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<td><a href="mailto:dodeaasa@hq.dodea.edu">dodeaasa@hq.dodea.edu</a></td>
<td>571-372-1465</td>
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**ACRONYMS**

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<tr>
<th>Acronym</th>
<th>Description</th>
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<tr>
<td>A/E</td>
<td>Architect/Engineer</td>
</tr>
<tr>
<td>AFF</td>
<td>Above Finished Floor</td>
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<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
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<td>ASA</td>
<td>Architecture, Standards and Auditing</td>
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<tr>
<td>AV</td>
<td>Analog Video</td>
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<td>BICSI</td>
<td>Building Industry Consulting Services, International</td>
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<td>Category 6 UTP Cable</td>
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<td>CATV</td>
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<td>CFCI</td>
<td>Contractor Furnished Contractor Installed</td>
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<td>CWE</td>
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<td>DTB</td>
<td>Data Terminal Backboard</td>
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<td>EIA</td>
<td>Electronic Industry Alliance</td>
</tr>
<tr>
<td>EF</td>
<td>Entrance Facility</td>
</tr>
<tr>
<td>EMI</td>
<td>Electro Magnetic Interference</td>
</tr>
<tr>
<td>FAD</td>
<td>Funding Authorization Document</td>
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<td>FOPP</td>
<td>Fiber Optic Patch Panel</td>
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<td>FRT</td>
<td>Fire Retardant Treated</td>
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<tr>
<td>GFGI</td>
<td>Government Furnished Government Installed</td>
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<td>Institute of Electrical and Electronics Engineers</td>
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<td>Interactive White Board</td>
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<td>LAN</td>
<td>Local Area Network</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>LC</td>
<td>Local Channel</td>
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<tr>
<td>MHz</td>
<td>MilliHertz</td>
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<tr>
<td>MILCON</td>
<td>Military Construction</td>
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<td>NEC</td>
<td>National Electric Code or Network Enterprise Center</td>
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<td>National Electrical Contractors Association</td>
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<td>National Fire Protection Act</td>
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<tr>
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<td>Optical Time Domain Reflectometer</td>
</tr>
<tr>
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<td>Power Distributing Unit</td>
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<td>Protected Entrance Terminal</td>
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<td>Powered Over Ethernet</td>
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<td>Registered Communication Distribution Designer</td>
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<td>Software Test Document</td>
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<td>Telecommunications Distribution Methods Manual</td>
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<tr>
<td>TIA</td>
<td>Telecommunications Industry Association</td>
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<tr>
<td>TMGB</td>
<td>Telecommunications Main Grounding Bus</td>
</tr>
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<td>TR</td>
<td>Telecommunications Room</td>
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<tr>
<td>TTB</td>
<td>Telephone Terminal Backboard</td>
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<tr>
<td>U</td>
<td>Unit of measurement for rack mount equipment (1.75in)</td>
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<tr>
<td>USACE</td>
<td>United States Army Corps of Engineers</td>
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<tr>
<td>VAV</td>
<td>Variable Air Volume</td>
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<td>VoIP</td>
<td>Voice over Internet Protocol</td>
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1.0 PURPOSE

This design guide has been prepared to provide the Architect/Engineer (A/E) community with the necessary criteria to assist in the design of the special systems that are typically found in an educational facility. While certain features of the system design will vary from project to project, the requirements reflected in this guide are intended to provide the minimum requirements required by the Department of Defense Education Activity (DoDEA). This document provides information about DoDEA Network Requirements. A separate Special Systems guide accompanies this document and includes standards for additional low voltage special systems.

2.0 APPLICABILITY

These instructions apply to DoDEA, the US Army Corps of Engineers (USACE) Norfolk DoDEA Design Center, Construction Agents having DoDEA Military Construction (MILCON) responsibilities to include USACE, Naval Facilities Command (NAVFAC), and the Air Force Civil Engineer Center (AFCEC), as well as Architect/Engineer (design) firms, and construction contractors. These instructions are intended to be used for new DoDEA MILCON projects or projects that are modifying existing facilities.

For all new or modified DoDEA facilities, the designer/construction contractor must demonstrate that the criteria outlined in this and other relevant guides for each technology system have been met. Host Nation funded projects should comply with this guideline to the greatest extent possible; after standard warranty periods have expired, any modifications to host nation funded facilities shall comply with the criteria outlined in this guide.

3.0 REFERENCES

References include, but are not limited to, the following documents. Use the most recent version available of the listed references, if the listed version has been superceded.

ANSI/TIA/EIA-568-B, Commercial Building Telecommunications Cabling Standard

ANSI/TIA/EIA-569-A, Commercial Building Standards for Telecommunications Pathways and Spaces

ANSI/TIA/EIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces
ANSI/TIA/EIA-606-A, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

ANSI/TIA/EIA-607-A, Commercial Building Grounding and Bonding Requirements for Telecommunications

ANSI/TIA/EIA 526-7, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant

ANSI/TIA/EIA 526-14-A, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant

NFPA 70 2008, National Electrical Code


ANSI-J-STD-607-A-2002, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunication Cabling

Telecommunications Distribution Methods Manual


Unified Facilities Criteria (UFC) 3-580-01, Telecommunications Building Cabling Systems
4.0 RESPONSIBILITIES

4.1 HEADQUARTERS, DEPARTMENT OF DEFENSE EDUCATION ACTIVITY

HQ DoDEA is responsible for program management by providing scope, direction, funding, and financial management of the entire DoDEA Military Construction (MILCON) design and construction program. HQ DoDEA Facilities Branch, in coordination with the DoDEA Design Center, and each DoDEA Area Project Manager (PM), is responsible for ensuring that design submittals for DoDEA projects are routed through HQ DoDEA’s Information Technology (IT) Architecture, Standards and Auditing (ASA) MILCON review team. The HQ IT ASA MILCON review team reviews and provides timely comments on design submittals to ensure compliance with this guide and other relevant standards, and provides review comments to the respective DoDEA Area PM to be implemented into the project. Other HQ DoDEA functions, such as, but not limited to, the Office of Safety and Security or Education Division, shall also provide guidance where their Areas of Responsibility intersect with Technology System requirements.

4.2 DODEA AREA OFFICES (DODEA-AMERICAS, EUROPE, PACIFIC)

The DoDEA Area Offices shall provide a Project Manager (PM) who shall coordinate with the School Superintendent, local logistical staff, and host installation representatives regarding local technology requirements. This individual, the Facilities Engineer for the project, shall be referred to throughout this document as the DoDEA Area PM. In concert with the HQ staff, to include the IT ASA MILCON review team, Area Facilities and IT representatives, the DoDEA Design Center, and the Construction Agent Project Manager, the DoDEA Area PM shall ensure that the A/E and construction contractor implement the latest DoDEA standards for DoDEA Network and Special Systems within DoDEA projects. The DoDEA Area PM shall initiate coordination with IT ASA at the Planning stage of the project, with detailed IT ASA reviews beginning at the 35% stage for all projects. A half-size hard copy of drawings and an electronic copy of specifications shall be provided.

4.3 HOST INSTALLATION

The host installation and supporting agencies (such as the Network Enterprise Center on Army installations) are responsible for working with the DoDEA Area PM to ensure DoDEA projects satisfactorily incorporate local technology requirements. The installation shall provide relevant information regarding local telecommunication facilities, network infrastructure and distribution systems, shall identify the location and capacity of the existing available fiber optic and copper cables in the proximity of the project, and shall provide technical support as needed during design and construction activities.
4.4 CONSTRUCTION AGENT

The Construction Agent Project Manager for USACE, NAVFAC or AFCEC, in concert with the DoDEA Area PM, and the DoDEA Design Center, shall ensure that the A/E and construction contractor implement the latest DoDEA standards for DoDEA Network and Special Systems within DoDEA projects.

4.5 DODEA DESIGN CENTER – NORFOLK DISTRICT TECHNICAL MANAGER (TM)

The Norfolk District TM supports HQ DoDEA, the DoDEA Area PM, the Construction Agent, and the A/E as a technical subject matter expert. The Norfolk District TM shall support IT design reviews to verify compliance with the latest DoDEA standards for DoDEA Network and Special Systems. Along with the DoDEA Area PM, the Norfolk District TM shall ensure that review comments provided by the IT ASA MILCON review team are adequately addressed in DoDEA project designs.

4.6 ARCHITECT/ENGINEER DESIGNER AND CONSTRUCTION CONTRACTOR

The Architect/Engineer designer and construction contractor must demonstrate that the criteria outlined in this and other relevant guides for each technology system have been met in all new or modified DoDEA facilities.

