MIT
Design Standards

DIVISION 27 — Communications

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Information Systems and Technology

Department of Facilities

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1. MIT IS&T INFRASTRUCTURE COMMUNICATION SYSTEM GOALS

Information Systems and Technology (IS&T) is MIT's central IT organization, tasked with supporting MIT's core mission: "...to advance knowledge and educate students in science, technology, and other areas of scholarship that will best serve the nation and the world in the 21st century."

The organization's role is to provide modern, efficient, and cost-effective IT services to the entire MIT community. IS&T provides the technical infrastructure, services, and support to enable the diverse work that takes place at MIT, from high speed networks and state-of-the-art data centers supporting faculty research collaboration, to academic software packages and teaching systems used by MIT's over 10,000 undergraduate and graduate students. Through partnerships with other academic and administrative units, IS&T strives to continuously improve the Institute, streamlining business processes and lowering administrative costs wherever possible.

MIT's IT environment is large and diverse. MIT's network infrastructure in the Cambridge/Boston area is made up of more than 7,500 miles (12,070 km) of fiber, more than 10,000 wireless access points, and more than 4,000 switches providing on-campus wired connectivity. The MIT Kendall Wi-Fi network covers approximately 1,000,000 ft2 (92,903 m2) of outdoor space in the Kendall Square area and surrounding neighborhoods. The MIT Regional Optical Network—a 2,500 mile (4,023 km) optical ring—connects the MIT network to New York City and about 10 other locations, including the Massachusetts Green High-Performance Computing Center. MIT's 100-gigabit backbone supports connections to Internet2 and the Energy Sciences Network, which in turn provides access to the CERN Large Hadron Collider. MIT also has 10-gigabit dedicated connections to Amazon, Comcast, and Apple, as well as dual redundant 10-gigabit links to the commodity internet.

In addition to end-user computing, MITnet also supports a large data center environment. IS&T operates infrastructure across 6 data centers and numerous co-location sites supporting a wide array of academic, administrative, and research applications: email, web publishing, learning management, academic records, financial data, and many others. These applications are supported by more than 3,500 virtual servers backed by more than 1 petabyte of disk storage. Additionally, 17 petabytes of data from about 1,000 Institute servers are stored in near-line backups, while more 20,000 MIT community desktops and laptops are being actively backed up to the cloud.

IS&T's Campus Safety and Security team manages the infrastructure, systems, and software that provide campus physical security services including video surveillance, access control, alarms, key management, intercoms, and emergency phones. MIT's physical security and access control

systems include more than 750 panels for access control and intrusion alarm systems and more than 4,700 card readers supporting both physical ID cards and MIT's digital ID for smartphones.

IS&T support teams handle more than 80,000 help requests each year. They provide 24/7 IT help by phone or email to any member of the MIT community, as well as direct support to more than 50 departments, labs, and centers.

To learn more about the organization, please visit: http://ist.mit.edu.

2. PURPOSE

2.1 Overview

MIT Information Systems & Technology has developed this document to establish a uniform standard for IS&T infrastructure, services, and support systems criteria that is required for building IT infrastructure Tel/Data Rooms (TR)'s and pathway systems at MIT. The purpose of the IS&T Standards is to ensure that secure, appropriately sized, environmentally controlled, and sustainable TR's and pathway systems are built consistently for structured cabling, network, and technology systems deployed and operated by IS&T at MIT. Each environment will have its own unique requirements based on these standards, local codes and regulations.

MIT IS&T will provide design guidance for these systems, and the designer shall coordinate the implementation with MIT IS&T.

2.2 Terminology

There are a number of names and acronyms used to describe Tel/Data Rooms, also referred to as Telecommunication Rooms, (TR) including: Main Distribution Frame (MDF), Building Distribution Frame (BDF), Intermediate Distribution Frame (IDF), Tele/Data Closet, Equipment Rooms (ER), etc. The purpose of this document is to focus on two types of telecommunication rooms, the BDF and IDF. IS&T reserves the use of the MDF or Data Center to spaces that support multiple services, campus buildings, or the entire Campus. Telecommunication rooms (TR) provide environmentally suitable and secure spaces for installing cables, network switching equipment, associated hardware, racks and wall mounted technology equipment. Abbreviations throughout this document and related standards include:

1. BDF: Building Distribution Frame.
2. EF: Entrance Facility.
3. ER: Equipment Room.
4. HC (FD): Horizontal Cross-Connect (Floor Distributor).
5. IDF: Intermediate Distribution Frame.
6. MDF: Main Distribution Frame or Data Center.
7. PDU: Power Distribution Unit.

8. TR: Telecommunications or Tel/Data Room.

2.3 Application

Each new building or addition to an existing building should include consistent spaces designated for the location of networking and technology equipment, incorporated into project documents by architects and engineers in accordance with design criteria herein. Such spaces must be specifically considered in the Program Statement phase or similar planning or planning processes used to define the scope of a project. Consideration for structured cabling pathways should also be included in project planning and documentation processes. The sizing guidelines set forth in the latest version of the BICSI Telecommunications Distribution Methods Manual (TDMM), should be adhered to when sizing TR's. If deviations are required from the guidelines set forth in the latest version of the BICSI TDM Manual, the minimum requirements stated in this document should be followed when reviewing the needed TR and pathway infrastructure requirements for projects. If there are discrepancies in the existing building environment or areas of planning that cannot be accommodated with the designs as described or shown in the BICSI TDM Manual, then the design team must review and coordinate all exceptions with IS&T.

Refer to individual thematic folders for more information on particular equipment, for example Classrooms and Lecture Halls.

3. DESIGN CRITERIA FOR BUILDING DISTRIBUTION FRAMES (BDF)

The BDF is the main Technology Room for each building and will support the termination of backbone and campus cabling and house centralized communications equipment supporting the entire building. In addition to the BDF, a separate Entrance Facility (EF) should be built for connections to the campus outside plant (OSP) optical fiber and data network backbone and should be able to support two physically separate points of entry, and the outside plant (OSP) copper cabling backbone. This means that a building shall have two separate Entrance Facilities connecting to the BDF to allow for redundancy of connection to the campus system. Splitting the feed after the Entrance Facility point is not acceptable.

1. Entrance Facility (EF): Built for connections to the campus outside plant (OSP) optical fiber and data network backbone, and the outside plant (OSP) copper cabling backbone. Access should be controlled through a secured door with an IS&T specific key core and card access.

The BDF may also support other building information systems such as security in Division 28, Building Management Systems (BMS) in Divisions 23 and 25, and other building signaling systems in coordination with IS&T. In most cases the BDF will also support the function of one

or more Intermediate Distribution Frames (IDF) supporting the connection points between backbones and horizontal cabling infrastructure.

3.1 BDF Room and Location Physical Requirements

BDF Room Size:

1. The minimum space allocated to the BDF shall be 153 square feet with a minimum dimension of 17 feet in one direction. Any deviation from this standard must be reviewed and approved by IS&T.
2. Refer to the appendix for drawings of typical BDF room layouts.

BDF Room Location:

1. The BDF, including if also serving as an IDF, requires a centralized location no further than 295 feet in cable length from the furthest communication outlet. Vertical rise shall be included in the length calculation. Architects shall include at least one floor-to-floor height with overall linear separation when evaluating BDF locations. BDFs shall be located off of a main corridor with doors that open into the corridor. Ideally, BDFs will be stacked directly under IDFs to support the vertical distribution of services between rooms.
2. Do not locate BDFs in any place that may be subject to water infiltration, steam infiltration, humidity from nearby water or steam, heat (e. g., direct sunlight) or any other corrosive atmospheric or adverse environmental conditions.
3. Locate BDFs above any threat of flooding. Avoid locations that are below elevation of 'plus 26.0 feet' referenced to the Cambridge base. BDF should not be located below grade and may need to start as high as the 2nd or 3rd level. Avoid BDF locations that are below or adjacent to areas of potential water hazard (e. g., restrooms and kitchens).
4. Locate BDFs far enough away from sources of Electromagnetic Interference (EMI) to reduce interference with network and telecommunications cabling, including EMI from electrical power supply transformers, motors, generators, and induction heating devices. Because BDFs are frequently occupied by technicians and sensitive electronic equipment, the room location should not be adjacent to sources of constant, excessive, low or high frequency noise, such as air-handling equipment, pumps, generators, etc.

BDF Room Use:

1. Room occupancy class, including requirements for cooling, power, and expected availability shall comply with ANSI/TIA-942 Telecommunications Infrastructure Standard for Data Centers defined levels (tiers) for each space. Tier levels may vary for BDFs depending on room contents. Coordinate with IS&T as required.
2. The BDF shall be dedicated solely to technology and related facilities including voice, data, wireless, security, access control, building management system, and cellular distributed antenna systems indicated in project engineering narratives and contract

documents.

3. Equipment that does not support the BDF (e. g., pipes, duct work, distribution of building power) shall not be located in or pass through the BDF. While strongly discouraged, in cases where alternatives are punitive to the project's overall interests, electrical conduits and non-liquid plumbing piping only may pass through an BDF provided that they are located no lower than any other overhead obstruction in the room and that there are no pull boxes, valves or other devices that require access by staff other than IS&T. In the case where a conduit must pass through the BDF, written approval from IS&T is required before routing and final placement.

3.2 BDF Architectural Requirements

BDF Structural Requirements:

1. The floor rating under distributed loading must be greater than 4.8 kPa and the rating for concentrated loading must be greater than 8.8 kN in areas that will support network and telecommunications equipment such as batteries and UPS equipment. If access flooring is used in the BDF, it must be rated accordingly.

BDF Wall Requirements:

1. BDF walls shall extend from the finished floor to the structural ceiling (e.g., the slab).
2. BDFs should not have windows installed on any wall. Coordinate with IS&T where existing windows cannot be changed.
3. At least 8 feet of contiguous wall space shall be reserved for access control panels and security panels in the BDF.
4. Backboards: AC-grade fire rated plywood, 8 feet high with a minimum thickness of 3/4 inch around the perimeter of the room over drywall, painted on one side with MIT white. The bottom of the plywood shall be mounted 6 inches above finished floor.
5. Wall Base: Resilient base shall be 6 inches high typical.

