Sandia National Laboratories

Telecommunications Systems Design Manual

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1 General

This subsection covers the design of a complete telecommunication system, to include an intermediate distribution room (IDR), backbone cabling, and backbone raceway systems for intra-building telecommunication cabling projects at Sandia National Laboratories/New Mexico. Requirements both for new construction and building remodeling are included. The subsection provides criteria to lay out and design an IDR and to design an associated horizontal backbone fiber distribution system for both RED (classified) and BLACK (unclassified) data telecommunication systems including a copper voice system.

The designer shall understand the telecommunication connectivity requirements so as to be able to provide a complete telecommunication system design. In some cases, it may be necessary to refer customers to Sandia's Telecommunication Operations Department, hereafter referred to as the Department, to ensure its networking requirements are adequately addressed. (The contact number for the Department is 844-2316.)

Network electronics are not included in the telecommunication system for any project and for that reason they are not addressed herein. The designer shall inform customers that the project will bear these costs and direct them to contact the Department for any additional telecommunication systems cost.

The telecommunication infrastructure that is installed or modified as part of any construction activity is part of a laboratory-wide utility administered and maintained by the Department. Questions regarding intra-building cabling components, cabling test procedures, or inter-building telecommunications should be directed to the Department. For standard product specifications, refer to Table 2 of Sandia's Construction Specification Section “Intra-Building Telecommunication New System,” Division 16. The designer shall review the preliminary design with the Department for conformance with these design standards.

2 Code Compliance

The designer shall provide designs that meet the following:

- United States Department of Energy. Telecommunications Security Manual [DOE TSM 200.1-1]. March 15, 1997. The Department of Energy has mandated that this manual will not be available to contractors, but it can be viewed at Sandia by making an appointment with the Protected Transmission System Site Manager by calling 844-2316. DOE has delegated to the PTS Site Manager the sole authority to interpret this manual, as necessary.
- International Building Code (IBC)
- National Fire Protection Association (NFPA)
  - ⇒ 70 *National Electrical Code* (NEC)
  - ⇒ 101 *Life Safety Code*
- The Department will provide Department of Energy (DOE) orders and requirements affecting other specific aspects of the RED and BLACK systems.

The IDR architectural design is not required to comply with the Uniform Federal Accessibility Standards (UFAS) because it is considered a non-occupied space.

3 References

The designer should be familiar with the following publications because they contain design and technical criteria that may be pertinent to the project.

American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA)/ Electronics Industries Association (EIA)

- ANSI/TIA/EIA 568A *Commercial Building Telecommunications Cabling Standard*
- ANSI/EIA/TIA 569 *Commercial Building Standard for Telecommunications Pathways and Spaces*
- ANSI/EIA/TIA 570 *Residential and Light Commercial Telecommunication Wiring Standards*
- ANSI/TIA/EIA 606 *Administration Standard for the Telecommunications Infrastructure of Commercial Buildings*
- ANSI/TIA/EIA 607 *Commercial Building Grounding and Bonding Requirements for Telecommunications*
- ANSI/TIA/EIA-472OOOO-A *Generic Specification for Fiber Optic Cable*
- ANSI/TIA/EIA-472COOO-A *Sectional Specification for Fiber Optic Communications Cable for Indoor Use*
- ANSI/TIA/EIA-472CAAA *Detail Specification for All-Dielectric (Construction 1) Fiber Optic Communications Cable for Indoor Plenum Use Containing Class Ia, 62.5 μm Core Diameter/125 μm Cladding Diameter Optical Fiber(s)*
- ANSI/TIA/EIA-472DOOO-A *Sectional Specification for Fiber Optic Communications Cable for Outside Plant Use*
- ANSI/TIA/EIA-472DAAA *Detail Specification for All-Dielectric Fiber Optic Communications Cable for Outside Plant Use,Containing Class Ia, 62.5 μm Core Diameter/125 μm Cladding Diameter/250 μm Coating Diameter Optical Fibers*

Building Industry Consulting Service International (BICSI)

- *Telecommunications Distribution Methods Manual*
- *LAN Design Manual*

Underwriters Laboratories Inc. (UL)

- *94 Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances*
- *910 Test Method for Fire and Smoke Characteristics of Electrical and Optical - Fiber Cables Used in Air-Handling Spaces*
- *1449 Transient Voltage Surge Suppression (TVSS)*
- *1666 Standard Test for Flame Propagation Height of Electrical and Optical - Fiber Cables Installed Vertically in Shafts.*

4 Construction Drawings

The following is an approximate list of the construction drawings required to illustrate the scope of the telecommunication project or portion of the project. Specific project conditions may require additional drawings for clarification.