In general, telecommunications racks, conduit, cable trays, terminations, and outlets shall be MILCON funded. Rack switches are typically Operations & Maintenance (O&M) funded. Controllers and amplifiers for PA/Intercom/Clocks/Bells, proximity card access controls, Ai-Phone access controls, etc. can be MILCON or O&M funded depending upon the interpretation of the contracting authority in an individual location/Area, but, if funds are available, use of MILCON funds for these systems is preferred in order to ensure complete and usable/testable systems at construction completion.

5.0 DATA/TELECOMMUNICATIONS SYSTEMS SUMMARY

This chapter describes the Data/Telecommunications systems design and installation/testing requirements.

The design requirements are intended to provide uniformity between design firms of symbols, equipment layouts, cabling methods, pathways, drawing submittal requirements, and specification requirements.
Every facility shall have wired and wireless data systems installed and tested by a qualified contractor experienced in cabling installations. All designs shall be in accordance with Building Industry Consulting Services, International (BICSI). The cabling system shall be designed by a Registered Communication Distribution Designer (RCDD) and installed in accordance with the Telecommunications Industry Association (TIA) and Electronic Industry Alliance (EIA) General Guidelines, and the National Electrical Code (NEC). The design professional shall include in the design analysis of all projects a list of active components and a pull schedule as indicated in this guide, to be furnished via the DoDEA Area PM to the appropriate HQ DoDEA IT ASA staff to facilitate planning. These guidelines shall be coordinated with the Education Specifications (Ed Specs) and shall be a supplement. This active equipment shall be furnished and installed by the Government; however, the schedule shall be developed by the design team. Government furnished and installed equipment is noted in the Design Guide.

If a community has Voice over Internet Protocol (VoIP), the standards of that community must be followed. See Section 10 of DoDEA’s Special Systems IT Design Guidelines if VoIP is not available within the community or for additional guidance regarding copper cabling.

The following list indicates the minimum requirements for IT deliverables to be included in the construction drawings.

- [1] Zone Map
- [2] Cable and Outlet Labeling Plan
- [3] Equipment Schedules
- [4] Rack Elevations

IT systems shall consist of the following:

- [1] Incoming fiber optic and copper cables from the community telecommunication demarcation building to the Main Telecommunications Room 1 (TR1).

- [2] TR1 housing the main network equipment rack.

- [3] Secondary telecommunications rooms (TR2, TR3, etc.) housing network distribution equipment racks as needed.

- [4] Fiber optic and copper distribution cables from TR1 to each Secondary telecommunications room (copper distribution cable for voice).

- [5] Cable trays, conduits, and supporting devices for fiber optic and copper work area cables (copper distribution cable for voice).
[6] CAT 6 copper cables from the distribution rack patch panels to individual work area outlets.

[7] Work area outlets consisting of work area connectors, faceplates, room identification, patch panel, and ports serving each connector.

[8] All IT and special systems, both software and hardware, installed, intended to be procured as FF&E or otherwise used in DoDEA schools must have prior approval and are subject to DITSCAP/DIACAP security provisions. A/E design teams shall contact their DoDEA Area PM at the appropriate time during design to obtain the latest listing of approved systems and software. These items are suggested for use as basis of design, but not required. Items not specifically listed on this pre-approved listing that are intended for use in a DoDEA school design or used as a basis of design intent should be submitted as a separate, independent package to HQ DoDEA, Attn: Director of Information Technology for review and preliminary approval. DoDEA will initiate the approval of these systems if they are deemed appropriate.

[9] The design and installation of the network shall comply with the referenced standards listed under Section 3.0 unless otherwise modified by this document.

### 5.1 OUTSIDE PLANT CABLES (OSP)

At the onset of the project, the telecommunications design team must communicate with the installation community responsible for the telecommunication facilities, network infrastructure and distribution system. In particular, this discussion shall identify the location and capacity of the existing available fiber optic and copper cables in the proximity of the project. The design intent is to provide a dedicated 24 strands of single mode fiber optic cable and a 50 pair copper cable from the installation’s demarcation point to the new school (a minimum of 100 pair of copper shall be used when there is a school community system service point, previously known as complex). The connection points and routing path shall be clearly identified in the facility construction documents. All OSP cables, raceways, and codes shall be compliant with the local Authority having jurisdiction in the location in which the work shall be performed.

The construction documents to be prepared by the A/E shall include detail drawings of all the requirements, governed by the military community telecommunication standards, for the OSP. These shall include, but are not limited to, the number and type of conduits, cable vaults, pedestals, any innerduct, maintenance holes, minimum burial depths and details that depict how the OSP shall enter into the building.
The OSP, including both fiber and copper cables, shall enter underground into the main telecommunication room, Telecommunications Room 1 (TR1). Refer to the TR1 floor plan drawing [Diagram 1] for the configuration of the room and cable entrance locations. The incoming copper cables shall be terminated in a protected entrance terminal enclosure (PET) and routed in ladder trays to a separate equipment rack(s). The connections shall be terminated in the rack(s) on patch panels specifically designated for voice services.

5.2 SYSTEM REQUIREMENTS

5.2.A MAIN TELECOMMUNICATIONS ROOM (TR1)/ENTRANCE FACILITY (EF)

The A/E shall provide detailed plan drawings of TR spaces that indicate proposed layout interconnections and key clearances. Each facility shall contain one main TR1 for network equipment and which serves as the entrance facility (EF) for both public and private network service cables. If this building will also be the main distribution point for a community, refer to Appendix 1 for additional guidance.

The main telecommunications room shall meet the following requirements:

- The room shall be a minimum of 160 SF with dimensions in each orientation of 10’ x 16’ with a 9’ minimum ceiling height. The room shall have one door, minimum of 36” wide. The door shall have a proximity card access control system (Americas/Pacific) or electronic lock (Europe) to control access. The room shall have no exterior windows. In the Americas and Pacific, all walls shall be covered with 4’ x 8’ x 3/4” painted, plywood from 6” AFF. The plywood shall be mounted in a vertical position, adjoined to minimize seams, contain no knots, and have “A” grade exposed face. If the A/E determines that fire-retardant-treated (FRT) plywood is required for compliance with applicable building codes, fire retardant paint shall be used to paint the plywood. Refer to Diagrams 2-5 for additional information. In Europe, the plywood is not required, assuming there is no equipment to be mounted on the wall.

- In order to mitigate the potential conflict of electromagnetic interference (EMI), TR1 shall not be located adjacent to any electrical room and the racks within TR1 shall maintain a minimum separation of 4’ from any electrical equipment.

- The room shall have a dedicated cooling system independent from the mechanical system serving the rest of the building. No racks or equipment shall be located under a cooling unit that could potentially drip condensate onto equipment. The Main TR shall have its own thermostat. The room shall be provided with positive pressure to minimize dust intrusion. The size of the cooling system shall be determined by the heat load produced by the communications equipment. The designer shall provide heat load
estimates based on equipment systems that shall be installed in the TR1 to support building systems. The formula provided can be used to calculate a baseline heat load.

- Any equipment unrelated to TR1 shall not be installed in or routed through this room.
- This room shall be dedicated to systems described herein.
- The room shall contain a minimum of four side-by-side two-post equipment racks, secured at the top and bottom, with and shall include physical parameters to mount an additional rack to accommodate future expansion (in Europe, this rack shall be provided, in the Americas and Pacific, space for the rack shall be provided). IT shall interconnect these cabinets as part of the outfitting process. Refer to Diagrams 1-6 for additional information. Minimal electrical requirements can be determined using the adjacent diagram.
- TR1 shall have a standard telephone communication system wiring and outlets.
- Rack-1 shall be dedicated to horizontal data cabling for data drops located in the proximity of TR1. Switches and patch panels as described below shall be installed in Rack-1 to a maximum of 240 cables. Refer to Diagram 6 for additional information.
- Rack-2 shall be used for termination of all voice and wireless distribution cabling. Refer to Diagram 6 for additional information.
- Rack-3 shall be used to support video distribution/CATV and any requirements for public address intercom and clock systems. Refer to Diagram 6 for additional information.
- Rack-4 shall contain the fiber optic termination and distribution equipment in the top-most part of the rack. The site incoming fiber shall terminate in this rack. The outgoing fiber to each additional Telecommunication Room and/or adjacent racks shall originate in the top of this rack. Refer to Diagram 6 for additional information.
- The rack configuration for TR1 shall include physical parameters to mount a fifth rack for use by the installation (in Europe, the fifth rack shall be provided). All racks shall have a
minimum clearance of 3’-0” from any face of the equipment, including sides of end racks, to any wall or wall-mounted equipment.