BDF Connecting Sleeves and Slots:

1. Firestop Requirements: Comply with Division 07 "Firestopping".

BDF Service Doors and Security:

1. Door Type: Hollow metal, minimum STC 35 with sound gaskets.
2. Minimum Size: 3 foot 6 inches wide and 80 inches tall.
3. Door sills and thresholds impede the movement of equipment, block ventilation, and are not recommended.
4. Doors that open outward provide additional usable space and reduce constraints on BDF layout.
5. BDF door hardware requires control against unauthorized access, typically a mechanical

lock and key and IS&T card access. Doors shall include hinges with non-removable pins, single cylinder lockset with card access. Doors should remain open until manually closed. Automatic door closers shall not be used.

6. A security camera will be installed in each BDF. Comply with additional requirements in the security documents.

BDF Ceilings:

1. The minimum ceiling height is 8 feet 6 inches above the finished floor with ceiling protrusions (e. g., sprinkler heads) placed to assure a minimum clear height of 8 feet, clear of obstructions, to provide space over the equipment frames for cables and suspended ladder racks.
2. To permit maximum flexibility and accessibility of cabling pathways, ceilings are not allowed in BDFs.
3. Exposed ceilings with fireproofing or other non-smooth, potentially dust collecting surfaces shall be reviewed with IS&T and may require enclosure.
4. Require exposed slabs above or concrete floors to be sealed and painted white to improve visibility and minimize dust.

BDF Floors:

1. Floor Finish: Static dissipative resilient flooring unless otherwise indicated, provide the following. Comply with additional requirements in Division 09 "Flooring".
   a. Static Resistance: to ESD-S7.1 and ASTM F-150, Point to point and point to ground: 10^6 to 10^9 ohms.
   b. Static Generation: to ESD STM 97.2.
   c. Static Decay: Flooring in combination with ESD shoes and a person (5000 volts to zero): 0.5 seconds.

3.3 BDF Fire Suppression Requirements

Provide sprinkler heads in wire cages to prevent accidental operation. Coordinate the layout of fire protection systems with the equipment layout to avoid obstructing sprinklers, access to the alarm or other protective measures.

Comply with additional requirements in the local building code and Division 21 "Fire Suppression".

3.4 BDF HVAC Requirements

Provide BDF with dedicated cooling equipment; e.g., a CRAC or fan coil unit that is dedicated to cooling the BDF and that is monitored by the Building Automation System (BAS). Comply with additional requirements in ANSI/TIA-942 and Divisions 23 "HVAC" and 25 "Integrated Automation". Cooling shall not be from chilled water as this prohibits normal shutdown of the

building chilled water system for repair, construction and maintenance. Cooling shall be local DX equipment rejecting heat to the ambient air.

The BAS should be configured to identify the room as being an IT room on the operator's screen in the event of an alarm.

Technology equipment requires the HVAC system to function 24 hours per day, 365 days per year.

If a standby power source is available in the building, connect the HVAC system that serves the BDF to standby power.

The HVAC system that serves the BDF should be tuned to maintain a positive air pressure differential with respect to surrounding areas with a minimum of one air change per hour. Provide equipment to maintain the following acceptable ranges:

1. Temperature of 75 degrees F with no humidity control.

Estimated Heat Loads: ~ 5,000 to 7,500 BTU per equipment rack. Confirm heat loads with equipment to be deployed with the IS&T Project Manager as some equipment may generate more heat than others. Note: UPS and stand-alone air conditioning systems produce additional heat, if present.

3.5 BDF Electrical Requirements

Comply with additional requirements in Division 26 "Electrical".

BDF Lighting:

1. Provide adequate and uniform lighting that provides a minimum equivalent of 50 foot-candles when measured 3 feet above the finished floor level.
2. Locate light fixtures a minimum of 8 feet 6 inches above finished floor level. Any variation should be coordinated with the IS&T Project Manager.
3. Locate light switches near the entrance to the BDF.
4. Coordinate lighting layout with the equipment rack layout, especially overhead ladder rack, to ensure that light is not obstructed. Preference is for lights over aisles rather than racks.
5. Power for the lighting should be separated from circuits that power technology equipment.
6. Provide non-heat generating LED lamps unless otherwise indicated.

BDF Equipment Power:

1. Provide individual branch circuits serving a single load from the feeder panel directly to a branch circuit receptacle (for cord- and plug-connected equipment), or equipment power terminal (for hardwired equipment).
2. Provide branch circuits for equipment power that are protected and wired for 120V, 20A.

Confirm the need for 120V, 30A circuits with the IS&T Project Manager.

3. As a minimum, provide four 120V, 20A (NEMA 5-20R) dedicated circuits with one duplex receptacle per circuit per equipment rack.

BDF Convenience Power:

1. Provide separate duplex 120V, 20A convenience outlets (NEMA 5-20R) for tools, test sets, etc., located at least 18 inches above the finished floor, placed at approximately 6 foot intervals around perimeter walls and identified and marked “Convenience Power”.

BDF Dedicated Power Feed and Panel:

1. Provide BDFs with a power supply circuit that serves only the BDF and terminates in its own electrical panel within the BDF (see typical BDF drawings in Appendix B).
2. The feeders that supply the power for technology equipment in BDFs should be dedicated only to supplying that equipment and should be designed to facilitate future growth. More than one dedicated feeder may be required for large installations with a wide variety of technology equipment.
3. The dedicated power panels should be wired and capable of future generator support if the standby power support is not already installed for the building.

BDF Bonding and Grounding:

1. Provide a complete Grounding/Bonding system per EIA/TIA 607-B and current BICSI Grounding and Bonding standards.
2. Comply with additional requirements in Divisions 26 “Grounding and Bonding” and 27 “Grounding and Bonding for Communications Systems.”

BDF Conduit Sleeve Penetrations:

1. Provide horizontal and backbone conduit sleeves into the BDF for the distribution of the horizontal and backbone cable from the ladder rack. Provide vertical conduit sleeves from the BDF if stacked above to support the distribution of backbone cables. If the IDFs are not stacked with the BDF, provide continuous conduit.
2. Conduit and conduit sleeves consist of a minimum of four 4 inch conduits/sleeves stubbed into the BDF extending 6 inches on both sides if sleeved. Additional conduits/sleeves may be required depending on the cable density.
3. All conduit and conduit sleeve counts shall be coordinated and approved by the IS&T Project Manager. Comply with additional requirements in Division 27 “Conduits and Backboxes for Communications Systems”.

3.6 BDF Communications Requirements

Comply with additional requirements in Division 27 including “Communications Cable Management and Ladder Racks”, “Communications Cabinets, Racks, Frames and Enclosures”, and “Grounding and Bonding for Communications Systems”.

BDF Overhead Ladder Rack:

1. Provide overhead ladder rack within the BDFs to route cable to or from sleeves, risers, ducts, ladder racks to termination fields within equipment racks or mounted on walls. This overhead ladder system shall be contained within the confines of the BDF.
2. Overhead ladder rack encircling the TR will be minimum 18 inches wide; actual size should be calculated to accommodate the cabling within the room at its maximum density.
3. Overhead ladder rack crossing over the 19 inch equipment racks will be minimum 20 inches wide.

BDF Overhead Ladder Rack Materials and Applications:

1. BDF overhead ladder rack may be mounted horizontally or vertically on walls and over equipment racks.
2. Vertical ladder rack will be used to support riser cable from floor to ceiling as it passes between floors.
3. The overhead ladder rack system shall be mounted to walls, the top of equipment rack while leaving appropriate space for the proper tray fittings, or hung with threaded rods for bracing and support in compliance with seismic codes.

BDF Overhead Ladder Rack Bonding and Grounding:

1. In the BDFs, the overhead ladder rack system shall be bonded to the Telecommunications Grounding Busbar with 6AWG stranded copper wire per current BICSI Grounding/Bonding standards.

BDF Equipment Racks:

1. Provide 7 foot by 19 inch Equipment Racks in the BDF with vertical wire management.
2. All equipment racks should have two 10 inch vertical cable managers, one cable manager per side. This may change depending on cabling densities, but any deviation from this standard should be reviewed and approved by IS&T.

BDF Power Accessory Requirements:

1. Each equipment rack is to have a minimum of two vertically mounted Power Distribution Units (PDU) at the rear of the rack.
2. Both PDUs will connect to the rack-mounted UPS systems; one UPS will be installed per

dedicated 20amp circuit.

3. The power receptacles on the PDU shall be NEMA 5-20R compatible. The plug shall be NEMA 5-20P compatible.
4. The IS&T Project Manager will provide the PDU and UPS specification.

BDF Equipment Rack Installation Requirements:

1. Provide all racks. Provide mounting components and accessories to securely fix equipment racks to floor.
2. Provide appropriate seismic transverse and longitudinal bracing per any local codes and the current National Uniform Seismic Installation Guidelines (NUSIG).
3. Provide cable bend management fixtures to maintain the proper bend radius as cables drop into equipment racks.
4. Do not allow cables to be unsupported at distances greater than 4 feet, or sag more than 3 inches, as they run from conduit or cable ladder to equipment racks. Comply with BICSI and TIA 569-C for additional requirements.
5. Non-continuous pathway supports shall be UL listed.

BDF Equipment Racks Bonding and Grounding:

1. The equipment racks shall be bonded to the Telecommunications Ground Bus with 6AWG stranded copper wire per current BICSI Grounding/Bonding standards.
2. Comply with additional requirements in Divisions 26 “Grounding and Bonding” and 27 “Grounding and Bonding for Communications Systems”.

4. DESIGN CRITERIA FOR INTERMEDIATE DISTRIBUTION FRAMES (IDF)

4.1 IDF Room and Location Physical Requirements

IDF Room Size:

1. IDFs shall have a minimum clear dimension of 9 feet in one direction. The program, port density, and the desired technology requirements will drive the actual room size. Provide 36 inches of clearance from front of equipment to any obstruction.
2. As a general rule, use the following parameters to determine the minimum TR size:

    a. 9 by 11-1/2 feet - (3) Rack TR = 20,000 usable square feet coverage area.
    b. 9 by 14 feet - (4) Rack TR = 40,000 usable square feet coverage area.
    c. 9 by 17 feet - (5) Rack TR = 60,000 usable square feet coverage area.