- IDR/MDR Plans and Elevations
- Floor Master Backbone Conduit Plan
- Backbone Conduit Plans (quarter-scale size)
- Power One-Line
- Lighting Plan
- Receptacle Plan
- Communications Riser Diagram (to include conduit-fill percentages)
- Backbone Conduit Details
- Fire and Intrusion Alarm Plan
- Electrical Equipment List
- All Telecommunications Standard Drawings
- Architectural wall details
- Mechanical Systems Plans

5 Intra-Building Cabling

The Sandia/NM cabling infrastructure design can support three separate telecommunication networks. The Sandia Classified Network (SCN), also known as the Sandia Classified Environment (SCE), referred to as the RED system in this document, is used to transmit classified data. The Sandia Restricted Network (SRN) or Internal Web, and the Sandia Open Network (SON) or External Web, are both referred to as the BLACK system. Unless encrypted in an approved manner, classified data cannot be transmitted via the BLACK system. These two networks are installed and maintained per DOE directives. Identical cabling media types of optical fiber cable are used for both the RED and BLACK systems. Twisted pair copper is used only for the voice cable systems.

The RED SCN system currently supports data connections and is installed in conduit using fiber only. The BLACK SON, SRN system supports data using fiber only installed in the same conduit as the RED fiber. The BLACK and RED communication system shall be capable of delivering as a minimum two SRN connections, two SON connections, four SCN connections in the same multi media outlet. The fiber conduit system shall always be sized for two four-fiber 50-micron multi-mode cables and two four fiber single mode cables to each user outlet location. In addition to the data multi media outlet, one voice connection on a twisted pair copper system shall be installed in a separate single gang, single port faceplate. Conduit for the copper voice cable is optional except in concealed spaces, e.g., within walls or hard ceilings, or unless code requires it. Plenum cable for voice system is preferred.

In addition to user outlets, cabling shall be provided to support other equipment such as emergency telephones, courtesy telephones, copy and facsimile machines, shared network printers, file servers, and computer room equipment. Check with the customer and building occupants for other specific telecommunication needs and coordinate any non-standard design requirements with the Department. In the event fiber and copper multi media outlets exist in the majority of an existing building the existing outlet configuration shall be followed for new installations.

6 Removal or Relocation of Existing Telecommunication Outlets

The designer is responsible for coordinating with the Department any work to be performed on existing telecommunication outlets and in particular, any work affecting RED telecommunication outlets before removal or relocation of such outlets.

Subject to the requirements of Sandia's Construction Specification Section “Intra-Building Telecommunication New System,” Division 16, the following actions shall be taken when an outlet must be removed:

- After consulting with the building customer, confer with the Department regarding the nature and scope of the required work. Submit a project plan for any telecommunication connection, disconnection, removal, and/or telephone number change to be performed. Contact the Department before performing work affecting any telecommunication outlets used for voice or data communications.
- Notify the Department before any construction begins that affects existing RED telecommunication outlets with Tamper Indicating Prismatic Seals (TIPS), including the demolition of sheet rock or any other wall construction in the vicinity of such outlets. The use of TIPS has been deployed Sandia wide. All TIPS shall be inspected and removed by the Department or a Department-approved representative. The contractor shall be alert to notice signs that warn of the presence of TIPS, e.g., **"This outlet and wall contains communications CDIN and/or is protected by tamper indicating material. No construction is to take place without notice to the PTS site manager. Report suspected tampering to the PTS site manager 844-2316."**
- Notify the Department of the quantity and location of outlets being affected by the work by listing the outlet numbers of each outlet in a project plan.
- If an outlet is being removed, all cabling within that outlet shall be disconnected and removed from the outlet to connection points within the IDR.
- If the outlet is being relocated and the existing cabling pulled through relocated/re-installed conduit, the Contract documents shall indicate that the following procedures shall be performed:
    1. Before start of any work, existing cables to be reused shall be tested at both ends in conformance with the test procedures specified in Sandia's Construction Specification Section “Intra-Building Telecommunication New System,” Division 16. All cables shall pass the Sandia testing requirements.
    2. New test forms and cable charts shall be updated in the IDR and sent electronically to the Department.
    3. If cables do not pass or there are concerns with the test results, contact the Department.
    4. If cables pass, continue with the project.
    5. After the project is complete and communication cables are reinstalled and re-terminated at the outlet, all cables shall be tested at both ends.
    6. Contact the Department regarding any work affecting noninspectable conduit, e.g., within walls, associated with RED communication outlets encompassed in items 1 through 4 above. In addition, a PTS/CDIN inspector certified by the Sandia PTS Site Manager shall be present to observe any addition, relocation, or removal of RED communication outlets.