- Provide a telecommunication main grounding bus bar (TMGB) in TR1 for grounding the equipment racks and cable trays. The TMGB shall be a minimum of 12” long, 1/4” thick copper and attached to the wall with two insulators at 7’-0” AFF. The TMGB shall be connected to the electrical system main grounding electrode with a conductor sized in accordance with ANSI-607. The electrode grounding system shall be designed to provide a maximum resistance to earth of 5 ohms or less.

- TR1 shall be illuminated to an average of 50 foot-candles at 36” AFF position at front and rear of racks to avoid shadows on the primary rack surface planes.

- For MILCON funded projects, the A/E shall install 20A, 120V duplex receptacles on the perimeter walls at approximately 6’ O.C.; there should be three receptacles per dedicated circuit. In Europe, use the host nation electrical standard (i.e. 240V at most locations in Europe). In addition, provide a dedicated 20A, 120 volt (or host nation standard) circuit that terminates in a twist lock receptacle mounted on the top rear of each rack for connection to remotely manageable power distribution units (PDUs) with ammeter mounted within the racks (one per rack). No equipment within the rack requires 208 volt connections. For host nation projects, coordinate the project to include local power requirements.

- PDU Management: The power distribution units at each of the racks shall incorporate switching technology to provide a manageable system for remote control, alarms, current monitoring and power delays. The system shall be Web based and shall allow the user to access, configure and manage the units from remote locations. PDUs for network equipment shall be GFGI; however, PDUs shall be provided by the contractor as needed to support any CFCI (i.e. to support intercom/AV systems, etc.). These PDUs shall be installed at the top of the rack, horizontally aligned, as shown on Diagram 6.

- Power Panel: In TR1, provide a 100 amp, 120/208 volt (or host nation standard), three phase power panelboard located on the wall of the TR1 to provide easy access to the power circuit so that they can be de-energized and such that available power is in the room to accommodate any additional circuits that may be needed in the future.

### 5.2.B SECONDARY TELECOMMUNICATIONS ROOMS (TR2, TR3, ETC)

Secondary Telecommunication Rooms (TR2, TR3, etc.) shall be located where required to limit the total length of the CAT6 copper cable from the patch panel to the furthest outlet, to 275’ or less, as measured through the cable tray pathways, and in-room routing to include vertical rises
The 275’ limit provides for sag and unexpected downturns of pathway as well as patch cables at the wall outlets. Each level of a multi-story facility shall contain a minimum of one TR. These telecommunication room(s) shall meet the same requirements as TR1 except as indicated by the following requirements:

- The room shall be a minimum size of 10’ x 10’ with a 9’ minimum ceiling height. The room shall have one door, minimum of 36” wide. The door shall have a proximity card access control system (Americas/Pacific) or electronic lock (Europe) to control access. The room shall have no exterior windows if located on exterior walls. In the Americas and Pacific, all walls shall be covered with 4’ x 8’ x 3/4” painted, plywood from 6” AFF. The plywood shall be mounted in a vertical position, adjoined to minimize seams, contain no knots, and have “A” grade exposed face. If the A/E determines that fire-retardant-treated (FRT) plywood is required for compliance with applicable building codes, fire retardant paint shall be used to paint the plywood. Refer to Diagrams 2-5 for additional information. In Europe, the plywood is not required, assuming there is no equipment to be mounted on the wall.

**Diagram 1. Main Telecommunications Room (Floor Plan)**
Diagram 2. Main Telecommunications Room (1 of 4)

[1] PUBLIC ADDRESS/PROGRAM SYSTEM CABINET (IF NOT LOCATED IN RACK; MAY ALSO BE FLOOR MOUNTED)
[2] 4’x8’x3/4” PLYWOOD SHEETS MOUNTED VERTICALLY - TYPICAL FOR ALL WALLS
[3] DRYWALL EXTENDS TO STRUCTURE BEYOND 8’5”
[4] COORDINATE PLACEMENTS OF RECEPTACLES WITH PLYWOOD
[5] LAY-IN CEILING ACOUSTICAL CEILING TILE/EXPOSED CEILING
Diagram 3. Main Telecommunications Room (2 of 4)

1. 4’X8’X3/4” PLYWOOD SHEETS MOUNTED VERTICALLY - TYPICAL FOR ALL WALLS
2. OVERHEAD LADDER TRAY FOR COPPER CABLES
3. DRYWALL EXTENDS TO STRUCTURE BEYOND 8'6"
Diagram 4. Main Telecommunications Room (3 of 4)

Diagram 5. Main Telecommunications Room (4 of 4)
This room shall be dedicated to LAN equipment. This TR shall be used to distribute or terminate fiber optic and copper cables to any location other than TR1. Refer to Diagram 7 for additional information.

The room shall contain at least one free-standing equipment rack, secured at the top and bottom, and associated cable management system. The room layout should indicate planned space for a future rack.

The incoming fiber optic cable from the TR1 room shall terminate in the upper-most part of the rack.

CAT6 patch panels for the horizontal cables shall be located below the fiber optic patch panel leaving a minimum of 2U space between FOPP and the first CAT6 patch panel. This allows space for the enclosed cable management system.

Install additional racks (and cable management system) as needed for the quantity of horizontal cables to be terminated.

Provide space in the data racks for the active equipment that shall be furnished and installed by DoDEA.

The rack configuration for TR2, TR3, etc., shall include physical parameters to mount an additional rack to accommodate any future expansion (in Europe, the additional rack shall be provided). All racks shall have a minimum clearance of 3'-0" from the face of...
the equipment, including sides of end racks, to any wall or wall-mounted equipment. Refer to Diagram 7 for additional information.

5.2.C VIDEO DISTRIBUTION

- As noted above, the video distribution shall originate in Rack-2 located in TR1 and shall be routed through the respective secondary TR if needed.

Diagram 7. Access Telecommunications Rooms (TR2, TR3, etc.) – Rack Elevation

- The video distribution in the teaching spaces is preferred to be provided through the Interactive White Board (IWB). Each IWB shall have a cart-mounted unit that connects to the wall outlet through an attachment CAT6 cable with strain relief provided. Refer to Appendix 1 of the Special Systems Guide for additional information.

- IWB connections shall be as shown in the IT connections matrix in the Special Systems Guide.
• The location of the IWB’s shall be coordinated with the entire design team and user group to ensure they are located in the optimum locations. IWBs may also be portable, which requires an electrical connection and wired or wireless data connections (refer to the IT Connection Matrix in the Special Systems IT Design Guideline document for more information). The diagram at Appendix 1 in the Special Systems Guide is a representation of how an IWB can be connected (note that most IWBs typically include integral speakers, but this should be verified with the DoDEA Area PM). Supporting items such as speakers, video display systems, computers, etc. are GFGI (data/power connections are CFCI).

5.2.D WIRELESS CONNECTIVITY

• The A/E shall designate the location of the wireless access point outlets to provide full and optimal coverage relative to the actual design conditions of the project, including room layout, heights, and building materials utilized. The density of the wireless usage is expected to increase over time. The quantity and location of the wireless data points included in the original design shall be based on the total student population and shall assume laptop operation by every student and staff member. Each neighborhood may have up to 120 students and/or wireless network devices.

• Each primary teaching space (does not include one plus one and group rooms) shall have a minimum of one ceiling mounted wireless access point outlet. Adequate wireless coverage must be demonstrated through the wireless heat map deliverable.

• The wireless shall be powered-over-Ethernet (POE) and be centrally located for optimal coverage. Facility mapping of wireless zones coverage and capacity must be considered.

5.2.E TELEPHONE SYSTEMS

• The telephone system requirements shall be coordinated with the military community telecommunications authority to ensure that all new equipment is compatible. The intent is to design a voice system that is compatible for use with VoIP systems where available. All cabling, routing and limitations as indicated in this Design Guide also apply to the voice cabling. VOIP systems shall be DISA (JITC) approved and on the approved products list.

• Telephone handsets (GFGI) shall be distributed throughout the building for use by teaching and Administration staff.
5.2.F EQUIPMENT RACKS

Equipment racks shall meet the following requirements:

- Equipment racks shall be free-standing standard EIA 19” racks with 84” overall height secured at the top and bottom (45 units). Racks shall be furnished with 6” vertical cable management system mounted on both sides of each rack or between adjacent racks. Racks shall contain the cable patch panels, neat-patch organizers, switches, fiber optic patch panels and other Government-furnished equipment.

- A minimum allocation of 25% spare capacity shall be included in the bottom-most part of all racks. Additional patch panels shall be installed in the rack to achieve the number of spare ports required for the 25% spare allocation.

