CRAY C92A™, CRAY C92AD™, and CRAY C94A™ Site Planning Reference Manual

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Cray Research, Inc.

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PREFACE

The *CRAY C92A, CRAY C92AD, and CRAY C94A Site Planning Reference Manual* contains technical information needed to plan and prepare a site for the installation of a CRAY C92A (C92A), CRAY C92AD (D92A), or CRAY C94A (C94A) computer system. This manual is intended for management and personnel responsible for the planning and preparation process.

NOTE: The CRAY C92AD will hereafter be referred to as the CRAY D92A.

This manual provides information about the site planning and preparation process and the operational requirements for both computer systems. It also includes individual computer system configurations, specifications, electrical requirements, separation limits, and floor preparation information. This manual also includes information about peripheral devices that can be configured with your computer system.

Related site planning information is referenced in this manual. Refer to the bibliography for a description of these manuals, related publications, and ordering information.

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1 SITE PLANNING AND PREPARATION

Cray Research regional or international site planning personnel and the Cray Research customer share site planning, preparation, and installation responsibilities. Cray Research regional or international site planning personnel will be in direct contact with you during the planning and preparation stages prior to system installation.

Prior to system installation, Cray Research personnel and customers must complete a number of site planning and preparation steps to ensure the successful installation of a CRAY C92A, CRAY D92A, or CRAY C94A computer system. This section outlines the steps needed to prepare a typical site for a Cray Research computer system installation. The site planning process is described, followed by information on site preparation and system installation.

Cray Research recommends that you involve qualified electrical and mechanical facility engineers early in the design stage of the site preparation. Regional or international site planning personnel must review and approve customer-prepared electrical and mechanical design drawings before any site preparation begins. Site planning meetings are held to discuss the electrical and mechanical design drawings and customer concerns.

Site Planning Meetings

Site planning meetings establish a communication link between you and Cray Research regional or international site planning personnel; one or two site planning meetings are needed to discuss the site planning and preparation process. Examples of items to be discussed include site evaluation, general site requirements, computer room design, equipment layout, service personnel office requirements, and system installation procedures. The following subsections describe these items.

Site Evaluation

Site evaluation is an important step in computer room planning. Consider the following features when you select a site for your facility:

- Electrical power quality. Electrical requirements are discussed in Section 2 of this manual, "Operational Requirements."
- Air quality. Refer to *Federal Standards Clean Room and Work Station Requirements, Controlled Environment*, Federal Standard number 209, for information on computer room air-quality requirements.
- Cooling water quality. (Cooling water is optional for the CRAY C92A, CRAY D92A, and CRAY C94A computer systems.) Refer to *Water Quality Requirements*, Cray Research Site Engineering document number 10658280, for information about water quality requirements.
- Vibration sources (such as heavy industrial traffic). Refer to *Vibration and Shock Limits for Installed Computer Systems*, Cray Research Site Engineering document number 10658300, for information on vibration limits for computer equipment.
- Structural strength of the building. Examine the floor loading characteristics of the equipment to be installed to ensure that the building structure will support the computer equipment.

Refer to the *Principles of Computer Room Design*, Cray Research publication number HR-04013, for more information about site evaluation. The manual provides building design surveys in the "Surveys of Computer Room Design, Construction, and Maintenance" subsection.

Site Access Requirements

Prior to system installation, your site must meet certain site access requirements. This subsection explains these requirements and provides specifications for each.

Your building should have a loading dock approximately 46.00 in. to 50.00 in. (117 cm to 127 cm) high for computer system delivery. The loading dock should not open directly into the computer room because the computer room environment must be carefully controlled. Take special precautions when moving equipment if the access route has a textured floor pattern; a textured floor pattern could cause vibration damage to computer equipment on casters.

If no loading dock exists, or if your loading dock does not meet access requirements, you will have to provide a forklift to unload computer equipment from the truck. Refer to *Forklift Size Requirements for the Handling of Cray Research Equipment*, Cray Research Site Engineering document number 10658374, for information on forklift requirements.

The entire access route to your computer room should meet the following specific requirements:

- Minimum ceiling and door height - 80.00 in. (203 cm)
- Minimum hallway and door width - 48.00 in. (122 cm); however, equipment can be disassembled to enable the system to fit through a 36.00-in. (91-cm) door.
- Maximum delivery route slope - One unit in height for every six units in length
- Minimum floor loading per rolling caster - 1,190 lbs (539 kg)

If your computer room is on a different level than your loading dock, you will need an elevator to move the computer equipment to the proper floor level. Verify that the elevator has the capacity to transport the computer equipment. If your building does not have an elevator, you may have to arrange for a crane or other special handling equipment to lift the computer system onto the same level as your computer room. Refer to the appropriate computer system section in this manual for specific shipping weights and sizes.

Computer Room Design

Computer room design is important in the site planning and preparation process. Proper computer room design can minimize problems with static electricity, security, personnel safety, and air contamination. The following list contains considerations for designing your computer room:

- Personnel safety
- Security
- Air quality
- Positive air pressure
- Future computer equipment
- Seismic vibration
- Raised flooring
- Sound reduction
- Lighting
- Handicapped personnel access
- Layout

Refer to the *Principles of Computer Room Design*, Cray Research publication number HR-04013, for a complete explanation of these considerations and for proper construction procedures.

Service Personnel Office Requirements

Cray Research provides trained hardware service personnel on a contractual basis to support the computer system. It is important that the field engineers and software analysts have a quiet, secure office area in which to work. Even if your site will not have on-site personnel, you must provide a locking office, approximately 150 ft^2 (14 m^2), for occasional use by off-site personnel. The office should be located as close to the computer room as possible.

The following items should be provided:

- One locking desk
- One chair
- One 3-shelf bookcase
- One locking, 4-drawer file cabinet
- Two locking parts cabinets, approximately 36.00 in. x 72.00 in. (91 cm x 183 cm)
- One worktable, 30.00 in. x 60.00 in. (76 cm x 152 cm), with a static-dissipative work surface
- One worktable stool with static-dissipative feet
- One telephone

Your system configuration might require additional items. Check with your site planning representative for any additional items necessary for your computer system.

Modem Requirements

Cray Research systems support personnel use a modem data communications link as a diagnostic aid to administrate, troubleshoot, and maintain Cray Research computer systems.

If site security regulations permit the use of a modem, contact the local telephone company well in advance of system delivery to arrange for installation of the telephone line required for the modem. You must supply a private, analog telephone line that is not routed through a PBX telephone system. Make arrangements with Cray Research, who pays the monthly service charges.

Cray Research supplies the QX Series Microcom modem, model QX/4232hs, for systems located in the United States and Canada. For computer system installations outside of the United States and Canada, contact your local Cray Research field engineer's office for the modem type and telephone line requirements.

Telephone company representatives might request information about modem requirements. Table 1-1 provides the specifications necessary for modem operation.

Table 1-1. Modem Requirements

Option	Specification
FCC registration number	CLB772-10785-MD-E
Transmission rate	V.32/V.42bis (9,600 bps)
Modem uses a standard telephone with a voice grade line; jack type	RJ11C
Touch tone/rotary dial	Touch tone preferred
Ringer equivalence	1.6 B
External/internal clock	Internal
Grounding	Chassis ground to signal ground
Transmit level	Up to 38.4 Kbps
Private/dial-up line	Dial-up line
Receive long space disconnect	Disabled
Transmit long space disconnect	Disabled
Data terminal ready disconnect	Enabled
Carrier fail disconnect	Enabled
Auto-answer/manual-answer	Auto-answer
Make busy in analog loopback	Disabled
Permanent/DTR controlled auto-answer	DTR controlled auto-answer
Synchronous/asynchronous	Asynchronous
9-bit/10-bit/11-bit character	10-bit character

Cray Research also supplies the Telebit NetBlazer dial-up router, which is used in conjunction with the Microcom modem to provide Transmission Control Protocol/Internet Protocol (TCP/IP) dial-up access to the Cray Research Area Service Centers. Refer to Figure 1-1 for an illustration of the Telebit NetBlazer. The NetBlazer dial-up router is positioned on top of the maintenance workstation (MWS). Table 1-2 provides the specifications for the NetBlazer dial-up router.

Table 1-2. NetBlazer Specifications

Characteristic	Specification
Height	3.25 in. (8 cm)
Width	15.00 in. (38 cm)
Depth	15.00 in. (38 cm)
Weight	14 lbs. (6 kg)
Power cable	8-ft (2.4-m) plug-compatible drop cord
Power receptacle: North American International	 NEMA# 5-15R or equivalent IEC 309, single phase, 16 amp

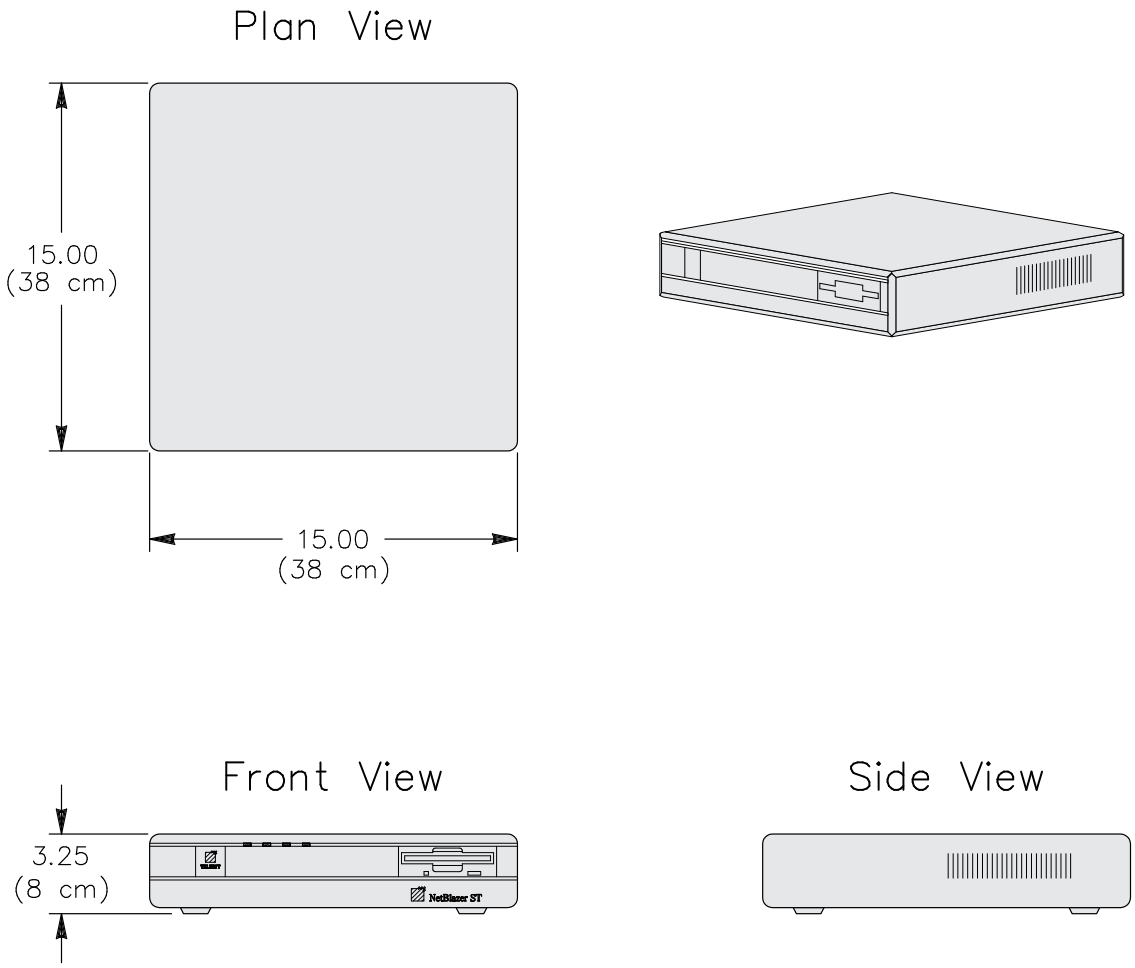

Figure 1-1. NetBlazer Dial-up Router

System Installation Overview

The installation of a Cray Research computer system consists of the following stages:

- Shipping preparation
- Transportation
- Installation
- Start-up and stabilization
- On-site quality assurance
- Operations preparation

Approximately 1 week before delivery, Cray Research personnel prepare the computer system for shipment. Major components are disassembled and protectively packaged in their shipping configurations. Cables and miscellaneous materials are packaged and labeled for shipment.

The system equipment is transported to your facility by a commercially available, dedicated tractor-trailer semi with air-suspension ride and climate control. For intercontinental shipments, the system equipment is prepared for shipment and transported by commercial cargo-carrying aircraft and then transported to your facility by tractor-trailer semi.

Cray Research personnel will unload and move the system equipment into your computer room. If needed, you must make arrangements for any special equipment (such as forklifts, cranes, platforms, and so on) required to unload the computer equipment.

After Cray Research installation personnel unload the system equipment from the tractor-trailer semi, they perform the following tasks:

- Position all equipment in designated locations
- Reassemble the computer system
- Connect all logic cables
- Attach dielectric-coolant hoses
- Connect all water hoses (if applicable)
- Plug computer equipment into customer-installed receptacles

Upon completion of these tasks, system start-up and power and cooling stabilization tests are performed. Cray Research personnel perform a series of quality assurance functions to ensure that the computer system is operating properly.

Cray Research declares the system ready for use upon satisfactory completion of all quality assurance functions. At this point Cray Research personnel install the operating system software to prepare the system for customer acceptance.

2 OPERATIONAL REQUIREMENTS

Cray Research designs computer equipment to operate within specific ranges of air quality, temperature, relative humidity levels, and electrical tolerances. Significant variations in a computer room environment may cause disruptions in equipment operation and decrease the life of the equipment. To ensure proper operation of the CRAY C92A, CRAY D92A and CRAY C94A computer systems, your facility must meet the operational requirements outlined in the following subsections.

Computer Room Environment

Cray Research designs resilience into system hardware. However, your facility's environment must be properly maintained to ensure that hardware reliability is not adversely affected.

The computer systems must operate in a controlled computer room environment. Although the requirements outlined in this section encompass the overall computer room, they are particularly important for air-cooled devices such as the mainframe power supplies, cooling units, disk drives, printers, and graphics display terminals (GDTs). Therefore, your environmental control system (such as computer room air-conditioning units) must ensure that inlet air to the air-cooled devices meets the specified environmental requirements in this section.

The computer systems require a computer room environment controlled within the following ranges:

- Temperature: 60 ºF to 83 ºF (16 ºC to 28 ºC)
  The maximum temperature change in a 1-hour period is 3 ºF (2 ºC). The rate of change cannot exceed 10 ºF (6 ºC) per hour.
- Humidity: 35% to 65% relative humidity (noncondensing)
  The maximum rate of change of relative humidity is 5% per hour.

- Dewpoint: 70 ºF (21 ºC) maximum (C92A, D92A, and C94A mainframes)
  60 ºF (16 ºC) maximum (SSD and IOS/SSD chassis)
- Air quality: For particles greater than 0.5 micron in size, the concentration must not exceed 1.0×10^5 particles/ft^3 (3.5×10^6 particles/m^3).

  For particles greater than 1.0 micron in size, the concentration must not exceed 2.0×10^4 particles/ft^3 (7.1×10^5 particles/m^3).

  For particles greater than 5.0 microns in size, the concentration must not exceed 6.5×10^2 particles/ft^3 (2.3×10^4 particles/m^3).

Electrical Requirements

Cray Research makes every effort to minimize the effects of power failures and interruptions to the hardware. However, if a computer system is subjected to repeated power fluctuations or interruptions, it will have a higher component failure rate than it would with a stable power source. Cray Research encourages you to provide a stable power source, such as an uninterruptible power system, to reduce the possibility of component failures.

Cray Research computer equipment has certain voltage, frequency, and grounding requirements. The following subsections describe these requirements.

Voltage and Frequency Requirements

The mainframe and cooling unit require one of the following 50- or 60-Hz, 3-phase electrical voltages. Refer to the appropriate computer system section of this manual for specific circuit information about your computer system.

- 208 Vac
- 380 Vac
- 415 Vac
- 480 Vac

The operator workstation (OWS) and the maintenance workstation (MWS) require 120- or 220-Vac, 50- or 60-Hz, single-phase power.

Disk drive units require 208-Vac, 50- or 60-Hz, 3-phase power. Refer to Section 5, “Peripheral Equipment,” for related disk drive site planning information, and for MWS and OWS site planning information. Refer to Table 2-1 for the electrical service requirements.

Table 2-1. Electrical Service Requirements

Electrical Service	Requirement
Voltage tolerance	+6 % to –10 %
Phase imbalance	5% maximum (line-to-line, line-to-line neutral)
Voltage harmonics	5% maximum total, 3% largest
Voltage deviation from sine wave	+5% to –10%
Voltage modulation	3% maximum
Transient voltage surges	+5%
Transient voltage sags	–5%
Frequency tolerance	±5%
Frequency rate of change	Less than 1.0 Hz during any 10-cycle period

Total kilowatt power requirements depend on system configuration and expansion allowances. Cray Research will provide documentation upon request or during the initial site planning meeting that you can use to estimate the power requirements for your specific system configuration.

Equipment Grounding

Cray Research provides you with *Equipment Grounding for Cray Research, Inc. Computer Systems*, Cray Research Site Engineering document number 10658002. This document describes the grounding system requirements and identifies alternate methods for providing the signal reference grid. In addition, the document discusses electrostatic discharge (ESD) precautions and maintenance of the facility’s grounding systems.

All Cray Research computer equipment requires a protective power safety-ground system. The power safety-ground system protects personnel from shock hazards and protects the computer equipment from damage caused by electrical malfunctions. The power safety-ground system is regulated by your local and national electrical codes.

In addition to the power safety-ground system, all Cray Research computer equipment requires a signal reference grid. The signal reference grid establishes an equipotential reference plane for high-frequency digital signals between interconnected computer equipment. All Cray Research computer equipment is supplied with braided ground straps and clamps, except graphics display terminals (GDTs) and line printers.

You must provide, install, and maintain the approved grounding systems as described in the Cray Research equipment grounding document.

3 CRAY C92A AND CRAY D92A COMPUTER SYSTEMS

This section provides detailed site planning information for the CRAY C92A and CRAY D92A computer systems including system configurations, specifications, equipment separation limits, floor preparation information, power wiring requirements, electrical requirements, piping requirements, and cooling water requirements.

System Configurations

The CRAY C92A and CRAY D92A computer systems have a number of configurations. Standard CRAY C92A and CRAY D92A computer systems consist of the following components:

- Mainframe chassis (MFC) with an optional SSD-E/32i or SSD-E/128i solid-state storage device module
- MFC cooling unit
- Optional SSD solid-state storage device (SSD) chassis
- SSD cooling unit
- Operator workstation (OWS)
- Maintenance workstation (MWS)
- Disk drives and other peripheral equipment

The CRAY C92A and CRAY D92A computer systems can be configured with either an SSD chassis that is a stand-alone chassis, or with an optional SSD-E/32i or SSD-E/128i solid-state storage device module integrated within the MFC. The SSD-E/32i module can provide 32 million words of memory for the computer system. The SSD-E/128i module can provide 128 million words of memory for the computer system.

The MFC and optional SSD chassis house various configurations of logic modules and power supplies. In both the MFC and SSD chassis, the logic modules are arranged in a single column at the front of the chassis, and the power supplies are located in the back portion of the chassis.

The cooling units for the MFC and SSD dissipate the heat generated by the modules contained within these devices to an air-cooled or water-cooled refrigeration system.

The OWS is designated for your computer operator use. Cray Research hardware and software support personnel use the MWS for maintenance and troubleshooting. Both the OWS and MWS consist of a graphics display terminal (GDT-200) and a VME-based microcomputer (VBM-2). The OWS and MWS also share a single laser printer (LP-6).

Disk drives and other peripheral equipment are also used with the CRAY C92A and CRAY D92A computer systems. The number and type of disk drives and other peripheral equipment depends on individual customer needs. However, typical CRAY C92A and CRAY D92A computer system disk drive configurations consist of disk enclosures (DE-60s and DE-100s) or network disk arrays (ND-12s and ND-14s).

Refer to Section 5, “Peripheral Equipment,” for more information about the OWS, MWS, disk drives, and other optional peripheral equipment.

Figure 3-1 illustrates a typical floor plan for a CRAY C92A and CRAY D92A computer system. This diagram represents an 18 ft x 20 ft (5.5 m x 6.1 m) grid with 24 in. x 24 in. floor panels. Figure 3-2 is an illustration of a typical computer room floor plan for a CRAY C92A or CRAY D92A computer system with an SSD. Figure 3-2 represents a 22 ft x 20 ft (6.7 m x 6.1 m) grid with 24 in. x 24 in. floor panels.

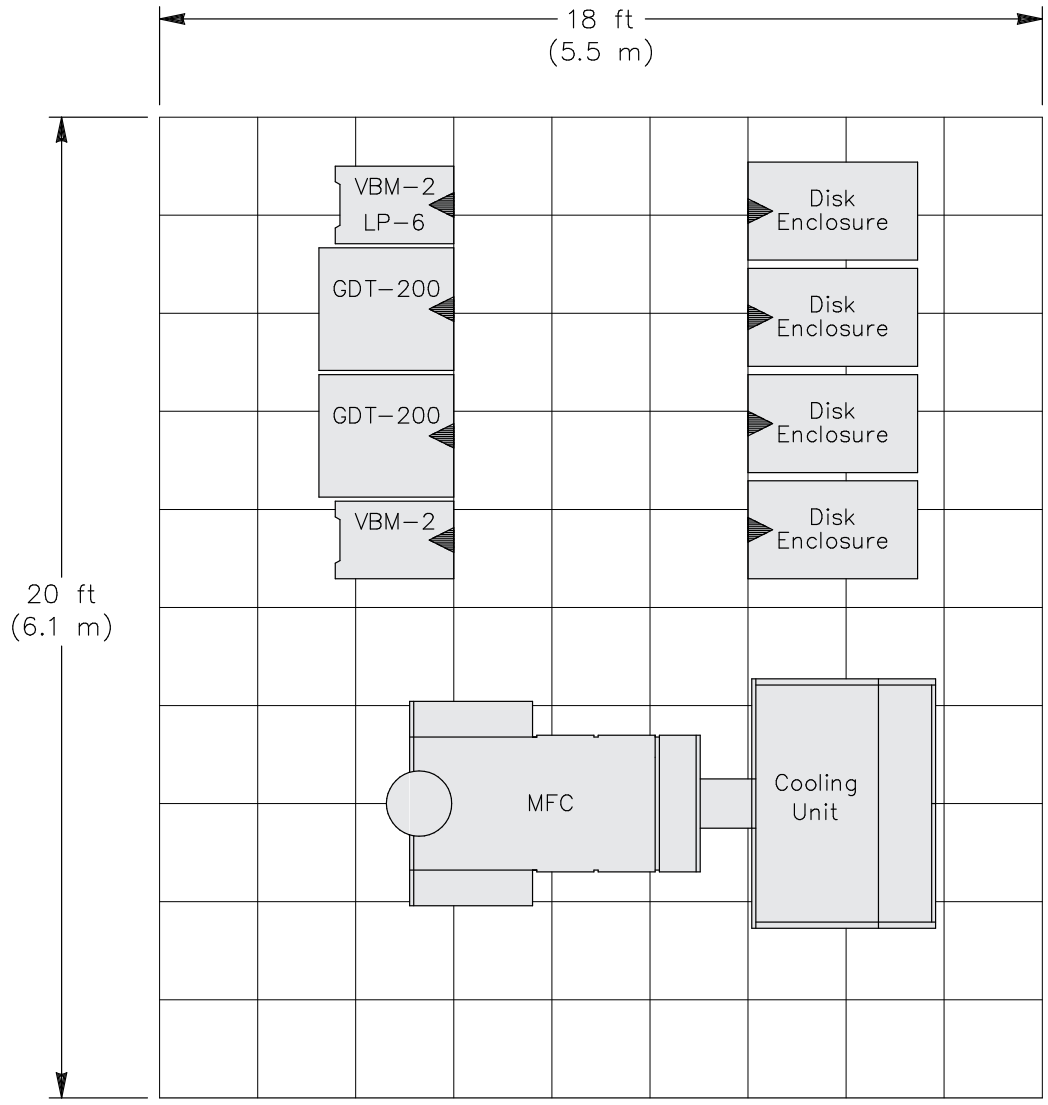

Figure 3-1. Typical Floor Plan for CRAY C92A and CRAY D92A Computer Systems

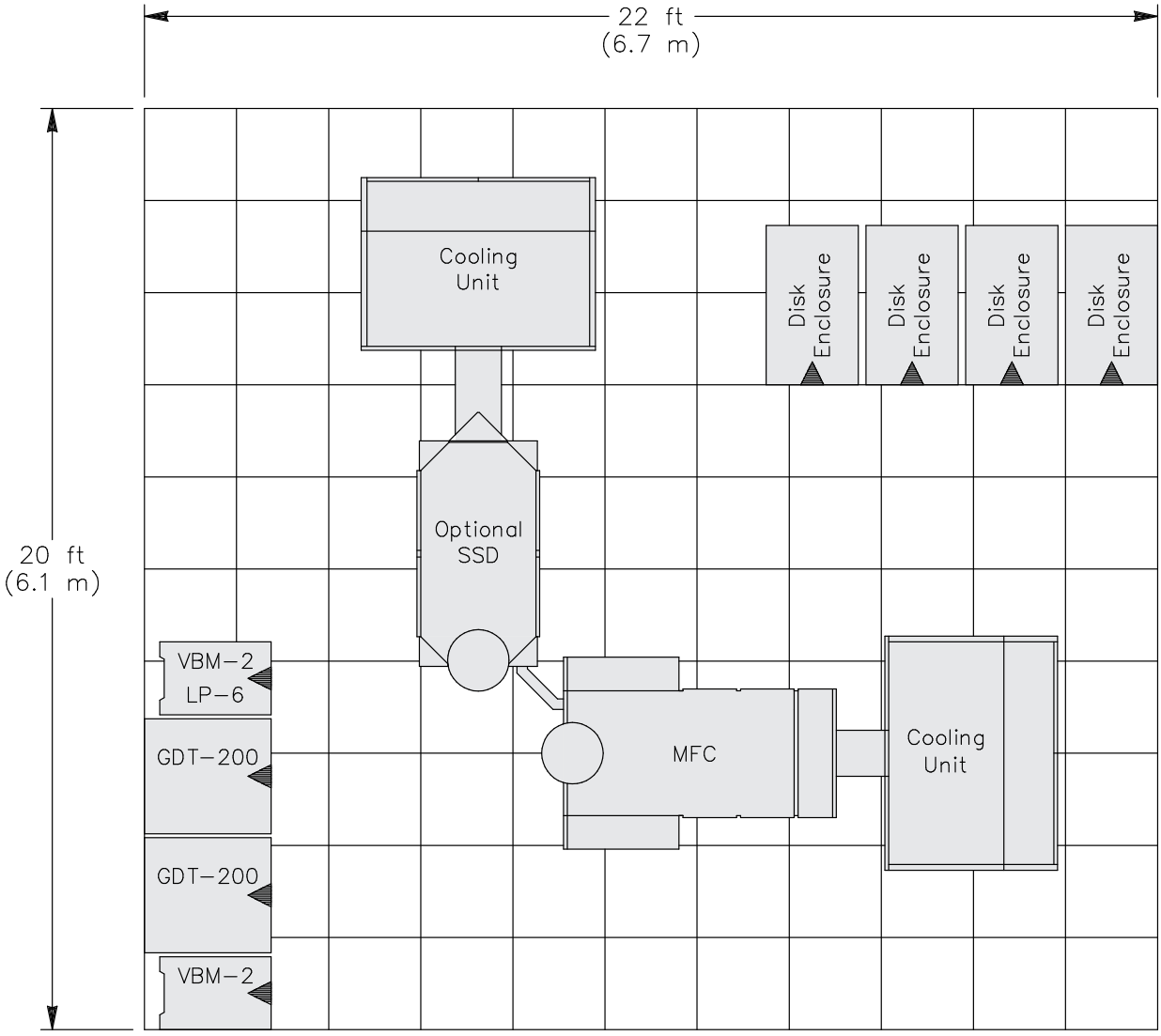

Figure 3-2. Typical Floor Plan for CRAY C92A and CRAY D92A Computer Systems with an Optional SSD

Specifications

This subsection describes the specifications for the mainframe chassis (MFC), optional SSD solid-state storage device (SSD) chassis, and cooling unit. Use the information in this section to design the computer room, plan the floor layout, and install the equipment.

Mainframe Chassis

The CRAY C92A and CRAY D92A mainframe chassis (refer to Figure 3-3) contains central processing unit (CPU) modules, memory modules, an integrated input/output subsystem (IOS), and power supplies.

Table 3-1 provides additional mainframe chassis specifications for the CRAY C92A and CRAY D92A. Refer to Figure 3-4 for the mainframe chassis shipping configuration.

Table 3-1. CRAY C92A and CRAY D92A Mainframe Chassis Specifications

Characteristic	Specification
Height	78.00 in. (198 cm)
Width	50.00 in. (127 cm)
Depth	76.75 in. (195 cm)
Weight	4,663 lbs (2,115 kg)
Floor loading	386 lbs/ft^2 (1,884 kg/m^2)
Access requirements: Sides Front	 3 ft (0.9 m) 4 ft (1.2 m)
Power consumption †	19.7 kW to 38.2 kW
Heat dissipation to air †	4.8 kW to 8.5 kW
Shipping size: Height Width Depth	78.25 in. (199 cm) 34.00 in. (86 cm) 100.50 in. (255 cm)
Shipping weight	4,562 lbs (2,069 kg)

† Refer to a machine unit specification (MUS) for the actual power consumption and heat dissipation values for your system configuration. An MUS can be obtained from your site planning representative.