7 Telecommunication Outlets

For new buildings and major renovations affecting 70 percent of an existing building, a full suite of fiber cables for a multi-media BLACK/ RED user outlet will be installed. A full suite of fiber multi-

media outlets consists of two (one BLACK and one RED) four-fiber 50-micron multi-mode optical fiber cables and two (one BLACK and one RED) four-fiber single-mode optical fiber cables. RED and BLACK fiber shall share the same telecommunication outlet and conduit backbone system. RED fiber cables will be terminated using SC connectors on one half of the outlet and the BLACK fiber cables will be terminated using LC connectors on the other half of the outlet. One twisted pair copper cable will be used for the voice system installed in a separate single gang faceplate next to the fiber outlet. The installation of IMC or rigid conduit without fittings behind walls may be an approved method for installing fiber telecommunication outlets.

A PTS/CDIN Inspector shall be present to install the TIPS at applicable fiber communications outlets. All IMC or rigid conduit to be installed in non-inspectable space shall also be inspected and recorded on as-built drawings before the conduit is covered up. A general note on all drawings prescribing this requirement shall be incorporated in all design packages. Consult with the Department on any question regarding the requirement for installation of TIPS, IMC or rigid conduit.

In general, it is desirable for new outlet installations to match the configuration of existing modern outlets within the building. The backbone raceway system shall be designed to support a full suite of cables installed to each outlet in order to accommodate possible future expansion. Per DOE M 200.1-1, Telecommunications Security Manual, surface- mounted conduit is the preferred method for installing conduit associated with a RED outlet. Concealed RED telecommunication conduit requires the installation of TIPS on each non-inspectable conduit connector. The installation of IMC or rigid conduit without fittings behind walls is an approved method for installing fiber telecommunication outlets. The installation of conduit with fittings behind walls may be welded. The Department shall be notified before covering up any conduit in a RED system that would become concealed by the installation of building finishes.

The Contract documents shall indicate that the construction Contractor is required to contact the Department and the SDR, who will then notify the Facilities Construction Observer, to coordinate the inspection of this work.

8 Inter-Building Cabling

A fiber-optic trunk connection shall be provided between each IDR and the nearest Main Distribution Room (MDR), formerly called a Tech Control Center (TCC), in order to connect it to Sandia's enterprise networks and computing resources. The building service entrance termination frame shall be interconnected to the voice termination frame in the IDR. Coordinate with the Department to determine adequate service to a new IDR, including details of required working clearances and additional details. Investigate all appropriate existing exterior plant pathways as a means of providing the new inter-building service. If spare capacity does not exist, a new ductbank may be required. It is important to include this as part of the project and include the expense in the initial construction cost estimate.

Within limited areas (areas requiring a security clearance for unescorted access, such as the technical areas at Sandia), the RED (SCN) telecommunication system is considered to be a Classified Distributive Information Network (CDIN) by DOE. A protected distribution system (PDS) is a portion of the secure network that exists outside a limited area. All requirements for installation or modification of such a system are governed by DOE Manual DOE M 200.1-1 *Telecommunications Security Manual*. This manual is marked "For Official Use Only" and is controlled by the Department. Additional installation of PDS conduit is not permitted. When installing a new cable in the existing PDS, use the Department as a design consultant and to check the system design from a DOE security requirement standpoint. Future

needs for SCN outside limited areas will be met through encryption. Contact the Department for design details.

9 Intermediate Distribution Room

An Intermediate Distribution Room (IDR) is a special-purpose room that provides and maintains (1) a suitable operating environment for network communication equipment, (2) a connection point between backbone and horizontal pathways, and (3) the termination point of all horizontal cables. The IDR telecommunication design shall meet or exceed the latest approved ANSI/EIA/TIA standards, particularly EIA/TIA 568A and 569. Before beginning the IDR design, review ANSI/EIA/TIA standards, other industry standards, and published methods for system design.

