and used according to manufacturer’s written instructions. This warranty shall be in addition to, and not limiting, other rights Owner may have under other provisions of the Contract Documents.

2. Special Warranty Period: Two years from date of Substantial Completion.

3. Technical Assistance: CCTV equipment manufacturer shall provide a 24-hour technical telephone assistance program, allowing for the communications directly with manufacture employees to answer any questions and resolve problems over the telephone on a 24-hour basis.

4. Repairs: Manufacturer shall provide 24-hour repair and turn around service on all CCTV equipment.

This section applies to security cameras accessories and equipment.

1.08 GENERAL REQUIREMENTS

A. Design, furnish and install the camera system equipment and layout in conformance with IES recommended procedures. All CCTV system components are to be new, unused products provided with complete Manufacturer’s and Contractor’s warranty of no less than two years Parts and Labor service. All of the equipment to be furnished is to interface and directly connect to the existing Pelco CCTV equipment in place. Code converter boxes or translator equipment will not be acceptable.

B. Wiring

The wiring system shall consist of tying into owner supplied multimode fiber, running from the new construction site to University of Maryland, Building Security Systems in Building 10. The fiber transceivers shall be supplied by the contractor and will need to be coordinated for the type based on the cameras in the new building site and shall be American Fiber Tech products to integrate with the existing fiber backbone.

C. Lighting

Contractor will assure that adequate area lighting exists to allow for the proper viewing of the video images in the viewing area. This may be accomplished by use of the appropriate combination of cameras, lenses, environmental enclosures, and mounts, as well as, the possible addition of exterior lights. Metal Halide is the preferred exterior lighting source.
D. Parking Garage

Cameras installed within parking garages will conform to the general requirements listed above for cameras, lenses, environmental enclosures, mounts and lighting. Locations where the pendant mount camera suspends below the concrete beam structure a breakaway mount shall be used to keep from destruction to the camera unit or a vehicle.

1.09 PROJECT RECORD DOCUMENTS

Accurately record actual locations of each camera with the switching arrangements and provide the University with accurate As-built plans within 30 days of contract closeout.

1.10 REFERENCES

A. Poles - Shall conform to University of Maryland standard poles or PERT Telephone (Police Emergency Reporting Telephone) Installation Criteria 4.15.97 for Free Standing Talk-a-Phones with Camera Extensions.

B. Building exterior shall be a mountable surface capable of bearing a shear weight of 100 lbs.

1.11 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.

PART 2 PRODUCTS

2.01 EXTERIOR EQUIPMENT AND ACCESSORIES

Equipment supplied shall be compatible with existing Pelco CCTV equipment, code converter boxes or translator equipment will not be acceptable.

A. Environmental enclosures, complete with gaskets to form weatherproof assembly.

B. Low temperature operation to zero degrees Fahrenheit.
C. Camera enclosure shall be vandal-proof.

E. Transceivers supplied shall be compatible with existing equipment.

F. Camera’s mounted on parapets must not be mounted on false parapets.

2.02 CAMERA EQUIPMENT AND ACCESSORIES

A. Internal Wiring: Component wiring within enclosures shall be UL Listed.

B. Digital Video Multiplexer:

1. The video multiplexers shall be a 16-camera input, color, full duplex system. The multiplexer will allow for simultaneous time base corrected digital recording of all cameras to VCR’s in a full screen format. Recording shall be accomplished in a field recording sampling method.

2. The multiplexer shall offer live selectable multi-screen displays while recording. The video multiplexer shall allow any input to be programmed into any display location: PIP (programmable for size and location on screen), quad (2x2), nine cameras (3x3), and sixteen cameras (4x4). The video multiplexer shall allow sequencing of at least four different Quad (4x4) displays and at least two different nine (3x3) camera displays.

3. The video multiplexer shall have three monitor outputs, one for full and/or multi-camera viewing in live or playback modes, one for full screen viewing of live cameras, and one for automatic sequencing of full screen live cameras. All three monitors shall be capable of automatically displaying cameras in alarm and/or cameras that have detected activity. The multiplexer shall provide a digital zoom display in full screen, in live and playback modes. The video multiplexer shall have an automatic speed-tracking mode that allows the VCR’s recording speed to automatically adjust and control the multiplexer’s record speed via the VCR's head switching pulse.

4. The unit shall feature programmable, digital activity detection on all video channels. Digital activity detection shall provide programmable detection mask and sensitivity levels for each camera.

5. The multiplexer shall be capable of control of up to sixteen (16) pan-tilt-zoom cameras when wired in a daisy-chain configuration.
6. All video communications between the CPU’s, the VCR’s, and the monitors will be transmitted via RS485 connector to a CM9760-CDU or approved equal.