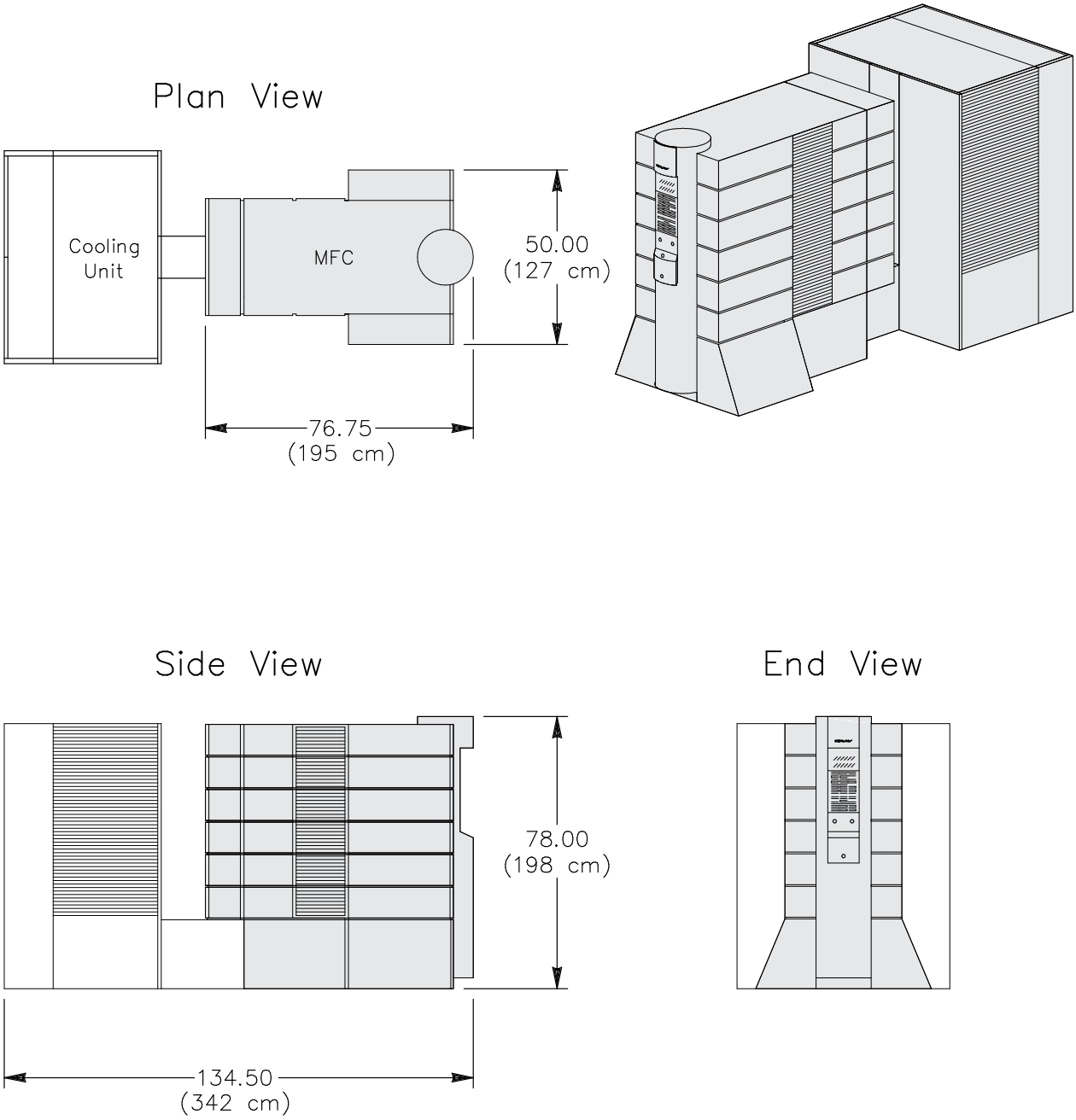

Figure 3-3. CRAY C92A and CRAY D92A Mainframe Chassis

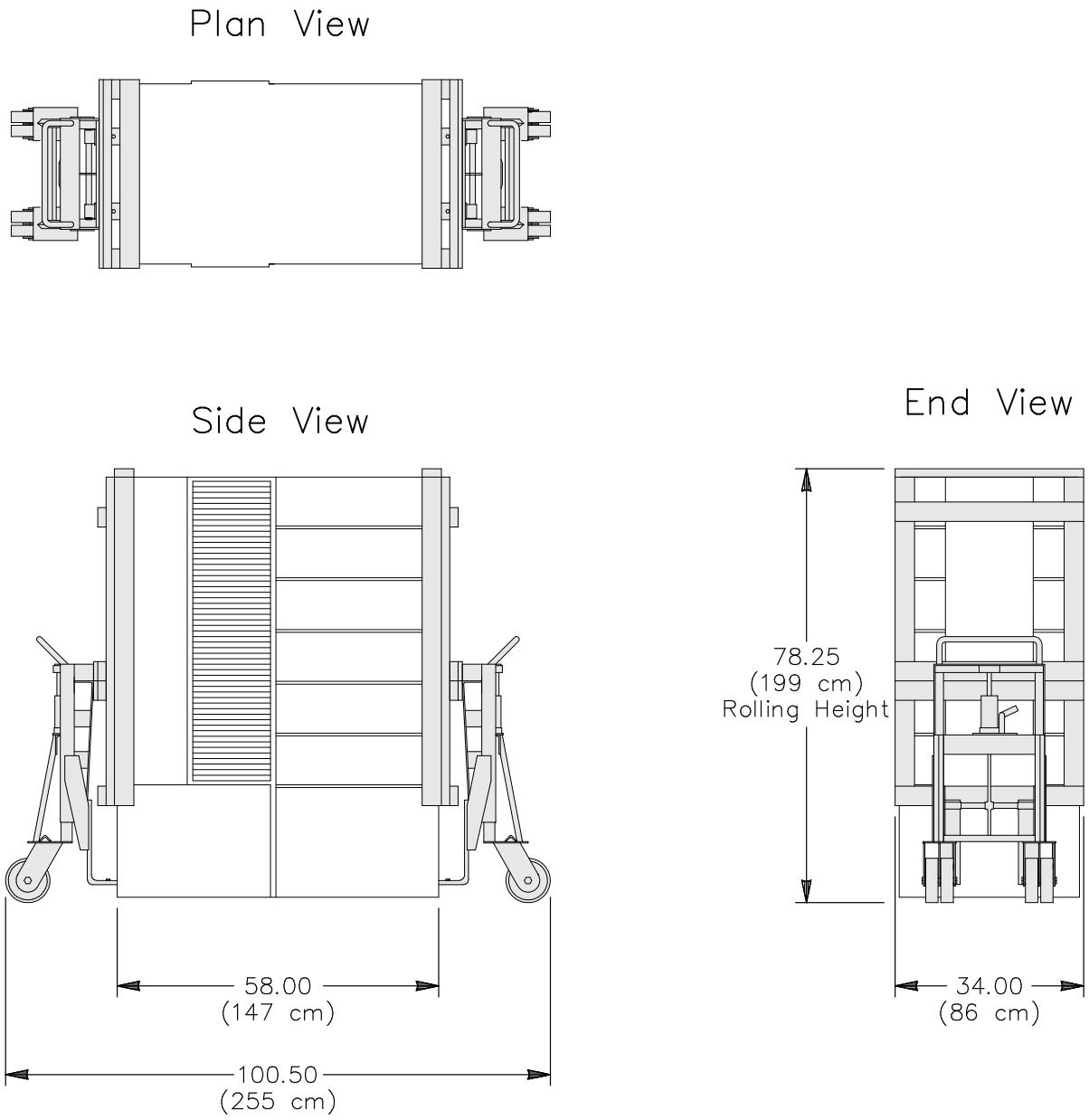

Figure 3-4. CRAY C92A and CRAY D92A Mainframe Chassis Shipping Configuration

SSD Chassis

The optional SSD chassis for the CRAY C92A and CRAY D92A computer systems contains the SSD logic and memory modules and power supplies. Refer to Table 3-2 for the SSD chassis specifications and to Figure 3-5 for an illustration of the SSD chassis.

Table 3-2. SSD Chassis Specifications

Characteristic	Specification
Height	78.00 in. (198 cm)
Width	32.00 in. (81 cm)
Depth	65.00 in. (165 cm)
Weight	3,751 lbs (1,701 kg)
Floor loading	310 lbs/ft^2 (1,513 kg/m^2)
Access requirements	3 ft (0.9 m) on front and sides
Power consumption †	11.1 kW
Heat dissipation to air †	3.1 kW
Shipping size: Height Width Depth	71.00 in. (180 cm) 34.00 in. (86 cm) 100.50 in. (255 cm)
Shipping weight	4,033 lbs (1,829 kg)

† Refer to a machine unit specification (MUS) for the actual power consumption and heat dissipation values for your system configuration. An MUS can be obtained from your site planning representative.

The SSD chassis must be placed next to the mainframe chassis. Refer again to Figure 3-2 for an illustration of the placement of the SSD chassis. Figure 3-6 illustrates the shipping configuration for the SSD.

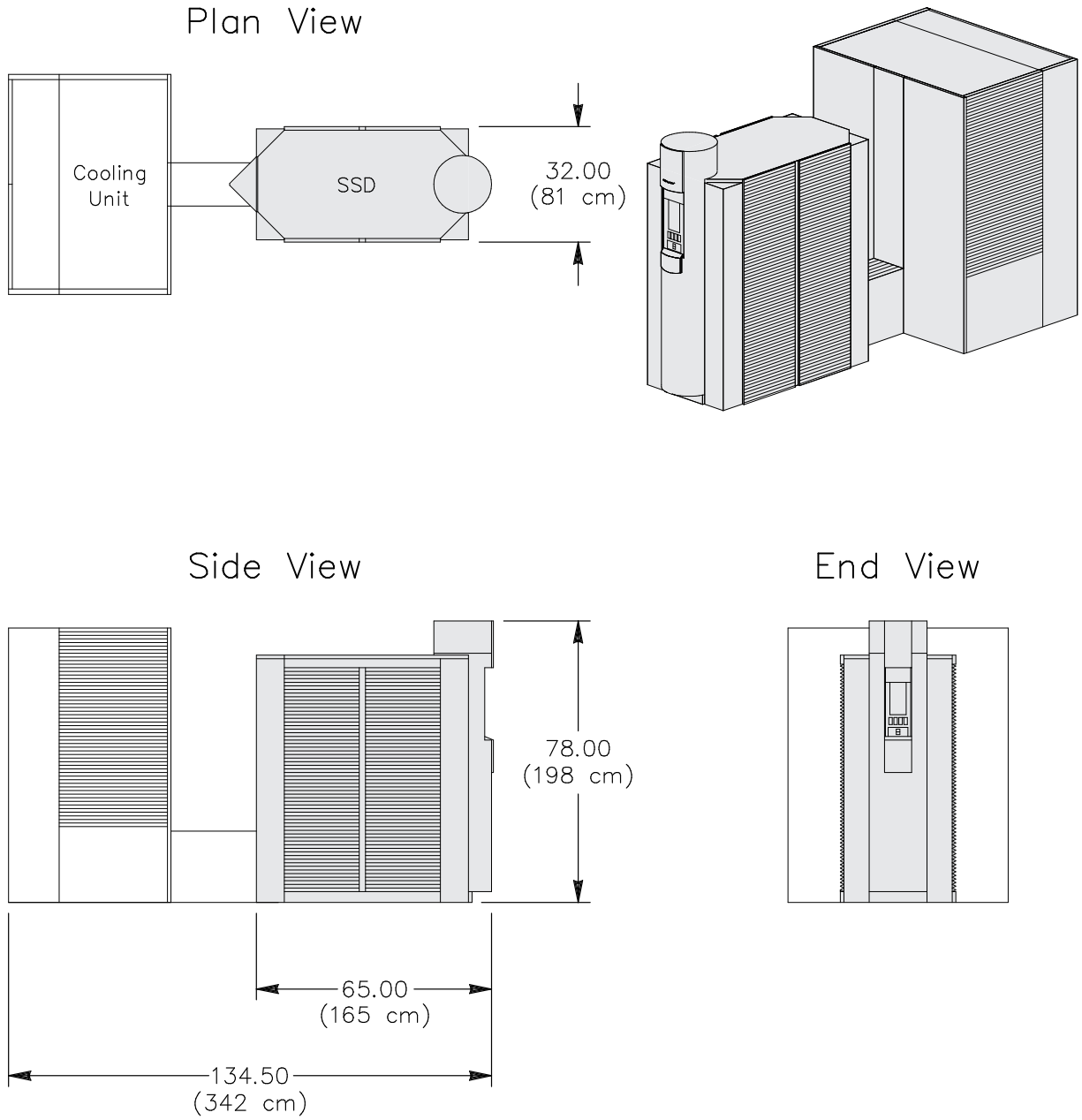

Figure 3-5. SSD Chassis

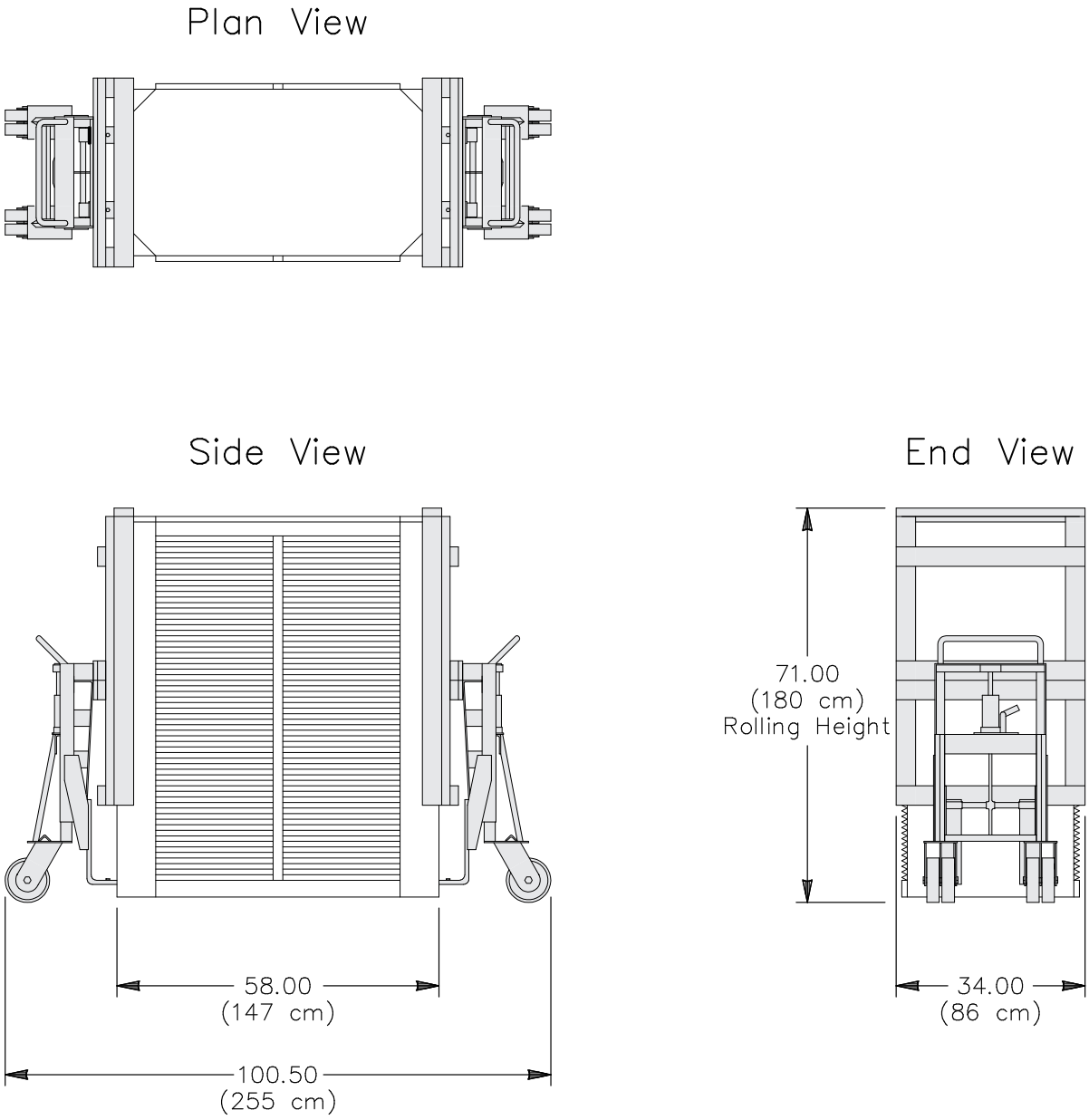

Figure 3-6. SSD Shipping Configuration

Cooling Unit Chassis

The CRAY C92A and CRAY D92A computer systems can be cooled by either air or water. The number of cooling units your computer system requires depends upon your system configuration. The mainframe has a single cooling unit. If your computer system has an SSD, it also has a cooling unit (refer to Figure 3-7). The cooling units for the mainframe and SSD have identical specifications.

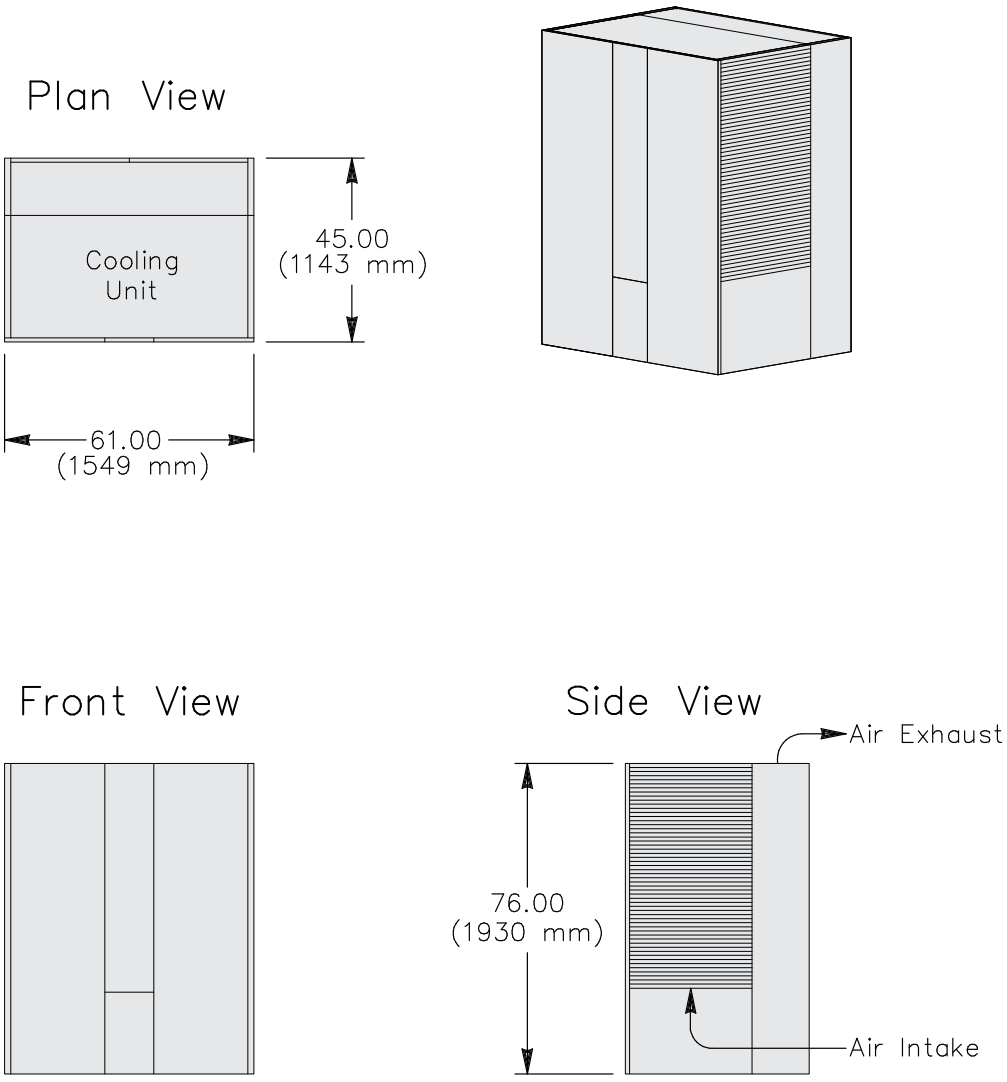

Figure 3-7. Cooling Unit Chassis

The cooling unit consists of a closed-loop dielectric-coolant system and a closed-loop refrigerant system. Refer to Figure 3-8 for an illustration of the CRAY C92A and CRAY D92A cooling system configurations. These

two systems work together to remove heat from the modules located in the MFC or optional SSD and transfer it to customer-supplied water or computer room ambient air.

NOTE: Dielectric coolant is a safe product when used properly. However, when exposed to excessive heat, dielectric-coolant liquid can decompose and produce hazardous by-products. Refer to *Safe Use and Handling of Fluorinert Liquids*, Cray Research publication number HR-00306, for information on dielectric-coolant liquid properties and precautionary requirements.

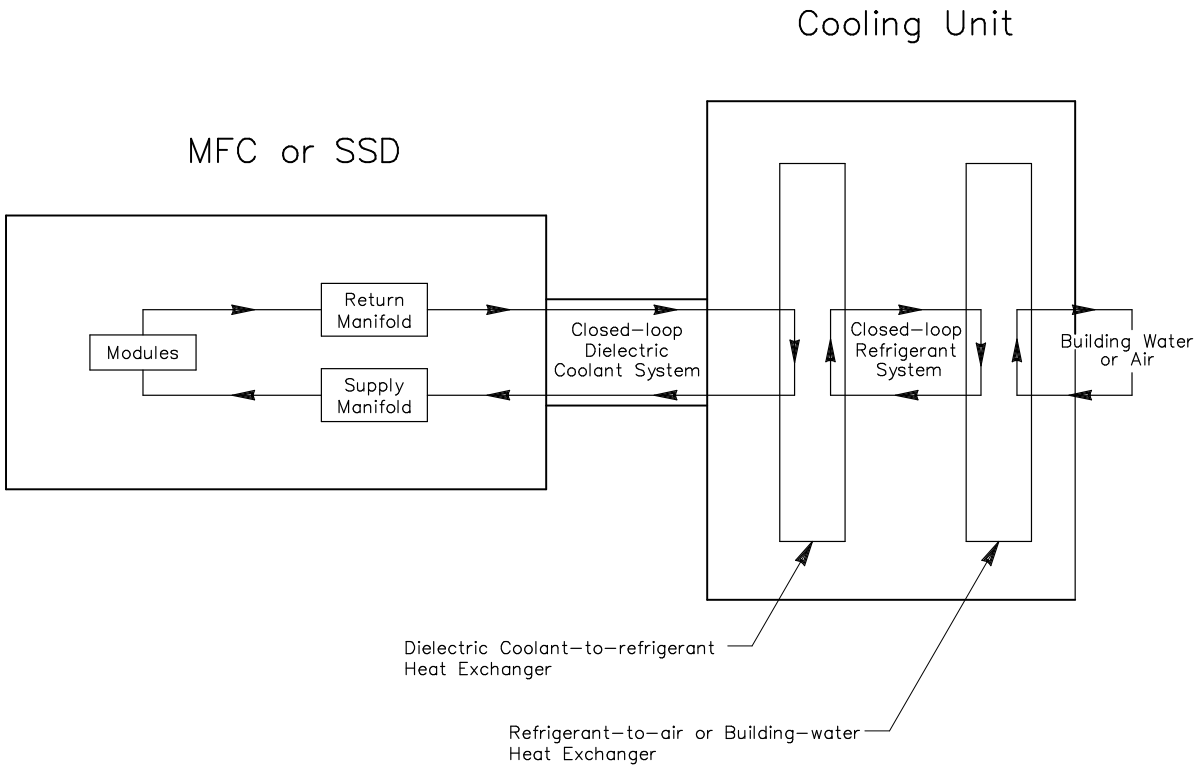

Figure 3-8. CRAY C92A and CRAY D92A Cooling System Configuration

The cooling unit chassis must be located adjacent to the MFC chassis or optional SSD chassis. Refer to Figure 3-1 and Figure 3-2 for an illustration of the placement of the cooling unit chassis.

Table 3-3 provides the cooling unit specifications. Refer to Figure 3-9 for the cooling unit shipping configuration.

Table 3-3. Cooling Unit Chassis Specifications

Characteristic	Specification
Height	76.00 in. (193 cm)
Width	61.00 in. (155 cm)
Depth	45.00 in. (114 cm)
Weight	3,344 lbs (1,517 kg)
Floor loading	193 lb/ft^2 (942 kg/m^2)
Access requirements	2 ft (0.6 m) on back and sides
Power consumption †	
MFC cooling unit	8.5 kW to 11.4 kW
SSD cooling unit	11.1 kW
Heat dissipation †	
MFC cooling unit	
Air-cooled mode	24.1 kW to 41.1 kW
Water-cooled mode	1.8 kW to 2.2 kW (to air) 21.6 kW to 38.2 kW (to water)
SSD cooling unit	
Air-cooled mode	19.1 kW
Water-cooled mode	1.6 kW (to air) 16.7 kW (to water)
Shipping size:	
Height	77.00 in. (196 cm)
Width (with blower)	44.00 in. (112 cm)
Width (without blower)	30.00 in. (76 cm)
Depth	95.00 in. (241 cm)
Shipping weight (with blower)	3,248 lbs (1,473 kg)

† Refer to a machine unit specification (MUS) for the actual power consumption and heat dissipation values for your system configuration. An MUS can be obtained from your site planning representative.

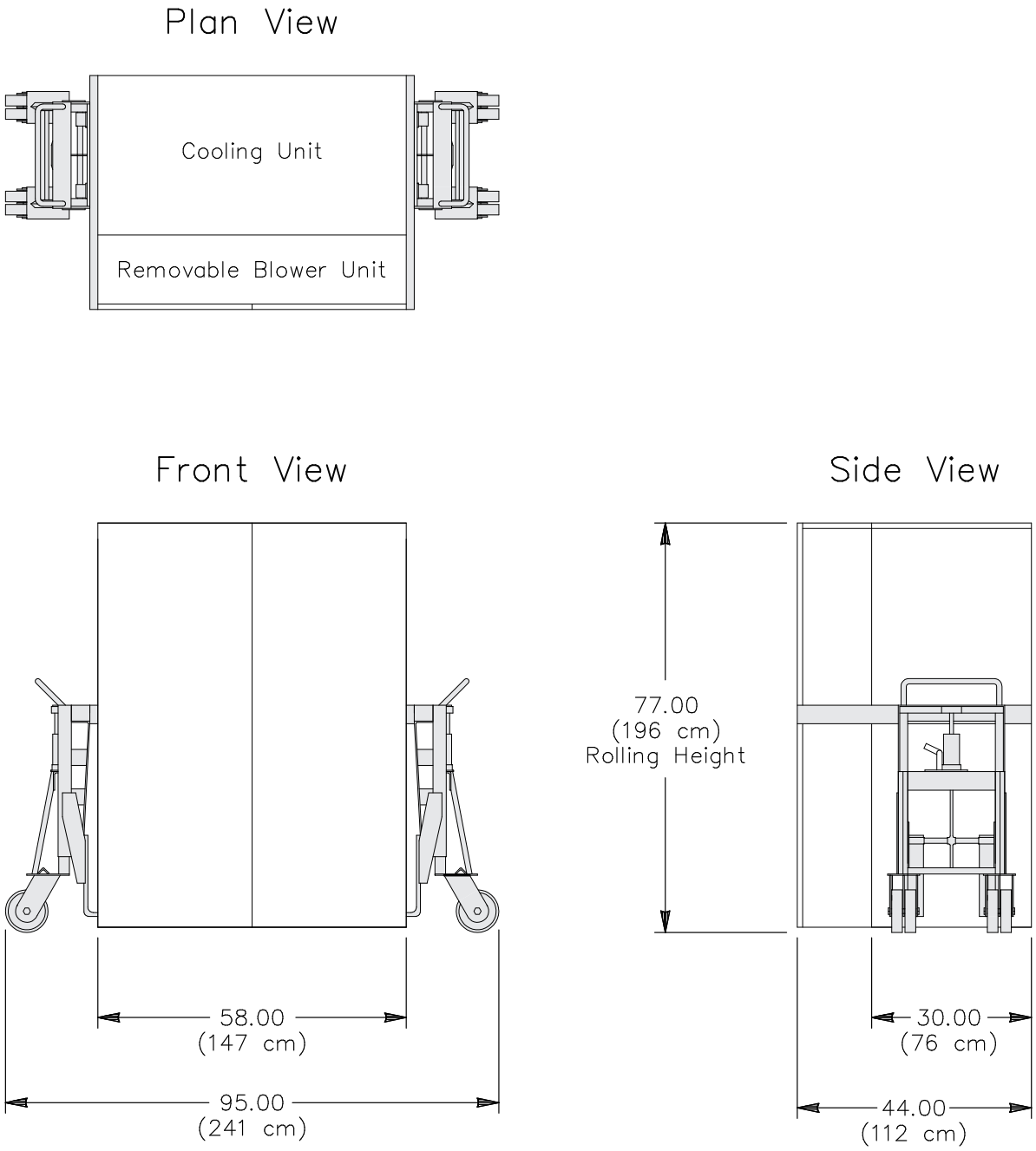

Figure 3-9. Cooling Unit Shipping Configuration

As standard equipment, the cooling unit is designed to operate in either a refrigerant-to-air or a refrigerant-to-water mode of operation. This heat-exchanger design enables the system to be air cooled or water cooled without modification.

The cooling unit is capable of functioning in one of three operating modes: water-cooled mode, air-cooled mode, or automode. You can select the operating mode by setting the cooling mode selector switch on the cooling unit to the desired mode.

When you select the water-cooled mode, heat from the system is dissipated to water.

When you select the air-cooled mode, heat from the system is dissipated to computer room air.

When you select automode, the cooling unit always begins operating in water-cooled mode. The system then can automatically switch from water-cooled mode to air-cooled mode if water does not adequately cool the system. However, the cooling unit cannot automatically switch from air-cooled mode to water-cooled mode. The cooling unit must be manually returned to water-cooled mode.

CAUTION

After switching to air-cooled mode, an additional 17.5 kW to 38.9 kW of heat is added directly to the computer room air-conditioning heat load. Unless the air-conditioning system of your facility can adequately handle this additional heat load, the room temperature and humidity conditions could vary from recommended specifications.

For additional information about the operating modes, contact your local site planning representative.

Equipment Separation Limits

The arrangement of computer equipment within the facility must meet certain placement and separation requirements. You must prepare drawings and documents that specify detailed information about the arrangement and location of the computer equipment. Cray Research site planning personnel must review and approve these drawings prior to any site preparation. You should involve the site planning personnel early in the design stage.

The following general requirements must be met when arranging your computer room:

- Personnel safety
- Maximum system performance
- Satisfactory system installation
- Satisfactory operator and maintenance access

All computer equipment arrangements must meet signal-cable length restrictions.

Figure 3-10 illustrates the equipment separation limits for the CRAY C92A and CRAY D92A computer systems.

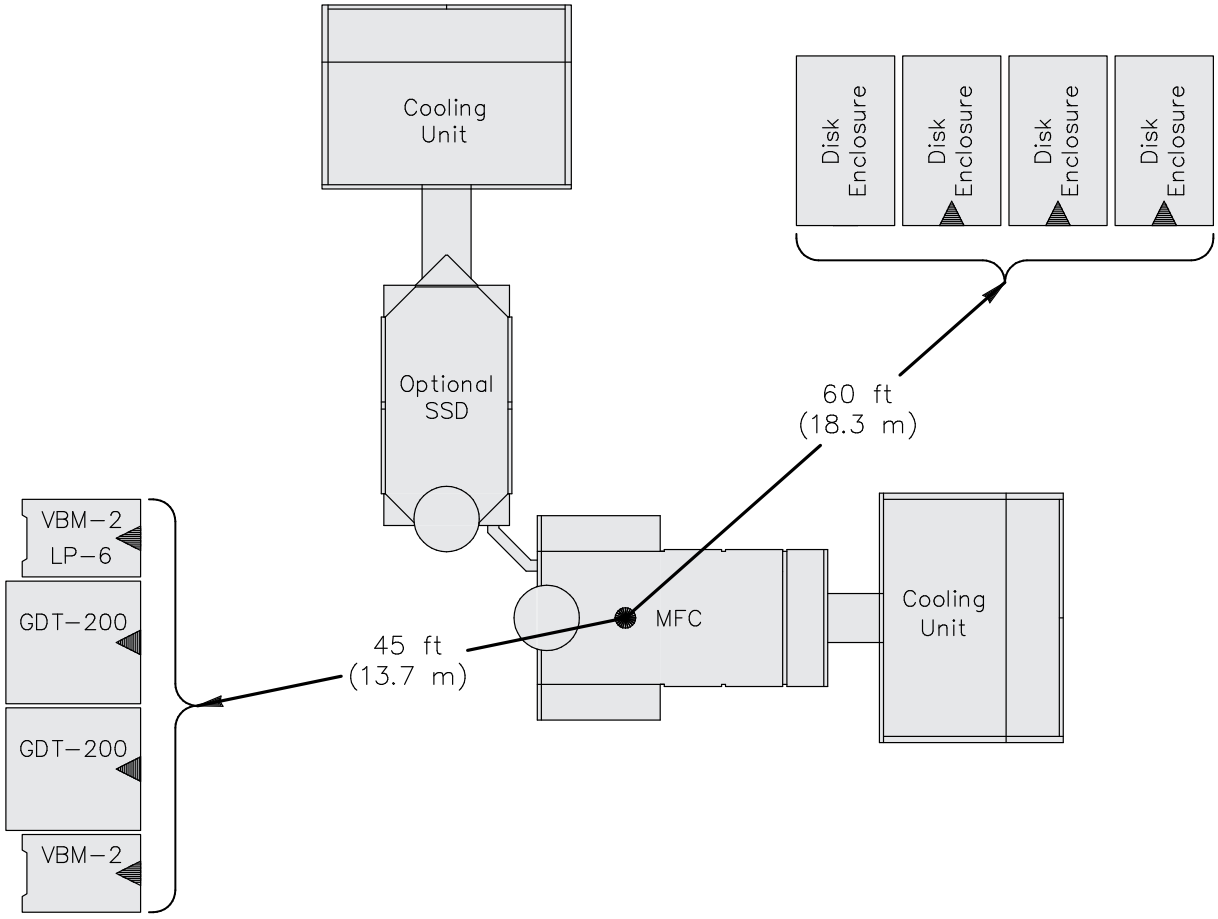

Figure 3-10. CRAY C92A and CRAY D92A Equipment Separation Limits

Floor Preparation

A properly designed and constructed raised floor serves several purposes. A raised floor can provide a signal reference grid for your computer system and provides space to route power cables, signal cables, and coolant piping. The raised-floor system should be static dissipative. Refer to *Equipment Grounding for Cray Research, Inc. Computer Systems,* Cray Research Site Engineering document number 10658002.

Cray Research recommends a minimum computer room raised-floor height of 8.00 in. (20 cm) for the CRAY C92A and CRAY D92A computer systems. If a raised floor is not available, Cray Research will supply a kit that enables you to route cables between the appropriate Cray Research equipment. You should be aware, however, that other Cray Research products require a minimum floor heights of either 12.00 in. to 18.00 in. (30 cm to 46 cm) depending upon the system model.

Your computer room floor requires three floor cutouts for the MFC and three floor cutouts for the optional SSD. These floor cutouts provide for the entrance of data, power, and cooling system connections; all floor cutouts must be free of burrs and sharp edges. In addition, some equipment requires reinforcement of the raised floor because of the concentrated floor-loading conditions. Your site planning representative will supply you with full-scale floor cutout templates to prepare the cutouts for the CRAY C92A and CRAY D92A MFC, the SSD, and the cooling units.

The illustrations in this section provide a general overview of the floor cutout requirements for the CRAY C92A and CRAY D92A computer systems. Cray Research-supplied templates show exact requirements. The following diagrams illustrate floor cutout locations and additional floor support pedestal locations. (Additional floor support pedestals reinforce the computer room floor panels beneath the CRAY C92A and CRAY D92A MFC and optional SSD.) The following list provides information about each illustration:

- Figure 3-11 illustrates a computer room floor plan in which the equipment units are arranged on 24 in. x 24 in. floor panels.
- Figure 3-12 illustrates a computer room floor plan in which the equipment units are arranged on 45 cm x 45 cm floor panels.
- Figure 3-13 illustrates a computer room floor plan in which the equipment units are arranged on 60 cm x 60 cm floor panels.