3. Refer to the appendix for drawings of a typical IDF room layout in 3-rack, 4- rack or 5-rack versions.

IDF Room Location:

1. Provide at least one IDF room per floor. Floor plates over 10,000 square feet may require more than one TR.
2. Multiple rooms are required on a floor if the cable length between the IDF and the most distant telecommunications outlet, including slack, exceeds 295 feet including both vertical and horizontal dimensions
3. All TRs should be located off of a main corridor with door(s) opening into the hallway.
4. Locate IDFs above any threat of flooding. Avoid locations that are below or adjacent to areas of potential water hazard (e. g., restrooms and kitchens). Comply with flooding prevention requirements for BDF above.

IDF Room Use:

1. The IDF shall be dedicated solely to Technology and related facilities including voice, data, wireless, security, access control, and cellular distributed antenna systems indicated in project engineering narratives and contract documents.
2. Equipment that does not support the IDF (e. g., pipes, duct work, distribution of building power) shall not be located in or pass through the IDF. While strongly discouraged, in cases where alternatives are punitive to the project's overall interests, electrical conduits and non-liquid plumbing piping only may pass through an IDF provided that they are located no lower than any other overhead obstruction in the room and that there are no pull boxes, valves or other devices that require access by staff other than IS&T. In the case where a conduit must pass through the IDF, written approval from IS&T is required before routing and final placement.

4.2 IDF Architectural Requirements

IDF Structural Requirements:

1. Provide a minimum floor loading of 50 pounds per square foot.

IDF Wall Requirements:

1. IDF walls should extend from the finished floor to the structural ceiling (e.g., the slab).
2. The IDF should not have windows installed, nor is it desirable to locate IDFs on perimeter walls where windows comprise the majority surface of the wall.
3. At least 8 feet of contiguous wall space should be set aside for access control panels and security panels in the IDF.
4. Backboards: AC-grade fire rated plywood, 8 feet high with a minimum thickness of 3/4 inch around the perimeter of the room over drywall, painted MIT white. The bottom of the plywood shall be mounted 6 inches above finished floor.
5. Wall Base: Resilient base shall be 6 inches high typical.

IDF Connecting Sleeves and Slots:

1. Firestop Requirements: Comply with Division 07 “Firestopping”.

IDF Service Doors and Security:

1. Door Type: Hollow metal, minimum 1-hour fire rated, minimum STC 35 with sound gaskets.
2. Minimum Size: 3 foot 6 inches wide and 80 inches tall.
3. Door sills and thresholds impede the movement of equipment, block ventilation, and are not recommended.
4. Doors that open outward provide additional usable space and reduce constraints on IDF layout.
5. IDF door hardware requires control against unauthorized access, typically a mechanical lock and key and IS&T card access. Doors shall include hinges with non-removable pins, single cylinder lockset with card access. Doors should remain open until manually closed. Automatic closers shall not be used.
6. A security camera will be installed in each IDF. Comply with additional requirements in the security documents.

IDF Ceilings:

1. The minimum ceiling height is 8 feet 6 inches above the finished floor with ceiling protrusions (e. g., sprinkler heads) placed to assure a minimum clear height of 8 feet, clear of obstructions, to provide space over the equipment frames for cables and suspended ladder racks.
2. To permit maximum flexibility and accessibility of cabling pathways, ceilings are not allowed in IDFs.
3. Exposed ceilings with fireproofing or other non-smooth, potentially dust collecting surfaces shall be reviewed with IS&T and may require enclosure.

IDF Floors:

1. Floor Finish: Static dissipative resilient flooring unless otherwise indicated, provide the following. Comply with additional requirements in Division 09 “Flooring”.

    a. Static Resistance: to ESD-S7.1 and ASTM F-150, Point to point and point to ground: 10^6 to 10^9 ohms.
    b. Static Generation: to ESD STM 97.2.
    c. Static Decay: Flooring in combination with ESD shoes and a person (5000 volts to zero): 0.5 seconds.

4.3 IDF Fire Suppression Requirements

Provide sprinkler heads in wire cages to prevent accidental operation. Coordinate the layout of fire protection systems with the equipment layout to avoid obstructing sprinklers, access to the alarm or other protective measures.

Comply with additional requirements in the local building code and Division 21 “Fire Suppression”.

4.4 IDF HVAC Requirements

Provide HVAC that will maintain continuous and dedicated environmental control (24 hours per day, 365 days per year). Cooling shall not be from chilled water as this prohibits normal shutdown of the building chilled water system for repair, construction and maintenance. Cooling shall be local DX equipment rejecting heat to the ambient air.

The HVAC system that serves the IDF should be tuned to maintain a positive air pressure differential with respect to surrounding areas with a minimum of one air change per hour. Provide equipment to maintain the following acceptable ranges:

1. Temperature of 75 degrees F with no humidity control.

Estimated Heat Loads: ~ 5,000 BTU per equipment rack. Confirm heat loads with equipment to be deployed as some equipment may generate more heat than others. UPS and stand-alone air conditioning systems produce additional heat, if present.

Comply with additional requirements in Division 23 “HVAC”.

4.5 IDF Electrical Requirements

Comply with additional requirements in Division 26 “Electrical”.

IDF Lighting:

1. Provide adequate and uniform lighting that provides a minimum equivalent of 50 foot-candles when measured 3 feet above the finished floor level.
2. Locate light fixtures a minimum of 8 feet 6 inches above finished floor level. Any variation should be coordinated with the IS&T Project Manager. Preference is for lights over aisles rather than racks.
3. Locate light switches near the entrance to the IDF.
4. Coordinate lighting layout with the equipment rack layout, especially overhead ladder rack, to ensure that light is not obstructed.
5. Power for the lighting should be separated from circuits that power technology equipment.
6. Provide non-heat generating LED lamps unless otherwise indicated.

IDF Equipment Power:

1. IDFs shall be equipped to provide adequate electrical power. As a minimum, provide four 120V, 20A dedicated circuits, with one duplex receptacle per circuit per equipment rack. Confirm the need for 120V, 30A circuits with the IS&T Project Manager.

IDF Convenience Power:

1. Provide separate duplex 120V, 20A convenience outlets (NEMA 5-20R) for tools, test sets, etc., located at least 18 inches above the finished floor, placed at approximately 6 foot intervals around perimeter walls and identified and marked "Convenience Power".

IDF Dedicated Power Feed and Panel:

1. Provide IDFs with a dedicated power supply circuit that serves only the IDF and terminates in its own electrical panel within the IDF (see typical IDF drawings in Appendix B). The feeders that supply the power for technology equipment in IDFs should be dedicated only to supplying that equipment and should be designed to facilitate future growth.
2. The dedicated power panels should be wired and capable of future generator support if the generator support is not already installed for the building.

IDF Backup Power:

1. Because of the "mission-critical" nature of the IDF, backup power should be provided if possible.
2. Additionally, a rack-mounted UPS with a minimum of 30- minute battery capacity per each active rack circuit for each rack at full load shall be provided.

IDF Bonding and Grounding:

1. Provide a complete grounding/bonding system per EIA/TIA 607-B and current BICSI Grounding and Bonding standards.
2. Comply with additional requirements in Divisions 26 "Grounding and Bonding" and 27 "Grounding and Bonding for Communications Systems."

IDF Conduit Sleeve Penetrations:

1. Provide horizontal and backbone conduit sleeves into the IDF for the distribution of the horizontal and backbone cable from the ladder rack. Provide vertical conduit sleeves from the IDF if stacked above to support the distribution of backbone cables. If the IDFs are not stacked with the BDF, provide continuous conduit.
2. Conduit and conduit sleeves consist of a minimum of four 4 inch conduits / sleeves stubbed into the IDF extending 6 inches on both sides if sleeved. Additional conduits/sleeves may be required depending on the cable density.

3. All conduit and conduit sleeve counts shall be coordinated and approved by the IS&T Project Manager. Comply with additional requirements in Division 27 "Conduits and Backboxes for Communications Systems".

4.6 IDF Communications Requirements

Comply with additional requirements in Division 27 including "Communications Cable Management and Ladder Racks", "Communications Cabinets, Racks, Frames and Enclosures", and "Grounding and Bonding for Communications Systems".

IDF Overhead Ladder Rack:

1. Provide overhead ladder rack within the IDFs to route cable to or from sleeves, risers, ducts, ladder racks to termination fields within equipment racks or mounted on walls. This overhead ladder system shall be contained within the confines of the IDF.

IDF Overhead Ladder Rack Materials and Applications:

1. IDF overhead ladder rack may be mounted horizontally or vertically on walls and over equipment racks. Vertical overhead ladder rack will be used to support riser cable from floor to ceiling as it passes between floors. The overhead ladder rack system shall be mounted to walls, the top of equipment rack, or hung with threaded rods for bracing and support in compliance with seismic codes.

IDF Overhead Ladder Rack Bonding and Grounding:

1. In the IDFs, the overhead ladder rack system shall be bonded to the Telecommunications Grounding Busbar with 6AWG stranded copper wire per current BICSI Grounding / Bonding standards.

IDF Equipment Racks:

1. Provide between three and five 7 foot by 19 inch Equipment Racks in the IDF with two 10 inch double-sided vertical wire managers depending on the usable square footage served. See square footage served information in section "Room Size".

IDF Power Accessory Requirements:

1. Each equipment rack is to have a minimum of two vertically mounted Power Distribution Units (PDU) at the rear of the rack.
2. Both PDUs will connect to the rack-mounted UPS systems; one UPS will be installed per dedicated 20amp circuit.
3. The power receptacles on the PDU shall be NEMA 5-20R compatible. The plug shall be NEMA 5-20P compatible.
4. The IS&T Project Manager will provide the PDU and UPS specification.

IDF Equipment Rack Installation Requirements:

1. Provide all mounting components and accessories to securely fix equipment racks to floor. Provide appropriate seismic transverse and longitudinal bracing per any local codes and the current National Uniform Seismic Installation Guidelines (NUSIG).
2. Provide cable bend management fixtures to maintain the proper bend radius as the cables drop into the equipment racks.
3. Do not allow cables to be unsupported at distances greater than 4 feet, or sag more than 3 inches, as they run from conduit or cable ladder to equipment racks. Comply with BICSI and TIA 569-C for additional requirements.
4. Non-continuous pathway supports shall be UL listed.