7. Color Duplex Multiplexers shall be Pelco Model MX4016CD or approved equal.

C. VCR’s

Each VCR will be a time lapse VCR capable of recording in standard 6 and 8 hour recording modes and time-lapse recording modes for 18, 24, 30, 40, 54, 72, 78, 102, 104, 126, 136, 160, 174, or 232 hours dependent on type of tape. The VCR shall have a resolution of 400 lines in super resolution mode and more than 240 lines in VHS mode. The VCR shall have four rotary heads and utilize one rotary head for audio recording. The VCR shall have three direct drive motors. Search functions shall be made by time and date, alarm index, Skip, and counter memory stop. The unit shall have a jog/shuttle for easy forward or reverse field playback. The VCR shall be Pelco Model TLR3168 or approved equal. The VCR’s shall be rack mounted in a 19” console with a Pelco RM-2001 Rack Mount Kit.

D. Monitors

Each multiplexer will be equipped with both a main and a spot monitor. These color monitors are to have 18” diagonal viewing areas. Resolution shall be a minimum 900 TV lines. Audio inputs, speakers, and looping BNC video inputs are to be available. Separate S-VHS inputs will be available for future requirements. The monitors shall be Pelco Model PMC21A Monitors or approved equal. Monitors are to be mounted as requested by the University.

E. Interior Pan/Tilt/Zoom Color Dome Cameras

Each interior ptz color camera shall be recessed and secured to the beam structure of the building or the University may opt for corner mounted or wall mounted units. All cameras that are recessed will be required to have the domes at ceiling level. It is the contractor’s responsibility to coordinate the camera type and lens requirements with the University before the purchase of the cameras as stated in submittals above. The contractor shall refer to the camera schedule and drawings for installation location and type. The cameras shall be Pelco Model Spectra III SE or approved equal.
F. Exterior Pan/Tilt/Zoom Color Camera systems

The exterior ptz color cameras shall be mounted as required by the manufacturer and conform to University standards. The pan/tilt/zoom system shall have the receiver driver unit as an integral part of the unit. Separate receiver drivers are unacceptable. The camera shall be an integral part of the housing and be installed by the manufacturer and posses low light technology and utilize a 1/3” CCD imaging device with picture elements of a minimum 768 (H) x 494 (V) and a total of 480 TVL minimum. The camera shall have a minimum 0.023-lux at 35 IRE, f1.2 minimum illumination. Contractor shall coordinate the lens requirements with the University of Maryland, Building Security Systems before purchasing any unit. The Pan/tilt/zoom camera shall be a Pelco Model Esprit ES30CBW18-5W or approved equal.

G. Interior Color Fixed Cameras

The interior fixed color cameras shall be an integrated camera system consisting of surface and in ceiling mounted units. The fixed camera systems shall be color hi-resolution cameras with variable focus lenses, utilizing 1/4 inch CCD imaging devices with a horizontal resolution of 480 TV Lines and have a Signal-to-Noise ratio of at least 48dB and have a minimum illumination sensitivity of 1.2 lux. The fixed color cameras shall be Pelco Model ICS Series Cameras 100, 150, 200, or 300 or approved equal.

H. Console and Playback Stations

1. When necessary a complete security console with provisions to rack mount all recording, control, and display equipment will be provided for.

2. A complete playback station will be provided. This workstation will consist of Pelco MX4016CD Multiplexer, TLR3168 VCR and PM21A Monitor or approved equals. The playback/review station shall include a Toshiba 6A Printer Model EC 1200A or approved equal. The printer must also use print paper Model ECA-AGN or approved equal. This system shall allow for the offline review of any archived recorded video from the System with selectable, individual playback of multiplexed cameras.

I. Labels: All fixtures shall bear UL Wet Location and I.B.E.W. labels.
J. Lens

Lens-1 (Exterior Domed Sites), the complete camera/lens/connector package must be compact enough to fit internally into the Environmental Dome. The exterior domed site shall have 64 presets built into the dome unit. The zoom lens shall be a minimum 16x auto-iris with a minimum focal length of 4.0-64mm. Mechanical dimensions shall be such that the lens and camera combination will fit in the enclosure with a 5.9” acrylic bubble. The domed system shall have 360-degree pan rotation and 180-degree auto flip dome rotation.

Lens-2 (Free Standing Code Blue Sites), the complete camera/lens/connector package must be compact enough to fit internally to the Free Standing Code Blue Telephone enclosures, which are approximately 11” in diameter. The zoom lens shall be an auto-iris with a minimum focal length of 4.0-64 mm.