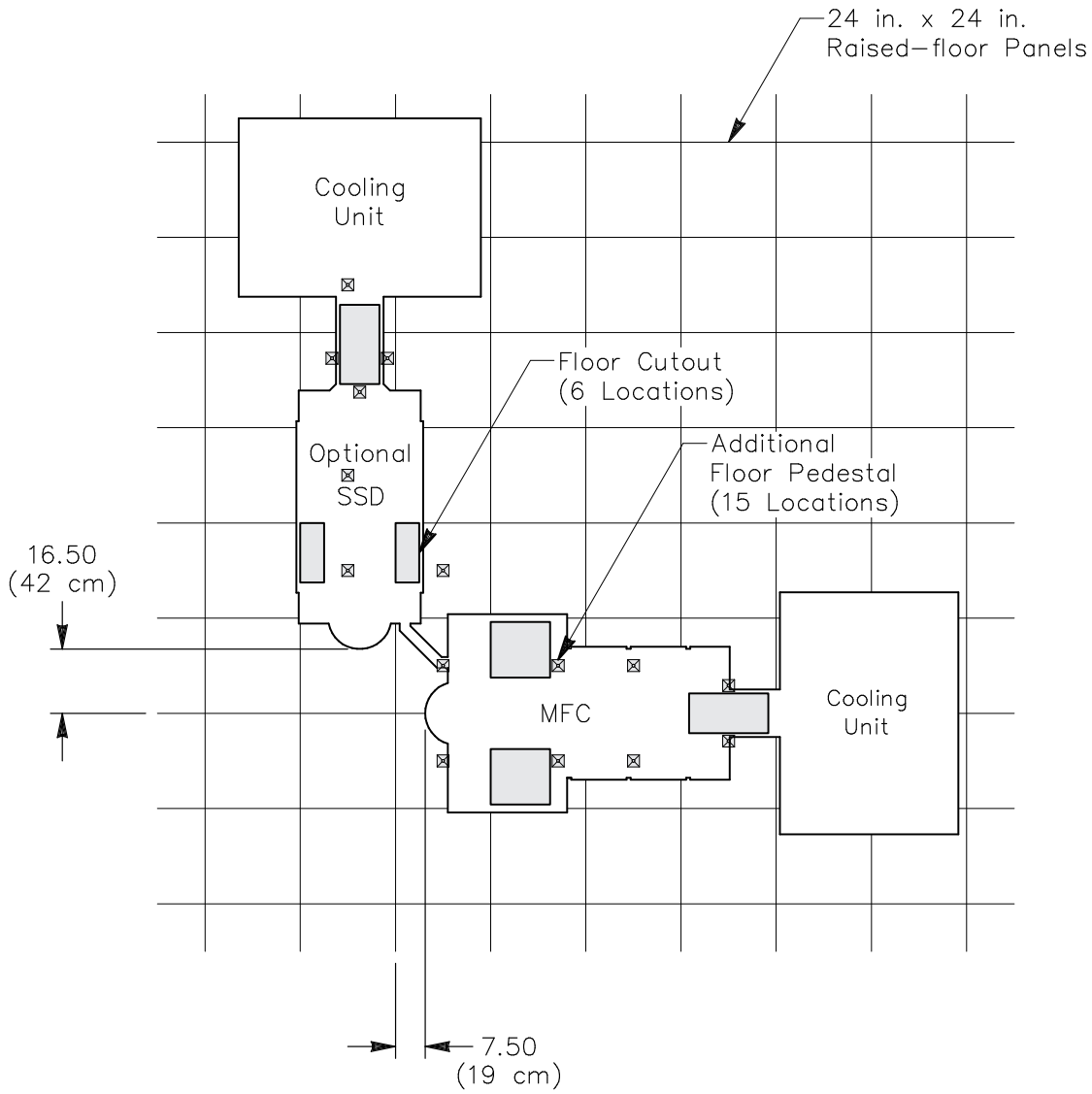

Figure 3-11. CRAY C92A and CRAY D92A Floor Plan on 24 in. x 24 in. Floor Panels

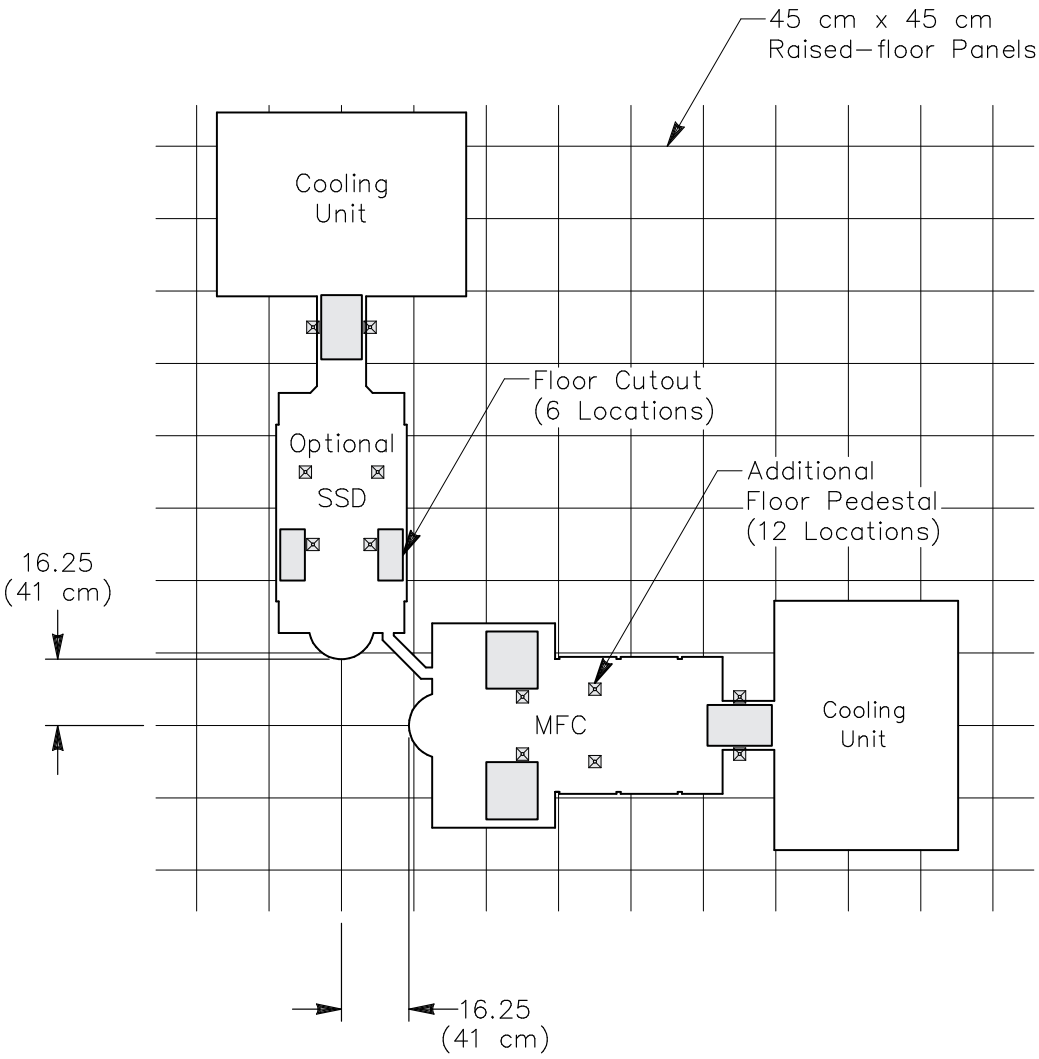

Figure 3-12. CRAY C92A and CRAY D92A Floor Plan on 45 cm x 45 cm Floor Panels

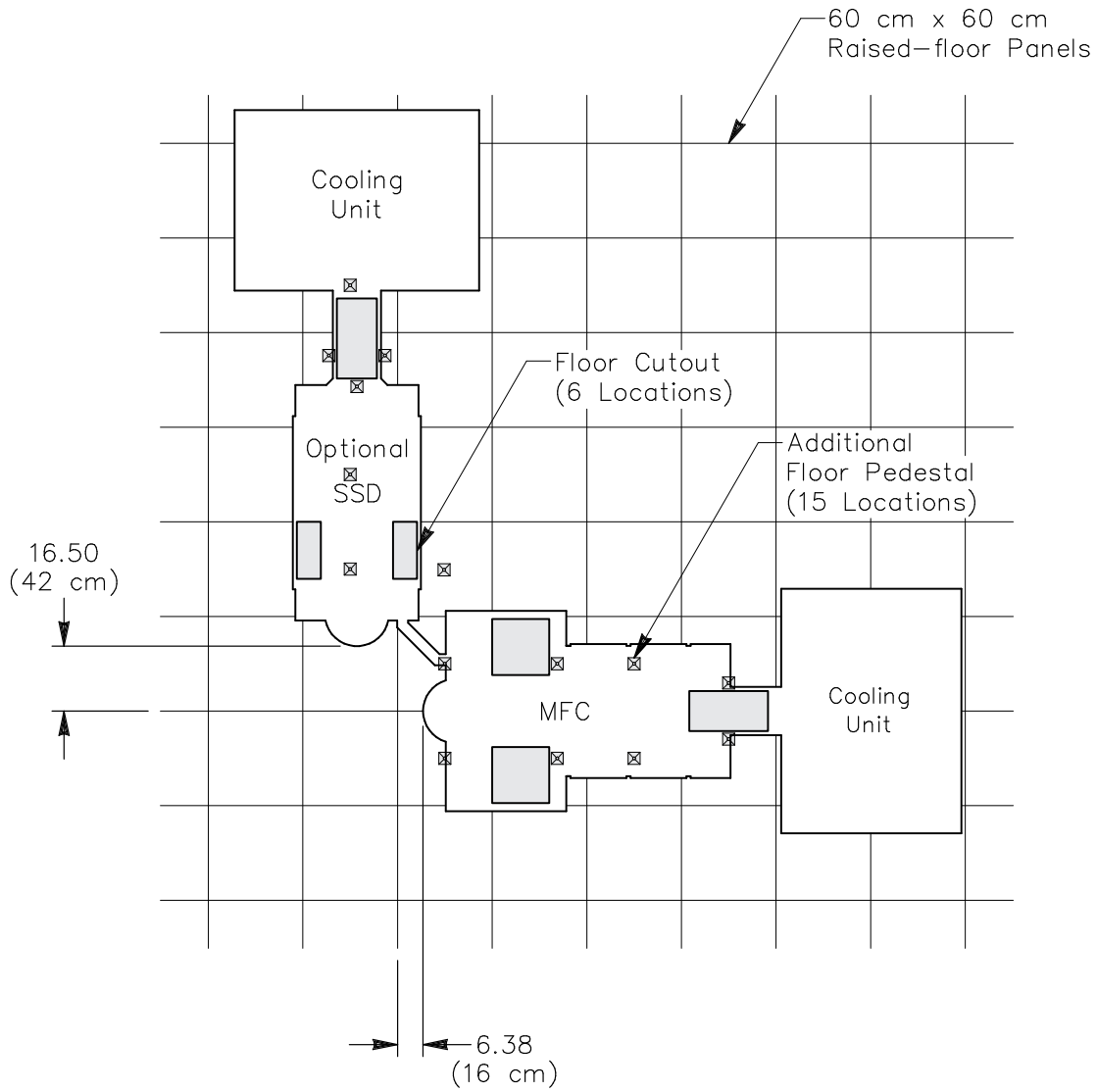

Figure 3-13. CRAY C92A and CRAY D92A Floor Plan on 60 cm x 60 cm Floor Panels

Power Wiring Requirements

You must provide and install all the power wiring, the circuit breakers, and the circuit breaker panels. Refer to Figure 3-14 for a CRAY C92A and CRAY D92A computer system wiring diagram.

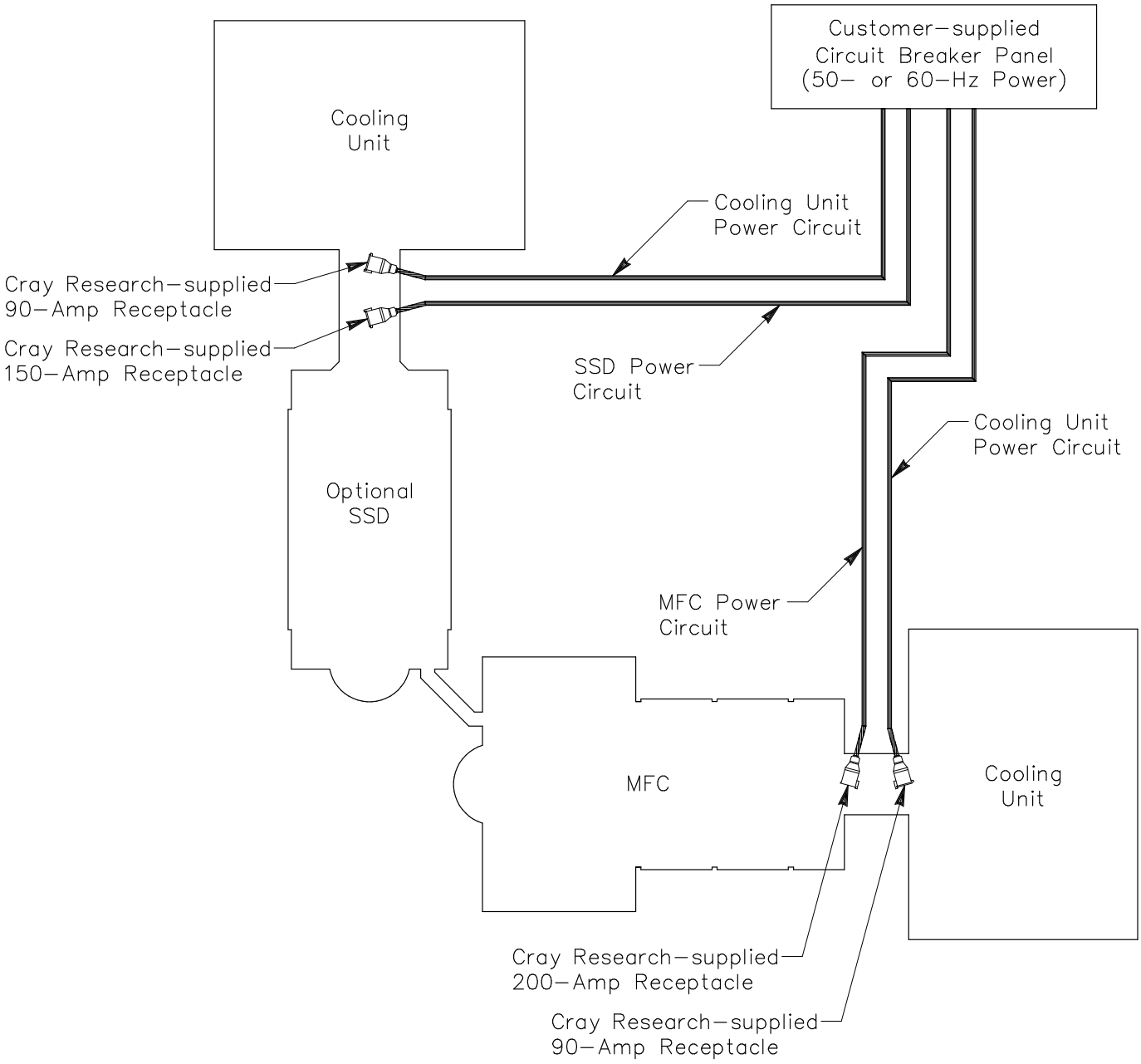

Figure 3-14. CRAY C92A and CRAY D92A Wiring Diagram

The following notes provide information in addition to the wiring diagram.

- The CRAY C92A and CRAY D92A mainframe chassis (MFC), SSD chassis, and cooling units each require one power circuit. The power circuits must be 3-phase, 4-wire circuits. The circuits must be protected by a high-instantaneous-rated circuit breaker that is tolerant of a short-term current inrush. Circuit breaker size depends on the voltage selected, as identified in Table 3-4 through Table 3-6.

NOTE: If you need additional information regarding equipment current inrush, contact your regional or international site planning representative.

- Cray Research supplies the mainframe, SSD, and cooling unit receptacles. Contact your site planning representative to arrange for the shipping of these receptacles to your site.

- Figure 3-14 is to be used as a guide for your electrical design engineer and must not be used as a bid document or as a working drawing.

- The equipment arrangement shown in Figure 3-14 is not an actual equipment layout.

- All wiring should be prepared according to applicable local and national codes.

- All cables must be routed in a manner that minimizes crosstalk. Power and logic cables should not be routed in parallel bundles.

- All circuit breakers, circuit breaker panels, magnetic contacts, main power disconnect switches, junction boxes, power wiring, and wiring raceways and conduits must be provided and installed by you.

- Your site preparation design should allow for circuit additions proportionate to system expansion plans.

- Cray Research recommends the installation of one emergency power-off switch at each computer room exit. All emergency power-off switches should interrupt power to the computer equipment and to all air-circulating units in the computer room.

- All Cray Research equipment must be earth grounded. Refer to the "Equipment Grounding" subsection in Section 2 of this manual for detailed requirements.

Table 3-4. Recommended CRAY C92A and CRAY D92A Mainframe Power and Wiring Specifications

Voltage	Amperage	Minimum Wire Size	
		AWG	mm^2
208 Vac	200 A	3/0	70
380 Vac	125 A	1	35
415 Vac	100 A	3	25
480 Vac	90 A	3	25

† The mainframe power receptacle must extend approximately 2 ft (0.6 m) above the floor cutout between the mainframe and cooling unit.

Table 3-5. Recommended SSD Power and Wiring Specifications

Voltage	Amperage	Minimum Wire Size	
		AWG	mm^2
208 Vac	150 A	1/0	50
380 Vac	90 A	3	25
415 Vac	80 A	4	25
480 Vac	70 A	4	25

† The SSD power receptacle must extend approximately 2 ft (0.6 m) above the floor cutout between the SSD and cooling unit.

Table 3-6. Recommended Cooling Unit Power and Wiring Specifications

Voltage	Amperage	Minimum Wire Size	
		AWG	mm^2
208 Vac	90 A	3	25
380 Vac	60 A	6	16
415 Vac	50 A	8	10
480 Vac	40 A	8	10

† The cooling unit power receptacle must extend approximately 6 ft (1.8m) above the floor cutout between the mainframe and cooling unit or SSD and cooling unit.

Electrical Requirements

Cray Research supplies separate receptacles to connect power to the mainframe chassis and SSD chassis; your site planning representative supplies you with these receptacles prior to system delivery. The receptacles plug into the mainframe or SSD through the floor cutout between the mainframe and cooling unit or SSD and cooling unit; the receptacles must extend approximately 2 ft (0.6 m) above the floor cutout.

The mainframe chassis and SSD chassis must be connected to the high-frequency signal reference grid with Cray Research-supplied braided straps and clamps. Refer to *Equipment Grounding for Cray Research, Inc. Computer Systems*, Cray Research Site Engineering document number 10658002, for more information about equipment grounding.

Cray Research supplies separate receptacles to connect power to the mainframe and SSD cooling units; your site planning representative supplies you with these receptacles prior to system delivery. The receptacles plug into the mainframe cooling unit or SSD cooling unit through the floor cutout between the mainframe or SSD and the cooling unit; the receptacle must extend approximately 6 ft (1.8 m) above the floor cutout.

Cray Research also supplies braided straps and clamps to connect the cooling units to the high-frequency signal reference grid. Refer to *Equipment Grounding for Cray Research, Inc. Computer Systems*, Site Engineering document number 10658002, for more information about equipment grounding.

Piping Requirements

If your system will be cooled by water, you must install water piping in the underfloor area within 4 ft (1.2 m) of the floor cutout between the mainframe and cooling unit cutout and within 4 ft (1.2 m) of the floor cutout between the SSD and cooling unit. Cray Research supplies flexible hoses with quick-disconnect couplings to connect the cooling unit to the facility piping connectors. It is the customer's responsibility to supply one of the following types of quick-disconnect nipples:

- Aeroquip - Part number FD45-1086-16-16
- Hansen - Part number B8-K36
- Parker - Part number BH8-61

The cooling unit refrigeration system contains pressure relief valves. Facility or building codes might require that a vent line be installed from the cooling unit to a suitable venting location. A union that accepts a 7/8-in (22-mm) o.d. copper tube for a soldered connection is available for the customer to attach. If a vent line is required, contact your regional or international site planning representative for additional information about sizing the pressure relief vent line.

Cooling Water Supply Requirements

The cooling unit can be cooled with water ranging in temperature from 40 ºF (4 ºC) to a maximum of 85 ºF (29 ºC). The cooling water must satisfy the requirements identified in *Water Quality Requirements*, Cray Research Site Engineering document number 10658280.

When in water-cooled mode with pure water, the maximum flow rate at 40 ºF (4 ºC) is approximately 4 gpm (0.91 m^3/hr), and at 85 ºF (29 ºC) is approximately 31 gpm (7.05 m^3/hr). Water pressure must be limited to 100 psi (690 kPa).

4 CRAY C94A COMPUTER SYSTEMS

This section provides detailed site planning information for the CRAY C94A computer system including system configurations, specifications, equipment separation limits, floor preparation information, and power wiring requirements, electrical requirements, piping requirements, and cooling water requirements.

System Configurations

The CRAY C94A computer system has several possible configurations. A standard CRAY C94A computer system consists of the following components:

- Mainframe chassis (MFC) with an optional SSD-E/32i or SSD-E/128i solid-state storage device module
- MFC cooling unit
- Optional Input/output subsystem and SSD solid-state storage device (IOS/SSD) chassis
- IOS/SSD cooling unit
- Operator workstation (OWS)
- Maintenance workstation (MWS)
- Disk drives and other peripheral equipment

The CRAY C94A computer system can be configured with either an optional IOS/SSD chassis that is a stand-alone chassis or with an optional SSD-E/32i or SSD-E/128i solid-state storage device module integrated within the MFC. The SSD-E/32i module can provide 32 million words of memory for the computer system. The SSD-E/128i module can provide 128 million words of memory for the computer system.

The MFC and optional IOS/SSD chassis house various configurations of logic modules and power supplies. In both the MFC and IOS/SSD chassis, the logic modules are arranged in a single column at the front of the chassis, and the power supplies are located in the back portion of the chassis.

The cooling units for the MFC and IOS/SSD dissipate the heat generated by the modules contained within the MFC and IOS/SSD to an air-cooled or water-cooled refrigeration system.

The OWS is designated for your computer operator use. Cray Research hardware and software support personnel use the MWS for maintenance and troubleshooting. Both the OWS and MWS consist of a graphics display terminal (GDT-200) and a VME-based microcomputer (VBM-2). The OWS and MWS also share a single laser printer (LP-6).

Disk drives and other peripheral equipment are also used with the CRAY C94A computer system. The number and type of disk drives and other peripheral equipment depend on individual customer needs. However, a typical CRAY C94A computer system disk drive configuration consists of disk enclosures (DE-60s and DE-100s) or network disk arrays (ND-12s and ND-14s).

Refer to Section 5, “Peripheral Equipment,” for more information about OWS, MWS, disk drives, and other peripheral equipment.

Figure 4-1 illustrates a typical floor plan for a CRAY C94A computer system. This diagram illustrates a 22 ft x 20 ft (6.7 m x 6.1 m) grid with 24 in. x 24 in. floor panels.

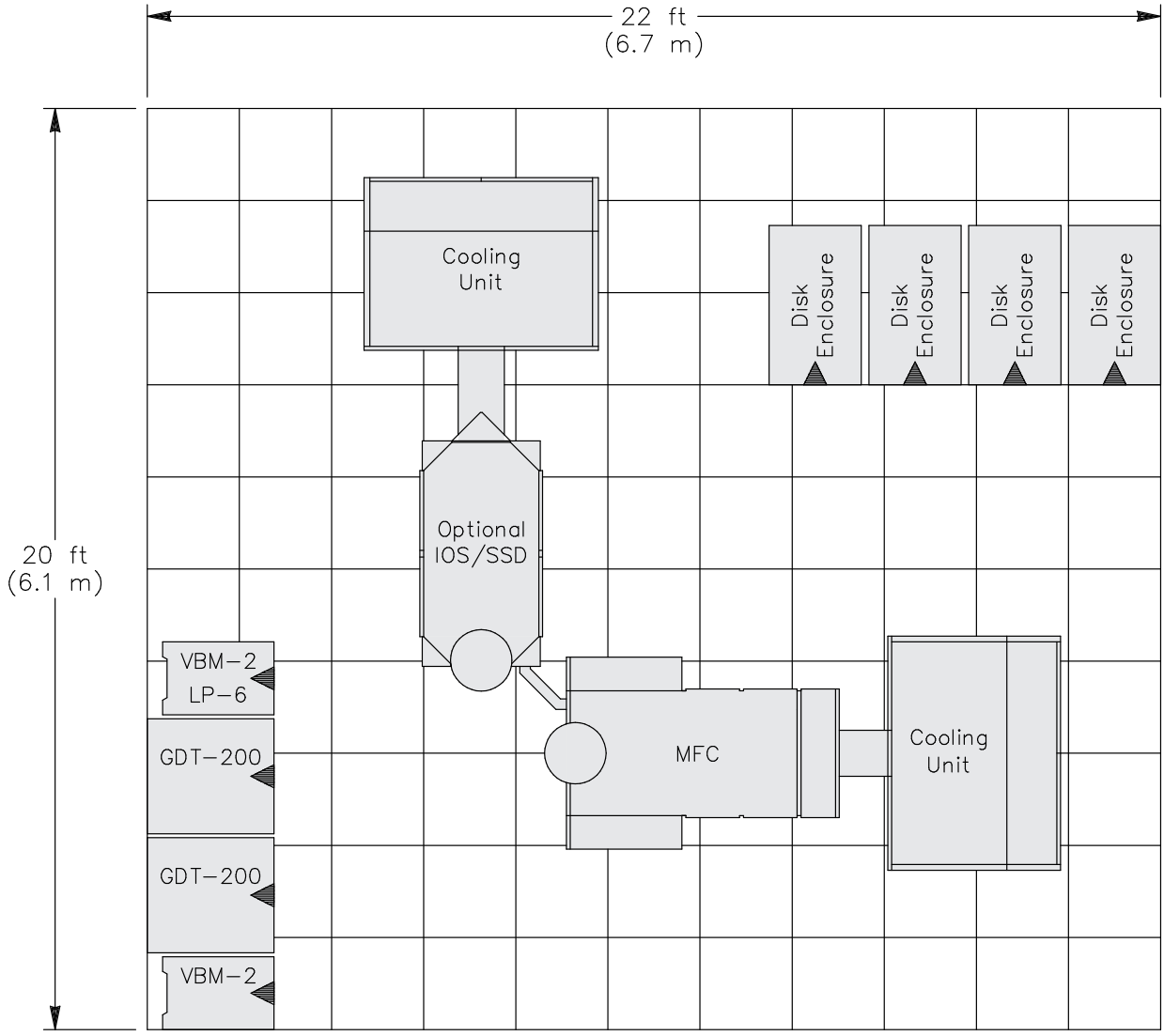

Figure 4-1. Typical Floor Plan for a CRAY C94A Computer System

Specifications

This subsection describes the specifications for the mainframe chassis (MFC), input/output subsystem and SSD solid-state storage device (IOS/SSD) chassis, and cooling units. Use the information in this section to design the computer room, plan the floor layout, and install the equipment.

Mainframe Chassis

The CRAY C94A mainframe chassis (refer to Figure 4-2) contains central processing unit (CPU) modules, memory modules, and power supplies.

Table 4-1 provides additional mainframe chassis specifications for the CRAY C94A. Refer to Figure 4-3 for the mainframe shipping configuration.

Table 4-1. CRAY C94A Mainframe Chassis Specifications

Characteristic	Specification
Height	78.00 in. (198 cm)
Width	50.00 in. (127 cm)
Depth	76.75 in. (195 cm)
Weight	4,863 lbs (2,205 kg)
Floor loading	402 lbs/ft^2 (1,962 kg/m^2)
Access requirements: Sides Front	 3 ft (0.9 m) 4 ft (1.2 m)
Power consumption †	25.5 kW to 44.2 kW
Heat dissipation to air †	6.0 kW to 9.7 kW
Shipping size: Height Width Depth	78.25 in. (199 cm) 34.00 in. (86 cm) 100.50 in. (255 cm)
Shipping weight	4,762 lbs (2,160 kg)

† Refer to a machine unit specification (MUS) for the actual power consumption and heat dissipation values for your system configuration. An MUS can be obtained from your site planning representative.

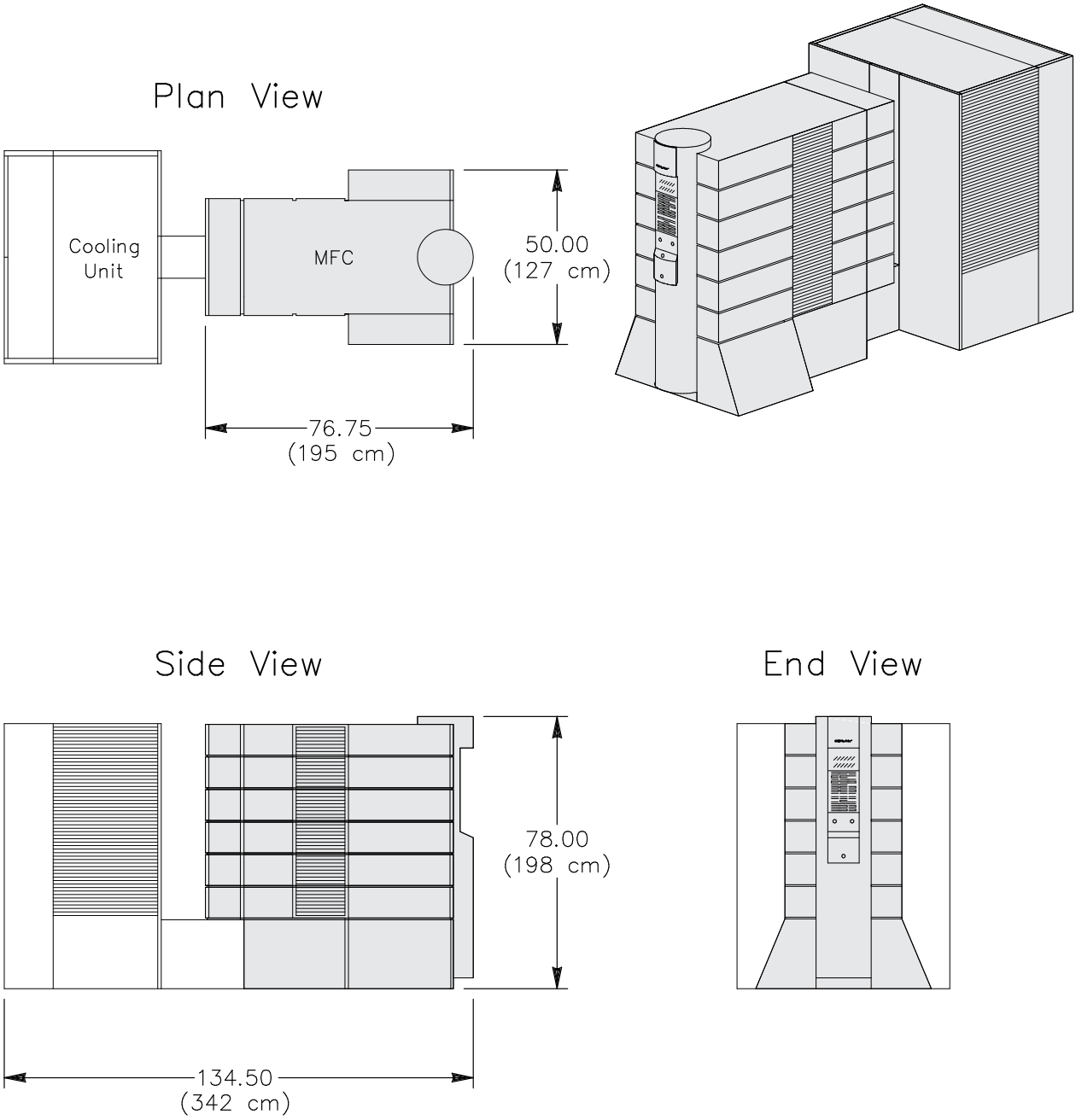

Figure 4-2. CRAY C94A Mainframe Chassis

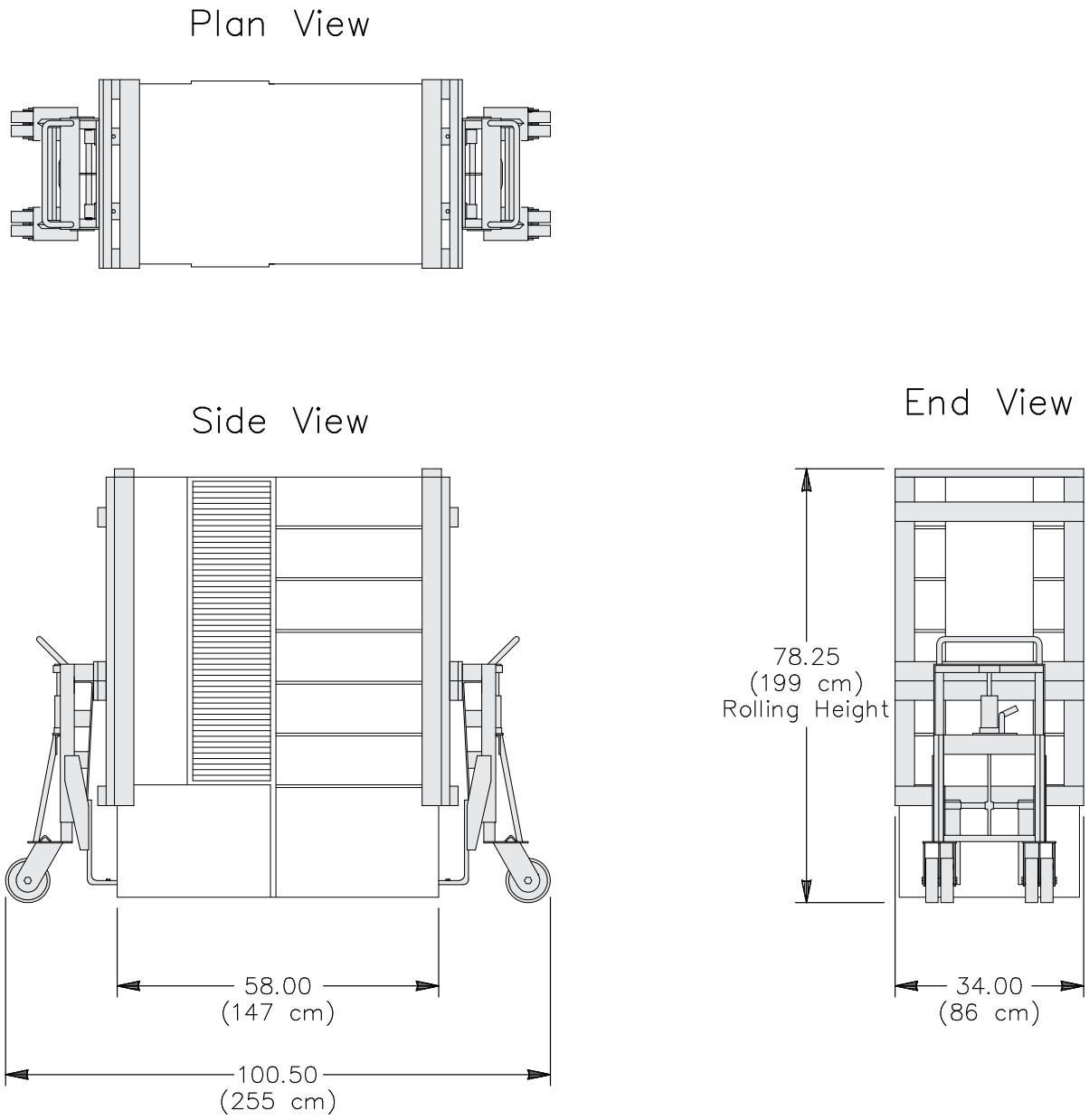

Figure 4-3. CRAY C94A Mainframe Chassis Shipping Configuration

IOS/SSD Chassis

The IOS/SSD chassis for the CRAY C94A computer system contains the IOS/SSD logic and memory modules and power supplies. Refer to Table 4-2 for the IOS/SSD chassis specifications and to Figure 4-4 for an illustration of the IOS/SSD chassis.