9.1 Sizing the IDR

The IDR shall be designed to accommodate both current and future needs. In general, the IDR size is dictated by the number of outlets it could serve and the networking equipment and cabinets required to serve those outlets. Contact the Department for assistance in sizing and configuring IDRs. In general, the following may apply:

- One linear foot (300 mm) of horizontal wall space is required for every 18 outlets served by the IDR (assuming a standard suite of two multi-mode fiber-optic cables and two single mode fiber-optic cables per outlet). An additional four linear feet (1.2 m) is required, divided equally between BLACK and RED cabinets. A typical IDR shall have two RED network equipment cabinets, two BLACK network equipment cabinets separated by RED fiber termination cabinets and BLACK fiber termination cabinets.
- Provide three linear feet (900 mm) of horizontal wall space for a voice copper termination frame, with a maximum of 3600 pairs on one termination frame or 3000 pairs if a building entrance protector frame is used. Frame(s) shall be installed on the BLACK half of the IDR.
- Approximately six linear feet (1.8 m) of horizontal wall space is required for the IDR power panel, access control cabinets, ISDN power, thermostat, and light switch.
- The size of the IDR doubles if BLACK and RED systems are both required. Allow 20 percent of the linear floor space for future expansion. Provide space in the center of the IDR for equipment cabinets that are 24 inches wide by 36 inches deep. A total of six cabinets minimum shall be installed in the center of the IDR floor (3 RED and 3 BLACK). More fiber termination cabinets may be needed for larger buildings. Observe requirements for thirty-six-inch (910-mm) clearances between equipment installed on walls and equipment installed in frames and racks. For buildings with minimal requirements, it may be possible to reduce walk-around floor space if adequate wall space exists, but floor space is limited. This may be accomplished by mounting equipment cabinets sideways, starting approximately 8 inches (200 mm) from the wall.

9.2 IDR Location

The location of the IDR affects all other aspects of the communication system design. Place the IDR in a location that minimizes the length of the backbone and horizontal distribution cables. The maximum lengths of horizontal cables shall not exceed 492 feet (150 m) if 50-micron LZ150 multi-mode fiber is used from the termination point in the IDR to the user outlet termination point. If this length requirement cannot be met with a single IDR within a given building, then use 50-micron LZ300 multi-mode fiber, extending the distance to 984 feet (300 m). If this length requirement cannot be met, multiple IDRs are

required. Place the IDR where it is accessible to conduit routing pathways, preferably adjacent to the main building utility chase. Vertically align IDRs in multi-story buildings whenever possible, if needed.

9.3 IDR Layout

The IDR shall have a clear and logical equipment layout that is easy to use and maintain. Locate equipment in the IDR to minimize the amount of wall space used. Locate the thermostat above and in line with the light switch. In remodel designs, adjust the layout and equipment placement to accommodate existing conditions.

Locate the power panel and access control system cabinets (typically mounted on the front IDR wall) on the BLACK side of the IDR. The BLACK side typically requires more equipment space. Mount copper termination frames on the rear or side walls of the IDR, keeping BLACK copper cabling systems as far apart from the RED networking equipment cabinet as possible: 36 inches (910 mm) minimum. Mount equipment cabinets centered in the room. When fiber conduits cannot terminate in fiber equipment cabinets, lay out slotted cable tray around the perimeter of the room and across the center of the sections of the room where equipment cabinets are located. Copper cable shall be supported and drop directly above voice/protector frame to eliminate the need for a cable tray.

10 IDR Design

The standard equipment for an IDR is shown in Sandia Standard Drawing T-6001STD. An IDR can contain the following components:

- Voice equipment
- Data equipment
- Distribution equipment (cabling)
- Networking electronics (does not include file servers, which must be maintained within the customer's space)

Provide one voice protection frame, as needed, for each of the following:

- BLACK voice frame for every 576 voice circuits (576 BLACK user outlets).

A typical BLACK copper outlet contains one voice circuit connected to the IDR via one four-pair copper cable terminated on a faceplate next to a all fiber data outlet (refer to Construction Specification 16742 Table 2 for cable requirements). A typical fiber user outlet contains one four-fiber 50-micron multi-mode and one four fiber single-mode for each RED and BLACK system (refer to Construction Specification 16742, Table 2, for cable requirements). With written permission of the Department, buildings permanently located outside a limited area may be exempt from pulling RED fiber to the user outlet. Conduit shall always be sized to accommodate RED and BLACK fiber regardless of location.

Secure voice communication, provided for example, by either a STU III or STE, is accommodated by using a secure telephone unit that operates on a BLACK telephone circuit.

Mount all termination frames to a Unistrut brace mounted horizontally on the wall to allow for space behind the frame to pull in cabling. A typical BLACK voice frame will have:

- Trunk/main cable field
- User circuits
- Spares (future growth)
- ISDN power field
- Miscellaneous (elevators, courtesy phones, alarms, MBCs, etc.)