- Provide rack elevation drawings for TR1 and for each TR room. The elevation shall clearly show the number and configuration of each rack. Detailed information including the number of switches (GFGI), patch panels, neat panels, wire management (CFCI), and PDU’s shall be included in the drawings. PDUs for network equipment shall be GFGI; however, PDUs shall be provided by the contractor as needed to support any CFCI. The number of terminated cables and the total number of available ports shall be illustrated. Refer to Diagrams 6-7 and Section 5.3.D for additional information.

- Plan TR spaces for an additional future rack location. Refer to Diagrams 6-7 for additional information.

5.2.G PATCH PANELS

- Patch panels shall be 48-port CAT 6.

- Each port shall be sequentially numbered from left to right 1 through 24 on top and 25 through 48 on the bottom. Install a Neat Patch (2U) horizontal wire manager below the 24-port (single-unit, single-row) or below the 48-port (double-unit, double-row) panels, then leave a 2U open space below for customer provided switches. Triple-row panels are not allowed. Below the switch, install an additional Neat Patch (2U) horizontal wire manager. Repeat this step for the quantity of patch panels provided. Refer to Diagrams 6-7 for additional information.

- Terminate cables by color and function using T568B configuration in the following order:

  [1] Blue – Data, leaving a minimum of 10% of open ports per rack for future use
  [2] Red - Video Distribution, leaving 4-6 open ports per rack for future use
5.2.H CAT6 COPPER CABLES

- Cables shall be CAT 6, UTP. The cable outer jacket and 8P8C (RJ-45) outlet colors shall be:

  [1] BLUE for Data
  [2] RED for Video
  [4] YELLOW for Voice

- No horizontal cable shall exceed 275 feet in length. In addition, any horizontal cable length in excess of 250 feet shall be specifically identified in the design documents. The telecommunications designer shall evaluate each cable run along its intended path of travel, including elevation changes, to verify the length restrictions are in compliance. All cables shall have passed the UL LAN certification program and be labeled with the UL marking. In above ceiling applications, utilize plenum-rated cable for air plenums.

- Splices within cable runs are not allowed. Cables in horizontal runs shall be bundled together neatly and untangled with hook-and-loop Velcro fastener straps. The installer must adhere to the manufacturer’s requirements for bend radius and pulling tensions for all CAT6 runs.

- Label all cables on both ends with computer generated, self-laminating, adhesive, wraparound labels with the telecommunications room number (TR1, TR2…), rack number, patch panel identifier, and port number. Place label 4-6” from the termination point. The work area outlet faceplate label shall be behind a protective clear identifying window. See example, at right:

  - The patch panel label shall also be behind a protective clear identifying window.

  - Provide cable pull schedule as indicated in Diagram 10 to identify all cables.
5.2.I FIBER OPTIC CABLES

- Terminate all fiber strands unless otherwise directed with LC type connectors.
- Install 50-Micron Multimode armored (MM)(OM-4) laser optimized cable to each Telecommunication Room from TR1. The manufacturer’s recommended bend radius must be adhered to at all times. Terminate the MM in ports 13-24 in the 1U patch panel installed at the top of Rack-3.
- Terminating points shall be clearly marked on the exterior of the fiber shelf indicating where each strand pair terminates at the opposite end (source and destination). A legend shall be provided at each fiber patch panel indicating the terminating end points.

5.2.J PATCH CABLES

- Specify that contractor provides the following CAT 6 patch cords to support the LAN connectivity:
  
  [1] Blue - 10’ for the workstation. Quantity to equal 85% of all work area outlets plus 10%
  [2] Blue - 15’ for the workstations. Quantity to equal 15% of all work area outlets plus 10%
  [3] Blue - 2’ for the patch panels. Quantity to equal total blue work area outlets, plus 10%
  [4] Red - 2’ for patch panels. Quantity to equal total red work area outlets plus 10%
  [5] Orange - 2’ for patch panels. Quantity to equal total orange work area outlets plus 10%

5.2.K CABLE PATHWAYS

- All cables shall be adequately supported and protected with materials specifically designed for this purpose. Cables shall not lie on top of ceilings, piping, or mechanical equipment.
- Pathways for CAT6 copper cables shall not be installed immediately adjacent to electrical distribution bus-duct or feeder conduits. Where the cables run parallel to such services, maintain a minimum 6” separation. 90 degree crossings are allowed with a minimum 12” separation.
- Cables shall not be installed within 12” of luminaires, motors, or other sources of
interference.

5.2.1 CABLE TRAYS

- The following services are permitted to be installed in cable trays. No other wiring shall be installed in the trays:

  [1] LAN cables
  [2] Telephone cables
  [3] Video cables
  [4] Projector and IWB data cables
  [5] Intercom cables (Data only, not power)
  [7] Wireless access point data cable

- Cable trays shall be installed above accessible ceilings to serve as the primary pathway between telecommunication rooms, and for the horizontal cables. The A/E is responsible for defining and indicating the pathway desired.

- Cable trays outside of TR1 shall be wire mesh type tray 4” in depth and width as required for the quantity of cables to be supported. Trays shall be filled in accordance with BICSI TDMM standards. The wire mesh shall be hot-dipped galvanized unless a special coating is required. Each section of tray shall be furnished with a grounding lug attached to the tray and bonded together.

- Cable trays shall be continuous the entire length. Horizontal or vertical changes in direction shall be made of components by the same tray manufacturer to function as an integrated complete system.

- Cable trays shall be installed according to NEMA Standard VE2-2006. Position the trays below any piping or ductwork above the ceiling to provide ease of future access. Maintain clearances in accordance with BISCI TDMM criteria.

- Cable trays shall be supported from the structure according to the methods described in NEMA Standard VE2 using wall brackets or trapeze hangers. Select all supporting hardware for the weight of the tray and cables contained therein. All cable tray mounting details shall incorporate the appropriate level of restraint as required by the seismic zoning for the application.

- Where cable trays pass through walls that extend to the deck, install a framed opening
in the wall the same dimensions as the outside dimensions of the tray and penetrate the wall through the framed opening. Where cable trays are shown to pass through fire-or sound rated walls; penetrations must maintain fire or sound rating.

5.2.M CONDUITS

- Conduits shall be installed in walls for the vertical drops from the ceiling to the outlet box containing the LAN jack. Minimum size of the conduit shall be 1”. Install a bushing on the conduit at the termination above the ceiling to protect the cable during installation. Every conduit installed for LAN cables shall contain a nylon pull string (empty and filled conduits).

- Where hard ceilings are encountered, extend the conduits completely across the hard ceiling area and terminate at the cable tray or above an accessible ceiling.

- Floor outlets are not a DODEA preference. However, where LAN jacks are installed in floor boxes, install conduits under the floor from the box to the nearest wall, run vertically up the wall and terminate above the ceiling. The minimum quantity and size conduits to a floor box shall be two 1” water resistant conduits for LAN cables. Ensure conduits are installed in accordance with the IT Connections Matrix in the Special Systems Guidelines.

- Where LAN jacks are installed in modular furniture partitions having internal raceways for LAN cables, install a furniture connection box at the location recommended by the partition supplier. The conduit sizing for service to the modular furniture shall be intentionally oversized to aid in future expansion. Install a minimum of 1.25” conduit from the box to above the accessible ceiling.

5.2.N OPEN CABLES

- Placing conduit from workstation outlet to cable tray is preferred, although cables may be run without conduit above accessible ceilings from the LAN outlet stub-up to the cable tray. A pathway for such cables shall be established during design and indicated on the design drawings. Bundle cables above the ceiling and support with J-hook or center spline type suspended racks hardware specifically designed for this purpose.

- All cables supplying LAN jacks in a room shall enter the room at one location. Where the wall extends to deck, install a conduit sleeve in the wall for installation of the cables. At firewall penetrations, seal around the outside of the sleeve with approved fire caulk. After installation of the cables, seal the interior of the sleeve with approved fire caulk.
material.

- All cables not in trays shall be properly supported with j-hooks installed at a minimum of 5’ increments. Position the supports such that the sag at the mid-point between supports is no more than 12”. Use additional supports if necessary. Cables cannot lie on the structural steel or “red-iron” of the facility. J-hooks should be installed at all conduit entrances and above all workstation locations to allow for a 3’ service loop in the cable.

- Neatly bundle conductors into logical bundles and secure with Velcro straps between J-hooks and in all telecommunication rooms.

5.2.O WORK AREA OUTLETS

- LAN outlets shall consist of an outlet box with faceplate containing the LAN jacks. Refer to Diagram 8 for additional information.