IDF Equipment Racks Bonding and Grounding:

1. The equipment racks shall be bonded to the Telecommunications Ground Bus with 6AWG stranded copper wire per current BICSI Grounding / Bonding standards.
2. Comply with additional requirements in Divisions 26 "Grounding and Bonding" and 27 "Grounding and Bonding for Communications Systems".

5. DESIGN CRITERIA FOR THE COMMUNICATION CABLE SYSTEM SUPPORT INFRASTRUCTURE

The horizontal communication cable system infrastructure includes the pathway and support hardware that concentrates supports and protects horizontal cable between its origination point in the IDF or BDF and the workstation outlet location. It also provides a permanent pathway that facilitates the addition or replacement of cable over time. Horizontal support hardware is further defined as continuous, (e.g., conduit, cable tray) and non-continuous (e.g., J-Hooks, Saddle Bags).

5.1 Communication Cable Trays

Distribution cable tray shall be installed above the accessible ceiling for the creation of main pathways for the management of high volumes of cable through corridors, and for access and egress to BDF and IDFs. Comply with additional requirements in Division 27 "Cable Trays for Communication Systems".

Construction:

1. Cable tray shall be the wire basket type manufactured of ASTM A510 high strength steel wires or equal, and comply with NEMA VE1.
2. The cable tray shall be Underwriters Laboratory (UL) listed.
3. Any variation of this shall be approved by the IS&T Project Manager.

Dimensions:

1. The cable tray shall be a minimum of 18 inch wide, with a depth of 4 inches. Comply with NEC requirement for 40% fill ratio when determining size.
2. Narrower cable tray may be used for locations with lower volumes of cable.
3. All cable tray dimensions shall be approved by the IS&T Project Manager.

Support Requirements:

1. A trapeze-style support shall be used along the span of the cable tray. The trapeze shall be constructed of channel stock and minimum 5/8 inch galvanized or stainless steel threaded rods. The trapeze support elevation should allow a minimum of 12 inches between the top edge of the cable tray and the slab above. Appropriate threaded rod anchors shall be selected and installed per manufacturer's instructions. Trapeze supports shall be selected based on project requirements and placed a minimum of every 10 feet and at cable tray intersections and terminations.
2. Seismic bracing for the cable tray as required by code, shall be installed along cable tray routes. Coordination of lateral and oblique bracing locations shall be coordinated with the other disciplines whose equipment and systems share the area above the suspended ceiling with coordination drawings or Building Information Model (BIM) clash detection.

Bonding and Grounding Requirements:

1. The cable tray shall be bonded to the Telecommunications Grounding Busbar in the IDF(s) per current BICSI Grounding/Bonding standards. All non-contiguous segments of the cable tray shall be bonded together using 6AWG stranded copper wire, with crimp-on lugs bolted to each segment of the cable tray to ensure electrical continuity throughout the length of the cable tray system.

Cable Tray Firestopping Requirements:

1. Cable trays that penetrate fire-rated walls shall be equipped with wall penetration sleeves at each location, and have appropriate firestopping materials installed after the placement of cable has been completed.

5.2 Communication Cable System Conduit

Provide Communications cable conduit in locations where access to cable tray is unavailable or where portions of the pathway span are inaccessible (i.e., embedded in walls or inaccessible ceilings). Provide conduit for small quantities of cable where cable tray is impractical. Conduit materials may be used to house non-rated cables between end points to ensure NEC Code compliance.

Conduits serving individual workstation outlets shall be a minimum of 1 inch. The conduits shall be connected to double-gang, deep device boxes 2-1/8 inches deep, equipped with a single-gang mud ring at the outlet location. Individual workstation conduits are to be dedicated to only one outlet box each, and shall not be "daisy- chained" together.

The following conduit type shall be utilized as described below. Comply with additional requirements in the local building code and Divisions 26 "Electrical" and 27 "Communications."

1. Rigid Galvanized Steel (RGS):

    a. Rigid galvanized steel conduit shall be used in areas exposed to the outside elements above ground and used for the containment of non-rated cable as specified in the NEC.
    b. RGS shall be installed using threaded couplers and fittings and should be left with pull strings for future use.

2. Thinwall Electrical Metallic Tubing (EMT):

    a. EMT shall be used for installations within the confines of an environmentally controlled building and should be left with pull strings for future use. EMT conduit is not acceptable for non-rated cable installations. EMT conduit may be used, however, to carry riser-rated cable and innerduct in vertical and horizontal cable applications. EMT conduit may be used as sleeves for wall penetrations, and for floor core riser penetrations.
    b. EMT conduit connectors and fittings shall be installed using "Set-Screw" type or airtight "Compression" type fittings.

3. Flexible Conduit ("Flex"):

    a. Flexible conduit shall not be used for communication cable installation when EMT conduit is available.
    b. Flex conduit may be used for connections into modular furniture or similar applications and should be left with a pull string for future use.
    c. When using Flex conduit, increase the diameter of the Flex by one trade size over what the requirement would be using smooth-wall conduit.

4. Plastic Conduit / Polyvinyl Chloride:

    a. Plastic and PVC conduit shall be used for underground duct construction between buildings and vaults.
    b. Plastic and PVC conduit shall be used for underground duct construction between buildings and vaults.

5. PVC:

    a. The PVC conduit shall be a minimum of Schedule 40 PVC. Plastic and should be left with mule tape or pulling rope for future use.

5.3 Conduit Installation Guidelines

Communication Cable System Conduit:

1. Support Requirements:

    a. Conduits shall be installed with support systems such as channel stock/threaded rod trapeze supports. Individual conduits may be supported using threaded rods with clamps. Conduits may be affixed to walls where practical. Seismic bracing shall be installed as required by local building codes and NUSIG (National Uniform Seismic Installation Guidelines).
    b. Accommodations for lateral and oblique bracing struts must be coordinated with the other disciplines that vie for critical ceiling space.

2. Bonding and Grounding:

    a. Bonding of conduits to the Telecommunications Grounding System is required. At the termination of conduit runs within IDFs, attachment of a ground wire between the Telecommunications Ground Bus to grounding rings installed on conduit box connectors should be accomplished to ensure electrical continuity of the conduit system.

3. Firestopping:

    a. Partially filled and empty conduits that pass through fire-rated walls or through floors shall be firestopped in accordance with Local Fire Codes. Material shall be flexible firestopping putty or pillows.

5.4 Communication Cable System Pull Boxes

1. Pull Boxes: A pull box shall be installed in conjunction with conduit installations to provide access to cables at appropriate locations for distribution to tributary locations, and to facilitate cable installation.

2. Materials: For indoor use, use NEMA Type 1 pull boxes. For exterior applications or areas exposed to heavy moisture, chemicals or weather elements, NEMA Type 3 or 4 pull boxes shall be installed. The pull box shall be equipped with hinged covers, or removable covers that are screwed or bolted on. The pull boxes shall have hardware for supporting and securing cabling and pulling eyes to facilitate cabling installation.

3. Placement: A pull box shall be installed after 100 feet of conduit has been placed, and/or after 180 degrees of directional change in the conduit pathway has been affected. The installation of a pull box shall not be used for directional change.

4. Support Requirements: Pull boxes shall be attached directly to the ceiling slab, or suspended by 4-point threaded rod supports anchored to the ceiling. Pull boxes require seismic bracing to comply with Local Building Codes. Seismic bracing shall be installed as required by local building codes and National Uniform Seismic Installation Guidelines (NUSIG). Accommodations for lateral and oblique bracing struts must be coordinated with the other disciplines that vie for critical ceiling space.

5.5 Horizontal Cable Support Hardware (Non-Continuous)

Horizontal Cable Support Hardware such as J-Hooks shall be used in locations where the communication cable cannot be supported by continuous systems such as cable trays or conduit. Note: Saddle Bags are also acceptable as per products listed in this Section.

Provide J-Hooks every 48 inches at a minimum, attached to threaded rod or ceiling hangers to provide support for cable bundles. The J-Hooks shall be metal stampings configured in a "J" form providing a broad cradle or saddle for supporting for of cable.

5.6 Jack Numbering Sequence

Faceplates shall have an applied P-Touch label with building number, room number and sequence jack number, for example W92-212-13.

Sequence numbering for jacks within a room shall be clockwise, starting as you enter the room, with lowest to highest number.

Patch panels shall have matching labels.

Green snap trim shall be used to indicate that the jack is connected to MITnet.

6. TEL/DATA DESIGN LAYOUT DRAWINGS

6.1 Room Diagrams

Comply with design layout drawings attached at the end of this document. Consult with IS&T prior to modifying design layout drawings.

APPENDIX A: IS&T PRODUCT LIST

The following materials are to be used for each of the components of the IT structured cabling systems at MIT. All products listed in this section shall be installed per the manufacturer's product installation instructions. Basis-of-design products which have been used at MIT are listed; equal products by comparable manufacturer's will be considered during the submittal process, except where 'no substitutions' is indicated.

Installers shall provide all factory fittings and accessories required for a complete installation in accordance with the manufacturers instructions.

A. Structured Cabling System - No Substitutions

Commscope, 760092429, MGS600-262, GigaSPEED X10D® MGS600 Series Information Outlet, white.

Commscope, 760105940, 2091B GR 4/23 R1000, GigaSPEED X10D® 2091B ETL Verified Category 6A U/UTP Cable, white jacket, 4 pair count, 1000 ft (305 m) length, reel.

Commscope, 760105858, 1091B SL 4/23 R3000, GigaSPEED X10D® 1091B ETL Verified Category 6A U/UTP Cable, slate jacket, 4 pair count, 3000 ft (914 m) length, reel.

Commscope, 874036404/10, CS44P-10 Indoor/Outdoor Category 6AU/UTP Cable, plenum, outdoor rated, black jacket, 4 pair count, 1000 ft (305 m) length, reel.

Commscope, 760152587, 360-IPR-1100-E-GS6-1U-24, SYSTIMAX 360™ GigaSPEED X10D® 1100GS6 Evolve Category 6A U/UTP Patch Panel, 24 port.