Provide for integrated services digital network (ISDN) power for each telephone circuit using a multiple power supply and battery back-up unit. These units are designed to provide battery-back-up capability. At a minimum, large units provide 4 hours back-up and small units provide 20 minutes to 1 hour back-up. Locate the power supply unit and batteries adjacent to the voice termination frame to minimize extension cable distances. Provide building entrance protector frames with solid-state circuit protector units for all voice circuits as required. Protect copper telephone service within 50 feet (15 m) from its point of emergence through an exterior wall, a concrete floor slab, or from a rigid metal conduit, in accordance with Part E, Article 800 of the NEC.

Provide a minimum of two network equipment cabinets (with power) per system (RED and/or BLACK) and two equipment cabinets (without power) per system for fiber terminations. Provide space for additional switches for small MOs. Small buildings may require only one switch and sufficient room for an additional switch in the future. Additional cabinets may be required after coordination with the Department. Provide rack-mounted Lightguide Shelf Termination (LST) units as required to connect optical fiber trunk cables in the MDR termination cabinets.

11 IDR Architectural and Structural Requirements

An IDR consists of several architectural and structural components to ensure functionality yet maintain building aesthetics. In addition to the interior base wall construction, a single layer of plywood is applied over the gypsum board and secured to the metal studs to provide a medium for mounting lightweight equipment. Plywood is only needed on the BLACK side of the IDR where the protector frame, ISDN power supply, and OSP splice case will be located. A final layer of gypsum board is added over the plywood to provide a finished wall surface. The interior wall and floor colors are designed to provide high light reflectivity for workers performing cable termination, detailed assembly operations, and continuing maintenance. Colors are standardized for all IDRs and shall not be changed to match building interiors. IDRs shall remain either square or rectangular. The Department shall approve any other shape. Contact the Department for IDRs that have greater than 200 user outlets. A mini-IDR design can be incorporated for buildings with less than 50 occupants; contact the Department for details.

11.1 Wall Construction

The IDR wall construction shall be a UL-type, one-hour fire-rated design. The intent of this criterion is not to provide a one-hour firewall meeting NFPA 101 requirements, but to set a minimum acceptable level of wall construction. Typically, the front wall of the IDR wall is constructed of six-inch (150-mm) metal studs to enclose the flush-mounted electrical power panel and access control equipment. Other walls of the IDR may be sized according to the building requirements.

The base layer of wall covering is type "X" gypsum board on both sides of the metal studs. Additional wall materials are added to the interior base layer of gypsum board. Fire-rated plywood is secured to the gypsum board, and one layer of gypsum board is then attached to the plywood. This forms the equipment backboard that is used to attach such items as termination blocks and panels. See Sandia's Standard Drawing AE3034STD and AE5032STD for wall sections and details. The telecommunications designer is responsible to forward these requirements to the architectural design team members.

The exterior wall of the IDR is finished to match the corridor's wall finish in texture and color. Interior IDR walls shall be taped, textured, and painted with Wellborn paint color "Birch White” or product that provides equivalent color and light-reflectivity. Refer to Sandia's Construction Specification Section “Painting,” Division 9, for painting product requirements. Install a four-inch (100-mm) vinyl cove base

around all wall perimeters. Refer to Sandia's Construction Specification Section “Resilient Tile Flooring,” Division 9, for vinyl base product requirements.

11.2 Doors and Door Hardware

The door to the IDR shall not be located at the center of the front wall. Place the door at the outermost end of the RED side of the IDR. The door shall swing inward. Provide a 45-minute fire-rated door assembly that complies with UL 10B. Refer to Sandia's Construction Specification Section “Steel Doors and Frames,” Division 8, for product requirements. Paint the door and frame to match building door colors. Door hardware includes: 1-1/2 pair 4-1/2 x 4-1/2 inches (144 mm x 114 mm) standard weight butts, regular arm closer, electric strike, smoke seal, door sweep, and lockset. The IDR lock shall be the type that remains locked at all times with no bypass hardware. Refer to Sandia's Construction Specification Section “Finish Hardware,” Division 8, for hardware requirements. Hardware finish is chosen to match building hardware finish. Coordinate electric strike operating requirements with access control system equipment requirements. Coordinate lockset key type with the Department. A separate door and frame may be needed to separate the RED and BLACK IDRs.

11.3 Floor and Ceiling

Provide vinyl composition floor tile for the IDR floor. Use Armstrong "Classic White," #51911, or product of similar color and light-reflectivity. Refer to Sandia's Construction Specification Section “Resilient Tile Flooring,” Division 9, for resilient product requirements.