- Recessed wall outlet boxes shall be galvanized steel boxes, 4-11/16” square with a minimum depth of 2-1/8” where 1” and 3/4” conduits are attached.

- Box faceplate shall contain the LAN jacks. Faceplates shall contain 1 to 6 jacks on a single gang plate. LAN jacks shall be TIA/EIA Cat 6, 8P8C terminated using a T568B configuration.

5.2.P TESTING – CAT 6 CABLES

- All cable runs shall be certified. Each cable run shall have a data run that meets UFGS 27 10 00 requirements, which shall contain a data report with the following information:

  [1] Circuit ID as labeled at the patch panel and jack.
  [2] Length of cable run
  [3] Date of test
  [4] Cable Type
  [5] Type of scanner used
  [6] Overall test result of cable (i.e. PASS)

  NOTE: Marginal tests are not acceptable
Wiring shall be tested and reported as complying with the following individual tests:

[1] Wire Map - Show the wiring is straight through with no open, crossed, reversed, or split pairs
[3] Length - Measured length of each cable pair
[4] Propagation Delay - Measured in nanoseconds, each pair
[5] Impedance - Determine if anomalies exist on cables longer than 16 feet, measured for each pair
[6] Attenuation - Measure the loss of signal over the length of the cable. Attenuation for each pair (dB), frequency for 100 MHz
[7] Measure the near-end crosstalk of a cable and verify the cable has adequate immunity from the next pairs

Submit the test results in spreadsheet format as directed by the contract specifications. Specifications shall include a requirement that HQ IT ASA receives a copy for review.

5.2.Q TESTING – FIBER OPTIC CABLES

Testing - Fiber Optic Cables:

[1] Perform continuity test on all fiber cables and connections.

[2] All installed fibers shall be certified via the use of an OTDR.

[3] Certification of fiber shall report the loss ratio of each fiber.

[5] A summary of all fiber tests, including dB loss for each fiber segment, shall be supplied in printed and spreadsheet format.

[6] Provide approximate length of each cable run.

5.3 DOCUMENTATION REQUIREMENTS

5.3.A ZONE MAP

The designer shall depict the cable length from each TR to the farthest outlet (vertical runs + horizontal runs + line slack) on a drawing in a format similar to the Diagram 12.
5.3.B CABLE AND OUTLET LABELING PLAN

An example learning neighborhood floor plan is included to illustrate a general depiction of communication outlet locations and their relationship to teaching spaces. As unique conditions exist with an individual project, the actual locations of the outlets, respective to the project, shall be coordinated with the floor plan. A similar plan shall be provided for all spaces in the school.

5.3.C EQUIPMENT SCHEDULES

The A/E shall be responsible for the design and consideration of all active and passive components of the communication system which shall include the scheduling of the quantity and type of all applicable equipment (to include make/model and how the equipment is connected). The scheduling shall be organized in a concise table format and provided to the Government for coordination in the design drawings. The construction contractor shall provide any changes to the pull schedules as a submittal. Active components shall be GFGI. Current Basis of Design equipment lists are available upon request from HQ IT ASA, via the DoDEA Area PM.

5.3.D RACK ELEVATIONS

The A/E and construction contractor shall depict rack elevations (rack, patch panels, PA/Clock/Bell, PDU, etc.) for both the Main Telecommunications Room (TR1) and Secondary Telecommunications Rooms (TR2, TR3, etc.). Items in racks shall be clearly marked as GFGI vs. CFCI equipment, as shown in Diagrams 6/7 (the typical convention is that it is CFCI unless otherwise noted (GFGI). This submittal shall be provided in the design drawings and the construction contractor shall provide any changes as a submittal.

5.3.E WIRELESS HEAT MAP

The A/E shall provide a drawing illustrating wireless coverage over the entire school facility. An example school floor plan is included at Diagram 13. The actual locations of wireless access points, respective to the project, shall be coordinated with the floorplan and included in the design drawings (the construction contractor shall provide any changes as a submittal. Wireless Access Points shall be GFGI. Minimum Wireless Access Point standards can be found in Appendix 2 of the Special Systems Guide.
Diagram 9. Fiber/Copper Distribution System
Diagram 10. Cable Pull Schedule – Sample Format

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Diagram 11.  Cable and Outlet Labeling Plan – Sample Format

*Diagram shall be used for purposes of understanding cable outlet labeling requirements only. See the Special Systems Guide, Appendix 3 for required outlet locations.
Diagram 12. Zone Map (Cable Distance to farthest outlet from each TR) - Sample
Diagram 13. Wireless Heat Map
APPENDIX-1 [SPECIFICATIONS FOR COMMUNITY DATA CENTERS]

APC InfraStruXure for Small Data Centers, 20kW Base Building Block

GUIDE SPECIFICATIONS FOR

10kW-20kW UPS/Distribution

PART 1 - GENERAL

1.1 SUMMARY

A. This specification describes the operation and functionality of a continuous duty, three-phase, solid-state, static Uninterruptible Power System (UPS) hereafter referred to as the UPS. The UPS shall utilize an N+1 redundant, scalable array architecture. The system power train shall be comprised of hot swappable / user replaceable 10kW/10kVA power modules, which shall operate in parallel, and be configured for N+1 redundant operation at rated load. Each 10kVA/10kW power module contains a full rated input rectifier / boost converter (hereafter referred to as Input Converter), full rated output inverter, and 10% battery charging circuit. The system shall also comprise of a user-replaceable continuous duty bypass static switch module, hot swappable / user replaceable battery modules, redundant control modules, redundant logic power supplies, and LCD interface display. System static switch shall be capable of being fed from the same input as the rectifier or a separate input. All of the above system components are housed in two standard, 24 inch wide, 36 inch deep, 42U high equipment racks.

B. In addition, this specification describes the performance, functionality, and design of the UPS Maintenance Bypass Cabinet and power distribution section of the UPS. In addition this specification also includes multi-conductor overhead distribution, rack level power management products, the Battery System, and connectivity solutions including complete InfraStruXure™ system management solutions.

C. The UPS and associated equipment shall operate in conjunction with a primary power supply and an output distribution section to provide quality uninterrupted power and distribution for mission critical, electronic equipment load. The entire system shall bear the UL60950 listing as a complete product solution.

D. All programming and miscellaneous components for a fully operational system as described in this specification shall be available as part of the System.
1.2 STANDARDS

A. UL 1778 Uninterruptible Power Supply Equipment

B. UL60950 Information Technology Equipment

C. Where applicable, the UPS shall also be designed in accordance with publications from the following organizations and committees

1. NFPA - National Fire Protection Associations
2. NEMA - National Electrical Manufacturers Association
3. OSHA - Occupational Safety and Health Administration


E. ISO 9001

F. ISO 14001

1.3 UPS MODES OF OPERATION

A. Normal: The input converter and output inverter shall operate in an on-line manner to continuously regulate power to the critical load. The input and output converters shall be capable of full battery recharge while simultaneously providing regulated power to the load for all line and load conditions within the range of the UPS specifications.

B. Battery: Upon failure of the AC input source, the critical load shall continue being supplied by the output inverter, which shall derive its power from the battery system. There shall be no interruption in power to the critical load during both transfers to battery operation and retransfers from battery to normal operation.

C. Recharge: Upon restoration of the AC input source, the input converter and output inverter shall simultaneously recharge the battery and provide regulated power to the critical load.

D. Static Bypass: The static bypass shall be used to provide transfer of critical load from the Inverter output to the bypass source. This transfer, along with its retransfer, shall take place with no power interruption to the critical load. In the event of an emergency, this transfer shall be an automatic function.
E. Maintenance Bypass: The system shall be equipped with an external make-before-break Maintenance Bypass Cabinet (MBC) to electrically isolate the UPS during routine maintenance and service of the UPS. The MBC shall completely isolate both the UPS input and output connections.

1.4 SUBMITTALS

A. Proposal Submittals:
   1. As bid system bill of materials.
   2. Product catalog sheets or equipment brochures.
   5. Installation information, including weights and dimensions.
   6. Information about terminal locations for power and control connections.
   7. Drawings and details for requested optional accessories.

B. Delivery Submittals:
   1. Installation manual, which includes instructions for storage, handling, examination, preparation, installation, and start-up of UPS.
   2. User manual, which includes operating instructions.
   3. As built equipment drawings
   4. InfraStruXure™ Welcome Package.
PART 2 – PRODUCT

2.1 DESIGN REQUIREMENTS

A. The UPS shall be sized for 20 kVA and 20 kW load.

B. The UPS battery shall be a maintenance-free, sealed battery – leak-proof, sized for ± 192V dc nominal voltage and a Power Factor of load output 0.5 to 1.0 with a load input of .99. The array of batteries should result in a runtime of 120 minutes.

