CRAY® COMPUTER SYSTEMS

CRAY-2
SITE PLANNING REFERENCE MANUAL
(S/N 2001 AND UP)

HR-2001

RECORD OF REVISION

CRAY RESEARCH, INC.

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Each time this manual is revised and reprinted, all changes issued against the previous version are incorporated into the new version and the new version is assigned an alphabetic level.

Every page changed by a reprint with revision has the revision level in the lower righthand corner. Changes to part of a page are noted by a change bar in the margin directly opposite the change. A change bar in the margin opposite the page number indicates that the entire page is new. If the manual is rewritten, the revision level changes but the manual does not contain change bars.

Requests for copies of Cray Research, Inc. publications should be directed to Logistics and comments about these publications should be directed to:

CRAY RESEARCH, INC.
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890 Industrial Blvd.
Technical Operations Building
Chippewa Falls, WI 54729

Revision	Description
	May 1985 - Preliminary printing.
A	April 1987 - Rewrite. Electrical and environmental specifications have been updated. Technical specifications changed to reflect new dielectric coolant reservoir. Trademarks are now documented in the record of revision.

PREFACE

This manual is intended for the management and personnel responsible for installing a CRAY-2 computer system. The manual contains technical information to plan and prepare a typical site for this installation.

Site planning and facility preparation are important early steps in the successful installation of a computer system. Close communication and mutual cooperation between you and Cray Research, Inc. (CRI) is essential during all phases of the preparation and installation sequence. CRI maintains a staff of highly qualified site planning engineers who are experienced in handling a wide variety of site planning and preparation problems. CRI recommends that you involve qualified mechanical and electrical facility engineers early in the design stages of site preparation.

This manual contains site planning information for the following computer equipment:

- CRAY-2 mainframe chassis (MFC)
- Master heat exchanger pod (M-pod)
- Support heat exchanger pod (S-pod)
- Coolant reservoir
- Module test station (MTS-200)
- Module repair station (MRS-200)

This manual includes site planning information for this equipment only, and is just one of several site planning manuals that are required to prepare for your installation. For complete site planning information, also refer to the following CRI publications:

- HR-0080 Cray Peripheral Equipment Site Planning Reference Manual (provides site planning information for maintenance control group equipment, disk storage units, front-end interface equipment, and maintenance engineering test equipment.)

- HR-0082 Cray Support Equipment Site Planning Reference Manual (provides site planning information for motor-generator sets.)

- HR-0089 Cray Computer Systems Site Planning Templates Package (Standard) (provides reduced templates (scale 1/4 in. = 1 ft) of CRI computer equipment for use in planning your computer room equipment layout. This is not the full-size template used in the floor preparation for your system.)

- HR-0094 Cray Computer Site Planning Templates Package (Metric) (provides reduced templates (scale 1 cm = 50 cm) of CRI computer equipment for use in planning your computer room equipment layout. This is not the full size template used in the floor preparation for your system.)

Because the information in this manual is subject to change, consultation with CRI site planning personnel and CRI approval of the actual site preparation working drawings is required before preparing a site. Questions involving site planning and preparation should be directed to CRI as early as possible in the installation sequence.

Submit requests for site planning information to the following address:

CRAY RESEARCH, INC.
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1.1.1 INITIAL MEETING

The first site planning meeting is held preferably 6 months before system delivery. At this meeting, site planning personnel perform the following tasks:

- Tour and review your facility
- Identify potential site difficulties
- Review the site planning manual with you
- Define the materials and labor to be supplied by you
- Define the materials and labor to be supplied by CRI
- Provide specifications and charts (not working drawings) for the proposed equipment

Using the CRI specifications and charts, your facility or consulting engineering staff will prepare the working drawings and specifications used to perform the electrical and mechanical work required for site preparation.

1.1.2 INTERIM MEETING

Interim meetings are held at your facility as required to review your progress and to resolve any site problems.

1.1.3 FINAL MEETING

Approximately 2 to 4 weeks before system delivery, a final site review is held to ensure that your facility is properly prepared. By this time, you will have installed the pre-installation equipment shipped by CRI. CRI personnel will review the preshipped equipment installation, floor cutout preparations, chilled water piping and manifolds and electrical wiring. The motor-generator sets (MGSs) will be run during the final site review.

1.2 INSTALLATION STAGES

The installation of a CRAY-2 computer system consists of seven basic stages:

1. Preshipment/installation of support equipment
2. System shipping preparation
3. System transportation
4. System installation
5. System startup/stabilization
6. System on-site quality assurance
7. System operational preparation

1.2.1 PRESHIPMENT/INSTALLATION OF SUPPORT EQUIPMENT

Approximately 6 to 8 weeks prior to the system delivery, CRI delivers all necessary equipment classified as support equipment. Support equipment, consisting of MGSs and subfloor junction boxes, is delivered to your site via commercially available transportation.