Ceilings open to the structure shall be painted white to match interior IDR walls. A lay-in ceiling is not preferred; however, building design or field conditions may require a drywall-type ceiling to maintain fire ratings. A minimum ceiling height of 10’-0” must be maintained. Conduit sleeves shall be used with plenum cable to penetrated hard ceilings.

11.4 Structural Considerations

Several areas of the IDR require structural consideration. Perform structural calculations to ensure that placement of the cable tray (if needed) around the room does not violate the overall structural stability and integrity of the wall. Based on the calculations performed, additional wall bracing may be required for placement of the cable tray. Ensure that the load-bearing capacity of the floor is adequate to support the floor-mounted IDR equipment. In addition, coordinate placement and support of the IDR fan coil unit, ISDN power supply, and battery backup unit with the mechanical design.

12 IDR Mechanical System Requirements

The IDR heating, ventilating, and air conditioning (HVAC) system is designed to maintain an air temperature in the room of between 55°f - 72°f, with a humidity level of 15 - 30%. Design the system for the maximum amount of telecommunication equipment that the IDR could support. Cooling in the IDR is critical to the operation of the network electronics and shall be maintained continuously. The cooling system within the IDR shall remain independent of the building automated systems and/or building automatic shutdown system, if any, and shall not be subjected to building power-saving shutdowns (evenings, weekends, and holidays).

12.1 Heating Ventilation and Air Conditioning

The HVAC is a building-independent system located and serviceable from outside the ceiling space of the IDR. Building air is supplied and returned to and from the IDR for air circulation purposes only. Generally, only cooling will be required because of the heat generation of the electrical and communication equipment. However, heating may be required and shall be coordinated with all other disciplines. Cooling is accomplished through the use of a single- or multiple-fan coil units ducted to ceiling diffusers. Condensate lines shall be taken out of the fan coil unit, and open condensate drains or lines are not permitted within the IDR.

Calculate heat loads using the heat loads of the electrical and communication equipment required for the service area. At no time shall the IDR reach levels over 77^{o} F. Coordinate equipment quantities and heat loads with the respective disciplines. Allow for adequate cooling capacity for future equipment growth within the IDR.

Fan coil sizing shall incorporate equipment heating loads, building piping systems, and available ceiling space. Because of the great number of communication conduits entering the IDR, coordinate fan coil location with electrical and communication requirements to ensure maintenance accessibility. The thermostat for the IDR shall be mounted above lighting switches next to the entry door.

12.2 Fire Protection

The IDR fire protection system shall be installed and connected to the building fire protection system. Coordinate the IDR fire protection sprinkler head and piping placement and smoke detectors with the location of the lights and cable trays and conduits being installed in the IDR space. Typically, sprinkler heads are located in the areas between the cable trays. Consult with Sandia's Facilities Fire Protection Engineers for sprinkler placement and required clearances between sprinklers, conduit and/or cable trays.

13 IDR Electrical System Requirements

Telecommunication equipment can be very sensitive to power abnormalities. For this reason, the lighting, HVAC, and convenience receptacles in each IDR shall be fed from different branch circuits than the telecommunication equipment.

13.1 Receptacle System Design

Install duplex receptacles on each interior wall 8 inches (200mm) above the finished floor to the top of the receptacle. This allows wall mounting of communications equipment starting at 12 inches (300 mm) above the finished floor. The wall elevation depicting the receptacle layout is shown on Sandia's Standard Drawing T-5004STD.

Mount convenience receptacles horizontally, if necessary for clearance. Provide a dedicated receptacle at 48 inches (1.2 m) above the finished floor for each ISDN power supply installed. This receptacle may require 120-volt AC/20 amp, 208-volt AC/30 amp receptacle, or another configuration depending upon the power supply. Consult with the Department for power supply specifications.

13.2 Power System Design

Install flush-mounted 225-amp, 120/208-volt AC, three-phase, four-wire, solid neutral dedicated panelboard in the IDR for telecommunication equipment. Populate the panelboard with the type and number of breakers required to support the equipment located in the IDR. Allocate dedicated circuits for each equipment cabinet, access control equipment, and ISDN power supply. Perform a short-circuit current calculation for the panel and annotate the power one-line drawing with the results. Do not serve lighting, convenience receptacles, or HVAC equipment for IDR from the dedicated panelboard. Non-powered fiber termination cabinets providing separation from RED network equipment and BLACK network equipment shall be centered in the IDR. Each RED and/or BLACK network equipment cabinet shall be served by two dedicated 120-volt AC/20 amp single-pole circuits and two dedicated 208-volt single phase 20 amp double-pole circuits from the panelboard located in the IDR. These circuits are connected to two separate 20-amp duplex receptacles and two separate 20-amp NEMA L6-20 receptacles mounted in the top of each cabinet. Refer to Sandia's Standard Drawing TJ5001STD for detail.