Commscope, 760152595, 360-IPR-1100-E-GS6-2U-48, SYSTIMAX 360™ GigaSPEED X10D® 1100GS6 Evolve Category 6A U/UTP Patch Panel, 48 port.

Commscope, 108168469, M12L-262, L Type Flush Mounted Faceplate, two port white.

Commscope, M106FR2-262, M106 Flush Mounted Modular Mounting Frame, two port, white.

Commscope, M106FR4-262, M106 Flush Mounted Modular Mounting Frame, four port, white.

Commscope, 108168469, M12L-262, L Type Flush Mounted Faceplate, two port, white.

Commscope, 108168543, M14L-262, L Type Flush Mounted Faceplate, four port, white.

B. Racks And Cable Management Components - No Substitutions

Chatsworth Products, 55053-703, Two-Post Standard Rack.

Chatworth Products, 30163-703, CCS Combination Cabling Section.

Chatworth Products, 30139-719, Universal Horizontal Cable Manager.

C. Power Strips

Chatsworth Products, 12848-756, Metered Power Strip, Vertical Mount.

D. Cable Tray For Tel/Data Rooms (Tr)

Type 1: Chatsworth Products, Cable Runway Pathway Dividers.

Type 2: Chatsworth Products, Universal Cable Runway

Connecting Components: To be determined.

E. Cable Tray For Distribution Systems

Chatsworth Products, Pemsa Wire Mesh Cable Tray System.

F. Horizontal Cable Support Hardware

Erico, CAT32HP, Caddy Cat HP, J-Hook.

Erico, CAT425, Adjustable Cable Supports.

G. Indoor Ribbon Cable - No Substitutions

Corning, 012EC8-14101-A3_NAFTA_AEN, Ribbon Interlocking Armored Cable, Plenum, 24 F, Single-mode (OS2).

Corning, 024EC8-14101-A3_NAFTA_AEN, Ribbon Interlocking Armored Cable, Plenum, 12 F, Single-mode (OS2).

Corning, 036EC8-14101-A3_NAFTA_AEN, Ribbon Interlocking Armored Cable, Plenum, 36 F, Single-mode (OS2).

Corning, 048EC8-14101-A3_NAFTA_AEN, Ribbon Interlocking Armored Cable, Plenum, 48 F, Single-mode (OS2).

Corning, 072EC8-14101-A3_NAFTA_AEN, Ribbon Interlocking Armored Cable, Plenum, 72 F, Single-mode (OS2).

Corning, 096EC8-14101-A3_NAFTA_AEN, Ribbon Interlocking Armored Cable, Plenum, 96 F, Single-mode (OS2).

Corning, 144EC8-14101-A3_NAFTA_AEN, Ribbon Interlocking Armored Cable, Plenum, 144 F, Single-mode (OS2).

H. Indoor-Outdoor Ribbon Cable - No Substitutions

Corning, 012ECF-14101-A1_NAFTA_AEN, FREEDM Ribbon Interlocking Armored, Gel-Filled Cable, Riser, 12 F, Single-mode (OS2).

Corning, 024ECF-14101-A1_NAFTA_AEN, FREEDM Ribbon Interlocking Armored, Gel-Filled Cable, Riser, 24 F, Single-mode (OS2).

Corning, 036ECF-14101-A1_NAFTA_AEN, FREEDM Ribbon Interlocking Armored, Gel-Filled Cable, Riser, 36 F, Single-mode (OS2).

Corning, 048ECF-14101-A1_NAFTA_AEN, FREEDM Ribbon Interlocking Armored, Gel-Filled Cable, Riser, 48 F, Single-mode (OS2).

Corning, 072ECF-14101-A1_NAFTA_AEN, FREEDM Ribbon Interlocking Armored, Gel-Filled Cable, Riser, 72 F, Single-mode (OS2).

Corning, 096ECF-14101-A1_NAFTA_AEN, FREEDM Ribbon Interlocking Armored, Gel-Filled Cable, Riser, 96 F, Single-mode (OS2).

Corning, 144ECF-14101-A1_NAFTA_AEN, FREEDM Ribbon Interlocking Armored, Gel-Filled Cable, Riser, 144 F, Single-mode (OS2).

I. Outdoor Ribbon Cable - No Substitutions

Corning, 012EC5-14100D53_NAFTA_AEN, SST-Ribbon Single-Tube, Gel-Free, Armored Cable, 12 F, Single-mode (OS2).

Corning, 024EC5-14100D53_NAFTA_AEN, SST-Ribbon Single-Tube, Gel-Free, Armored Cable, 24 F, Single-mode (OS2).

Corning, 036EC5-14100D53_NAFTA_AEN, SST-Ribbon Single-Tube, Gel-Free, Armored Cable, 36 F, Single-mode (OS2).

Corning, 048EC5-14100D53_NAFTA_AEN, SST-Ribbon Single-Tube, Gel-Free, Armored Cable, 48 F, Single-mode (OS2).

Corning, 072EC5-14100D53_NAFTA_AEN, SST-Ribbon Single-Tube, Gel-Free, Armored Cable, 72 F, Single-mode (OS2).

Corning, 096EC5-14100D53_NAFTA_AEN, SST-Ribbon Single-Tube, Gel-Free, Armored Cable, 96 F, Single-mode (OS2).

Corning, 144EC5-14100D53_NAFTA_AEN, SST-Ribbon Single-Tube, Gel-Free, Armored Cable, 144 F, Single-mode (OS2).

J. Rack-Mount Hardware – Option 1 - No Substitutions

Corning, CCH-01U_NAFTA_AEN, Closet Connector Housing (CCH), one rack unit, holds two CCH connector panels.

Corning, CCH-02U_NAFTA_AEN, Closet Connector Housing (CCH), two rack units, holds four CCH connector panels.

Corning, CCH-03U_NAFTA_AEN, Closet Connector Housing (CCH), three rack units, holds six CCH connector panels.

Corning, CCH-04U_NAFTA_AEN, Closet Connector Housing (CCH), four rack units, holds twelve CCH connector panels.

Corning, CCH-CS12-AE-P00RJ_NAFTA_AEN, Closet Connector Housing (CCH) Pigtailed Splice Cassette, 12 F, Shuttered LC UPC duplex, Single-mode (OS2), ribbon fiber.

Corning, CCH-CS24-AE-P00RJ_NAFTA_AEN, Closet Connector Housing (CCH) Pigtailed Splice Cassette, 24 F, LC UPC duplex shuttered, Single-mode (OS2), ribbon fiber.

K. Rack-Mount Hardware – Option 2 - No Substitutions

Corning, CCH-CP12-A9-P03RJ_NAFTA_AEN, Closet Connector Housing (CCH) Panel, ribbon pigtailed, LC Connectors, Duplex, UPC, 12 F, Single-mode (OS2).

Corning, CCH-CP24-A9-P03RJ_NAFTA_AEN, Closet Connector Housing (CCH) Panel, ribbon pigtailed, LC Connectors, Duplex, UPC, 24 F, Single-mode (OS2).

A LANscape Solutions Product, LAN-340-EN - heat shrinks 2806031-012, Fusion Splice Protection.

Corning, M67-076_NAFTA_AEN, Splice Tray, Mass Fusion Splices or Heat-shrink Fusion Splices, 0.4-inch; 6 mass fusion splices or 12 heat-shrink fusion splices. (Part number is valid, but does not fit in PCH-01U housing).

Corning, PC1-SPLC-04R_NAFTA_AEN, Splice Tray Bracket for PCH-01U.

Corning, PC2-SPLC-6SR_NAFTA_AEN, Splice Tray Bracket for PCH-02U.

Corning, PC4-SPLC-12SR_NAFTA_AEN, Splice Tray Bracket for PCH-04U.

Corning, PCH-01U_NAFTA_AEN, Pretium Connector Housing (PCH), one rack unit, holds two CCH connector panels.

Corning, PCH-02U_NAFTA_AEN, Pretium Connector Housing (PCH), two rack units, holds four CCH connector panels.

Corning, PCH-04U_NAFTA_AEN, Pretium Connector Housing (PCH), four rack units, holds twelve CCH connector panels.

L. Rack-Mount Hardware - No Substitutions

Corning, M67-076_NAFTA_AEN, Splice Tray, Mass Fusion Splices or Heat-shrink Fusion Splices, 0.4-inch; 6 mass fusion splices or 12 heat-shrink fusion splices. (For the WSH not the OSE housing).

Corning, OSE-LD0-0T-1-L_NAFTA_AEN, Optical Splice Enclosure (OSE) Universal, low density, 432 single fiber / 864 mass fusion splice, standard cable entry, with "T" slot mounting kit and lockable.

Corning, OSE-ST-3_NAFTA_AEN, Optical Splice Enclosure (OSE) Splice Trays, Mass Fusion (Ribbon). (For the OSE housing not the WSH).

Corning, WSH-11SPT-F_NAFTA_AEN, Wall-Mountable Splice Housings (WSH), for up to eleven 0.4-inch category 4S, 4R, or 4A splice trays.

M. Splicing Hardware - No Substitutions

Commscope, 931866-000, FOSC450-D6-6-NT-0-D6V, Fiber Optic Splice Closure, Gel Cable sealing, no pre-installed tray, 6 cable attach/six ground feedthrough lugs w/test valve. (Singled-ended round – Inside/OSP use).

Corning, HFC-FURC-KIT-C_Furction for Gel-Filled/Gel-Free Corning Central Tube Ribbon Cables 12-216F_1 kit per cable end. (Ribbon to Ribbon Splicing).

Corning, HFC-FURC-KIT-C_Furction for Gel-Filled/Gel-Free Corning Central Tube Ribbon Cables 12-216F_1 kit per cable end. (Termination in Splicing cassettes/SOC's).