Lens-3 (ESPRIT), the complete camera/lens/connector package must be compact enough to fit internally into the Environmental Enclosure. The zoom lens shall be a 16x auto-iris with a minimum focal length of 3.9-63mm.

K. Environmental Enclosures

All exterior camera sites are to be configured in an environmental enclosure, which incorporates a 360-degree rotation pan and tilt devise to allow for camera viewing in all directions from the camera site location. Two types of environmental enclosures shall be utilized.

Enclosure-1 (The Exterior Domed Sites enclosure) The enclosure shall incorporate a 5.9” lower hemisphere with a black opaque lower dome with a clear viewing slot. The environmental dome shall include factory installed heater and blower. The dome is to be powered by 24 VAC. The integral pan-tilt will be pre-wired for all system functions. The environmental dome shall be the Pelco Spectra III Series or approved equal.

Enclosure-2 (The ESPRIT Series Enclosure) The enclosure is to be powered by 110 VAC. The enclosure will be prewired for all system functions. The environmental enclosure shall include factory-installed heater. This heated enclosure system shall be a Pelco Model ESPRIT Series Positioning System with Integrated optics package or approved equal with wall mount and pole mount adapter where needed.

L. Mounts
An appropriate mounting device will be provided at all camera locations to provide a stable and accessible means of access to the camera site. The specifics of each site location will be determined by local considerations at the indicated mounting location during the site walk-through. When domes are mounted to the roof of buildings, parapet mounts, which incorporate swinging arms for serviceability, shall be provided. Whenever possible, domes are preferred to be roof mounted as opposed to wall mounted, for maximum serviceability. Typical building mounts shall be Pelco PP351 rooftop parapet mounts for Spectra series camera units or approved equal. Where pole mounted, the mounts, shall be Pelco IWM24 with a built in transformer for wall mounting the Spectra series cameras to a wall and pole adaptors with Pelco SWM-PA-GY or approved equal. Where corner mounts are to be used, the mount shall be Pelco SWM-CA or approved equal. Other mounts are to be applied where required.

2.03 SPLICES, TAPS

A. All splices underground; in hand holes or other wet locations shall be waterproof and made with Scotch-cast 85 Multi-Mold Splicing Kits, or approved equal.

B. All taps shall use suitable connectors such as Burndy Type Ks and taped with two layers of 3M Scotch Brand or approved equal rubber tape and six layers of vinyl plastic electrical tape.

C. Splices in hand holes shall be supported on bricks 8 inches above the bottom of the hand hole. Splices shall be kept to a minimum and are prohibited in locations other than hand holes, pull-boxes or lighting unit bases, except for the purposes of retaining circuitry of any existing underground wiring where existing poles or wiring are distributed.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Examine adjacent surfaces to determine that surfaces are ready to receive work.

B. Examine each piece of equipment to determine suitability for location specified.

3.02 INSTALLATION

A. Install camera equipment and accessories in accordance with
manufacturers instructions.

1. Install equipment in consoles and EIA Standard 19” Equipment Racks.

2. Connect equipment to the branch circuits and cables provided by Contractor.

3. Bond products and metal accessories to the branch circuit equipment-grounding conductor.

B. Equipment shall be located clear of equipment that will affect the field of view of the cameras. The University reserves the right to relocate any camera within 15 feet from locations shown on drawings at no cost to the University.

C. Open trenches shall not exceed 30 linear feet before backfilling. All trenching shall conform to National Safety Standards. Contractor shall be responsible for traffic control, backfilling, asphalt or concrete repairs to the roadway, driveways, or sidewalks. No trench shall be left open overnight. It is the contractor’s responsibility to provide any steel plates to maintain traffic and vehicle access each day at job shutdowns. Contractor is also responsible for locating any utilities before trenching or digging begins.

3.03 ADJUSTING AND CLEANING

A. Adjust equipment as directed by the University Building Security Systems.

B. Clean paint splatters, dirt, and debris from installed equipment.

C. Touch up enclosures, buildings, and interior finish at completion of work.

D. Replace equipment and mounts, which have failed at completion of work.

3.04 COORDINATION

A. Confirm compatibility and interface of other materials with CCTV system. Report discrepancies to the University Building Security Systems.

B. Supply trim rings, back boxes, etc. to other trades as necessary.

C. Coordinate with the Mechanical, and Structural Contractors to avoid conflicts between cameras, supports, fittings, and mechanical equipment.
D. Before ordering, confirm construction details and architectural finish for each area with the University Building Security Systems.

3.05 ACCEPTANCE

A. Contractor shall demonstrate to the satisfaction of the University Building Security Systems that all equipment is operating properly. Any faulty equipment shall be replaced at the Contractor’s expense. The Contractor shall demonstrate operation of all installed equipment.