13.3 Lighting

IDRs shall have adequate and uniform lighting. Design for a minimum of 50-foot-candles (540 lux) at 3 feet (910 mm) above floor level. Take into account the light loss due to the full cable tray and light that may be blocked by equipment cabinets when performing the lighting calculations. Coordinate positions of the light fixture with the equipment layout, particularly overhead cable trays and equipment cabinets, to ensure the light is not obstructed. Use four-lamp fixtures with high-efficiency electronic ballasts and RFI filters. Put two lamps on one switched circuit, and the other two lamps on another switched circuit. Provide emergency lighting in the IDR consistent with the emergency lighting system for the building.

13.4 Cable Tray Design

Install 18-inch (460-mm) wide, 4-inch (100-mm) load depth louvered, ventilated trough-type cable tray, only if backbone conduit cannot terminate in fiber termination cabinets. Locate the cable tray on the perimeter walls of the IDR with the cable tray providing access to equipment racks. Provide separate cable tray systems where RED and BLACK systems are required. All cable trays shall be UL approved for use with communication cabling. Use cable tray parts numbers listed in the Sandia's standard drawings equipment list for telecommunication work. Do not substitute a cable tray without permission from the Department. (Refer to Sandia's Standard Drawing T-6001STD).

13.5 Grounding

A standard IDR grounding system has been developed (refer to Sandia's Standard Drawing T-1001STD). The system is intended to provide a short, low-resistance path to ground from all conductive surfaces. Each IDR shall have a grounding bus consisting of a 4-foot by 6-inch by 1/4-inch solid copper bus bar wall mounted 12 inches below the finished ceiling on the BLACK side of the IDR near the voice frame.

Bond all incoming conduits, pipe, ductwork, cable trays, equipment cabinets, ISDN power supply frame, and termination frames to the bus bar with #6 AWG copper strap. Tie all IDRs together with a #4/0 copper conductor. Attach #4/0 copper conductor to the IDR bus bar(s) and to the building grounding

electrode/counterpoise. Resistance-to-ground measurements shall be performed in each IDR, and written documentation of the results provided to the Department.

13.6 Access Control Requirements

Each IDR shall have a dedicated access control system. Flush mount the power supply at 90 inches (2.3 m) above the finished floor and the controller at 60 inches (1.5 m) above the finished floor. Vertically align the power supply and controller whenever possible to conserve wall space.
Flush mount the access control system keypad at 58 inches (1.5 m). Mount access control cabinets on the BLACK side in IDRs.

14 Backbone System

At Sandia, the predominant cable jacket is riser rated and is installed in rigid galvanized steel or intermediate metal conduit (RGS or IMC) or electrical metallic tubing (EMT) and placed in gasketed, lockable metal pull boxes for maintenance and security purposes. Plenum-rated cable may be secured to the structure with UL approved hanging devices designed for the category of copper cable being installed. Reference the NEC, Article 770 for fiber-optic cable listing, markings, and acceptable substitutions, and Article 800 for listing, marking, and acceptable cable substitutions for copper wire communication cables. The use of cable tray or cable ladder type systems for voice cable distribution is not permitted. All substitutions shall be approved by the Department before being purchased or installed. Use of unapproved materials/equipment may void warranties Sandia has on the existing telecommunication installations.

Design the fiber backbone raceway system using 3-inch and 4-inch (75-mm and 100-mm) EMT in a physical "tree" configuration (refer to Sandia's Standard Drawing T-9001STD). Fiber cable shall always be in a conduit system. Conduit fill charts are available from the Department as an Excel spreadsheet if calculations are needed for other cables or conduits.

For initial installation design, cable capacity shall be limited to 30 percent maximum conduit fill to allow for possible future expansion and enable ease of cable pulling. For system upgrades, limit maximum fill to 40 percent calculated fill, which yields an approximate 80 percent utilization. Greater fills would prevent move/add/change activities; therefore, for fills exceeding 40 percent, provide additional backbone conduit. The use of plenum-rated cable for the voice copper system is allowed. Refer to Table 2 in Sandia's Construction Specification Section “Intra-Building Telecommunication New System,” Division 16, for required part numbers.
All communication trunk cables entering an IDR or MDR shall be installed with a service loop in the cable. All communication cabling installed from user outlets to the IDR shall be installed with sufficient slack to allow for termination. Refer to Sandia's Construction Specification Section “Intra-Building Telecommunication New System,” Division 16, for required slack cable measurements.