Table 4-2. IOS/SSD Chassis Specifications

Characteristic	Specification
Height	78.00 in. (198 cm)
Width	32.00 in. (81 cm)
Depth	65.00 in. (165 cm)
Weight	3,751 lbs (1,701 kg)
Floor loading	310 lbs/ft^2 (1,513 kg/m^2)
Access requirements	3 ft (0.9 m) on front and sides
Power consumption †	7.6 kW to 31.3 kW
Heat dissipation to air †	2.4 kW to 7.2 kW
Shipping size: Height Width Depth	71.00 in. (180 cm) 34.00 in. (86 cm) 100.50 in. (255 cm)
Shipping weight	4,033 lbs (1,829 kg)

† Refer to a machine unit specification (MUS) for the actual power consumption and heat dissipation values for your system configuration. An MUS can be obtained from your site planning representative.

The IOS/SSD chassis must be placed next to the mainframe chassis. Refer again to Figure 4-1 for an illustration of the placement of the IOS/SSD chassis. Figure 4-5 illustrates the shipping configuration for the IOS/SSD.

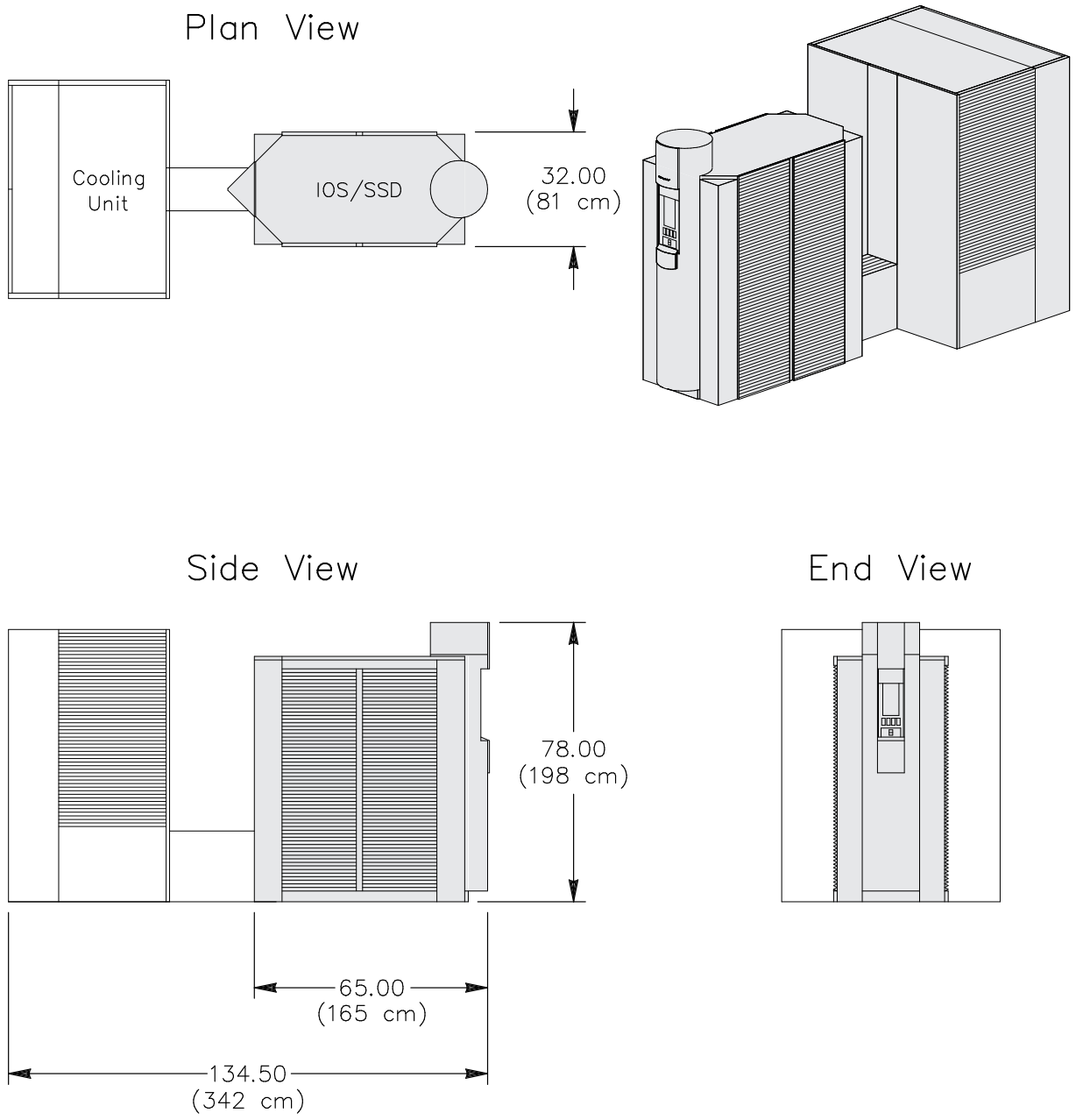

Figure 4-4. IOS/SSD Chassis

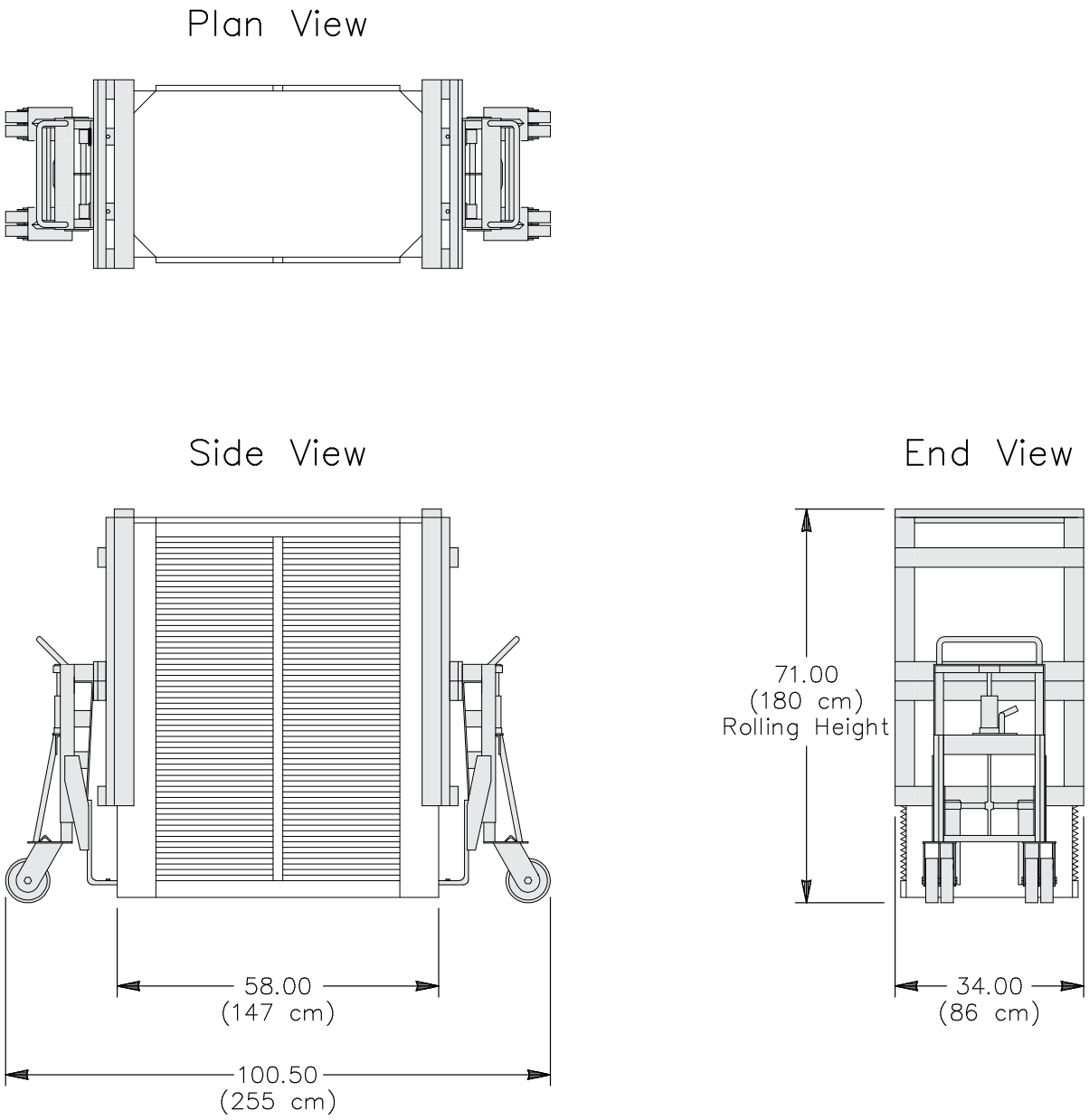

Figure 4-5. IOS/SSD Shipping Configuration

Cooling Unit Chassis

The CRAY C94A computer system can be cooled by either air or water. The mainframe has a cooling unit and the IOS/SSD has a cooling unit. The cooling units for the mainframe and IOS/SSD have identical specifications. Refer to Figure 4-6 for an illustration of the cooling unit.

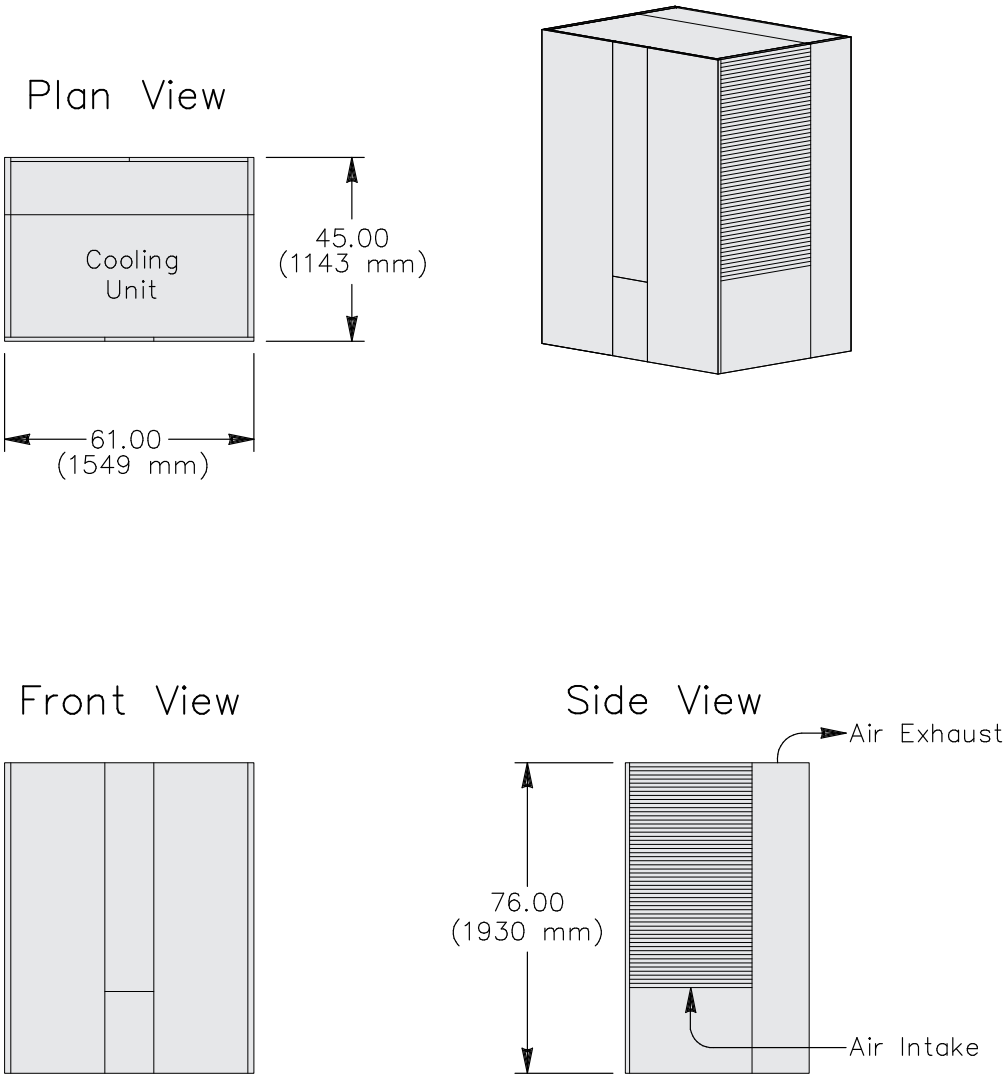

Figure 4-6. Cooling Unit Chassis

The cooling unit consists of a closed-loop dielectric-coolant system and a closed-loop refrigerant system. These two systems work together to remove heat from the modules located in the mainframe or IOS/SSD and transfer heat to customer-supplied water or computer room ambient air. Refer to Figure 4-7 for an illustration of the CRAY C94A cooling system configuration.

NOTE: Dielectric coolant is a safe product when used properly. However, when exposed to excessive heat, dielectric-coolant liquid can decompose and produce hazardous by-products. Refer to *Safe Use and Handling of Fluorinert Liquids*, Cray Research publication number HR-00306, for information on dielectric-coolant liquid properties and precautionary requirements.

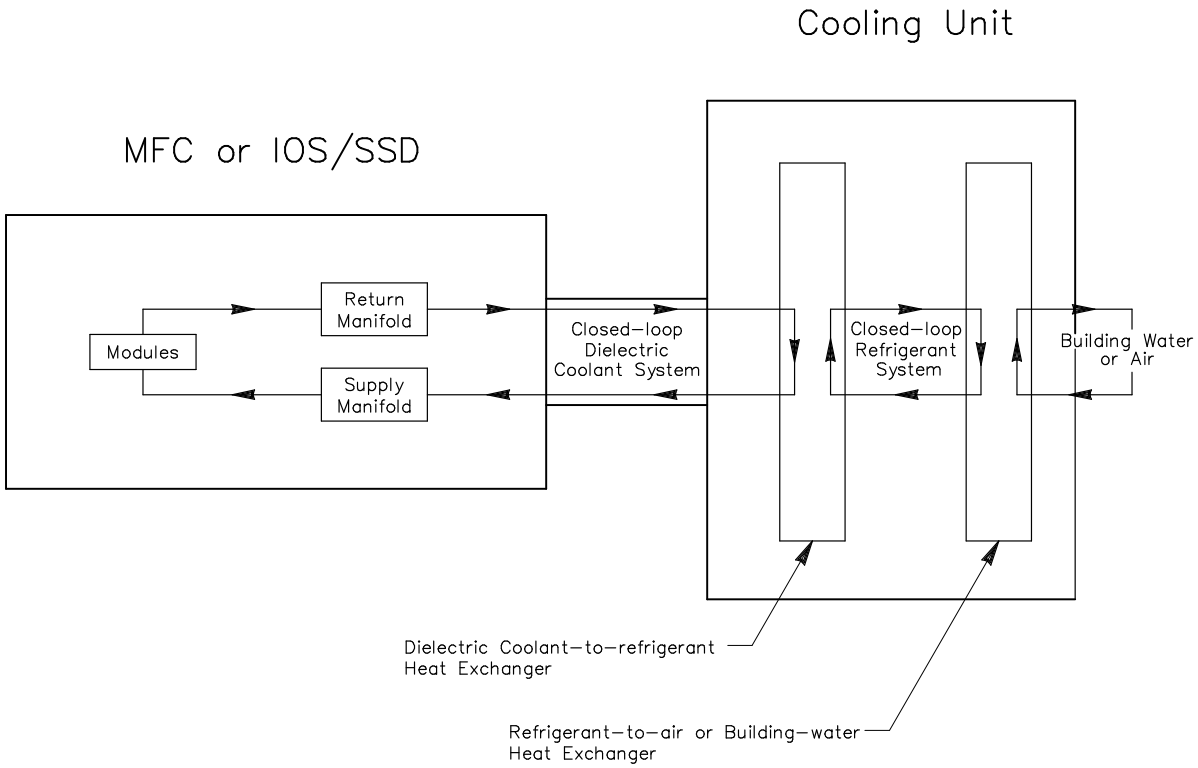

Figure 4-7. CRAY C94A Cooling System Configuration

The cooling unit chassis must be placed next to the MFC or IOS/SSD chassis. Refer to Figure 4-1 for the location of the cooling unit chassis.

Table 4-3 provides the cooling unit chassis specifications. Refer to Figure 4-8 for the cooling unit shipping configuration.

Table 4-3. Cooling Unit Chassis Specifications

Characteristic	Specification
Height	76.00 in. (193 cm)
Width	61.00 in. (155 cm)
Depth	45.00 in. (114 cm)
Weight	3,344 lbs (1,517 kg)
Floor loading	193 lbs/ft^2 (942 kg/m^2)
Access requirements	2 ft (0.6 m) on all sides
Power consumption †	
MFC cooling unit	9.1 kW to 11.6 kW
IOS/SSD cooling unit	8.4 kW to 13.4 kW
Heat dissipation †	
Mainframe cooling unit	
Air-cooled mode	30.1 kW to 46.1 kW
Water-cooled mode	2.0 kW to 2.3 kW (to air) 27.4 kW to 43.1 kW (to water)
IOS/SSD cooling unit	
Air-cooled mode	18.6 kW to 34.6 kW
Water-cooled mode	1.6 kW to 2.1 kW (to air) 16.2 kW to 31.8 kW (to water)
Shipping size:	
Height	77.00 in. (196 cm)
Width (with blower)	44.00 in. (112 cm)
Width (without blower)	30.00 in. (76.00 cm)
Depth	95.00 in. (241 cm)
Shipping weight (with blower)	3,248 lbs (1,473 kg)

† Refer to a machine unit specification (MUS) for the actual power consumption and heat dissipation values for your system configuration. An MUS can be obtained from your site planning representative.

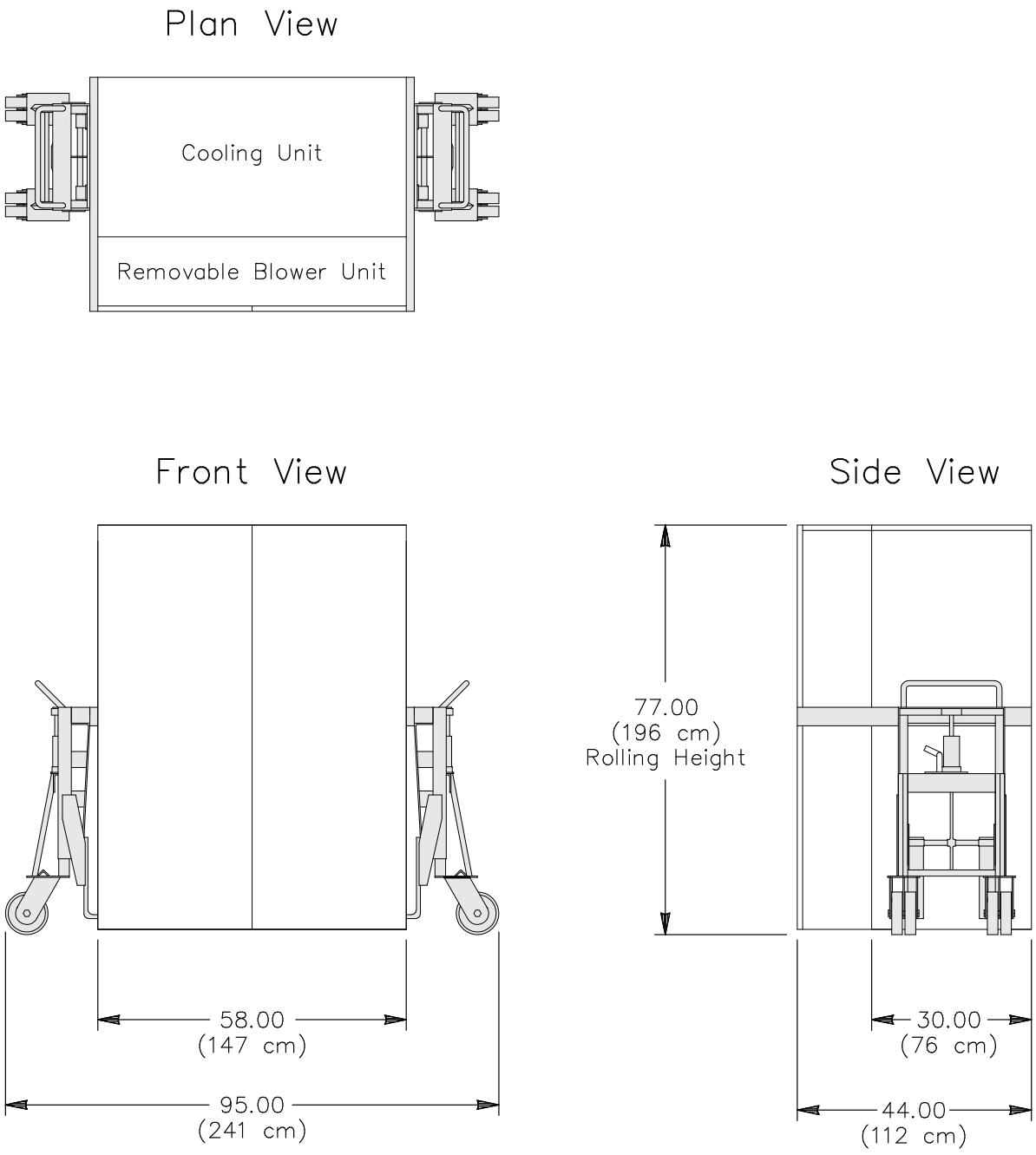

Figure 4-8. Cooling Unit Shipping Configuration

As standard equipment, the cooling unit is designed to operate in either a refrigerant-to-air or a refrigerant-to-water mode of operation. This heat-exchanger design enables the system to be air cooled or water cooled without modification.

The cooling unit is capable of functioning in one of three operating modes: water-cooled mode, air-cooled mode, or automode. The operating mode is selected by setting the cooling mode selector switch on the cooling unit to the desired mode.

When the system operates in water-cooled mode, heat from the system is dissipated to water.

When the system operates in air-cooled mode, heat from the system is dissipated to computer room air.

When automode is selected, the cooling unit always begins operating in water-cooled mode. The system then can automatically switch from water-cooled mode to air-cooled mode if water does not adequately cool the system. However, the cooling unit cannot automatically switch from air-cooled mode to water-cooled mode. The cooling unit must be manually returned to water-cooled mode.

CAUTION

After switching to air-cooled mode, an additional 17.5 kW to 44 kW of heat is added directly to the computer room air-conditioning heat load. Unless the air-conditioning system of your facility can adequately handle this additional heat load, the room temperature and humidity conditions could vary from recommended specifications.

For additional information about the operating modes, contact your local site planning representative.

Equipment Separation Limits

The arrangement of computer equipment within the facility must meet certain placement and separation requirements. You must prepare drawings and documents that specify detailed information about the arrangement and location of the computer equipment. Cray Research site planning personnel must review and approve these drawings prior to any site preparation. You should involve the site planning personnel early in the design stage.

The following general requirements must be met when arranging your computer room:

- Personnel safety
- Maximum system performance
- Satisfactory system installation
- Satisfactory operator and maintenance access

All computer equipment arrangements must meet signal-cable length restrictions.

Figure 4-9 illustrates the equipment separation limits for the CRAY C94A computer system.

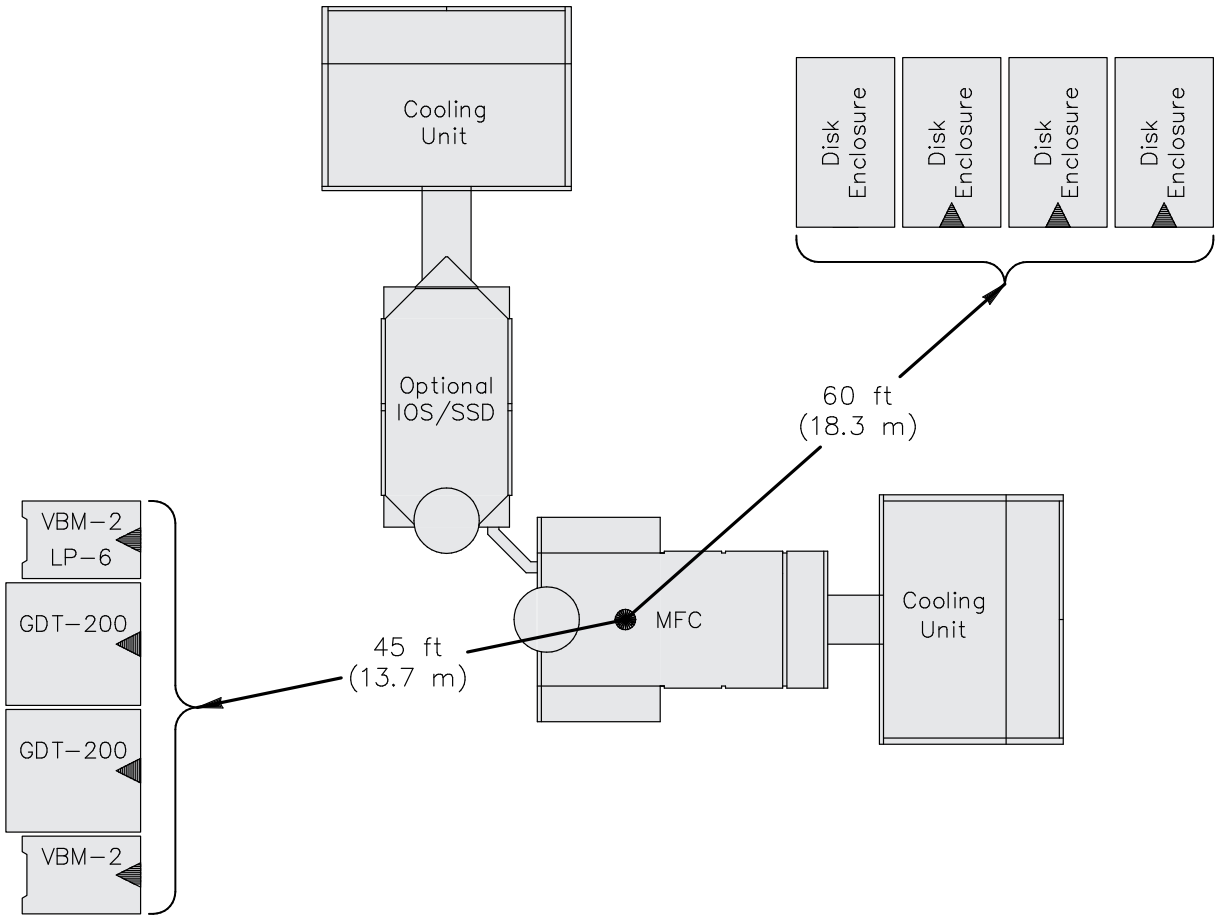

Figure 4-9. CRAY C94A Equipment Separation Limits

Floor Preparation

A properly designed and constructed raised floor serves several purposes. A raised floor can provide a signal reference grid for your computer system and provides space to route power cables, signal cables, and coolant piping. The raised-floor system should be static dissipative. Refer to *Equipment Grounding for Cray Research, Inc. Computer Systems,* Cray Research Site Engineering document number 10658002.

Cray Research recommends a minimum computer room raised-floor height of 8.00 in. (20 cm) for the CRAY C94A computer systems. If a raised floor is not available, Cray Research will supply a kit that enables you to route cables between the appropriate Cray Research equipment. You should be aware, however, that other Cray Research products require a minimum floor heights of either 12.00 in. to 18.00 in. (30 cm to 46 cm) depending upon the computer system model.

Your computer room floor requires three floor cutouts for the mainframe and three floor cutouts for the optional IOS/SSD. These floor cutouts provide for the entrance of data, power, and cooling system connections; all floor cutouts must be free of burrs and sharp edges. In addition, some equipment requires reinforcement of the raised floor because of the concentrated floor loading conditions. Your site planning representative will supply you with full-scale floor cutout templates to prepare the cutouts for the CRAY C94A mainframe, the IOS/SSD, and the cooling units.

The illustrations in this section provide a general overview of the floor cutout requirements for the CRAY C94A computer systems. Cray Research-supplied templates show exact requirements. Floor cutout locations and additional floor support pedestal locations are provided in the following diagrams. (Additional floor support pedestals reinforce the computer room floor panels beneath the CRAY C94A mainframe and IOS/SSD.) The following list provides information about each illustration:

- Figure 4-10 illustrates a computer room floor plan in which the equipment units are arranged on 24 in. x 24 in. floor panels.
- Figure 4-11 illustrates a computer room floor plan in which the equipment units are arranged on 45 cm x 45 cm floor panels.
- Figure 4-12 illustrates a computer room floor plan in which the equipment units are arranged on 60 cm x 60 cm floor panels.