C. Connection type input configuration should be 3P + N + G, with allowable output connections done at either 3P + N + G or 3P + G.

2.2 SYSTEM CHARACTERISTICS

A. System Capacity: The system shall be rated for full kW output in the following frame sizes:

   1. 20 kVA/kW - Can be configured with up to (3), 10kW power modules for N+1

B. Input:

   1. AC Input Nominal Voltage: 208 V, 3 Phase, 4 wire, 50/60 Hz.

   2. AC Input Voltage Window: ±15% of nominal (while providing nominal charging to the battery system).

   3. Short Circuit Withstand Rating: 30,000 Symmetrical Amperes

   4. Maximum Frequency Range: 40-70Hz

   5. Input Power Factor:
      a. > .96 at 50% load
      b. > .99 at 100% load

   6. Input Current Distortion with no additional filters:
      a. < 6% at 100% load
      b. < 6% at 50% load
7. **Soft-Start:** Shall be linear from 0-100% input current and shall not exhibit inrush. This shall take place over a 15 second time period

D. **UPS Output:**

1. **AC Output Nominal Voltage:** 208V, 3 Phase, 4 wire, 60 Hz.
2. **AC Output Voltage Distortion:** Max. 3% @ 100% Linear Load.
3. **AC Output Voltage Regulation:** +/- 1% For 100% Linear or Nonlinear Load
4. **Voltage Transient Response:** +/- 5% maximum for 100% load step
5. **Voltage Transient Recovery** within <60 milliseconds
6. **Output Voltage Harmonic Distortion:**
   a. <2% THD maximum and 1% single harmonic for a 100% linear load
   b. <5% THD maximum for a 100% non-linear load

7. **Phase Angle Displacement:**
   a. 120 degrees +/- 1 degree for balanced load
   b. 120 degrees +/- 1 degrees for 50% imbalanced load
   c. 120 degrees +/- 3 degrees for 100% imbalanced load

8. **Overload Rating:**
   a. **Normal Operation:**
      1) 150% for 30 seconds
      2) <105% continuous
   b. **Bypass Operation:**
      1) 125% continuous
      2) 1000% for 500 milliseconds

9. **System AC-AC Efficiency:** >91.5% at 100% load
10. Output Power Factor Rating: The UPS output shall not require derating for purely resistive loads (PF of 1). The output kW and kVA ratings of the UPS shall be equal. For loads exhibiting a power factor of .9 leading to .8 lagging no derating of the UPS shall be required.

2.3 ENVIRONMENTAL

A. Storage Ambient Temperature: -40°F to 158°F (-40°C to 70°C).

B. Operating Ambient Temperature: +32°F to 104°F (0°C to 40°C). (77°F is ideal for most battery types).

C. Relative Humidity: 0 to 95% Non-condensing

E. Altitude: Maximum installation with no derating of the UPS output shall be 10,000 feet (3000m) above sea level.

2.4 INPUT POWER CONVERTER

A. The input power converters of the system are housed within the parallel connected, removable power modules, and shall constantly control the power imported from the mains input of the system, to provide the necessary UPS power for precise regulation of the DC bus voltage, battery charging, and Main Inverter regulated output power.

B. Input Current Total Harmonic Distortion: The input current THD shall be held to 6% or less at full system, while providing conditioned power to the critical load bus, and charging the batteries under steady-state operating conditions. This shall be true while supporting loads of both a linear or non-linear type. This shall be accomplished with no additional filters, magnetic devices, or other components.

C. Soft-Start Operation: As a standard feature, the UPS shall contain soft-start functionality, capable of limiting the input current from 0-100% of the nominal input over a default 15 second period, when returning to the AC utility source from battery operation. The change in current over the change in time shall take place in a linear manner throughout the entire operation. (di/dt= constant)

D. Magnetization Inrush Current: The UPS shall exhibit 0% inrush current.

E. Input Current Limit:
1. The input converter shall control and limit the input current draw from utility to 150% of the UPS output. During conditions where input current limit is active, the UPS shall be able to support 100% load, charge batteries at 10% of the UPS output rating, and provide voltage regulation with mains deviation of up to +/-15% of the nominal input voltage.

2. In cases where the source voltage to the UPS is nominal and the applied UPS load is equal to or less than 100% of UPS capacity, input current shall not exceed 126% of UPS output current, while providing full battery recharge power and importing necessary power for system losses.

F. Redundancy: The UPS shall be configured with redundant input converters, each with semiconductor fusing, and logic controlled contactors to remove a failed module from the input bus.

G. Charging:
   1. The battery charging shall keep the DC bus float voltage of +/- 220v, +/-1%
   2. The battery charging circuit shall contain a temperature compensation circuit, which will regulate the battery charging to optimize battery life.
   3. The battery charging circuit shall remain active when in Static Bypass and in Normal Operation.

H. Back-feed Protection: The above-mentioned logic controlled contactor also provides the back-feed protection required by UL1778.

2.5 OUTPUT INVERTER
   A. The UPS output inverter shall constantly recreate the UPS output voltage waveform by converting the DC bus voltage to AC voltage through a set of IGBT driven power converters. In both normal operation and battery operation, the output inverters shall create an output voltage independent of the mains input voltage. Input voltage anomalies such as brown-outs, spikes, surges, sags, and outages shall not affect the amplitude or sinusoidal nature of the recreated output voltage sine wave delivered by the output inverters.
   
   B. Overload Capability: The output power converters shall be capable of 300% for short-circuit clearing. Steady-state overload conditions, of up to 150% of system capacity, shall be sustained by the inverter for 30 seconds in normal and battery operation.
Should overloads persist past the outlined time limitation, the critical load will be switched to the automatic static bypass output of the UPS.

C. **Output Contactor:** The output inverter shall be provided with an output mechanical contactor to provide physical isolation of the inverter from the critical bus. With this feature a failed inverter shall be removed from the critical bus.

I. **Battery Protection:** The inverter shall be provided with monitoring and control circuits to limit the level of discharge on the battery system.

J. **Redundancy:** The UPS shall be configured with redundant output inverters, each with semiconductor fusing, and logic controlled contactors to remove a failed component from the critical bus.

2.6 **STATIC BYPASS**

A. As part of the UPS, a system static bypass switch shall be provided. The system static bypass shall provide no break transfer of the critical load from the Inverter output to the static bypass input source during times where maintenance is required, or the inverter cannot support the critical bus. Such times may be due to prolonged or severe overloads, or UPS failure. The UPS and static bypass switch shall constantly monitor the auxiliary contacts of their respective circuit breakers, as well as the bypass source voltage, and inhibit potentially unsuccessful transfers to static bypass from taking place.

B. The design of the static switch power path shall consist of Silicon Controlled Rectifiers (SCR) with a continuous duty rating of 125% of the UPS output rating.

C. **Automatic Transfers:** An automatic transfer of load to static bypass shall take place whenever the load on the critical bus exceeds the overload rating of the UPS. Automatic transfers of the critical load from static bypass back to normal operation shall take place when the overload condition is removed from the critical bus output of the system. Automatic transfers of load to static bypass shall also take place if for any reason the UPS cannot support the critical bus.

D. **Manual Transfers:** Manually initiated transfers to and from static bypass shall be initiated through the UPS display interface.

E. **Overloads:** The static bypass shall be rated and capable of handling overloads equal to or less than 125% of the rated system output continuously. For instantaneous overloads caused by inrush current from magnetic devices, or short circuit conditions,
the static bypass shall be capable of sustaining overloads of 1000% of system capacity for periods of up to 500 milliseconds.

F. Modularity: The static bypass switch shall be of a modular design.

K. System Protection:

As a requirement of UL1778, back-feed protection in the static bypass circuit shall also be incorporated in the system design. To achieve back-feed protection, a mechanical contactor in series with the bypass SCR(s) shall be controlled by the UPS/static switch, to open immediately upon sensing a condition where back-feeding of the static switch by any source connected to the critical output bus of the system is occurring. One such condition could be a result of a shorted SCR.

2.7 DISPLAY AND CONTROLS

A. Control Logic: The UPS shall be controlled by two fully redundant, user-replaceable / hot-swappable control modules. These modules shall have separate, optically isolated, communication paths to the power and static switch modules. Logic power for the control modules shall be derived from redundant power supplies, each having a separate AC and DC input and output. The communication of the control modules shall be of Controller Area Network (CAN Bus).

B. Display Unit: A microprocessor controlled display unit shall be located on a hinged door in the front of the system. The display shall consist of an alphanumeric display with backlight, an alarm LED, and a keypad consisting of pushbutton switches.