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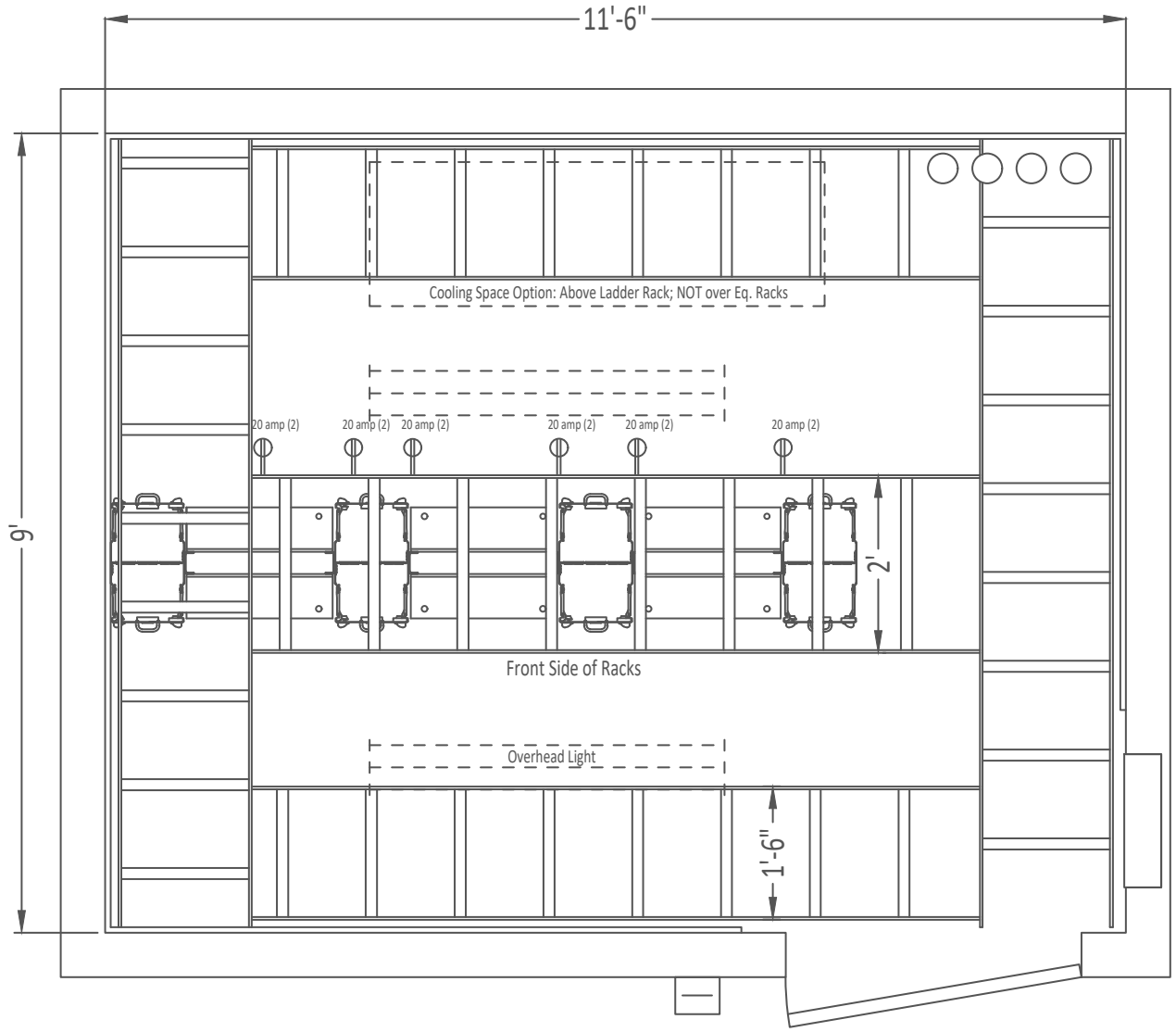

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R1	2022-04
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Detail Number:

27-001a

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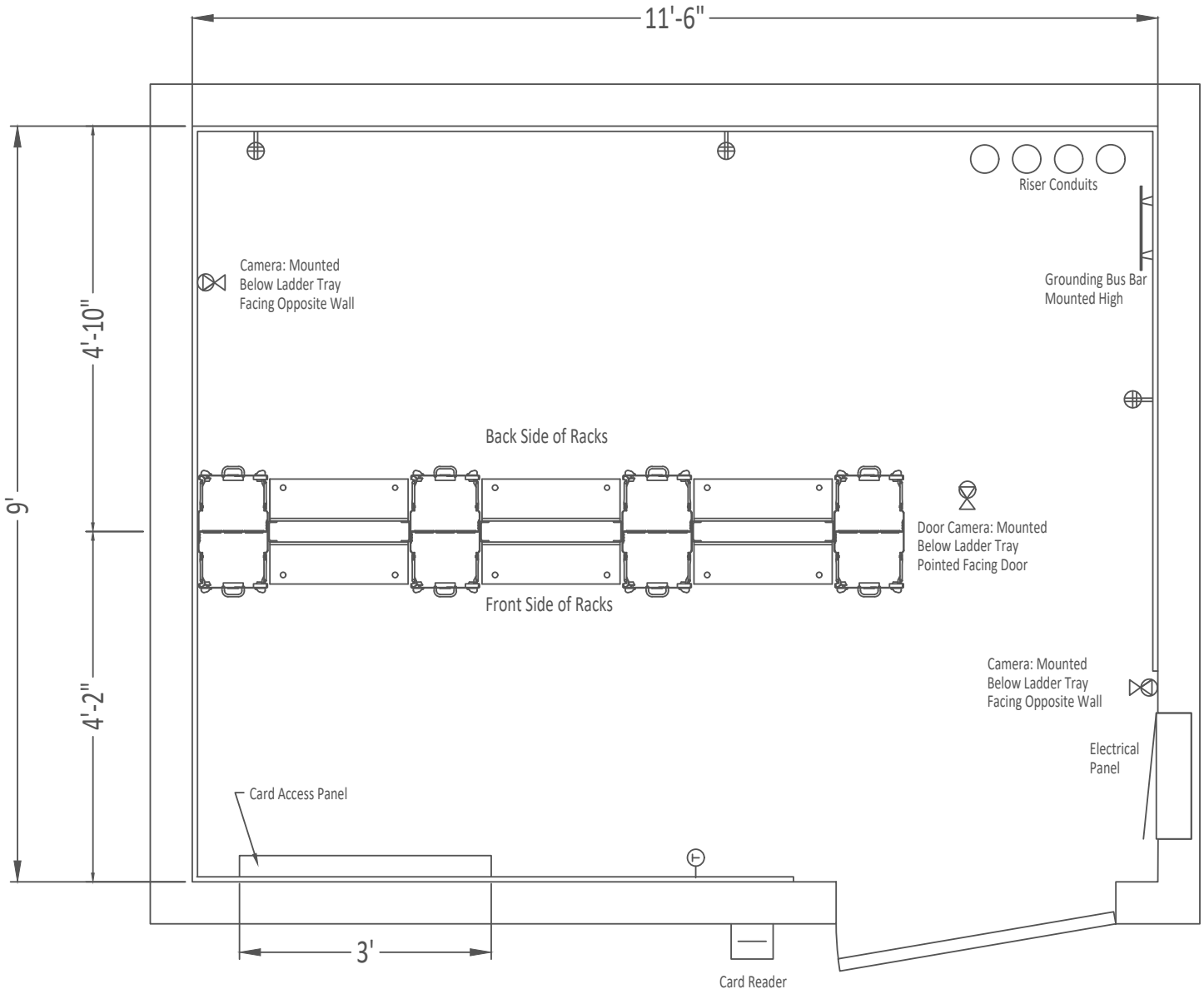
Massachusetts Institute of Technology



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Detail Number: 27-001b

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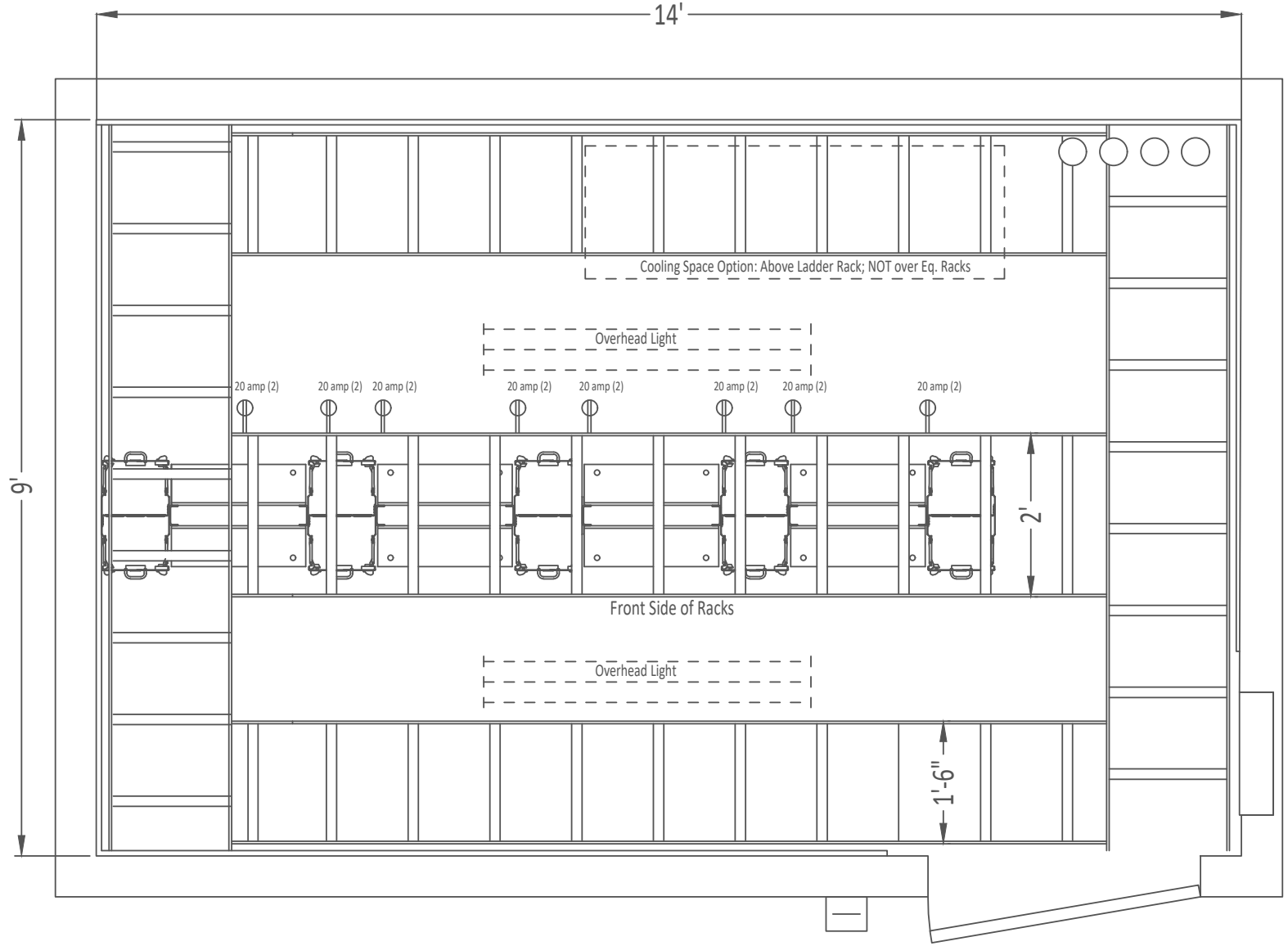