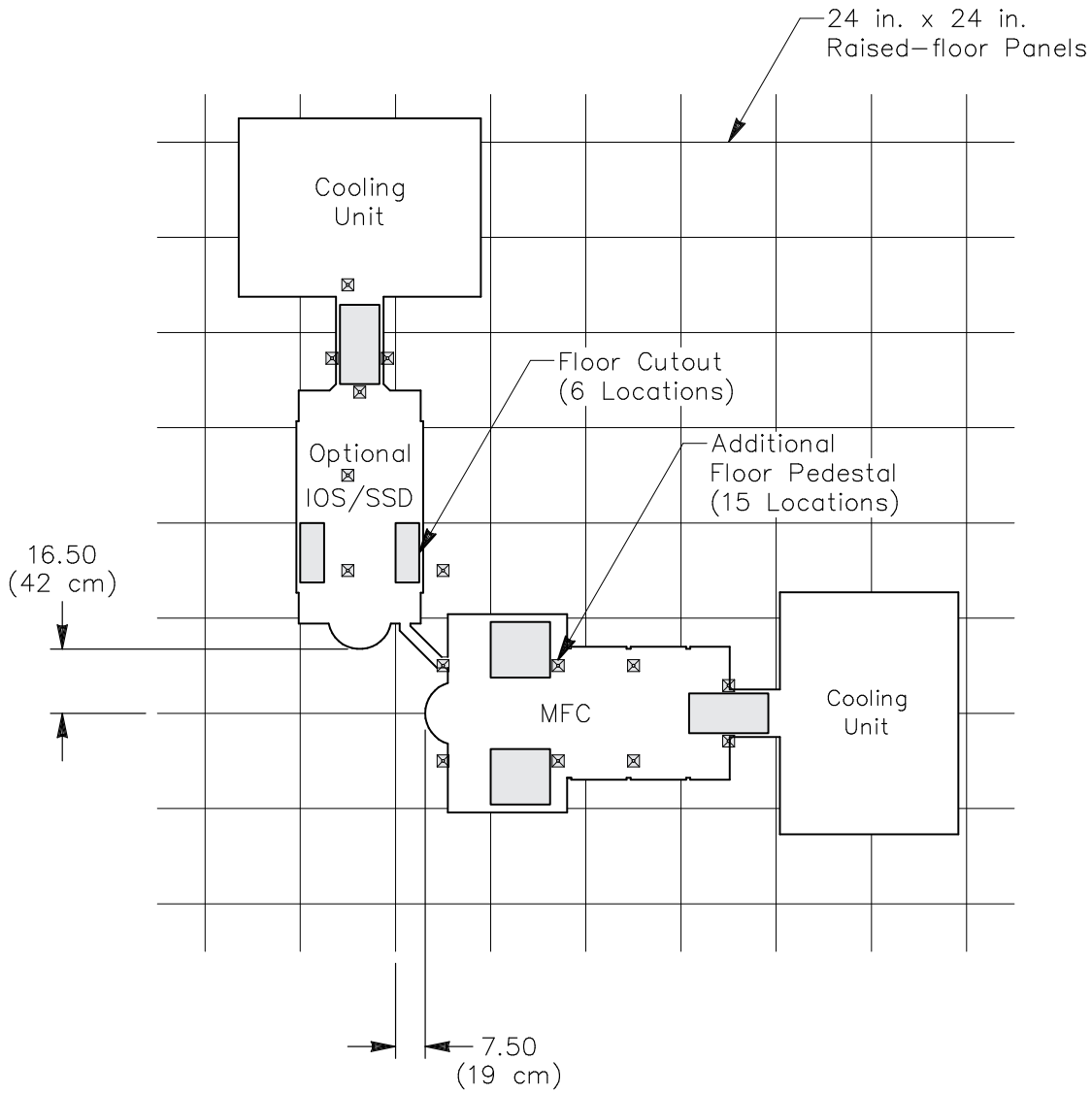

Figure 4-10. CRAY C94A Floor Plan on 24 in. x 24 in. Floor Panels

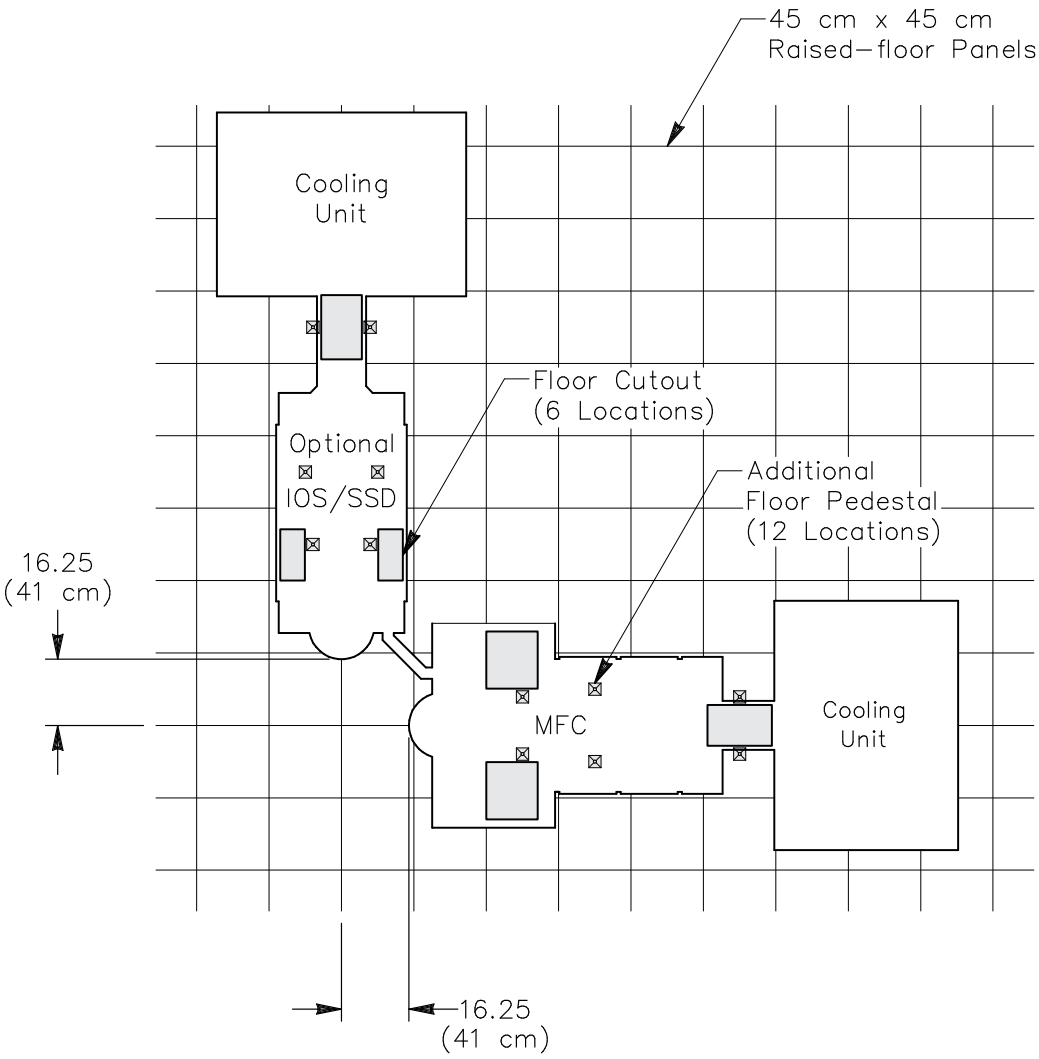

Figure 4-11. CRAY C94A Floor Plan on 45 cm x 45 cm Floor Panels

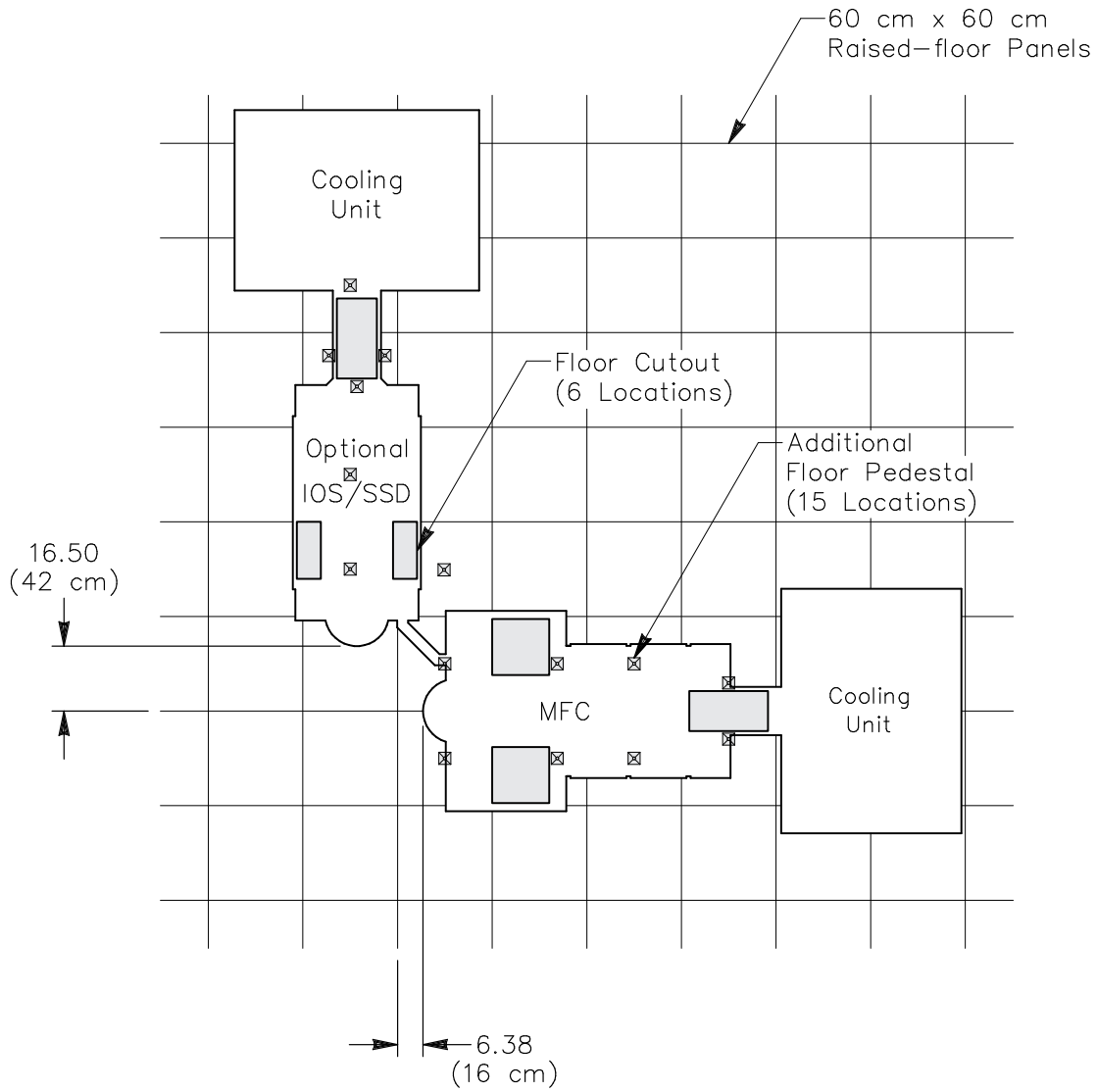

Figure 4-12. CRAY C94A Floor Plan on 60 cm x 60 cm Floor Panels

Power Wiring Requirements

You must provide and install all the power wiring, the circuit breakers, and the circuit breaker panels. Refer to Figure 4-13 for an illustration of the CRAY C94A computer system wiring diagram.

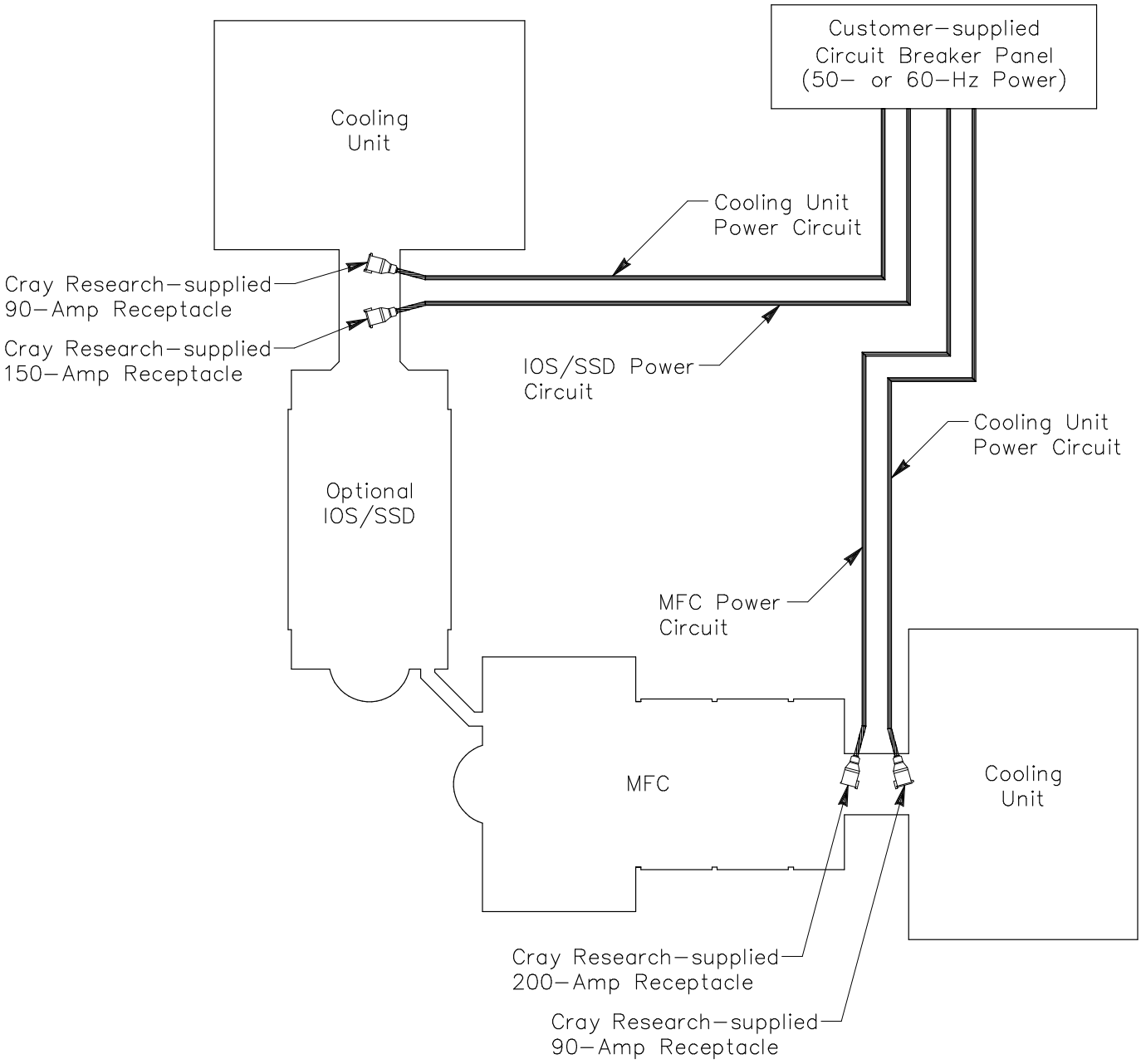

Figure 4-13. CRAY C94A Wiring Diagram

The following notes provide additional information to the wiring diagram.

- The CRAY C94A mainframe chassis (MFC), input/output subsystem and SSD solid-state storage device (IOS/SSD) chassis, and cooling units each require one power circuit. The power circuits must be 3-phase, 4-wire circuits. The circuits must be protected by a high-instantaneous-rated circuit breaker that is tolerant of a short-term current inrush. Circuit breaker size depends on the voltage selected, as identified in Table 4-4 through Table 4-6.

NOTE: If you need additional information regarding equipment current inrush, contact your regional or international site planning representative.

- Cray Research supplies the mainframe, IOS/SSD, and cooling unit receptacles. Contact your site planning representative to arrange shipment of these receptacles to your site.

- Figure 4-13 is to be used as a guide for your electrical design engineer and must not be used as a bid document or as a working drawing.

- The equipment arrangement shown in Figure 4-13 is not an actual equipment layout.

- All wiring should be prepared according to applicable local and national codes.

- All cables must be routed in a manner that minimizes crosstalk. Power and logic cables should not be routed in parallel bundles.

- All circuit breakers, circuit breaker panels, magnetic contacts, main power disconnect switches, junction boxes, power wiring, and wiring raceways and conduits must be provided and installed by you.

- Your site preparation design should allow for circuit additions proportionate to system expansion plans.

- Cray Research recommends the installation of one emergency power-off switch at each computer room exit. All emergency power-off switches should interrupt power to the computer equipment and to all air-circulating units in the computer room.

- All Cray Research equipment must be earth grounded. Refer to the "Equipment Grounding" subsection in Section 2 of this manual for detailed requirements.

Table 4-4. Recommended CRAY C94A Mainframe Power and Wiring Specifications

Voltage	Amperage	Minimum Wire Size	
		AWG	mm^2
208 Vac	200 A	3/0	70
380 Vac	125 A	1	35
415 Vac	100 A	3	25
480 Vac	90 A	3	25

† The mainframe power receptacle must extend approximately 2 ft (0.6 m) above the floor cutout between the mainframe and cooling unit.

Table 4-5. Recommended IOS/SSD Power and Wiring Specifications

Voltage	Amperage	Minimum Wire Size	
		AWG	mm^2
208 Vac	150 A	1/0	50
380 Vac	90 A	3	25
415 Vac	80 A	4	25
480 Vac	70 A	4	25

† The IOS/SSD power receptacle must extend approximately 2 ft (0.6 m) above the floor cutout between the IOS/SSD and cooling unit.

Table 4-6. Recommended Cooling Unit Power and Wiring Specifications

Voltage	Amperage	Minimum Wire Size	
		AWG	mm^2
208 Vac	90 A	3	25
380 Vac	60 A	6	16
415 Vac	50 A	8	10
480 Vac	40 A	8	10

† The cooling unit power receptacle must extend approximately 6 ft (1.8m) above the floor cutout between the mainframe and cooling unit or IOS/SSD and cooling unit.

Electrical Requirements

Cray Research supplies separate receptacles to connect power to the MFC and IOS/SSD chassis; your site planning representative supplies you with these receptacles prior to system delivery. The receptacles plug into the mainframe or IOS/SSD through the floor cutout between the mainframe and cooling unit or between the IOS/SSD and cooling unit; the receptacles must extend approximately 2 ft (0.6 m) above the floor cutout.

The mainframe chassis and IOS/SSD chassis must be connected to the high-frequency signal reference grid with Cray Research-supplied braided straps and clamps. Refer to *Equipment Grounding for Cray Research, Inc. Computer Systems*, Cray Research Site Engineering document number 10658002, for more information about equipment grounding.

Cray Research supplies separate receptacles to connect power to the mainframe and IOS/SSD cooling units; your site planning representative supplies you with these receptacles prior to system delivery. The receptacles plug into the mainframe cooling unit or IOS/SSD cooling unit through the floor cutout between the mainframe or IOS/SSD and the cooling unit; the receptacle must extend approximately 6 ft (1.8 m) above the floor cutout.

Cray Research also supplies braided straps and clamps to connect the cooling units to the high-frequency signal reference grid. Refer to *Equipment Grounding for Cray Research, Inc. Computer Systems*, Site Engineering document number 10658002, for more information about equipment grounding.

Piping Requirements

If your system will be cooled by water, you must install water piping in the underfloor area within 4 ft (1.2 m) of the floor cutout between the mainframe and cooling unit and within 4 ft (1.2 m) of the floor cutout between the IOS/SSD and cooling unit. Cray Research supplies flexible hoses with quick-disconnect couplings to connect the cooling unit to the facility piping connectors. It is the customer's responsibility to supply one of the following types of quick-disconnect nipples:

- Aeroquip - Part number FD45-1086-16-16
- Hansen - Part number B8-K36
- Parker - Part number BH8-61

The cooling unit refrigeration system contains pressure relief valves. Facility or building codes might require that a vent line be installed from the cooling unit to a suitable venting location. A union that accepts a 7/8-in (22-mm) o.d. copper tube for a soldered connection is available for the customer to attach. If a vent line is required, contact your regional or international site planning representative for additional information about sizing the pressure relief vent line.

Cooling Water Supply Requirements

The cooling unit can be cooled with water ranging in temperature from 40 ºF (4 ºC) to 85 ºF (29 ºC). The cooling water must satisfy the requirements identified in *Water Quality Requirements*, Cray Research Site Engineering document number 10658280.

When in water-cooled mode with pure water, the maximum flow rate at 40 ºF (4 ºC) is approximately 4 gpm (0.91 m^3/hr), and at 85 ºF (29 ºC) is approximately 31 gpm (7.05 m^3/hr). Water pressure must be limited to 100 psi (690 kPa).

5 PERIPHERAL EQUIPMENT

The peripheral equipment used with the CRAY C92A, CRAY D92A, and CRAY C94A computer systems includes the following devices:

- Disk enclosure (DE-60)
- Disk enclosure (DE-100)
- Removable disk cabinet (RDE-6)
- Network disk array enclosure
- Network disk personal computer (ND-PC)
- VME-based microcomputer (VBM-2)
- Color graphics display terminal (GDT-200)
- Line printer (LP-6)
- Single display table (TBL-3)
- Front-end interface cabinet (FEC)
- Fiber-optic link (FOL and FOL-4) cabinet
- Front-end interface and fiber-optic link (FEI/FOL)
- Fiber-optic enclosure (FOE-1)

To prepare your site for the installation of peripheral devices, you must provide floor cutouts. Floor cutouts provide an opening for data and power connections. The floor cutouts must be free of burrs and sharp edges to prevent damage to these system connections.

Some floor cutout diagrams indicate a 3.50-in. (9-cm) circular cutout; you may substitute a 4.00-in. (10-cm) square cutout for this circular cutout.

Disk Enclosure (DE-60)

The disk enclosure (DE-60) can house up to ten DD-60, DD-61, or DD-62 disk drives. These disk drives are fan-cooled devices. A DD-60 disk drive has a storage capacity of 1.96 Gbytes. A DD-61 disk drive has a storage capacity of 2.23 Gbytes. A DD-62 disk drive has a storage capacity of 2.73 Gbytes.

Table 5-1 provides additional specifications for the DE-60. Refer to Figure 5-1 for an illustration of the DE-60.

Table 5-1. DE-60 Specifications

Characteristic	Specification
Height	61.75 in. (157 cm)
Width	24.00 in. (61 cm)
Depth	41.50 in. (105 cm)
Weight (maximum)	960 lbs (435 kg)
Access requirements: Side Front Back	 2.00 in. (5 cm) 36.00 in. (91 cm) 30.00 in. (76 cm)
Heat dissipation to air (maximum)	8.53 kBtu/hr (2.50 kW)
Cooling requirements	Ambient air
Power cable	6-ft (1.8-m) pluggable drop cord
Power receptacle	NEMA-type L21-20R (box mounted or in line)

NOTE: The DE-60 must be positioned so that the exhaust air of another heat-rejecting device does not enter the air inlet of the DE-60. The air inlet is located at the front of the DE-60; the air exhaust is located at the top of the DE-60.

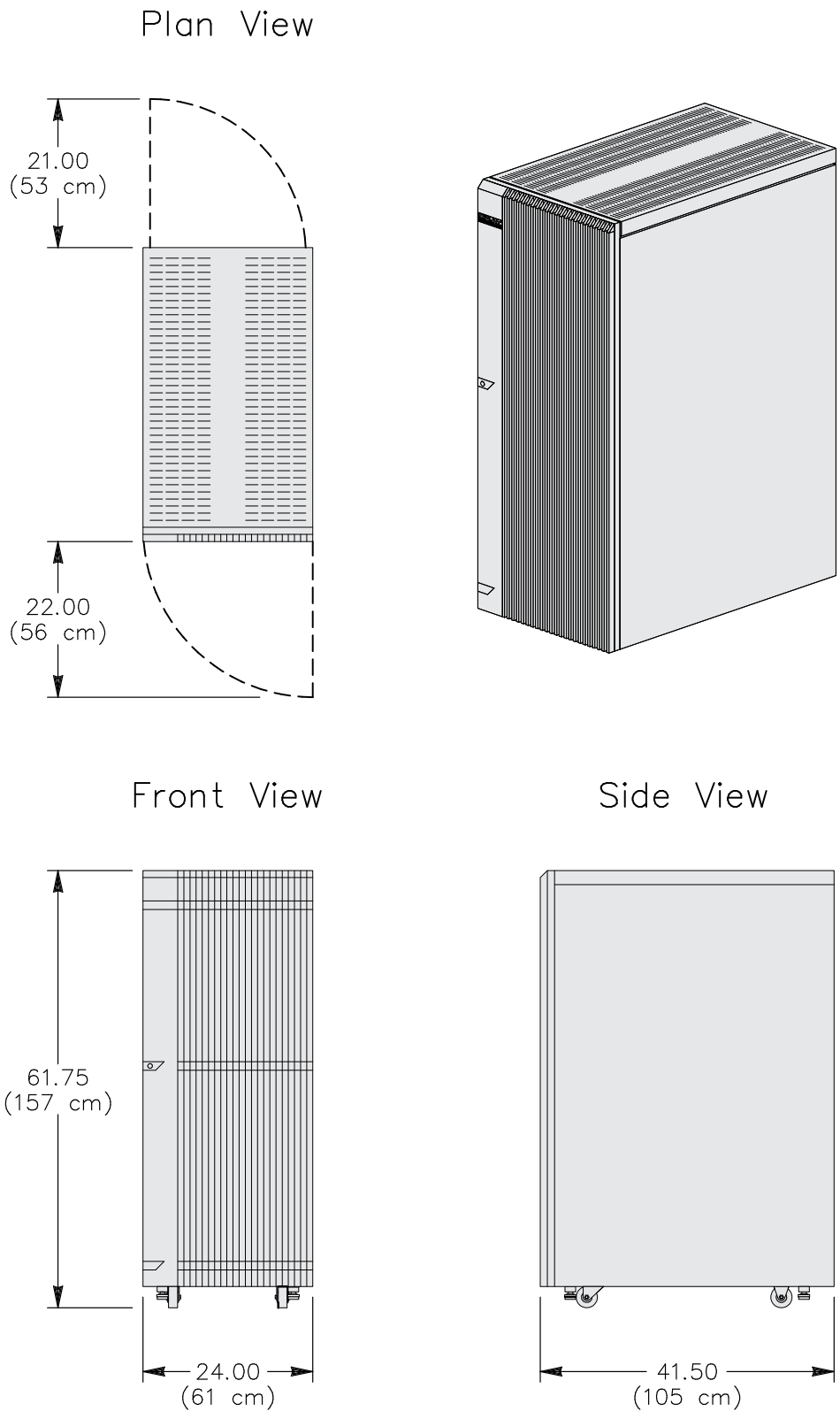

Figure 5-1. Disk Enclosure (DE-60)

You must prepare a single floor cutout for the DE-60. Refer to Figure 5-2 for an illustration of this floor cutout.

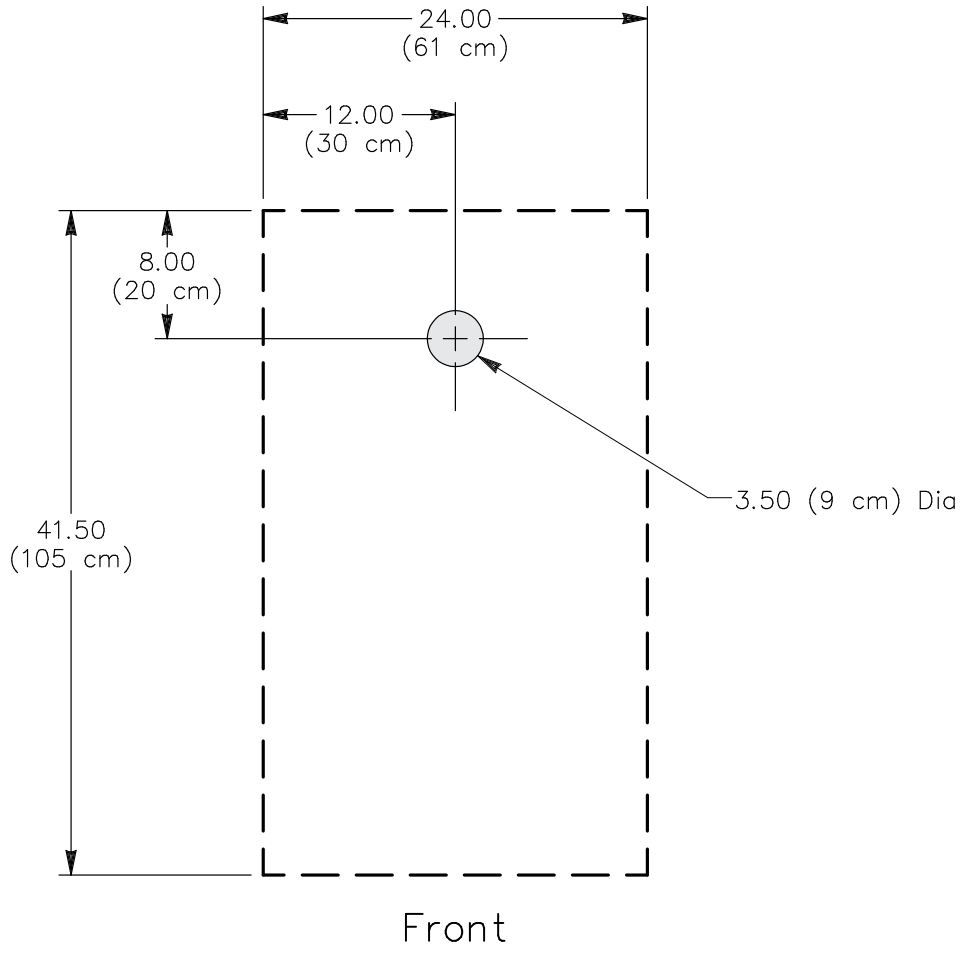

Figure 5-2. DE-60 Floor Cutout Requirements

Disk Enclosure (DE-100)

The disk enclosure (DE-100) houses the DD-301 disk drives. Each DE-100 contains one to four drawers (with a maximum of 20 disk drives per drawer) for a maximum of 80 disk drives per disk enclosure. The DE-100 is equipped with casters and leveling pads.

Refer to Table 5-2 for the DE-100 specifications and to Figure 5-3 for an illustration of the DE-100.

Table 5-2. DE-100 Specifications

Characteristic	Specification
Height	74.75 in. (190 cm)
Width	27.50 in. (70 cm)
Depth	31.50 in. (80 cm)
Weight	940 lbs (426 kg) maximum
Location	Within 60 ft (18.3 m) of the I/O subsystem
Access requirements	
Side	2.00 in. (5 cm)
Front	36.00 in. (91 cm)
Back	30.00 in. (76 cm)
Heat dissipation to air	13.31 kBtu/hr (3.90 kW) maximum
Cooling requirement	Ambient air
Power requirement	4.00 kVA (3.90 kW) maximum
Power cable	6-ft (1.8-m) pluggable drop cable
Power receptacle	
North America and Japan	IEC 309, 3-phase, 208-Vac, 30-amp, Hubbell #430C9W or equivalent
International	IEC 309, 3-phase, 400-Vac, 32-amp, Hubbell #532C6W or equivalent

NOTE: The DE-100 must be positioned so that the exhaust air of another heat-rejecting device does not enter the air inlet of the enclosure. The air inlet is located at the front of the enclosure; the air exhaust is located at the rear of the enclosure.

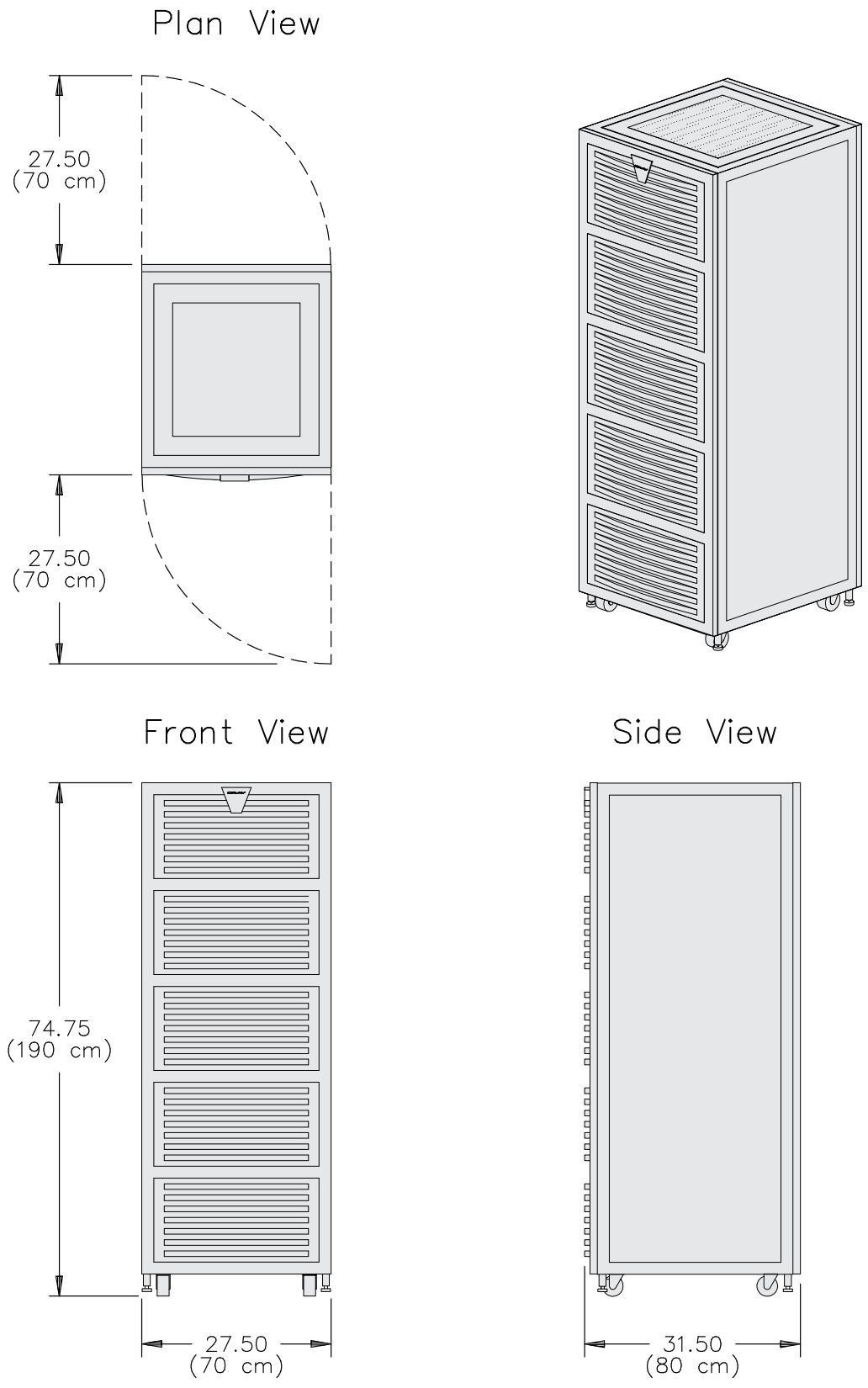

Figure 5-3. Disk Enclosure (DE-100)

A floor cutout is required beneath the DE-100 for entrance of data and power cables. Refer to Figure 5-4 for an illustration of the floor cutout.