B. Metered Data: The following metered data, shall be available on the alphanumeric display:

1. Year, Month, Day, Hour, Minute, Second of occurring events

2. Source Input Voltage

3. Output AC voltage

4. Output AC current

5. Input Frequency

6. Battery voltage
7. Internal Battery temperature

C. Event log: The display unit shall allow the user to display a time and date stamped log of the 64 most recent status and alarm events.

D. Alarms: The display unit shall allow the user to display a log of all active alarms. The following minimum set of alarm conditions shall be available:

1. Input Frequency outside configured range
2. AC adequate for UPS but not for Bypass
3. Low/No AC input, startup on battery
4. Intelligence Module inserted
5. Intelligence Module removed
6. Redundant Intelligence Module inserted
7. Redundant Intelligence Module removed
8. Number of Batteries changed since last ON
9. Number of Power Modules changed since last ON
10. Number of Batteries increased
11. Number of Batteries decreased
12. Number of Power Modules increased
13. Number of Power Modules decreased
14. Number of External Battery Cabinets increased
15. Number of External Battery Cabinets decreased
16. Redundancy Restored
17. Need Battery Replacement
18. The Redundant Intelligence Module is in control

19. UPS Fault

20. On Battery

21. Shutdown or unable to transfer to battery due to overload

22. Load Shutdown from Bypass. Input Frequency Volts outside limits

23. Fault, Internal Temp exceeded system normal limits

24. Input Circuit Breaker Open

25. System level fan failed

26. Bad Battery Module

27. Bad Power Module

28. Intelligence Module is installed and failed

29. Redundant Intelligence Module is installed and failed

30. Redundancy has been lost

31. Redundancy is below alarm threshold

32. Runtime is below alarm threshold

33. Load is above alarm threshold

34. Load is no longer above alarm Threshold

35. Minimum Runtime restored

36. Bypass is not in range (either frequency or voltage)

37. Backfeed contactor stuck in OFF position

38. Backfeed contactor stuck in ON position
39. UPS in Bypass due to Internal Fault

40. UPS in Bypass due to overload

41. System in Forced Bypass

42. Fault, Bypass Relay Malfunction

43. Q001 open/closed

44. Q002 open/closed

45. Q003 open/closed

46. High DC Warning

47. High DC Shutdown

48. Low Battery Shutdown

49. Low Battery Warning

L. Controls: The following controls or programming functions shall be accomplished by use of the display unit. Pushbutton membrane switches shall facilitate these operations.

1. Silence audible Alarm

2. Set the alphanumeric display language

3. Display or set the date and time

4. Enable or disable the automatic restart feature

5. Transfer critical load to and from static bypass

6. Test battery condition on demand

7. Set intervals for automatic battery tests
8. Adjust set points for different alarms

9. Program the parameters for remote shutdown.

G. Potential Free (Dry) Contacts

1. The following potential free contacts shall be available on an optional relay interface board:
   a. Normal Operation
   b. Battery Operation
   c. Bypass Operation
   d. Common Fault
   e. Low Battery
   f. UPS Off

H. Communication Interface Board: A communication interface board shall provide the following communication ports which can be used simultaneously:

1. RS232 Serial Port #1

2. RJ-45 Interface port for a Remote Display

2.8 BATTERY

A. The UPS battery shall be of modular construction made up of user replaceable, hot swappable, fused, battery modules. Each battery module shall be monitored for voltage and temperature for use by the UPS battery diagnostic, and temperature compensated charger circuitry.

M. The battery jars housed within each removable battery module shall be of the Valve Regulated Lead Acid (VRLA) type.

N. The UPS shall incorporate a battery management system to continuously monitor the health of each removable battery module. This system shall notify the user in the event that a failed or weak battery module is found.
PART 3 – ACCESSORIES

3.1 BATTERY DISCONNECT BREAKER

A. Each UPS system shall have a 250 VDC rated, thermal magnetic trip molded case circuit breaker. Each circuit breaker shall be equipped shunt trip mechanisms and 1A/1B auxiliary contacts. The circuit breakers are to be located within the UPS enclosure or as part of a line-up-and-match type battery cabinet.

3.2 MAINTENANCE BYPASS PANEL

A. The UPS cabinet shall include an integrated three-switch maintenance bypass panel (MBP). The MBP shall provide power to the critical load from the bypass source, during times where maintenance or service of the UPS is required. The PDU/System bypass shall provide a mechanical means of complete isolation of the UPS from the critical output distribution.

3.3 OUTPUT DISTRIBUTION PANEL

A. Each UPS cabinet shall include one 39 pole, 3-phase distribution panel. The distribution panel shall provide a means to install breakers and branch circuit conductors to power the connected critical load. Overhead distribution conductors like discussed in Section 3.7 may be connected to the distribution panel at the factory to provide a complete tested distribution system. Various breaker options may be factory installed and fully tested before shipment to site.

3.4 EXTENDED RUN (XR) BATTERY SOLUTIONS

Extended runtime battery enclosures shall be available for increased reserve battery runtime. For ease of maintenance the extended runtime battery enclosures, shall house draw-out battery cartridges. These cartridges shall conform to OSHA lifting requirements for one person to replace battery cartridges without lifting tools or additional mechanisms. Battery cartridges shall interlock in place within the battery enclosure to ensure proper contact. When withdrawing a battery cartridge, a catch shall stop the battery cartridge from inadvertently being withdrawn in an unsafe manner. The Extended Run Battery solution shall be housed in a standard, 24 inch wide, 36 inch deep, 42U high equipment racks. Up to (3) Extended Run Battery enclosures may be added for increased battery runtime.
3.5 RACK MOUNT POWER DISTRIBUTION UNITS

For purposes of distributing power within an IT enclosure, rack mount power distribution units shall be available for installation within the IT enclosure. The rack mount power distribution units shall be capable of being installed in the back of the accompanying enclosure to consume zero U space in the front of the rack, and shall not require tools for installation within the rack.

A. Input Connection - For ease of installation, the Rack Mount PDU shall be connected via a twist lock connector, and shall be capable of being fed from agency approved flexible corded distribution wiring as described in section 3.6 of this specification. The input shall be capable of being served by 208Y120 Volts from an L21-20 type NEMA connector.

A hard wired version of the product shall also be available as an option and shall be capable of being fed from a three-pole 20 Amp circuit breaker.

B. Output Connections - The output of the Rack Mount PDU shall be fed from 208Y120 Volts, and shall be distributed to receptacles capable of supplying power to cord connected equipment. Assuming Rack Mount PDU is fed from a circuit breaker with an 80% continuous rating, a single Rack Mount PDU shall be capable of distributing up to 5.7kW in a single rack.

C. Options

1. Phase metering – The current of each input phase of the Rack Mount PDU shall be monitored, displayed locally on an illuminated seven segment display, and reported through a built in Web/SNMP interface.

2. Outlet Management - The outlets of the Rack Mount PDU shall have managed switched capability as an option. The current of each input phase of the Rack Mount PDU shall be monitored, displayed locally on an illuminated seven segment display, and reported through a built in Web/SNMP interface. The Web/SNMP interface will also be used to manage and control the outlet receptacles.

3.6 RACK MOUNT TRANSFER SWITCHES
For purposes of providing redundancy (to single corded loads) as far as the equipment rack, and the load itself, 1U rack mount transfer switches shall be available. Rack mount transfer switches shall be capable of switching a combination of single-phase and three-phase loads up to 5.7kW. The Rack Mount Transfer Switch shall be designed to be fed from a 3 pole 20A circuit breaker via a NEMA L21-20 receptacle or cord cap.

3.7 OVERHEAD DISTRIBUTION

A. Flexible Distribution Conductors - For purposes of overhead distribution wiring of datacenter branch circuits from the output distribution panel, flexible conductors of either an SJO type, or TC type shall be available as a distribution means. Flexible conductors shall be equipped with NEMA or IEC style cord caps and shall be agency approved under UL60950 as part of the InfraStruXure™ system.

B. Cable Ladder - For purposes of routing data and power cables between rows in a datacenter aisle layout, cable ladders shall be available to span the gap between rows. Cable ladders shall be agency approved under UL60950 as part of the InfraStruXure™ system. The use of overhead cable management shall minimize the need to run data and power cable beneath a raised floor, thus minimizing potential air flow obstructions for down-flow type precision cooling solutions. This means of cable management shall also facilitate ease of installation of power and data cabling in datacenters not utilizing raised floor. Optional covers shall be available for ladders as a means of adhering to local codes requiring such.