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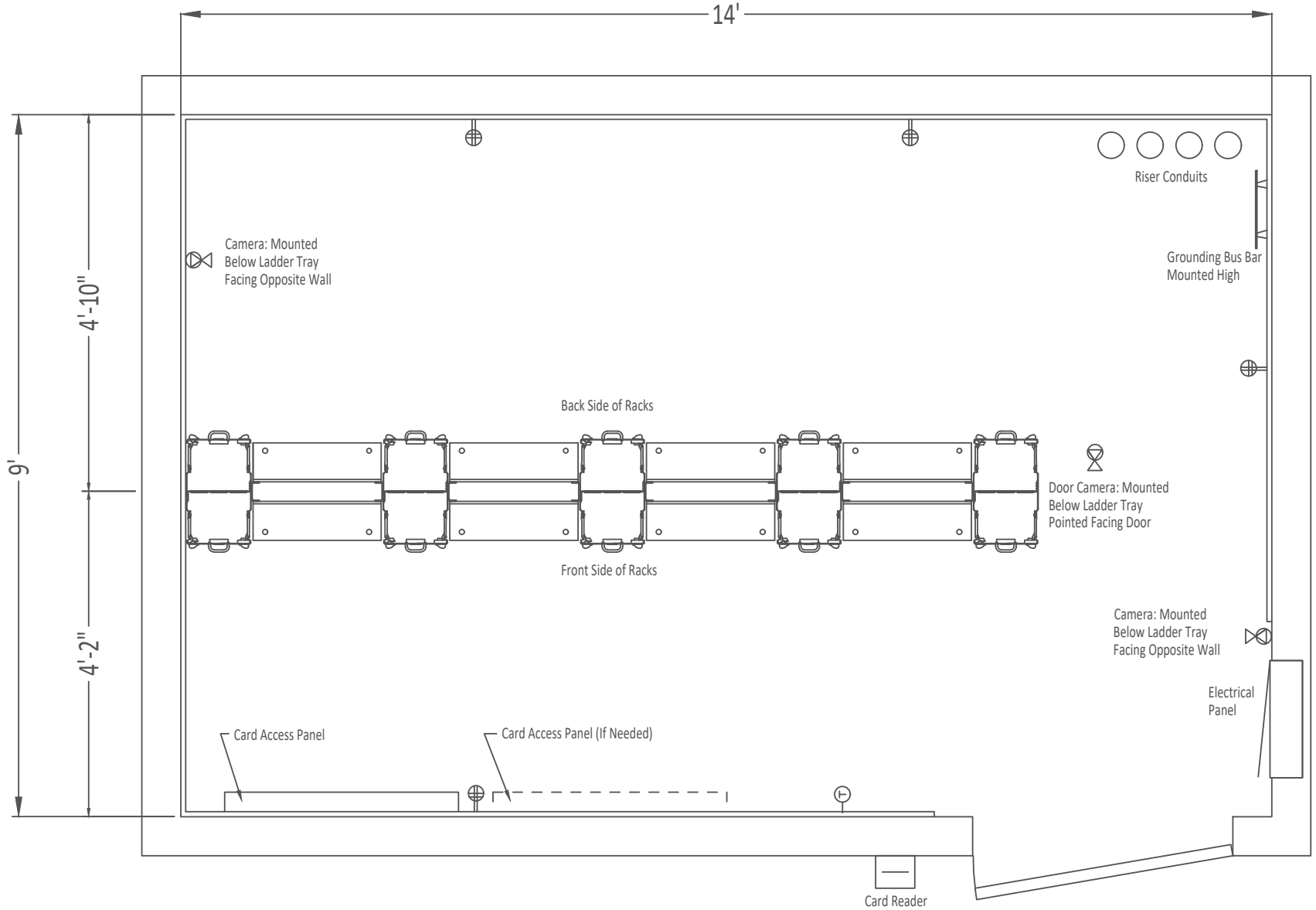

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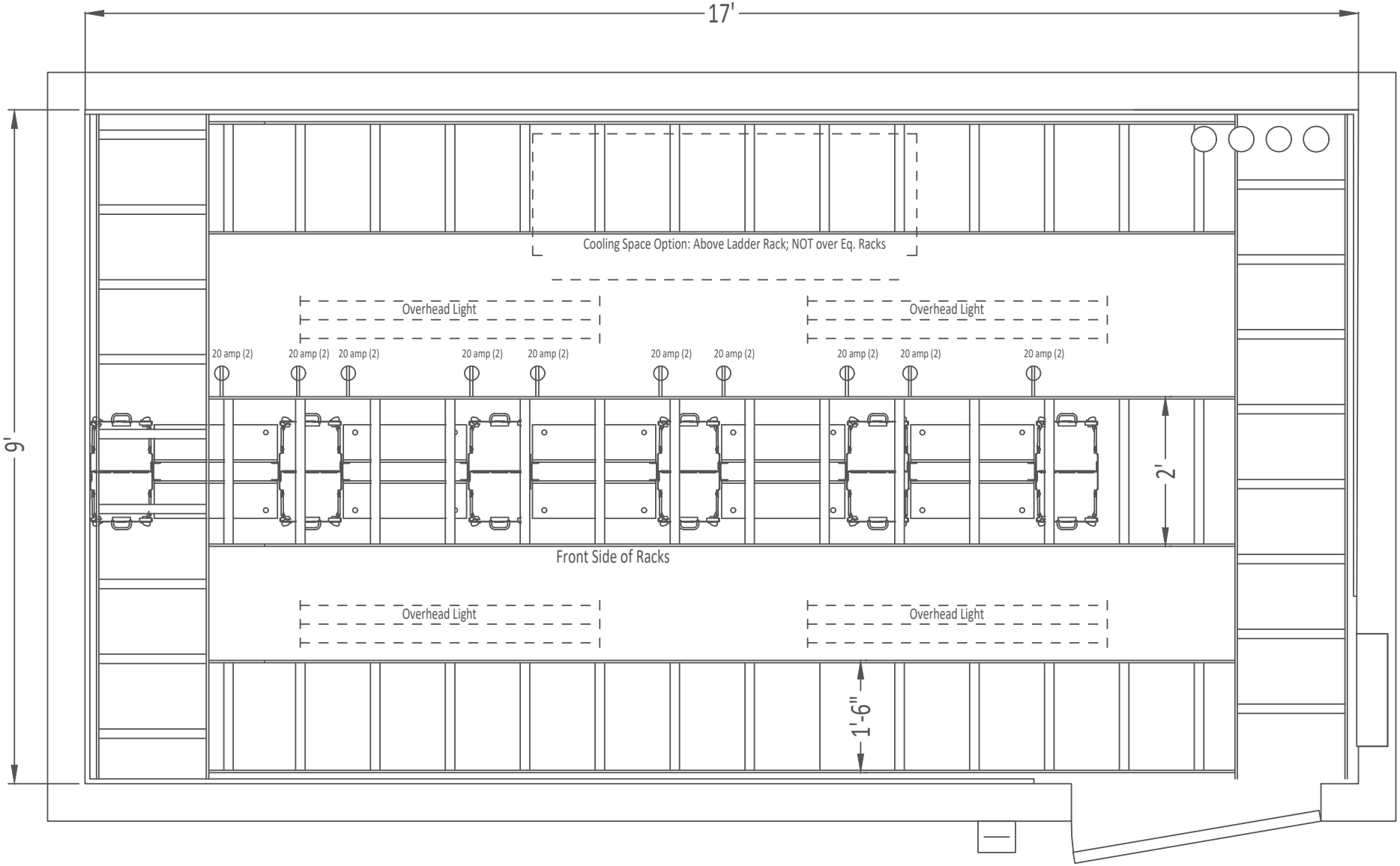