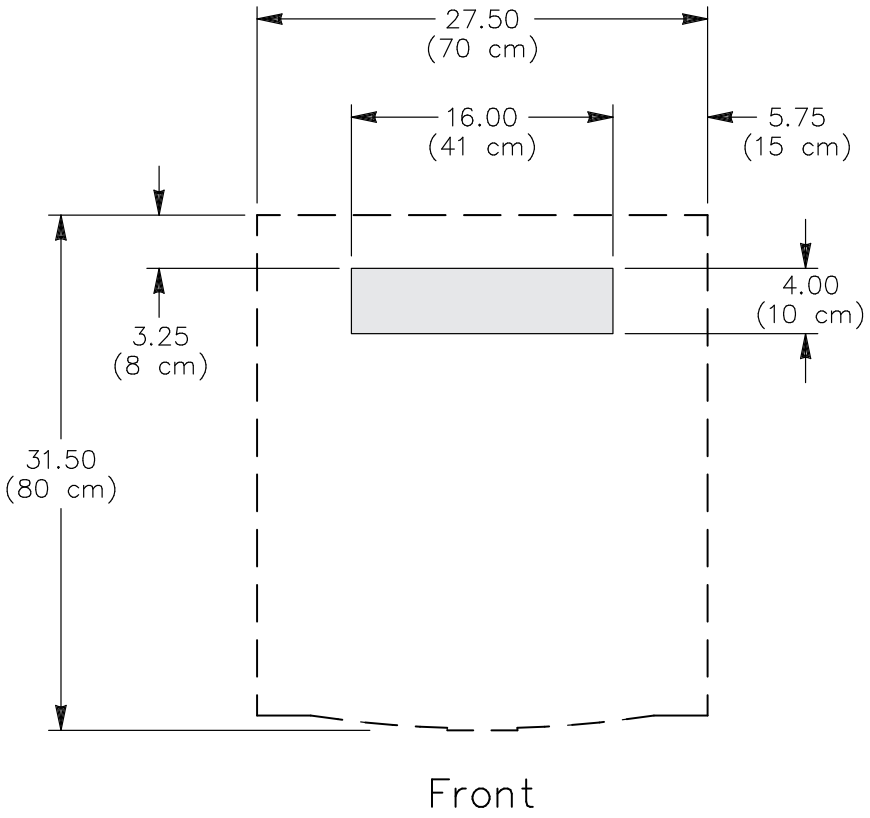

Figure 5-4. Disk Enclosure (DE-100) Floor Cutout

Removable Disk Cabinet (RDE-6)

The removable disk cabinet (RDE-6), shown in Figure 5-5, is an air-cooled device containing up to four removable disk drives (RD-62s). Each RD-62 has a storage capacity of 2.73 Gbytes. Table 5-3 lists the specifications for an RDE-6.

Observe the following guidelines when handling and storing RD-62 drives:

- Carefully remove the disk drives (RD-62s) from the RDE-6 chassis to minimize the amount of vibration and shock.
- Store the disk drives in a storage area that conforms to the same temperature, humidity, and dewpoint specifications as the computer room.

Table 5-3. RDE-6 Specifications

Characteristic	Specification
Height	41.75 in. (106 cm)
Width	23.00 in. (58 cm)
Depth	36.00 in. (91 cm)
Weight	494 lbs (224 kg)
Location	Within 50 ft (15.2 m) of the I/O subsystem
Access requirements: Front Back	 36.00 in. (91 cm) 30.00 in. (76 cm)
Heat dissipation to air	2,460 Btu/hr (720 W) maximum
Cooling requirements	Ambient air
Power cable	6-ft (1.8-m) pluggable drop cord
Power receptacle: 50 Hz 60 Hz	 Hubbell 320C6W (box mounted or in line) NEMA-type L6-20R (box mounted or in line)

NOTE: The RDE-6 must be positioned so that the exhaust air of another heat-rejecting device does not enter the air inlet of the RDE-6.

You must prepare a single floor cutout for the RDE-6. Refer to Figure 5-6 for the RDE-6 floor cutout.

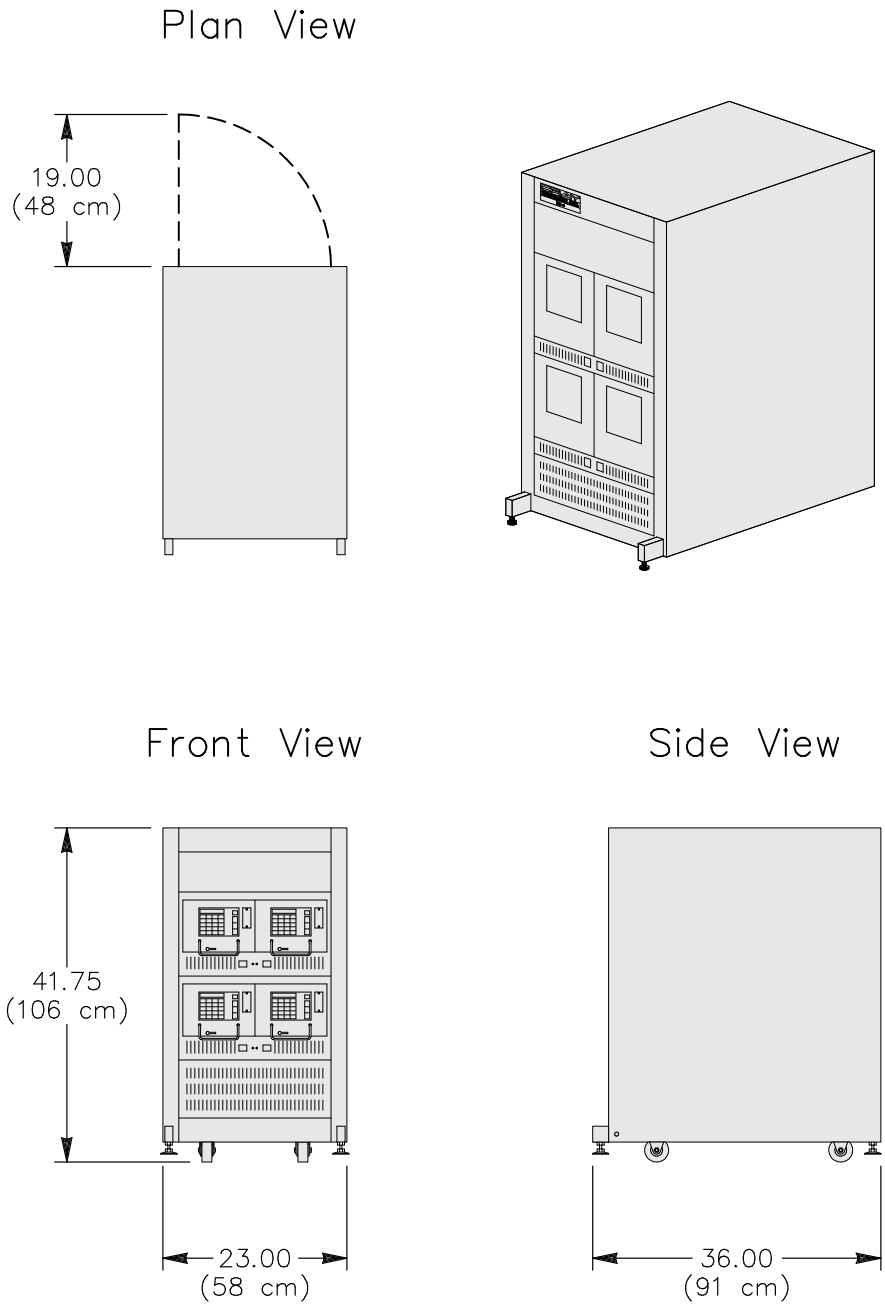

Figure 5-5. Removable Disk Cabinet (RDE-6)

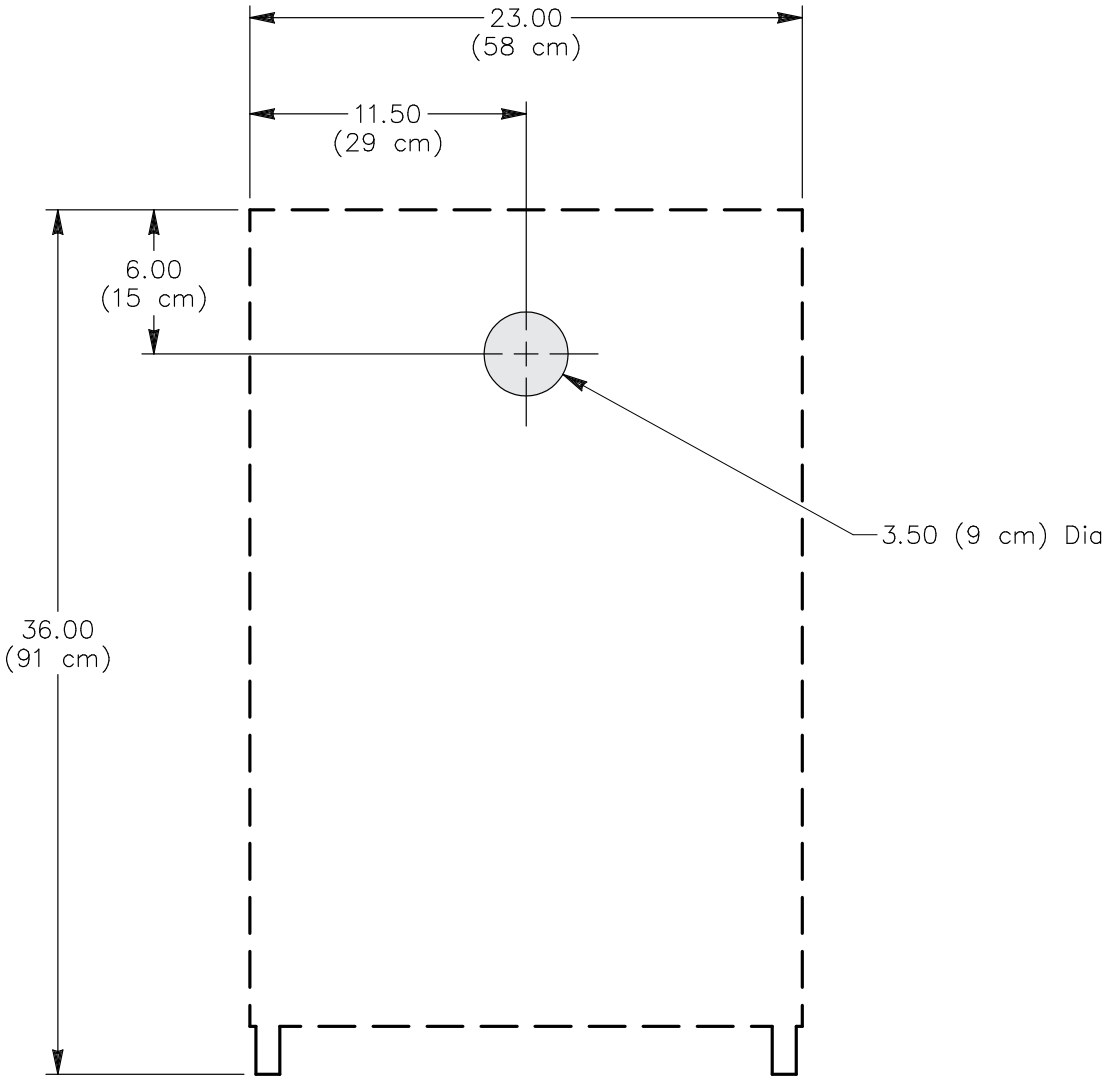

Figure 5-6. RDE-6 Floor Cutout Requirements

ND Series Network Disk Array Enclosure

The ND Series Network Disk Array enclosure (hereafter referred to as the network disk array enclosure) is a high-performance rack-mounted disk array storage system. The network disk array enclosure provides large data-storage capabilities, high data-transfer rate, and high data availability. It connects directly to the host computer system with a High Performance Parallel Interface (HIPPI) attachment and uses the intelligent peripheral interface (IPI-3) command protocol.

Refer to Table 5-4 for the network disk array enclosure specifications and to Figure 5-7 for an illustration of the network disk array enclosure.

Table 5-4. Network Disk Array Enclosure Specifications

Characteristic	Specification
Height	62.25 in. (158 cm)
Width	29.50 in. (75 cm)
Depth	38.50 in. (98 cm)
Weight	1,329 lbs (603 kg) maximum
Access requirements	
Side	2.00 in. (5 cm)
Front	36.00 in. (91 cm)
Back	30.00 in. (76 cm)
Heat dissipation to air	8.30 kBtu/hr (2.43 kW) maximum
Cooling requirement	Ambient air
Power requirement	2.95 kVA (2.43 kW) maximum
Power cable	6-ft (1.8-m) pluggable drop cable
Power receptacle	
North America and Japan	IEC 309, 3-phase, 208-Vac, 20-amp, Hubbell #420C9W or equivalent
International	IEC 309, 3-phase, 400-Vac, 16-amp, Hubbell #516C6W or equivalent

NOTE: The network disk array enclosures must be positioned so that the exhaust air of another heat-rejecting device does not enter the air inlet of the enclosure. The air inlet is located at the front of the enclosure; the air exhaust is located at the rear of the enclosure.

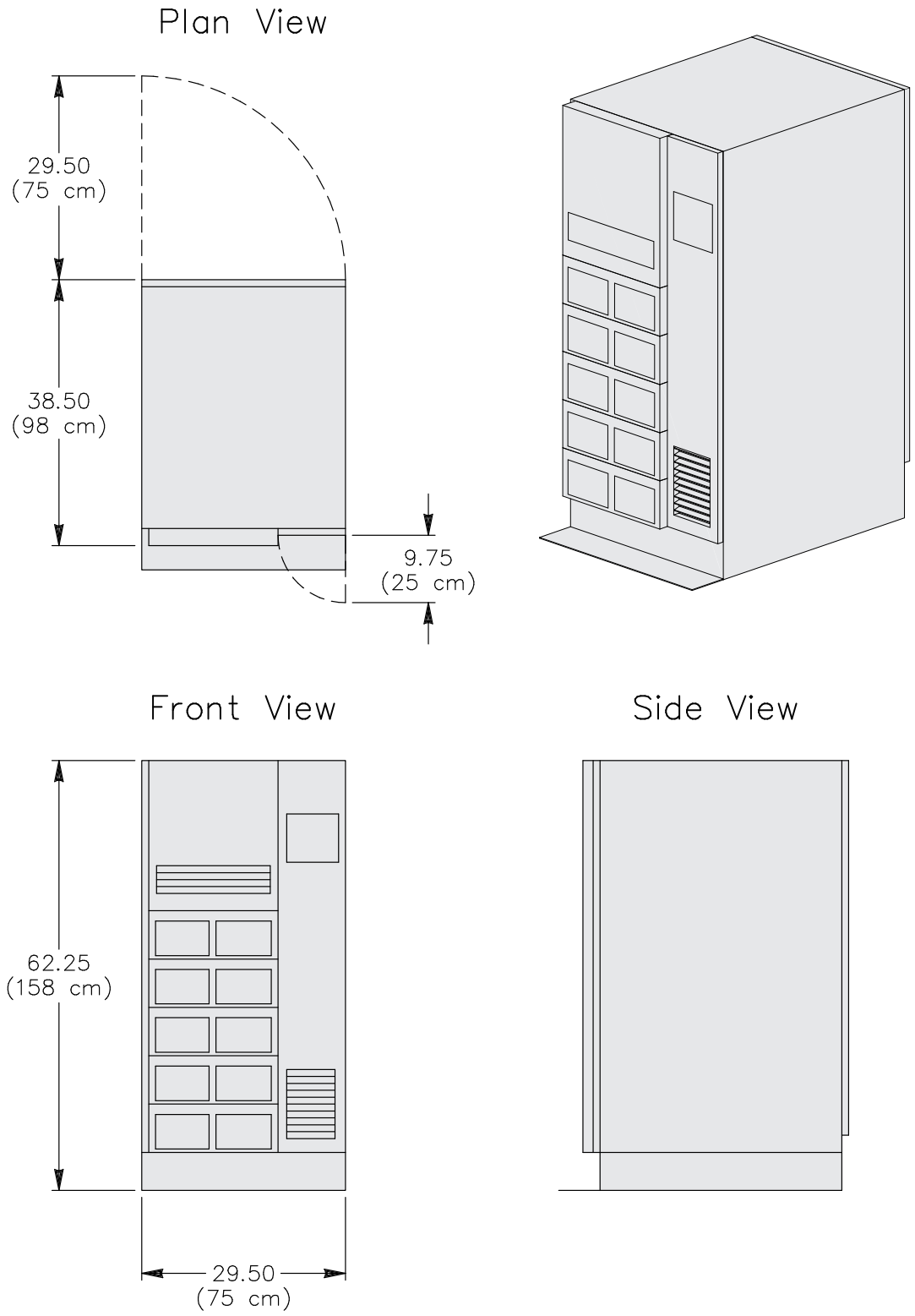

Figure 5-7. Network Disk Array Enclosure

The network disk array is available in two models and two associated expansion cabinets; the dimensions are identical for all cabinets. All network disk arrays are equipped with casters and wire wheel chocks.

Refer to Table 5-5 for the network disk array capacities.

Table 5-5. Network Disk Array Capacities

Network Disk Array Model Number	Data Capacity (32-Kbyte Block)	Data Capacity (64-Kbyte Block)	Number of Drives	Number of Drive Drawers
ND-12	27.4 Gbytes	29.0 Gbytes	20	10
ND-14	54.8 Gbytes	58.1 Gbytes	40	10
ND-22 Expansion Cabinet	27.4 Gbytes	29.0 Gbytes	20	10
ND-24 Expansion Cabinet	54.8 Gbytes	58.1 Gbytes	40	10
ND-4 Capacity Upgrade for an ND-12 or ND-22	27.4 Gbytes	29.0 Gbytes	20	N/A
ND-2 Optional HIPPI Channel Upgrade for an ND-12 or ND-14	N/A	N/A	N/A	N/A

Refer to the following list for additional network disk array and expansion cabinet information:

- The ND-12 and ND-14 disk array enclosures contain the HIPPI interface array controller and disk drives.
- The ND-22 and ND-24 expansion cabinets contain only disk drives and are daisy chained from the array controller.
- The ND-22 and ND-24 expansion cabinets can be used with either the ND-12 or the ND-14 network disk array enclosure.
- Up to three expansion cabinets can be used with each ND-12 or ND-14 disk array enclosure.
- The ND-12 and ND-14 disk array enclosures have a single HIPPI channel as standard equipment. Each expansion cabinet can be ordered with one additional HIPPI channel.

- The ND-12 and ND-14 disk array enclosures must be located within 75 ft. (22.9 m) of the I/O subsystem (IOS). The ND-22 and ND-24 expansion cabinets must be located adjacent to the ND-12 or ND-14 disk array enclosures.

- The ND-4 capacity upgrade is a 29-Gbyte upgrade for an ND-12 network disk array enclosure or ND-22 expansion cabinet. Up to 20 additional disk drives can be added with this upgrade.

- The ND-2 optional HIPPI channel upgrade provides a second HIPPI channel interface for an ND-12 or ND-14 disk array enclosure.

A 4-in. (10-cm) minimum floor cutout (refer to Figure 5-8) is required beneath the enclosure for entrance of data and power cables.

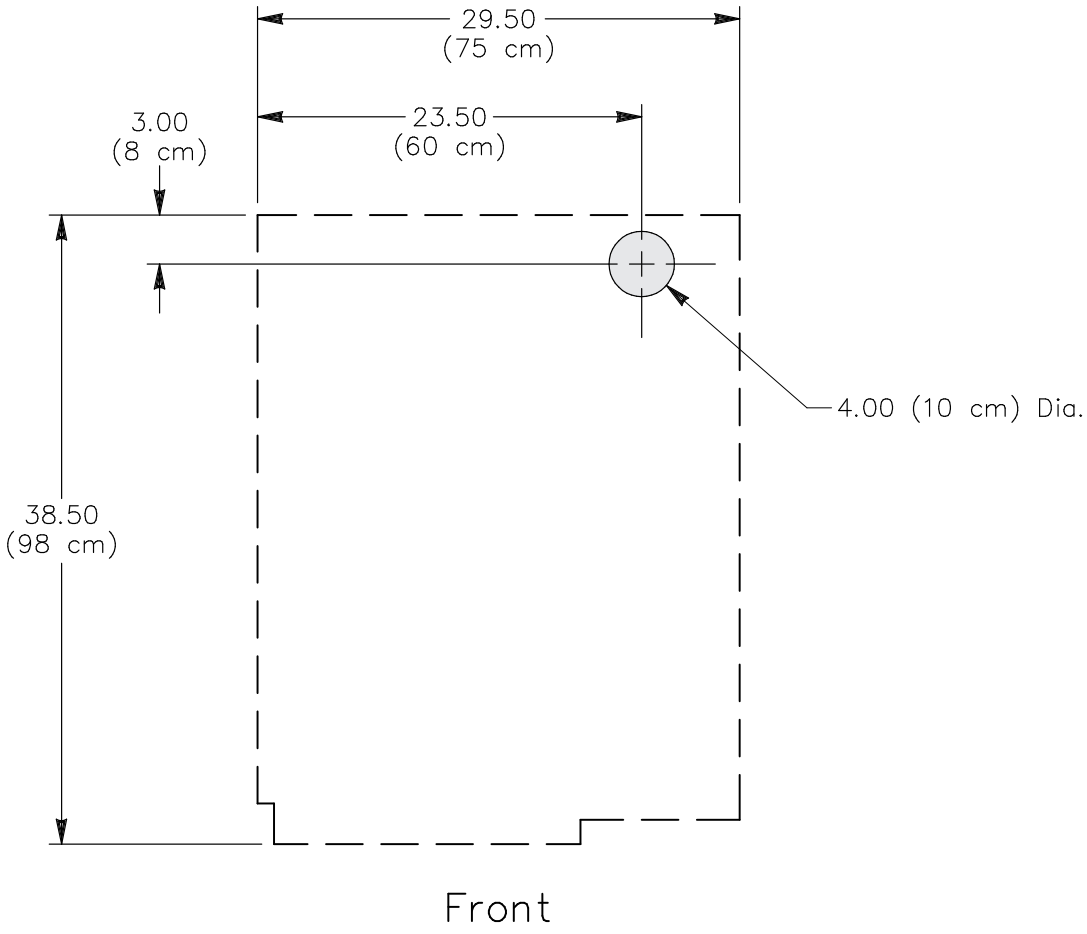

Figure 5-8. Network Disk Array Enclosure Floor Cutout

Network Disk Personal Computer

The network disk personal computer (ND-PC) is a Cray Research-supplied personal computer that has a built-in system maintenance facility. This maintenance facility controls diagnostics, formatting, and data reconstruction utilities, error logging, and status displays.

An ND-PC is required with each ND-12 or ND-14 disk array enclosure; an ND-PC is not included or needed with the ND-22 or ND-24 expansion cabinets. The ND-PC must be located within 25 ft (7.6 m) of the ND-12 or ND-14 enclosure.

Refer to Table 5-6 for the ND-PC specifications and to Figure 5-9 for an illustration of the ND-PC with a Cray Research-supplied table.

Table 5-6. Network Disk Personal Computer Specifications

Characteristic	Specification
Height	19.25 in. (49 cm)
Width	18.00 in. (46 cm)
Depth	23.00 in. (58 cm)
Weight	47 lbs (21 kg)
Heat dissipation to air	0.44 kBtu/hr (0.13 kW)
Cooling requirement	Ambient air
Power requirement	0.14 kVA/hr (0.13 kW)
Power cables (CPU and monitor)	Two 6-ft (1.8-m) pluggable drop cables
Power receptacle:	
North America and Japan	NEMA type 5-15R (box mounted or in-line)
International	Country specific

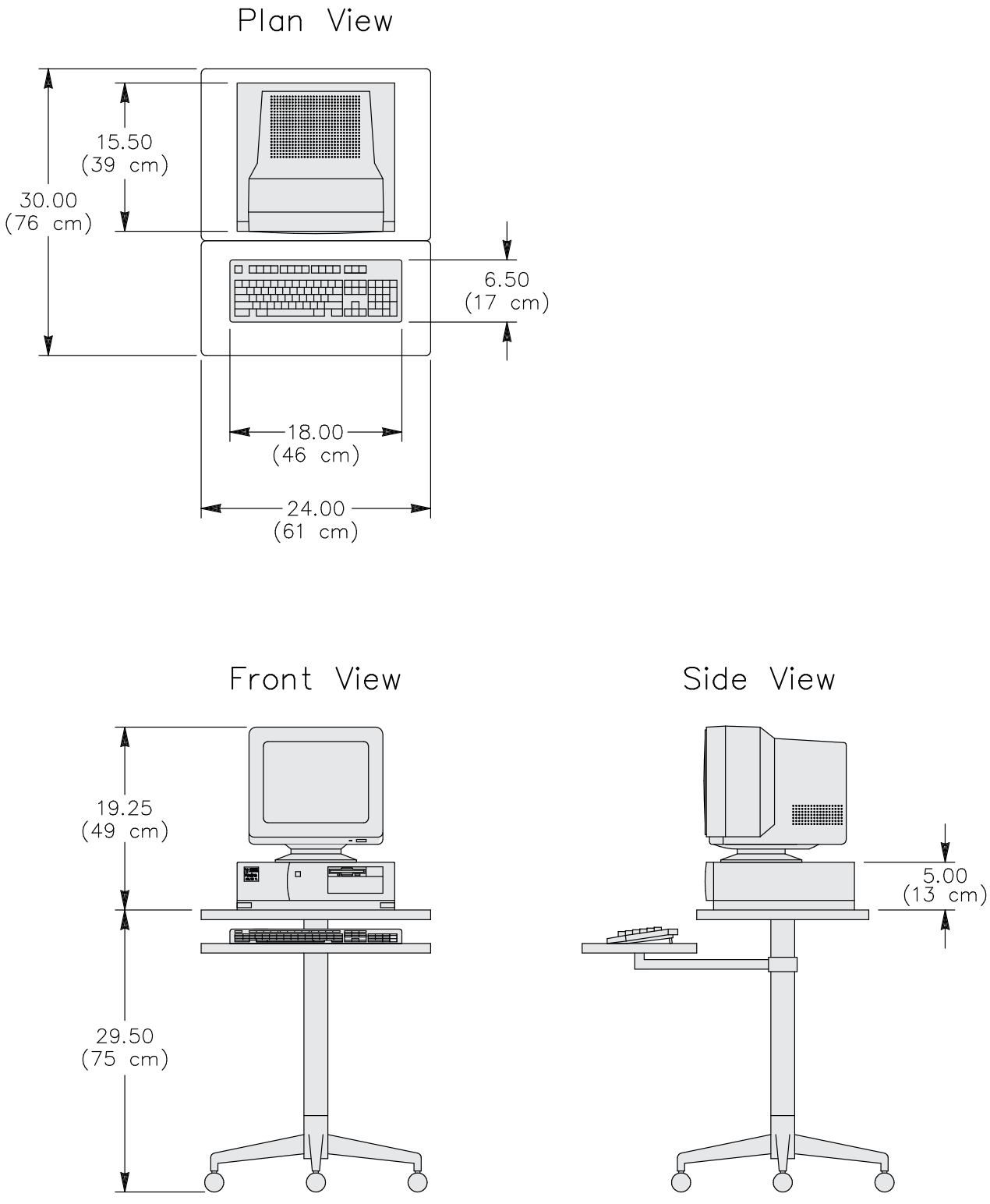

Figure 5-9. Network Disk Personal Computer (ND-PC)

A 3.50-in. (9-cm) minimum floor cutout (refer to Figure 5-10) is required beneath the ND-PC for entrance of data and power cables.

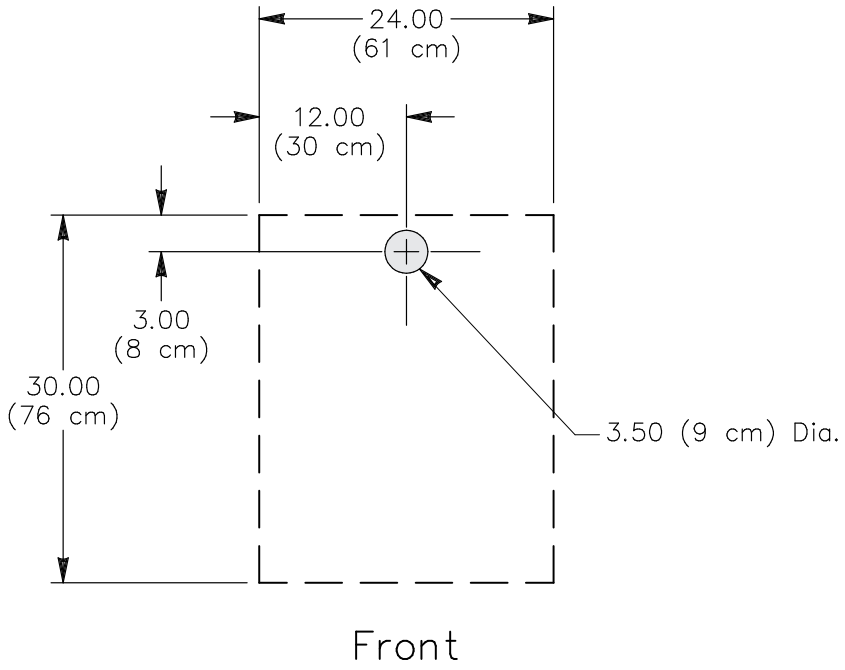

Figure 5-10. Network Disk Personal Computer Floor Cutout

VME-based Microcomputer (VBM-2)

The VME-based microcomputer (VBM-2) is configured with both the maintenance workstation (MWS) and the operator workstation (OWS). The VBM-2 is used for hardware maintenance, system operation, and system monitoring. The VBM-2 contains one 200-Mbyte removable disk module, one 150-Mbyte streaming tape drive, a Control Subsystem Network interface, a time-of-day clock, and additional interfaces and communication ports.

Table 5-7 provides additional specifications for the VBM-2. Refer to Figure 5-11 for an illustration of the VBM-2.

Table 5-7. VBM-2 Specifications

Characteristic	Specification
Height	26.00 in. (66 cm)
Width	19.00 in. (48 cm)
Depth	28.50 in. (72 cm)
Weight	220 lbs (100 kg)
Access requirements	36.00 in. (91 cm) front 6.00 in. (15 cm) back
Heat dissipation to air	4.50 kBtu/hr (1.32 kW)
Cooling requirements	Ambient air
Power cable	6-ft (1.8-m) pluggable drop cord
Power receptacle	NEMA-type L5-20R (box mounted or in line)

You must prepare a single floor cutout for the VBM-2. Refer to Figure 5-12 for an illustration of this floor cutout.

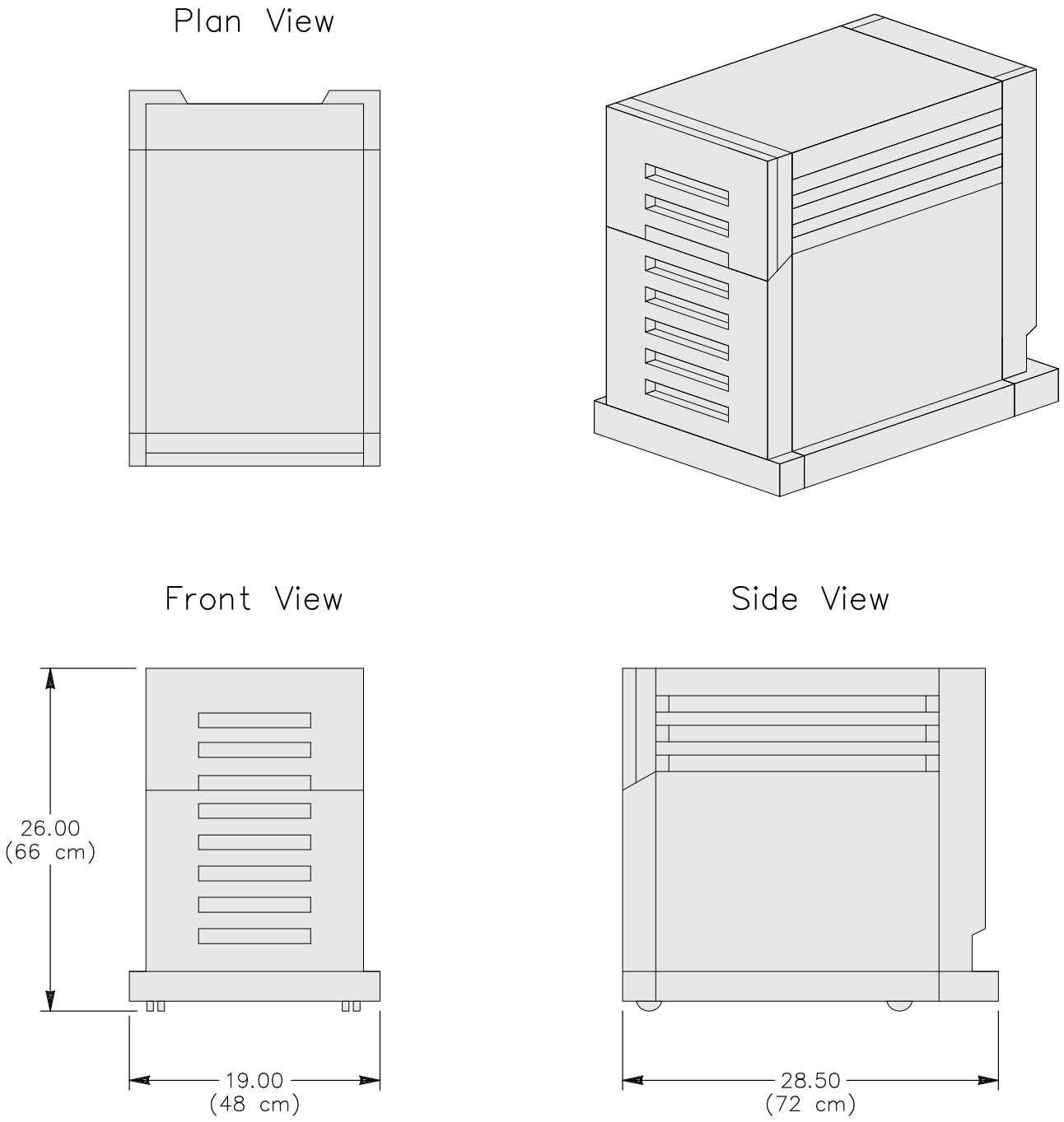

Figure 5-11. VME-based Microcomputer (VBM-2)

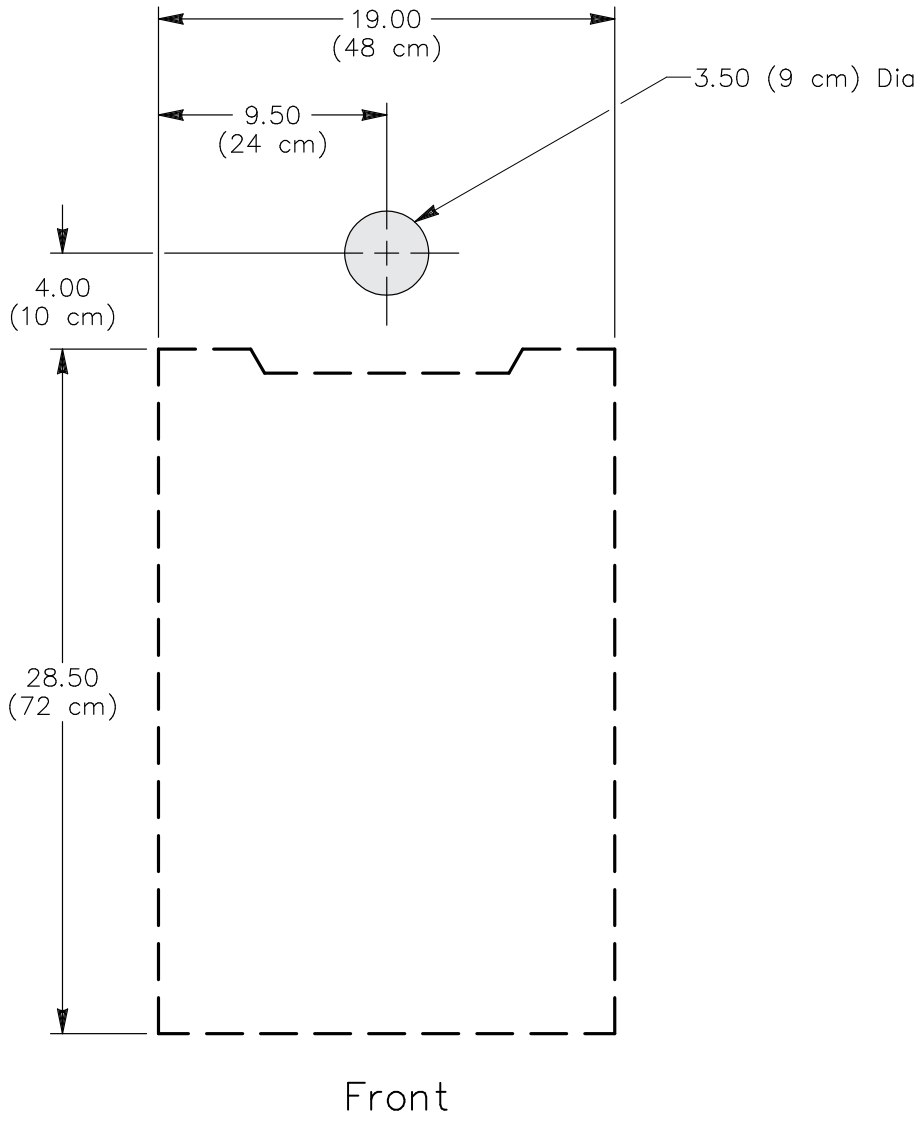

Figure 5-12. VBM-2 Floor Cutout Requirements

Color Graphics Display Terminal (GDT-200)

The color graphics display terminal (GDT-200) is configured with the maintenance workstation (MWS) and operator workstation (OWS) for device monitoring and system communication activities. Additional GDT-200 terminals may be ordered for operator use. The GDT-200 is designed to be table mounted and consists of a color monitor, a keyboard unit, and a mouse. The GDT-200 is located on the single display table (TBL-3) adjacent to the VBM-2.