C. Cable Trough - For purposes of routing data and power cable along the length of a row of IT enclosures in a data center environment, cable troughs shall be available as a means of separating and housing data and power cable. Optional covers shall be available for troughs as a means of adhering to local codes requiring such. The use of overhead cable management shall minimize the need to run data and power cable beneath a raised floor, thus minimizing potential air flow obstructions for down-flow type precision cooling solutions. This means of cable management shall also facilitate ease of installation of power and data cabling in datacenters not utilizing raised floor.

3.8 INFORMATION TECHNOLOGY (IT) ENCLOSURE

IT enclosures shall be available for housing of customer supplied IT equipment. Enclosures shall be listed under the same UL60950 agency approval as other products outlined within this specification.

A. General Requirements

1. The Enclosure shall be designed to provide a secure, managed environment for computer and networking equipment.
2. The Enclosure shall conform to EIA-310 Standard for Cabinets, Racks, Panel and Associated Equipment and accommodate industry standard 19” rack mount equipment.

3. The Enclosure shall be designed with four (4) vertical posts to allow rack mount equipment installation utilizing four (4) vertical mounting rails.

4. The Enclosure shall be available with a vertical equipment mounting space of 25U, 42U or 47U. (1U=1.75” or 44.45mm)

5. A four-post open frame configuration shall be available with 42U vertical equipment mounting space.

B. Physical Requirements

1. External Width Dimensions shall be 597mm (23.5”) for 19” rack enclosures, and 747mm (29.4”) for 23” rack enclosure.

2. External Depth Dimensions shall be 900mm (35.4”) or 1070mm (42.2”)

3. Rack enclosures of a 42U design shall have a maximum external height of 2070mm (81.5”) to allow passage through a standard 7ft. (84”) doorway without tipping.

4. Rack enclosure shall support a dynamic load (rolling on castors) of 909kG (2000 lbs.) total weight.

5. Rack enclosure shall also be designed and manufactured to be matching in both color and construction to the UPS, PDU/System bypass and extended runtime battery enclosures to provide a uniform and consistent appearance in a datacenter environment.

C. Equipment Access and Mounting

1. The enclosure shall provide [25U] [42U] [47U] of equipment vertical mounting space.

2. The vertical mounting rails shall be adjustable to allow different mounting depths.

3. Front and rear doors of the enclosure shall be designed with quick release hinges allowing for easy detachment without the use of tools.

3.9 FLOOR ANCHOR BRACKETS
Floor Anchor brackets shall be available to solidly connect UPS, PDU/System Bypass, and Battery Enclosure to minimize unintended moving of the equipment.

3.10  SEISMIC FLOOR STANDS

Seismic rated floor stands shall be available to take the place of supporting the PDU/system bypass, UPS, and Battery Enclosures on a raised floor environment. Floor Stands shall be available in custom heights to maintain a flush mount installation adjacent to the raised floor, and shall be designed in accordance to the equipment weight and contact points.

3.11  SOFTWARE AND CONNECTIVITY

A. Network Adaptor: The Ethernet Web/SNMP Adaptor shall allow one or more network management systems (NMS) to monitor and manage the UPS in TCP/IP network environments. The management information base (MIB) shall be provided in DOS and UNIX "tar" formats. The SNMP interface adaptor shall be connected to the UPS via the RS232 serial port on the standard communication interface board.

B. Unattended Shutdown

1. The System, in conjunction with a network interface card, shall be capable of gracefully shutting down one or more operating systems during when the UPS is on reserve mode.

2. The System shall also be capable of using an RS232 port to communicate by means of serial communications to gracefully shut down one or more operating systems during an on battery situation.

3.12  REMOTE SYSETEM MONITORING

A. The following three methods of remote UPS monitoring shall be available:

1. Web Monitoring: Remote monitoring shall be available via a web browser such as Internet Explorer.

2. RS232 Monitoring: Remote UPS monitoring shall be possible via either RS232 or contact closure signals from the UPS.

3.13 SOFTWARE COMPATIBILITY

A: The UPS manufacturer shall have available software to support graceful shutdown and remote monitoring for the following systems:
   a. Microsoft Windows 95/98/XP
   b. Microsoft Windows NT 4.0 SP6/2000
   c. OS/2
   d. Netware 3.2 – 5.1
   e. MAC OS 9.04, 9.22, 10
   g. Digital Unix/True 64
   h. SGI 6.0-6.5
   j. SCO UNIX
   k. SVR4 2.3, 2.41
   m. SCO Unix Ware 7.0 - 7.11
   n. SUN Solaris 2.6-2.8
   o. SUN OS 4.13, 4.14
   p. IBM AIX 4.3x-4.33g, 5.1
   q. HP-UX 9.x-11.i
   r. Linux

3.14 INFRASTRUXURE™ MANAGER

For purposes of complete system monitoring and management of all components outlined in this specification, there shall be a centralized manager, hereafter referred to as ISX Manager.

A. Monitoring - ISX Manager shall be capable of monitoring all products in this specification including, UPS, PDU/System Bypass, Extended Run Battery Enclosures, and rack level distribution options through a network of category 5 cable and a 24 port hub, supplied by the UPS manufacturer. This 24 port hub shall relay information to the ISX Manager, which in turn shall allow access to this information via the user’s public network via a single IP address.

B. Monitored Values - ISX Manager shall be capable of monitoring alarms, general status parameters, voltage and current of products outlined in section 3.15.A. of this specification.
C. Thresholds - For individualized customer needs, ISX Manager shall allow for user configurable thresholds for alarm notification. With this feature ISX Manager can notify clients of reaching thresholds for UPS capacity, PDU capacity, or branch circuit breaker capacity. Other custom programmable alarm points for non-APC products shall also be available via dry contact input signal.

D. Public Network Monitoring - The ISX Manager shall also be capable of monitoring other APC devices that are connected to the client’s public network.

Part 4 - EXECUTION

4.1. FACTORY ASSISTED START-UP

If a factory assisted UPS start-up is requested, factory trained service personnel shall perform the following inspections, test procedures, and on-site training:

A. Visual Inspection:
   1. Inspect equipment for signs of damage.
   2. Verify installation per manufacturer’s instructions.
   3. Inspect cabinets for foreign objects.
   4. Inspect Battery Units.
   5. Inspect Power Modules.

B. Mechanical Inspection:
   1. Check all UPS and external maintenance bypass cabinet internal control wiring connections.
   2. Check all UPS and external maintenance bypass cabinet internal power wiring connections.
   3. Check all UPS and external maintenance bypass cabinet terminal screws, nuts, and/or spade lugs for tightness.

C. Electrical Inspection:
1. Verify correct input and bypass voltage.

2. Verify correct phase rotation of all mains connections.

3. Verify correct UPS control wiring and terminations.

4. Verify voltage of all battery modules.

5. Verify neutral and ground conductors are properly landed.

6. Inspect external maintenance bypass switch for proper terminations and phasing.

D. Site Testing:

1. Ensure proper system start-up.

2. Verify proper firmware control functions.

3. Verify proper firmware bypass operation.

4. Verify proper maintenance bypass switch operation.

5. Verify system set points.

6. Verify proper inverter operation and regulation circuits.

7. Simulate utility power failure.

8. Verify proper charger operation.

9. Document, sign, and date all test results.

E. On-Site Operational Training: During the factory assisted start-up, operational training for site personnel shall include key pad operation, LED indicators, start-up and shutdown procedures, maintenance bypass and AC disconnect operation, and alarm information.
4.2 MANUFACTURER FIELD SERVICE

A. Worldwide service: The UPS manufacturer shall have a worldwide service organization Available, consisting of factory trained field service personnel to perform start-up, preventative maintenance, and service of the UPS system and power equipment. The service organization shall offer 24 hours a day, 7 days a week, 365 days a year service support.

B. Replacement parts: Parts shall be available through the worldwide service organization 24 hours a day, 7 days a week, and 365 days a year. The worldwide service organization shall be capable of shipping parts within 4 working hours or on the next available flight, so that the parts may be delivered to the customer site within 24 hours.

4.3 MAINTENANCE CONTRACTS

A complete offering of preventative and full service maintenance contracts for the UPS system and the battery system shall be available. All contract work shall be performed by APC factory trained service personnel.

4.4 TRAINING

UPS service training workshop: A UPS service training workshop shall be available from the UPS manufacturer. The service training workshop shall include a combination of lecture and practical instruction with hands-on laboratory sessions. The service training workshop shall include instruction about safety procedures, UPS operational theory, sub-assembly identification and operation, system controls and adjustment, preventative maintenance, and troubleshooting.

End Of Section