Design the conduit system so that all conduits entering the IDR will be vertical and terminated in fiber termination cabinets. Horizontal conduit entrances will not be allowed except in rare cases, which shall be approved by the Department before being installed. In rare cases where horizontal conduit entrances are required due to the physical constraints of the building structure and systems, the minimum vertical distance between the bottom of the conduit and the top of the cable tray shall be no less than 8 inches.

It may be necessary to install curved cable support “shoes” into the conduit terminations to mitigate stress on cables and the resultant damage. Incoming backbone conduits shall turn down around the perimeter of the room as much as possible to provide sufficient room in the center sections of cable tray for patch cables between the equipment cabinets and the termination frames. Do not use 90 degree pulling

elbows for communication cable because they may have sharp interior edges and may exceed the cable bend radius.

Design the conduit system to limit the bend radius in any backbone raceway conduit to a maximum of 270 degrees unless a pullbox is installed. Include design provisions to properly firestop all conduit penetrations passing through fire-rated barriers. Conduit entrances into a building from outdoor locations shall have sealing fitting installed at the point the conduit enters the building filled with appropriate sealing compound to prevent accumulation of moisture.

14.1 Copper Wire Telecommunication Media

Copper cable is used for voice BLACK communications. When properly installed and tested, this product exhibits performance capabilities that exceed the ANSI/TIA/EIA 568A Standards for Category 5E/6 unshielded twisted pair (UTP) cable. Refer to Table 2 in Sandia's Construction Specification Section "Intra-Building Telecommunication New System," Division 16, for required part numbers.

14.2 Optical Fiber Telecommunication Media

Three types of fiber-optic cable are used as part of intra-building cabling: 50-micron multi-mode 150 , 50 micron multi-mode 300 and single mode cable. The 50 -micron multi-mode 150 cable shall not exceed 150 meters from user outlet to IDR. If the cable distance from IDR to user outlet is greater than 150 meters use 50 micron multi-mode 300 fiber. Cable is riser-rated to meet UL 1666 requirements. Refer to Table 2 in Sandia's Construction Specification Section "Intra-Building Telecommunication New System," Division 16, for required part numbers. The use of 62.5-micron multi-mode fiber must be approved by the Department during the design phase of the project.

15 Termination and Testing of Telecommunication Media

All telecommunication cabling shall be terminated and tested in accordance with Sandia's Construction Specification Section "Intra-Building Telecommunication New System," Division 16. A Sandia pre-qualified and approved termination contractor shall perform terminations. All cable pulling, terminations, testing, and documentation shall be performed by an AVAYA Technologies Value Added Reseller (VAR). The installer must be AVAYA certified and approved by the Department. All terminated cables shall be labeled and tested in accordance with Sandia's Construction Specification Section "Intra-Building Telecommunication New System," Division 16. Test reports shall be prepared in accordance with the referenced specification and submitted to the SDR. The Department will review the test data and issue acceptance or disapproval.

GLOSSARY

ABBREVIATIONS

CCHD:	Corporate Computing Help Desk
CSI:	Cable Systems International
DOE:	United States Department of Energy
EMI:	Electrical magnetic interference
IDR:	Intermediate distribution room
LA:	Link attenuation
LIU:	Lightguide interconnection unit
LRL:	Link return loss
MDR:	Main distribution room
NEC:	National Electrical Code
NFPA:	National Fire Protection Association
NIST:	National Institute of Standards and Testing
NVP:	Nominal velocity of propagation
OF:	Optical fiber
OTDR:	Optical time-domain reflector
PTS:	Protected transmission system
SCN:	Sandia Classified Network
SDR:	Sandia-delegated representative
SFM:	Sandia-furnished material
SON:	Sandia Open Network
STU III	Secure Telephone Unit
STE	Secure Telephone Equipment
SRN:	Sandia Restricted Network
TIPS:	Tamper indicating prismatic seals

TERMS

AVAYA Technologies	A company formerly named Lucent that certifies telecommunication personnel and equipment in the United States.
Inaccessible conduit	Conduit within walls or ceiling where the conduit cannot be inspected.
Inter-building cable	Telecommunication cable between buildings.
Intra-building cable	Telecommunication cable within a building.
Sandia	Used here as a shortened form for Sandia National Laboratories, New Mexico
Telecommunication Operations Department	The department at Sandia responsible for its telecommunications infrastructure.

- End of Manual -