Table 5-8 provides additional specifications for the GDT-200. Refer to Figure 5-13 for an illustration of the GDT-200.

Table 5-8. GDT-200 Specifications

Characteristic	Specification
Height	18.75 in. (48 cm)
Width	19.00 in. (48 cm)
Depth	28.50 in. (72 cm)
Weight	72 lbs (33 kg)
Heat dissipation to air	1,360 Btu/hr (400 W)
Cooling requirements	Ambient air
Power cable	6-ft (1.8-m) pluggable drop cord
Power receptacle	NEMA-type 5-15R (box mounted or in line)

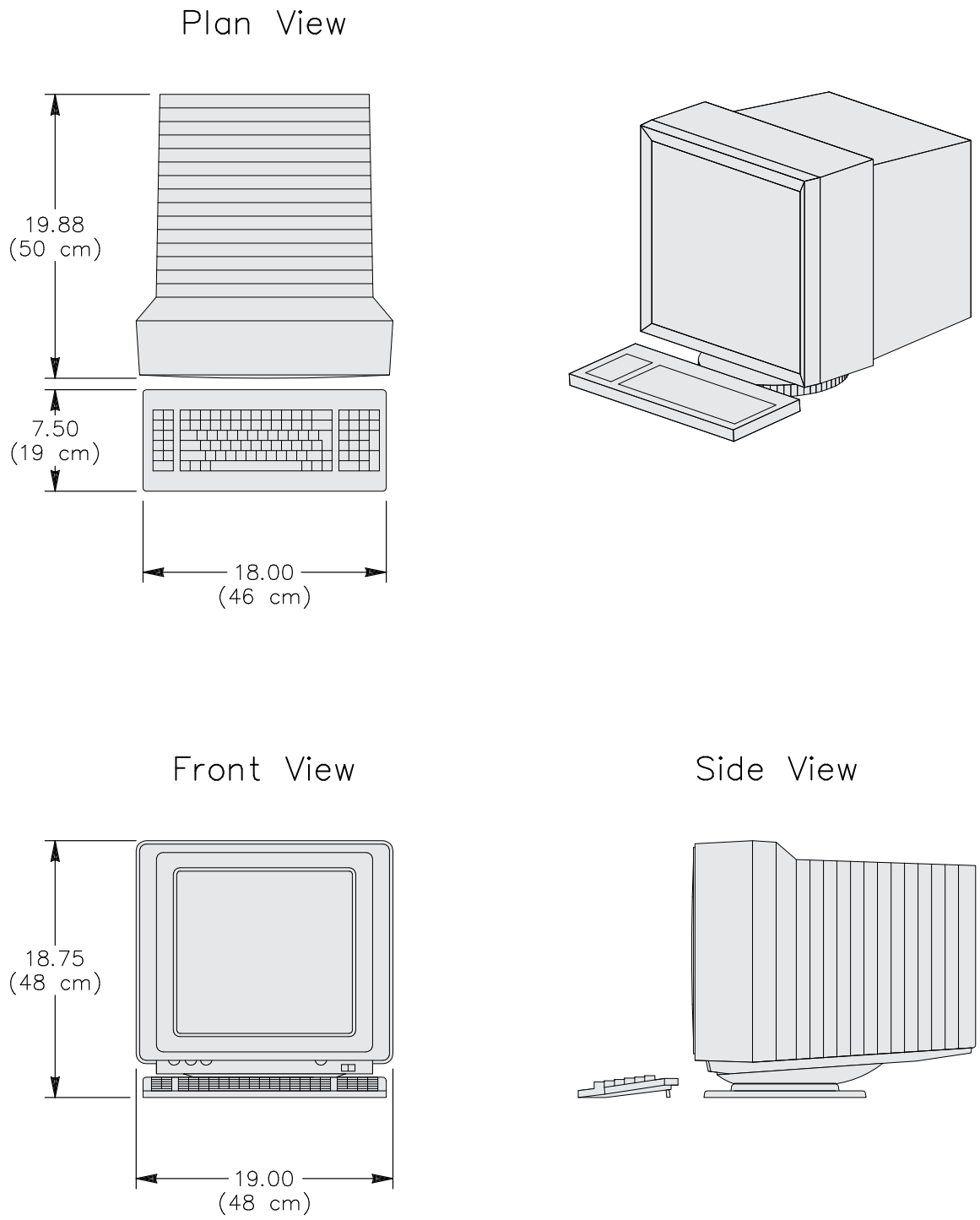

Figure 5-13. Color Graphics Display Terminal (GDT-200)

Line Printer (LP-6)

The line printer (LP-6) is a laser printing device equipped with numerous character sets. The LP-6 is an element of the OWS and is located on the VBM-2 in the computer room.

Table 5-9 provides additional specifications for the LP-6. Refer to Figure 5-14 for an illustration of the LP-6.

Table 5-9. LP-6 Specifications

Characteristic	Specification
Height	11.75 in. (30 cm)
Width	16.50 in. (42 cm)
Depth	16.00 in. (41 cm)
Weight	38 lbs (17 kg)
Heat dissipation to air	665 Btu/hr (195 W)
Cooling requirements	Ambient air
Power cable	8-ft (2.4-m) pluggable drop cord
Power receptacle	NEMA-type 5-15R (box mounted or in line)

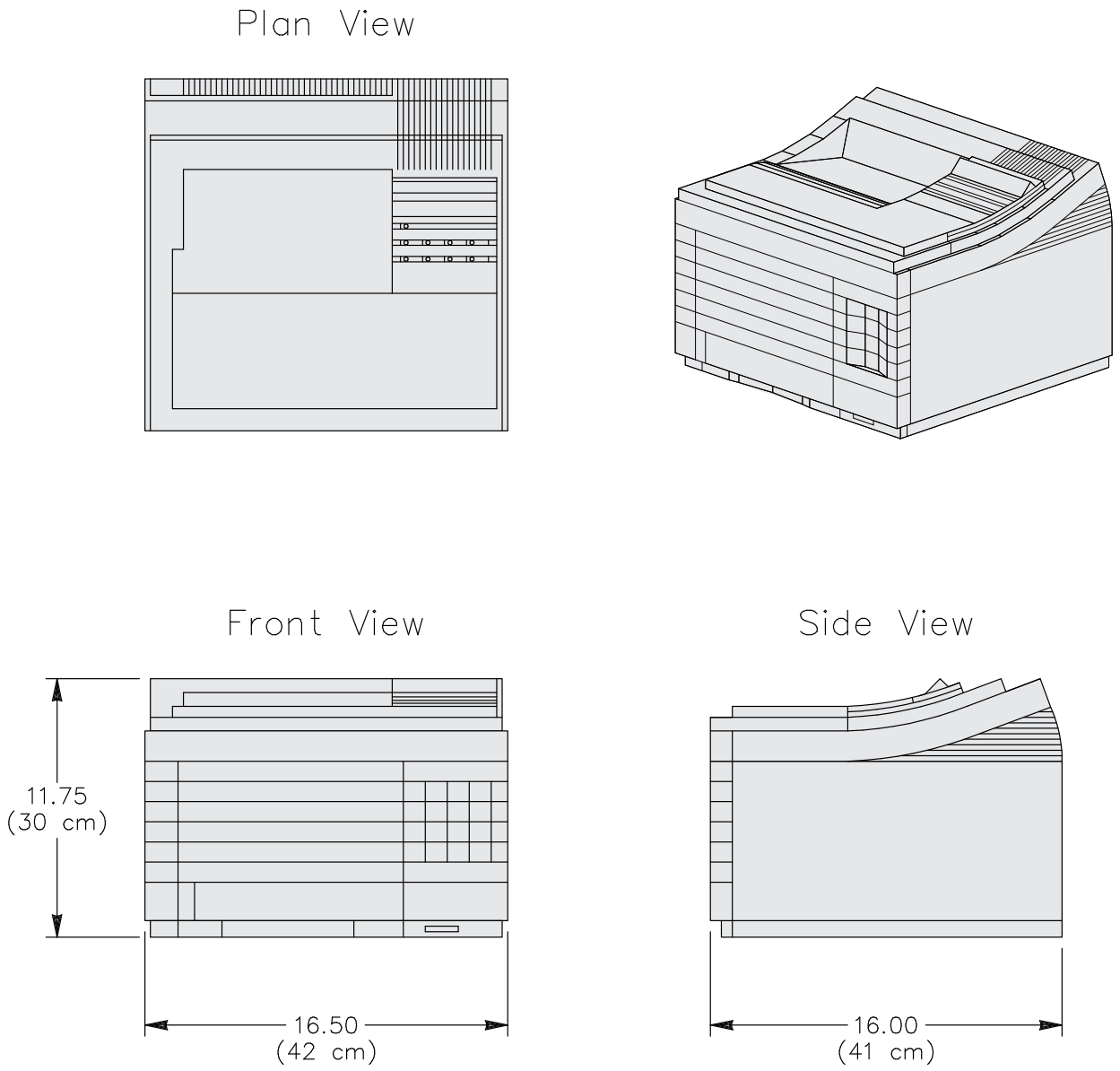

Figure 5-14. Line Printer (LP-6)

Single Display Table (TBL-3)

The single display table (TBL-3) accommodates one color graphics display terminal (GDT-200). Also, Cray Research supplies one operator's chair for each maintenance workstation (MWS) and one for each operator workstation (OWS).

Table 5-10 provides additional specifications for the TBL-3. Refer to Figure 5-15 for an illustration of the TBL-3.

Table 5-10. TBL-3 Specifications

Characteristic	Specification
Height	32.00 in. (81 cm)
Width	30.00 in. (76 cm)
Depth	33.00 in. (84 cm)
Weight	95 lbs (43 kg)
Access requirements	48.00 in (122 cm) front

You must prepare a single floor cutout for the TBL-3 in order to accommodate the power and data connections for the LP-5. Refer to Figure 5-16 for an illustration of this floor cutout.

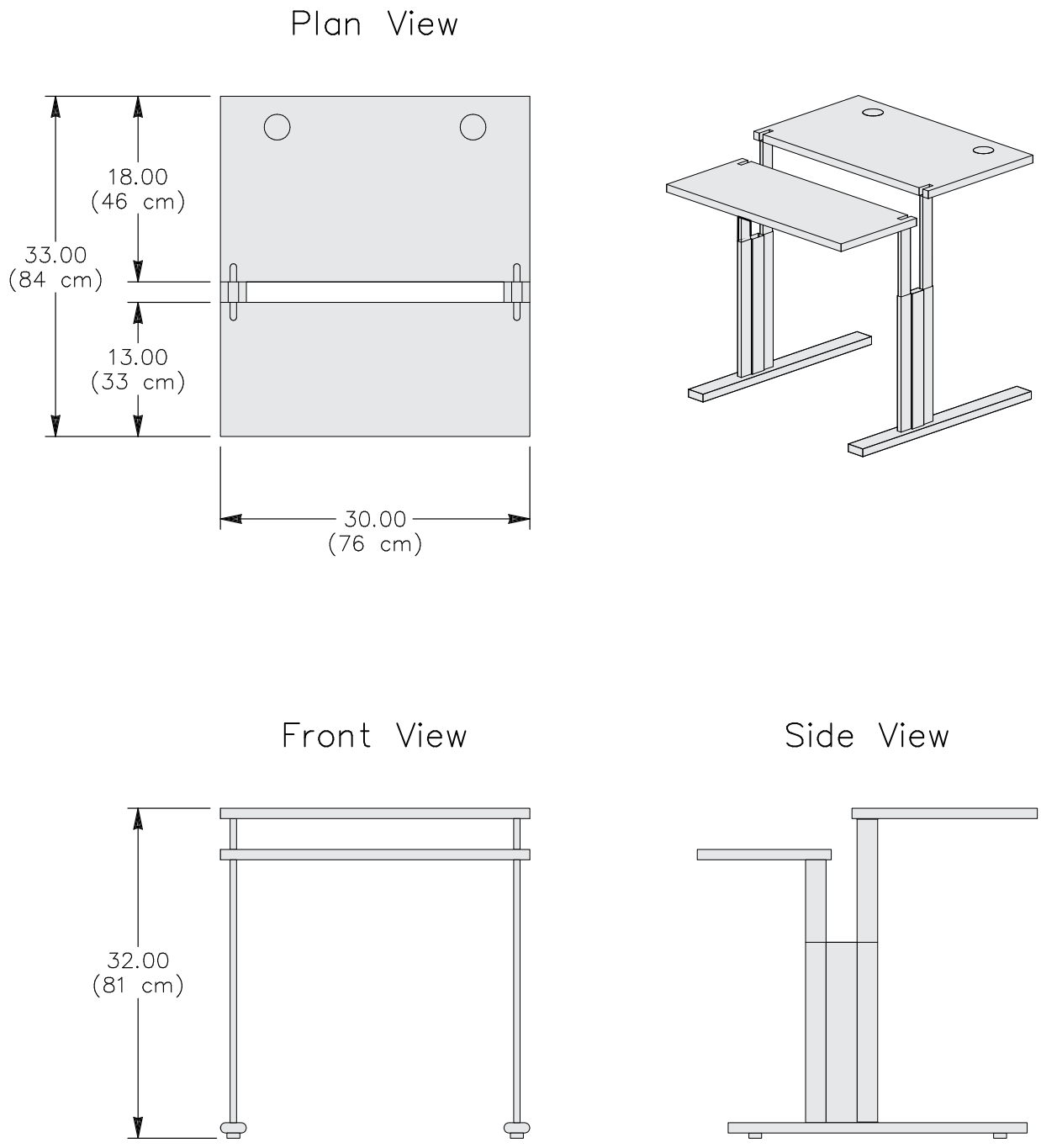

Figure 5-15. Single Display Table (TBL-3)

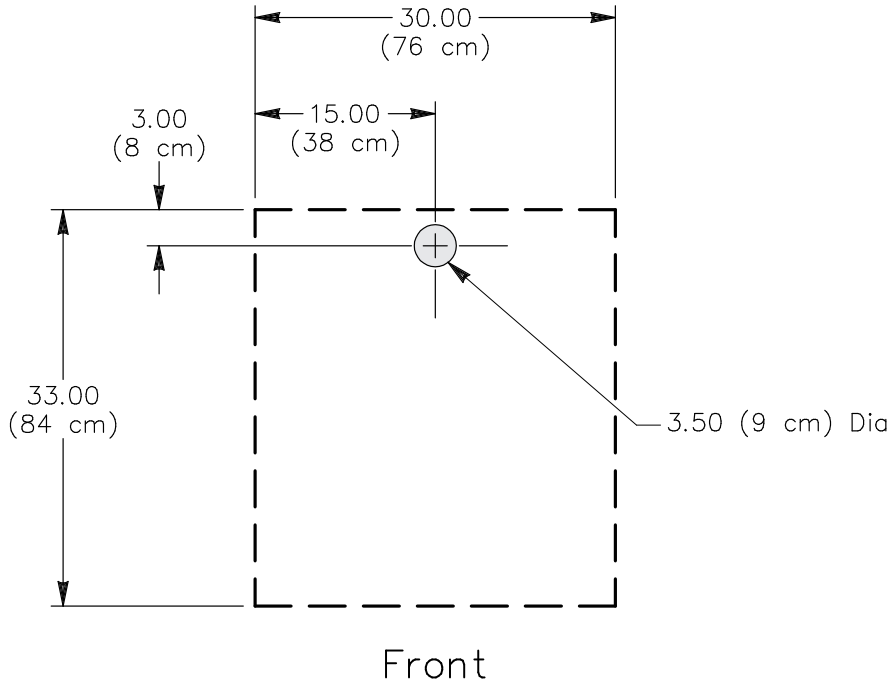

Figure 5-16. TBL-3 Floor Cutout Requirements

Front-end Interface Cabinet (FEC)

The front-end interface cabinet (FEC) houses special interface modules, power supplies, and controls.

Table 5-11 provides additional specifications for the FEC. Refer to Figure 5-17 for an illustration of the FEC. When multiple FECs are configured, an optional kit enables two FECs to be stacked. Refer to Figure 5-18 for an illustration of the FEC stacking cabinet kit.

Table 5-11. FEC Specifications

Characteristic	Specification
Height	23.00 in. (58 cm)
Width	26.25 in. (67 cm)
Depth	20.00 in. (51 cm)
Weight	200 lbs (91 kg)
Access requirements: Front and back Sides	 36.00 in. (91 cm) 6.00 in. (15 cm)
Heat dissipation to air	1,810 Btu/hr (530 W)
Cooling requirements	Ambient air
Power cable	10-ft (3-m) pluggable drop cord
Power receptacle	NEMA-type 5-15R (box mounted or in line)

Table 5-12 identifies the Cray Research front-end interfaces (FEIs) that are currently available and the signal-cable lengths for each. In some configurations, the FEI is located within the mainframe chassis (MFC) or input/output subsystem (IOS) chassis. In all other configurations, the FEI is located within front-end interface cabinets (FECs).

Cray Research supplies all signal cables associated with the FEIs, including the front-end computer system channel cables. Cray Research also installs all FEI signal cables except the front-end channel cables. You must arrange for the installation of the Cray Research-supplied front-end channel cables.

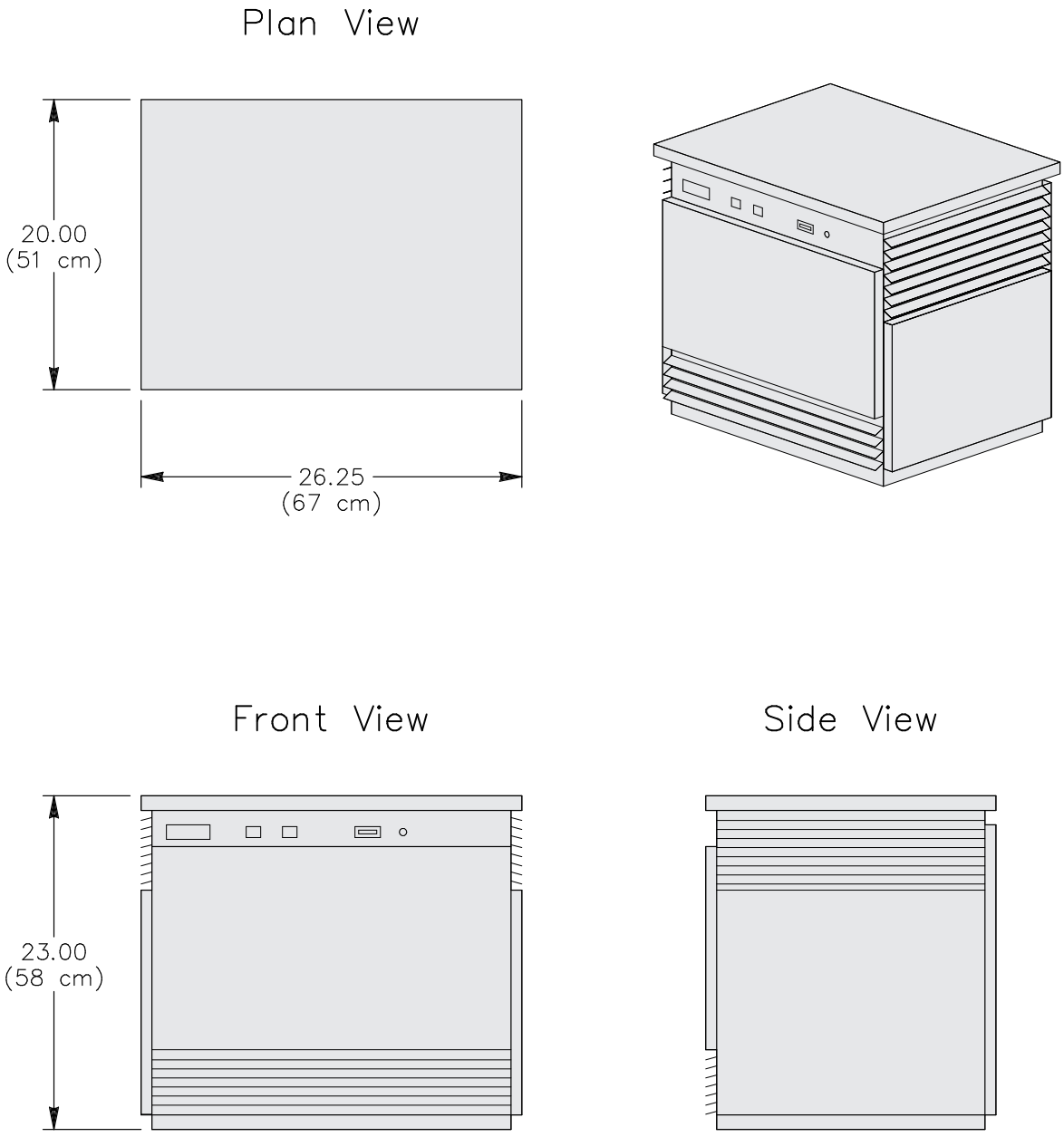

Figure 5-17. Front-end Interface Cabinet (FEC)

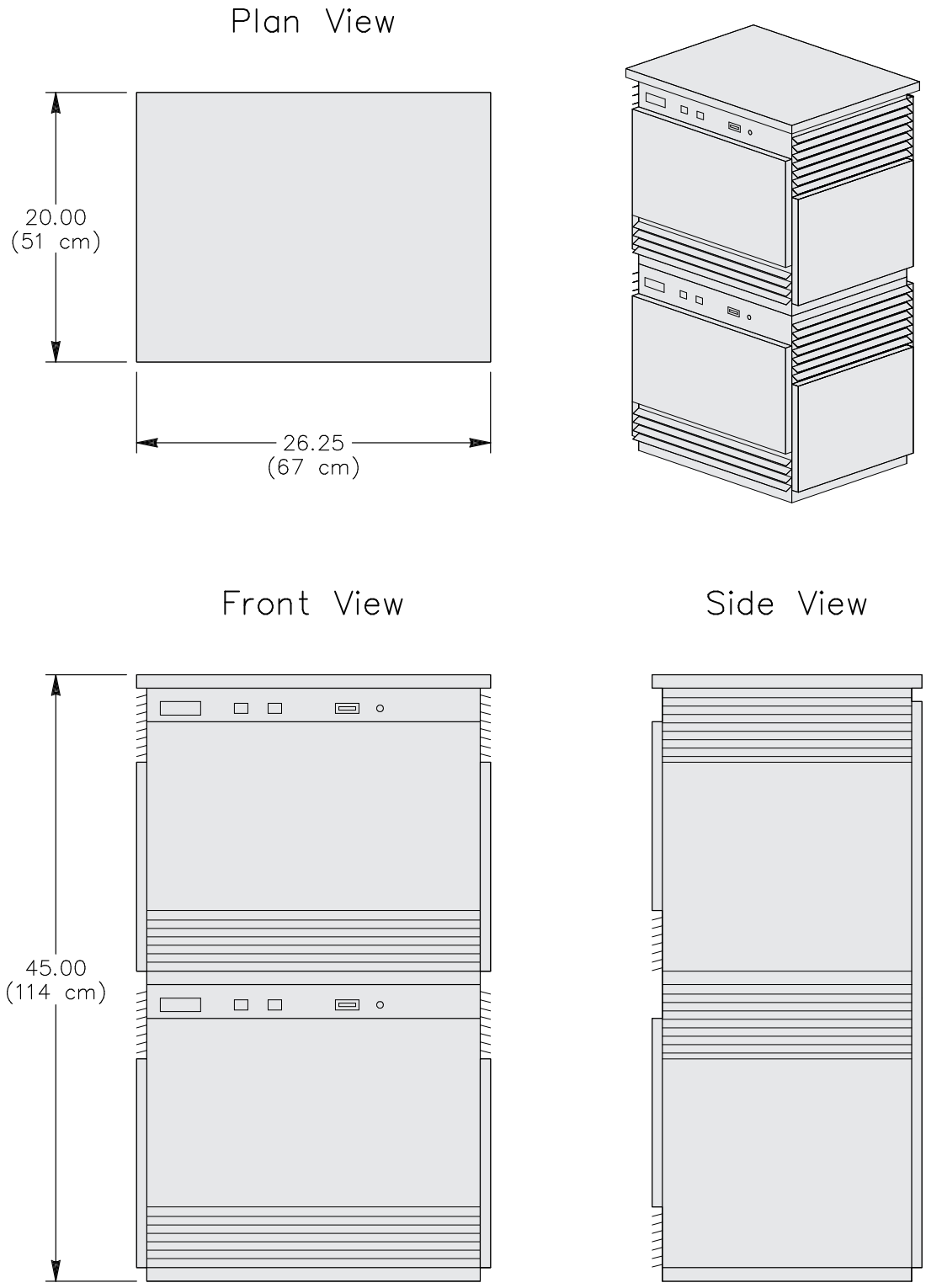

Figure 5-18. FEC Stacking Cabinet Kit

Table 5-12 defines the separation limits from a CRAY C92A or CRAY D92A MFC or CRAY C94A IOS/SSD to an interfacing computer system. In some configurations, the FEI is located within the front-end computer system, mainframe chassis, or IOS chassis. In all other configurations, the FECs.

Table 5-12. Signal-cable Lengths for Cray Research Standard FEIs

Front-end Interface (FEI-1)	Standard	Maximum
IOS to standard FEC	200 ft (61.0 m)†	500 ft (152.5 m)†
FEC to CDC 6000	65 ft (19.8 m)	65 ft (19.8 m)
FEC to CDC 7600 computer system	30 ft (9.2 m)	70 ft (21.4 m)
FEC to Honeywell Inc. computer system	40 ft (12.2 m)	75 ft (22.9 m)
FEC to IBM computer system data-streaming mode nondata-streaming mode	 25 ft (7.6 m) 25 ft (7.6 m)	 400 ft (122.0 m) 200 ft (61.0 m)
FEC to PDP/VAX computer system	15 ft (4.6 m)	15 ft (4.6 m)
FEC to Unisys computer system	25 ft (7.6 m)	200 ft (61.0 m)
FEC to Amdahl computer system	25 ft (7.6 m)	200 ft (61.0 m)
FEC to Fujitsu computer system	25 ft (7.6 m)	200 ft (61.0 m)
Front-end Interface (FEI-2)	Standard	Maximum
IOS to NSC computer system	50 ft (15.3 m)	50 ft (15.3 m)
IOS to Data General computer system	50 ft (15.3 m)	50 ft (15.3 m)
IOS to DEC BI computer system	50 ft (15.3 m)	50 ft (15.3 m)
IOS to another Cray Research MFC or IOS	50 ft (15.3 m)	500 ft (152.5 m) †
IOS to model E MFC or IOS	50 ft (15.3 m)	550 ft (167.8 m) †
IOS to CRAY-2 MFC	50 ft (15.3 m)	550 ft (167.8 m) †
Front-end Interface (FEI-3)	Standard	Maximum
IOS to Sun computer system	50 ft (15.3 m)	50 ft (15.3 m)
IOS to Motorola computer system	50 ft (15.3 m)	50 ft (15.3 m)

† An FEC adapter cabinet is required.

Adapter FECs are required when an FEC is configured, or when the distance between a CRAY C92A or CRAY D92A MFC or CRAY C94A IOS/SSD and another Cray Research computer system is more than 50 ft (15.3 m). Refer to Figure 5-19 through Figure 5-22 for illustrations of these configurations and separation limits. The site preparation requirements for an adapter FEC are identical to an FEC.

NOTE: Only a single cable of a channel pair is shown in the following figures.

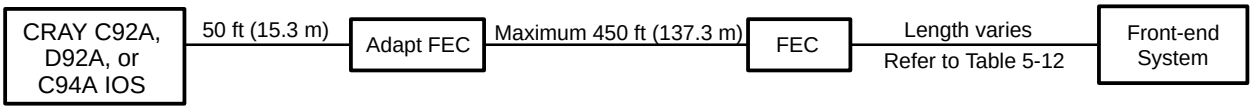

Figure 5-19. Separation Limit from a CRAY C92A, CRAY D92A or CRAY C94A Computer System to an Interfacing Computer System when the FEI is Located within the FEC

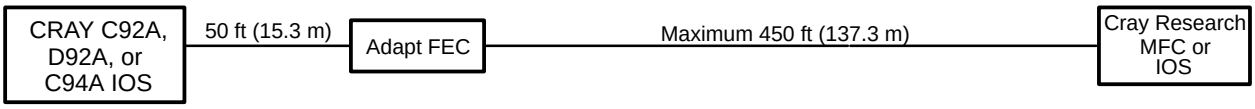

Figure 5-20. Separation Limit from a CRAY C92A or CRAY D92A MFC or CRAY C94A IOS to a Cray Research MFC/IOS beyond 50 ft (15.3 m)

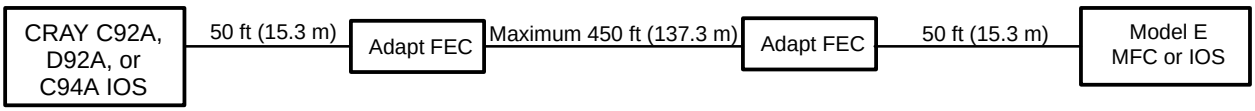

Figure 5-21. Separation Limit from a CRAY C92A, CRAY D92A or CRAY C94A Computer System to a Model E MFC or IOS beyond 50 ft (15.3 m)

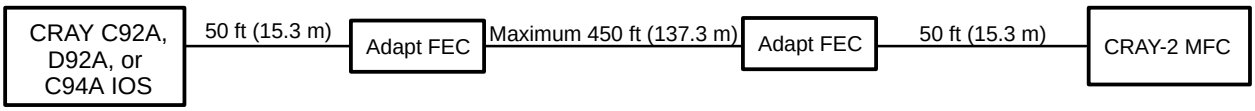

Figure 5-22. Separation Limit from a CRAY C92A, CRAY D92A, or CRAY C94A Computer System to a CRAY-2 Computer System beyond 50 ft (15.3 m)

You must prepare a single floor cutout for the FEC. Refer to Figure 5-23 for an illustration of this floor cutout.