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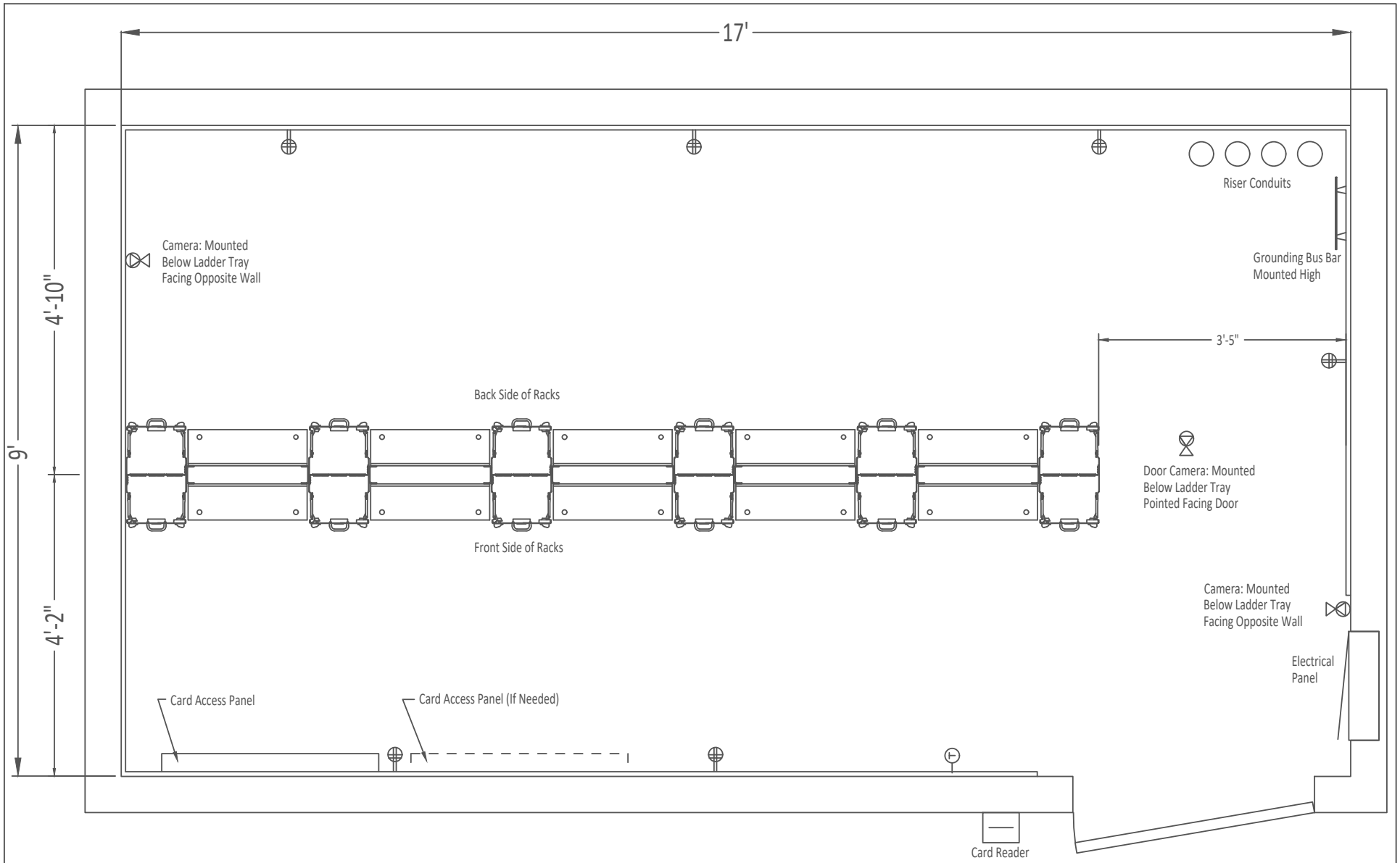

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R1	2022-04
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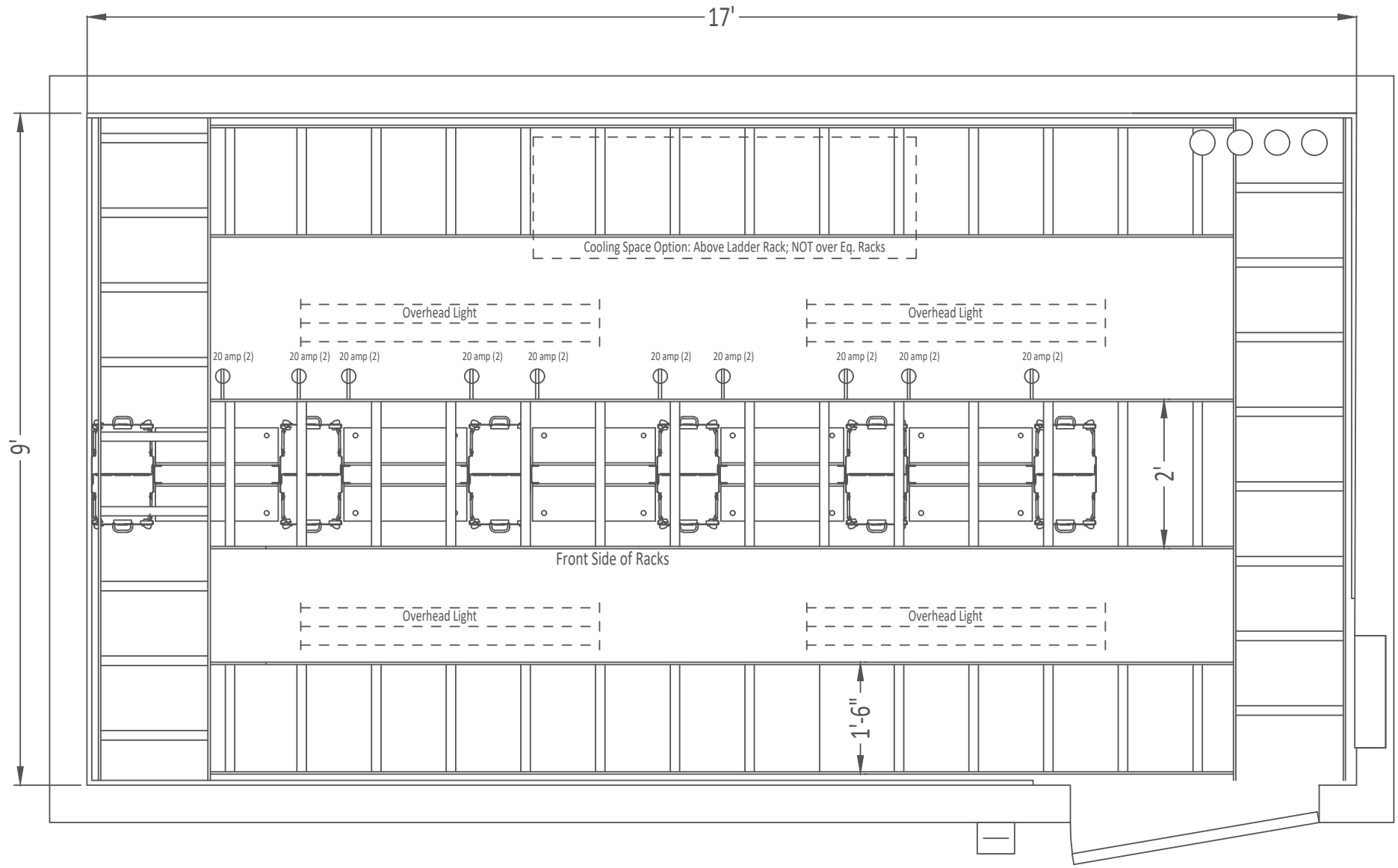

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Detail Title:

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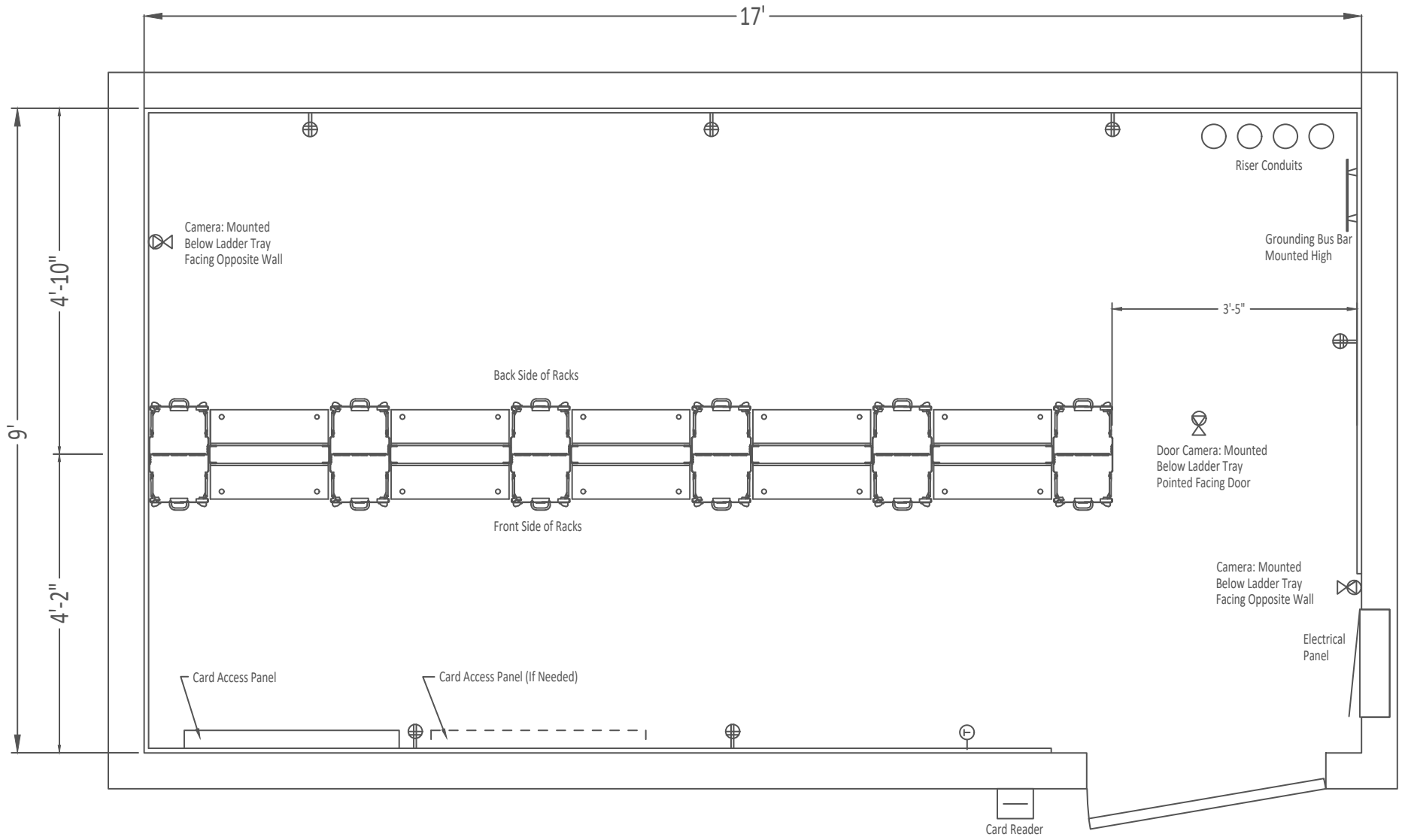
Detail Number: 27-004a

DESIGN STANDARDS

Massachusetts Institute of Technology



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Detail Title:

Tel/Data Room - 5 Rack BDF : Rack Top View

Detail Number:

27-004b

DESIGN STANDARDS

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