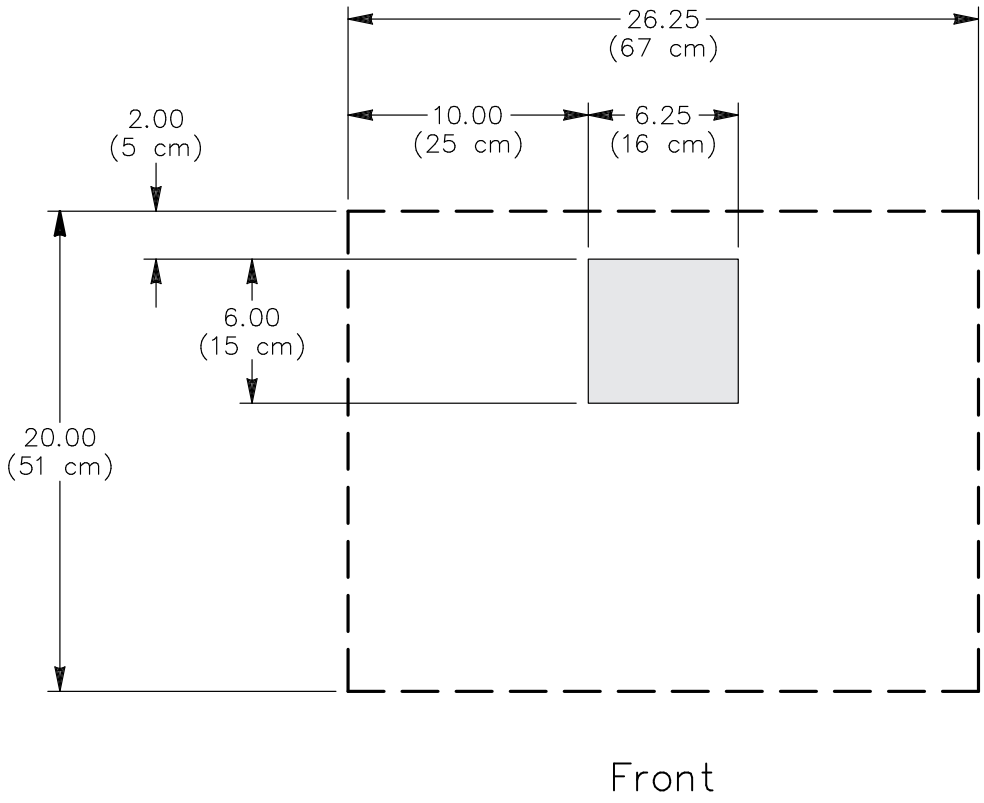

Figure 5-23. FEC Floor Cutout Requirements

Fiber-optic Link (FOL)

The fiber-optic link (FOL) extends the standard distance between the Cray Research computer system and the front-end system and enables complete electrical isolation. The FOL consists of two cabinets connected with fiber-optic cable: the FOL and the front-end interface (FEI/FOL). The FOL cabinet houses devices that convert the electronic signal to an optical signal; the FEI/FOL cabinet houses the interface modules and the devices that convert the optical signal to an electronic signal. The FOL and the FEI/FOL cabinets have identical site planning requirements.

The FOL and FEI/FOL cabinets are used in pairs (refer to Figure 5-24). You must position the FOL cabinet within 40 ft (12.2 m) of the IOS chassis. The FEI/FOL cabinet is usually positioned close to the front-end computer system.

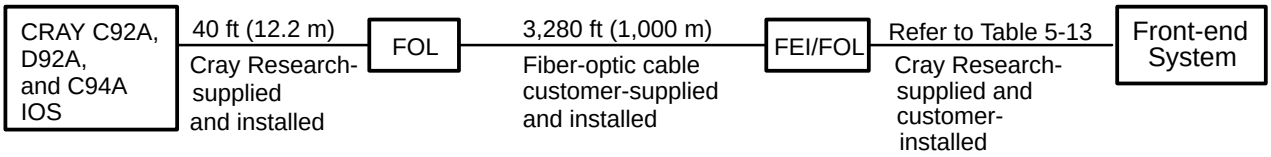

Figure 5-24. FOL and FEI/FOL Separation Limits

When multiple FOL or FEI/FOL cabinets are configured, an optional stacking kit, similar to the FEC stacking cabinet kit (refer to Figure 5-18), permits two FOL or FEI/FOL cabinets to be stacked.

You must supply and install the fiber-optic cable between the FOL and the FEI/FOL cabinets as indicated in Figure 5-24. Cray Research site planning documentation (available on request) specifies which type of fiber-optic cable you must install.

Cray Research supplies and installs the signal cables between the IOS and the FOL. You must arrange for the installation of the Cray Research-supplied signal cables between the front-end system and the FEI/FOL cabinet.

Table 5-13 lists the cable-length restrictions between the FEI/FOL cabinet and the various front-end systems. The maximum cable length between the FOL and the FEI/FOL cabinets is 3,280 ft (1,000 m).

Table 5-13. Signal-cable Lengths for FOL Interfaces

Front-end Interface (FEI)	Standard	Maximum
FEI/FOL to CDC 6000 computer system	65 ft (19.8 m)	65 ft (19.8 m)
FEI/FOL to CDC 7600 computer system	30 ft (9.2 m)	70 ft (21.4 m)
FEI/FOL to Honeywell, Inc. computer system	40 ft (12.2 m)	75 ft (22.9 m)
FEI/FOL to IBM computer system data-streaming mode nondata-streaming mode	 25 ft (7.6 m) 25 ft (7.6 m)	 400 ft (122.0 m) 200 ft (61.0 m)
FEI/FOL to PDP/VAX computer system	15 ft (4.6 m)	15 ft (4.6 m)
FEI/FOL to Unisys computer system	25 ft (7.6 m)	200 ft (61.0 m)
FEI/FOL to Amdahl computer system	25 ft (7.6 m)	200 ft (61.0 m)
FEI/FOL to Fujitsu computer system	25 ft (7.6 m)	200 ft (61.0 m)

Table 5-14 provides additional specifications for the FOL and FEI/FOL cabinets. Refer to Figure 5-25 for an illustration of the FOL and FEI/FOL.

Table 5-14. FOL and FEI/FOL Cabinet Specifications

Characteristic	Specification
Height	27.00 in. (69 cm)
Width	26.25 in. (67 cm)
Depth	22.50 in. (57 cm)
Weight	240 lbs (109 kg)
Access requirements: Front and back Sides	 36.00 in. (91 cm) 6.00 in. (15 cm)
Heat dissipation to air	1,190 Btu/hr (350 W)
Cooling requirements	Ambient air
Power cable	10-ft (3-m) pluggable drop cord
Power receptacle	NEMA-type 5-15R (box mounted or in line)

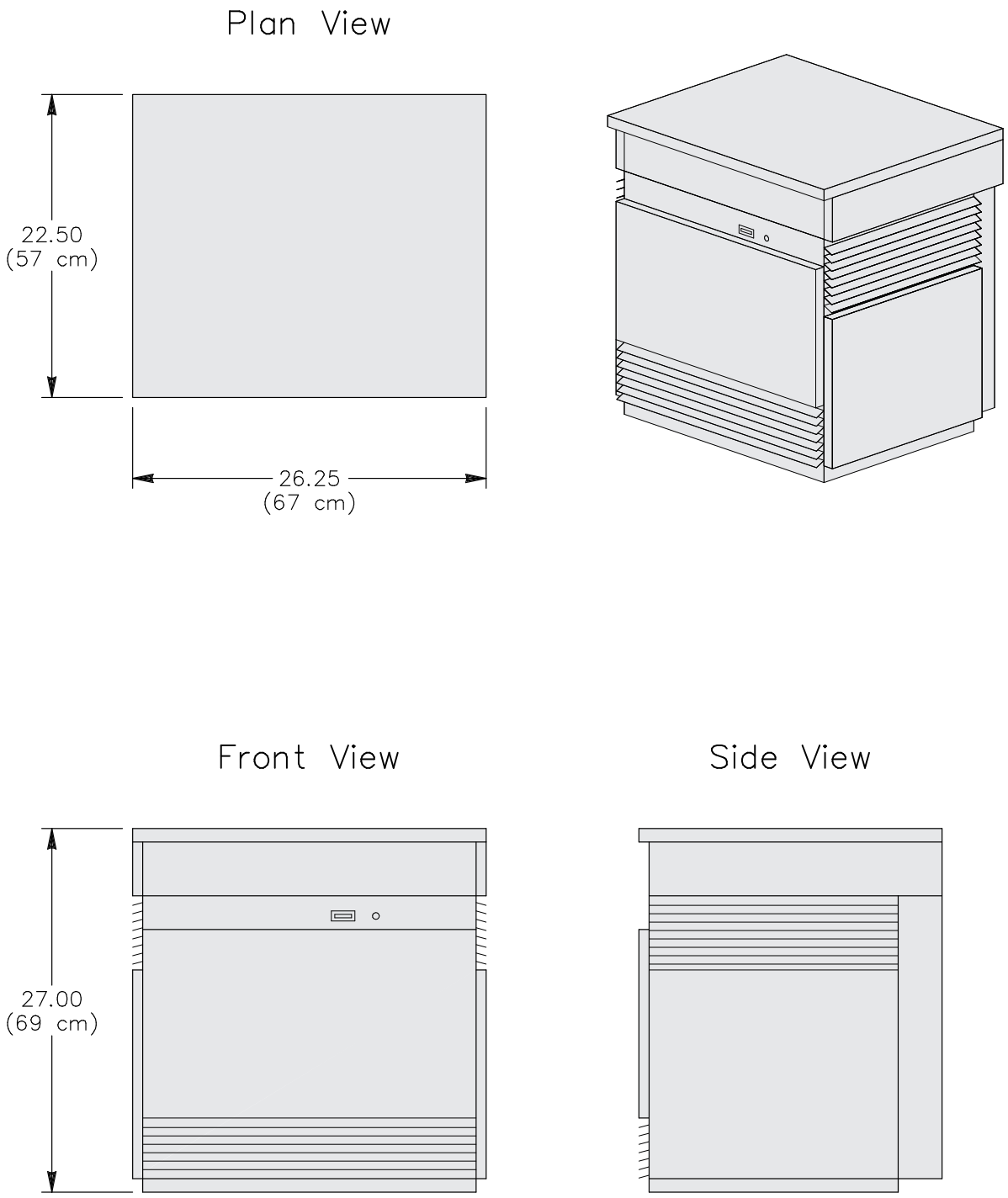

Figure 5-25. FOL and FEI/FOL Cabinets

You must prepare three floor cutouts for the FOL and FEI/FOL. Refer to Figure 5-26 for an illustration of these floor cutouts.

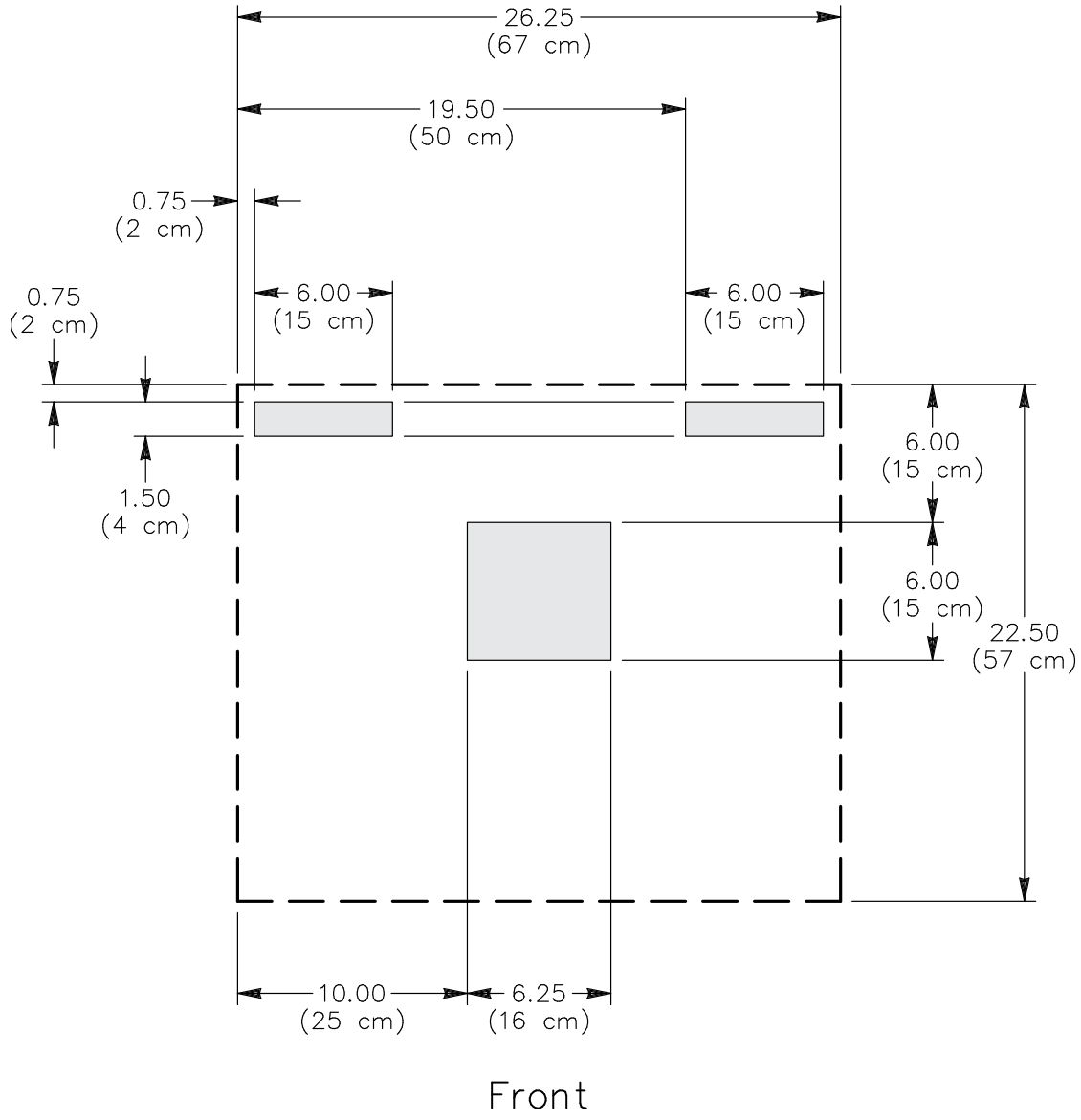

Figure 5-26. FOL and FEI/FOL Floor Cutout Requirements

Fiber-optic Link (FOL-4)

The fiber-optic link (FOL-4) is desk-mounted and extends the standard distances [up to 2.5 miles (4 km)] between a Cray Research computer system and a front-end system. Refer to Figure 5-27 and Figure 5-28 for illustrations of the FOL-4 separation limits.

Two FOL-4s are needed to provide this distance extension. One FOL-4 converts the electronic signal to an optical signal; the other FOL-4 converts the optical signal to an electronic signal. Refer to Figure 5-29 for an illustration of the FOL-4.

The FOL-4 operates at rates up to 100 Mbits/s and is compatible with any Cray Research computer system. The FOL-4 supports both 6-Mbyte/s and 12-Mbyte/s speeds and provides complete electrical isolation. Table 5-15 provides the FOL-4 specifications.

Table 5-15. FOL-4 Specifications

Characteristic	Specification
Height	7.25 in. (18 cm)
Width	19.00 in. (48 cm)
Depth	11.00 in. (28 cm)
Weight	15 lbs (7 kg)
Access requirements: Sides Front and back	 6.00 in. (15 cm) 36.00 in. (91 cm)
Cooling requirements	Ambient air
Power cable	Country specific
Power receptacle	Country specific

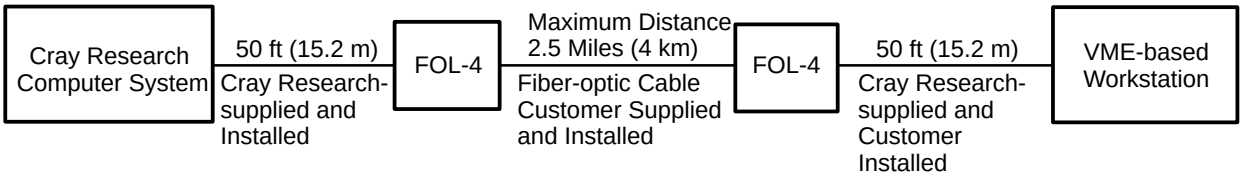

Figure 5-27. FOL-4 Separation Limits

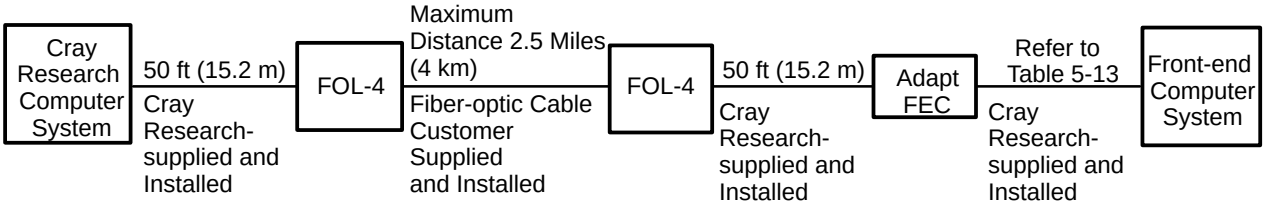

Figure 5-28. FOL-4 Separation Limits with Adapter FEC

You must supply and install the fiber-optic cable between the FOL-4s. Contact your site planning representative for specific information on the type of fiber-optic cable you must install.

Cray Research supplies and installs the signal cables between a CRAY C92A or D92A MFC or C94A IOS and the FOL-4. You must arrange for the installation of the Cray Research-supplied signal cables between the front-end system and the FOL-4 cabinet. The site preparation requirements for an adapter FEC are identical to those for an FEC (refer to the FEC subsection in this section).

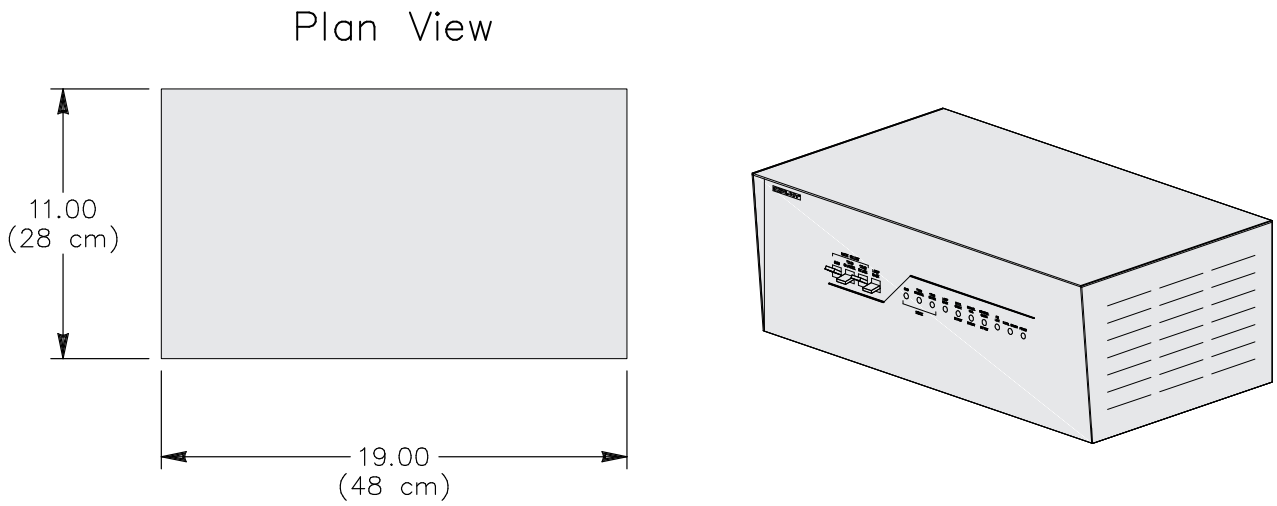

Figure 5-29. FOL-4

Fiber-optic Enclosure (FOE-1)

The fiber-optic enclosure (FOE-1) is a small air-cooled device designed to to support various Cray Research, Inc. fiber-optic converters and extender products. The FOE-1 internal logic chassis can accommodate up to four FCE-1 (FDDI) or FCE-2 (ESCON) modules. Refer to Figure 5-30 for an illustration of the FOE-1 enclosure.

FOE-1 enclosures can be stacked on top of each other or rack mounted into an industry standard 19-inch cabinet. The FOE-1 enclosure can also be located under the raised floor.

The separation limits for the FOE-1 enclosure and the front-end system varies, depending upon the type of module that is used in the FOE-1. Figure 5-31 represents the separation limits for an FOE-1 enclosure with FCE-1 modules. Figure 5-32 represents the separation limits for an FOE-1 enclosure with FCE-2 modules.

Table 5-16. FOE-1 Specifications

Characteristic	Specification
Height	6.75 in. (17 cm)
Width	17.00 in. (43 cm)
Depth	15.00 in. (38 cm)
Weight	34 lbs (15 kg)
Heat dissipation to air	573 Btu/hr (168 W)
Cooling requirements	Ambient air
Voltage	100 to 120 or 200 to 240 Vac
Frequency	50 or 60 Hz
Power cable	6-ft (1.8-m) pluggable drop cord
Power receptacle	Country specific

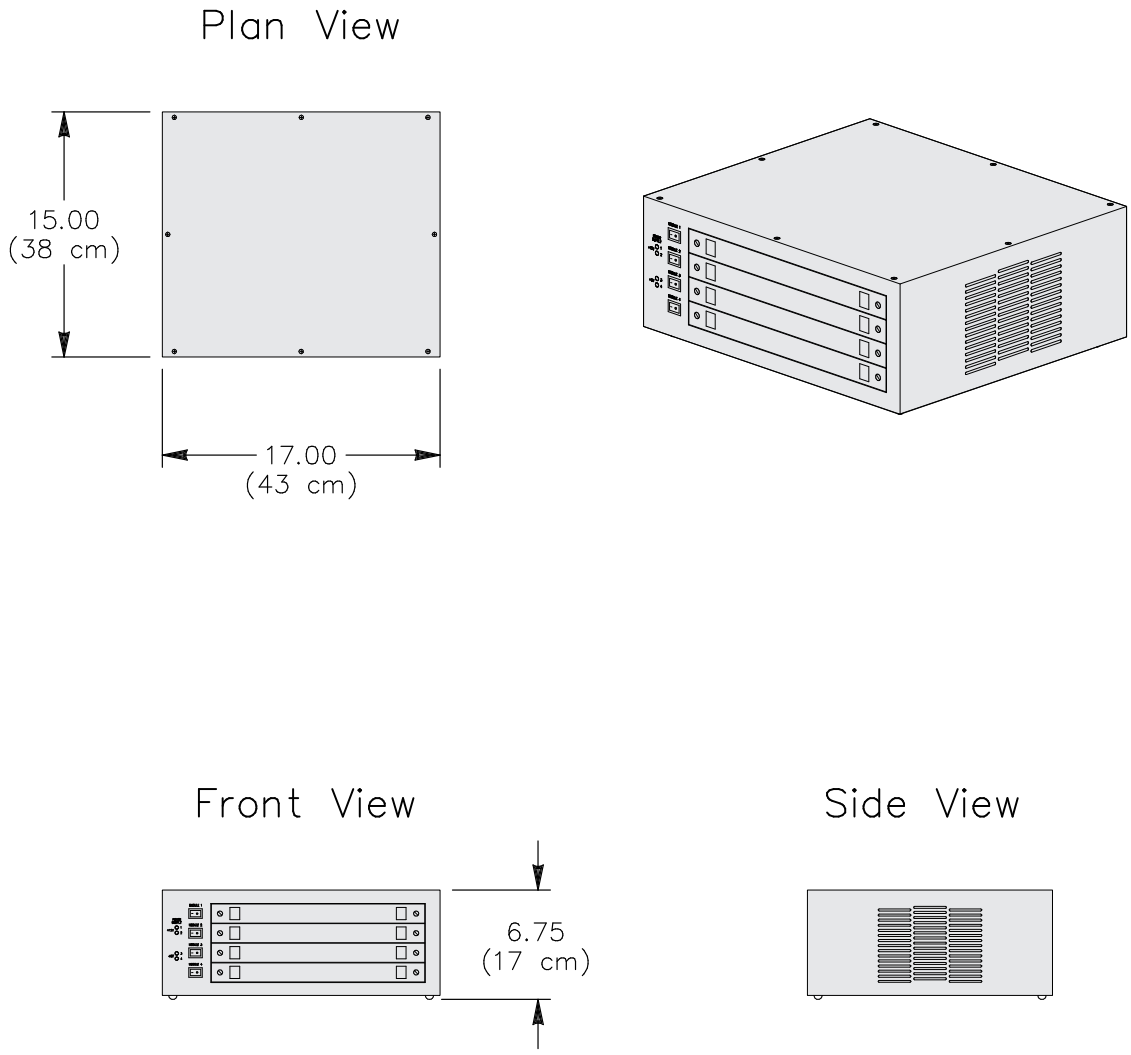

Figure 5-30. Fiber-optic Enclosure (FOE-1)

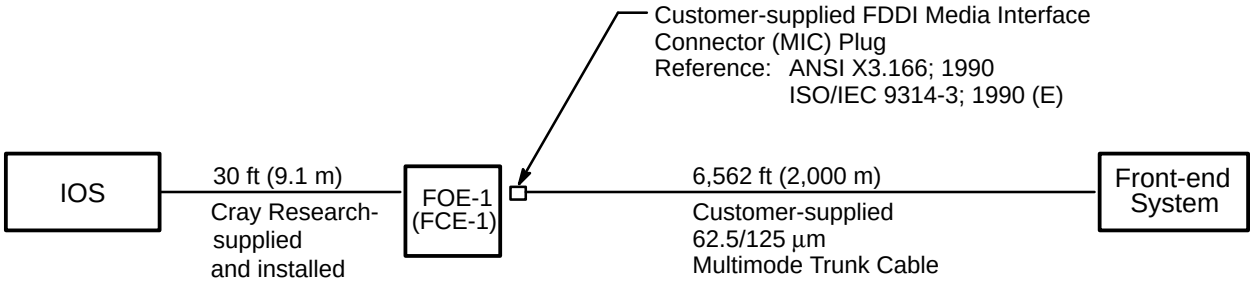

Figure 5-31. FOE-1 Enclosure with FCE-1 Modules Separation Limits

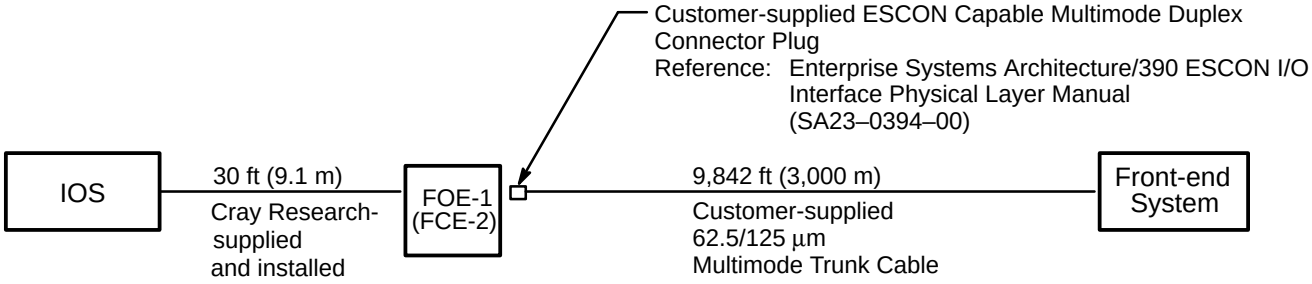

Figure 5-32. FOE-1 Enclosure with FCE-2 Modules Separation Limits

6 CHECKLISTS

Refer to Table 6-1 and Table 6-2 for site planning and site readiness checklists. These checklists are intended to be used as guidelines; additional preparation issues might exist at your site that are not included in these checklists.

Table 6-1. Site Planning Checklist

Yes	No	Site Planning Checklist	Comments
		Is the equipment layout established? Does the layout satisfy the equipment separation limits?	
		Has Cray Research approved the layout?	
		At which voltage will the mainframe, IOS/SSD (where applicable), and cooling unit be operated?_____	
		Will the cooling unit be cooled by air, water, or in automode? Is adequate capacity available?	
		Have the mainframe and cooling-unit floor cutout templates been ordered from Cray Research?	
		Have the mainframe, IOS/SSD (where applicable), and cooling-unit power receptacles been ordered from Cray Research?	
		Has an installation date been determined? Installation date:_____	
		What is the height of the raised floor?_____	

Table 6-1. Site Planning Checklist (continued)

		Has an access route to the system location been identified?	
		How will the signal reference grid be constructed?	

Table 6-2. Site Readiness Checklist

Yes	No	Site Readiness Checklist	Comments
		Has the method of unloading the computer system been determined (equipment and/or personnel)?	
		Is the path from the unloading area to the system location clear?	
		Does the path satisfy the access requirements outlined in Section 1?	
		Are elevator measurements adequate? (if applicable)	
		Are elevator door measurements adequate? (if applicable)	
		Is elevator weight capacity adequate? (if applicable)	
		Are ramp measurements adequate? (if applicable)	
		Are the floor cutouts for the OWS/MWS and disk drives complete?	
		Are all floor cutouts free of burrs and sharp edges?	
		Are the receptacles for the mainframe, IOS/SSD (where applicable), and cooling unit installed and positioned to satisfy the power circuit requirements?	
		Are the receptacles for the OWS/MWS and disk drives installed and positioned to satisfy the equipment power cord length?	
		Are circuit breaker panels and receptacles properly labeled?	
		Are the circuit breaker panels bonded to the signal reference grid?	
		Will the raised-floor stringer system act as the signal reference grid? If so, are the stringers bolted to the pedestal heads?	

Table 6-2. Site Readiness Checklist (continued)

Yes	No	Site Readiness Checklist	Comments
		Is the signal reference grid connected to the ground? How and where?	
		Are the raised-floor tiles conductive? (10^5 to 10^9 ohms of surface resistivity)	
		Has the computer room been tested to verify compliance with class 100,000 standards?	
		Have air handlers been tested?	
		Are the air handlers and air filters clean?	
		Does the computer room have positive air pressure?	
		Is the replacement air to the computer room filtered?	
		Is the rate of replacement air to the computer room satisfactory?	
		Does the computer room have proper humidity control?	
		Is the computer room vapor sealed?	
		Does the cooling water meet the specifications outlined in *Water Quality Requirements*, Site Engineering document 10658280? (if applicable)	
		Has the 50-Hz or 60-Hz power conditioner been load tested? (if applicable)	
		Have dedicated telephone lines for remote maintenance been installed?	
		Is the underfloor area clean?	
		Do the subfloor structures show any sign of corrosion?	
		Is the concrete subfloor sealed?	
		Do any unsealed penetrations in the underfloor exist that will allow plenum pressure to escape?	

Table 6-2. Site Readiness Checklist (continued)

Yes	No	Site Readiness Checklist	Comments
		Are ceiling tiles nonshedding, vapor barrier type?	
		Does the service personnel office space meet the standards outlined in Section 1?	
		Is one of the following types of fire suppression systems used?	
		Halon	
		Underfloor	
		Above floor	
		Sprinklers	
		Preaction	
		Wet type	
		CO_2	
		Underfloor	
		Above floor	
		If system is water cooled, are quick-disconnect nipples within 4 ft of cooling unit cutout?	
		Are the quick-disconnect nipples the correct type?	
		Are all water lines bonded to the signal reference grid?	

BIBLIOGRAPHY

Cray Research, Inc. Customer Publications

Submit orders for Cray Research, Inc. publications to the following address or telephone 800-284-2729 extension 35907.

Cray Research, Inc.
Distribution
2360 Pilot Knob Road
Mendota Heights, MN 55120

Principles of Computer Room Design, Cray Research publication number HR-04013.

The *Principles of Computer Room Design* manual describes computer room design principles to help computer room facility managers prepare, inspect, and maintain a stable, problem-free environment. Information on computer room and raised-floor construction, system cooling, environmental control, fire and lightning protection, power, and grounding is also discussed.

Safe Use and Handling of Fluorinert Liquids, Cray Research publication number HR-00306.

The *Safe Use and Handling of Fluorinert Liquids* manual is written for Cray Research, Inc. customers and field engineers whose Cray Research computer systems use Fluorinert liquid. This manual also describes the Material Safety Data Sheets (MSDS) and explains the significance of using Fluorinert liquid or any other chemical.

Cray Research, Inc. Site Engineering Documents

Submit orders for Cray Research, Inc. Site Engineering documents to the following address or telephone 800-284-2729 extension 62820.

Cray Research, Inc.
Site Engineering
1620 Olson Drive
Chippewa Falls, WI 54729

Equipment Grounding for Cray Research, Inc. Computer Systems, Site Engineering document number 10658002.

The *Equipment Grounding for Cray Research, Inc. Computer Systems* document describes the equipment grounding requirements for Cray Research computer equipment.

Forklift Size Requirements for the Handling of Cray Research Equipment, Site Engineering document number 10658374.

The *Forklift Size Requirements for the Handling of Cray Research Equipment* document provides forklift requirements and recommendations for the safe handling of Cray Research computer equipment.

Vibration and Shock Limits for Installed Computer Systems, Site Engineering document number 10658300.

The *Vibration and Shock Limits for Installed Computer Systems* document identifies the limits of vibration and shock levels an installed Cray Research computer system can tolerate.

Water Quality Requirements, Site Engineering document number 10658280.

The *Water Quality Requirements* document identifies the cooling water quality requirements for a Cray Research computer system.

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