You will be responsible for receiving, unloading and installing the support equipment without CRI attendance or supervision.

1.2.2 SYSTEM SHIPPING PREPARATION

At least 1 week before delivery, the computer system is prepared for shipping. Major components are disassembled to the shipping configuration and are structurally and protectively prepared. Cabling and miscellaneous materials are packaged and identified for shipment.

1.2.3 SYSTEM TRANSPORTATION

The system equipment is transported to your facility by commercially available, dedicated, tractor-trailer semis. All trailers are equipped with air-suspension ride and are climate controlled.

For intercontinental shipments, transported materials are containerized for shipment and transported by commercial cargo-carrying aircraft.

1.2.4 SYSTEM INSTALLATION

Under CRI supervision, you will unload and move the system equipment into the facility. Special equipment required to unload the computer equipment (forklifts, cranes, platforms, and so on) and all labor associated with the equipment unloading and movement must be arranged for and provided by you. CRI installation personnel ensure that all CRI equipment is properly placed and will mechanically reassemble the computer system, connect all logic cabling, and attach the coolant and water hoses. During the installation process, electricians, arranged for and supplied by you, will connect all power and control wiring to the equipment.

Site planning representatives generally accompany CRI installation personnel during system installation.

1.2.5 SYSTEM STARTUP/STABILIZATION

During system startup, CRI personnel activate all necessary electrical and dielectric coolant controls. If any electrical circuitry or chilled water problems arise, you must provide knowledgeable personnel to correct such problems.

1.2.6 SYSTEM ON-SITE QUALITY ASSURANCE

Upon completion of system startup and power/cooling stabilization, CRI personnel will perform all necessary CRI-defined system installation quality assurance functions and tests.

1.2.7 SYSTEM OPERATION PREPARATION

Upon satisfactory completion of all CRI installation quality assurance functions, CRI will declare the system ready for use. At this point, CRI on-site personnel will perform the necessary software activities to prepare the system for customer acceptance or use.

GENERAL REQUIREMENTS 2

For proper installation and operation of the CRAY-2 computer system, you must meet the general requirements outlined in this section. Specific equipment requirements are defined in sections 4 through 6. The equipment separation limits are described in section 7.

Equipment requirements for support and peripheral equipment are found in the Cray site planning reference manuals listed in the preface.

The CRAY-2 series computer system is exempt from the technical requirements of the FCC's Part 15 Subpart J Rules pursuant to section 15.801(C).

2.1 COMPUTER ROOM ENVIRONMENT

The CRAY-2 computer system must be operated in a controlled computer room environment. Although the requirements encompass the overall computer room, they are particularly oriented towards air-cooled devices such as tape drives, disk drives, printers, CRTs, and so on. Therefore, the design and component placement of your environmental control system (such as room air-conditioning units) must ensure that the inlet air to the air-cooled device meets the specified environmental requirements.

CRI makes every effort to improve its hardware's immunity to environmental irregularities; however, emphasis must be placed on the environment to ensure that hardware reliability is not adversely affected. Emphasis must also be placed on your ongoing housekeeping and maintenance practices to ensure continued hardware reliability.

The CRAY-2 computer system requires a computer room environment controlled within the ranges specified below.

- Temperature: 60 °F to 80 °F (16 °C to 27 °C)
  Maximum rate of change is 10 °F (5.5 °C) per hour
  Maximum shock is 3 °F (1.6 °C) per hour
  Maximum shock frequency is one per hour

- Humidity: 35% to 65% relative humidity (non-condensing)
  Maximum rate of change is 5% relative humidity per hour

- Dew point: Maximum 55 °F (13 °C)

- Air quality: For particles greater than 0.5 micron in size, 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, 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, concentration must not exceed 6.5×10^2 particles/ft^3 (2.3×10^4 particles/m^3).

One fresh air change per hour is required in the computer room environment.

NOTE

No smoking materials, food, or beverages are allowed in the vicinity of the CRI computer room equipment.

2.2 POWER PLANT ROOM ENVIRONMENT

In cases where the motor-generator sets (MGSs) are not located in the computer room, the following environmental specifications apply. The power plant room should be located close to the computer room and must have a controlled environment as specified:

- Temperature: 65 °F to 95 °F (18 °C to 35 °C)
  Maximum rate of change is 20 °F (5.5 °C) per hour

- Humidity: 30% to 80% relative humidity (non-condensing)

- Air quality: a clean, dirt- and dust-free environment must be maintained

2.3 SITE ACCESS REQUIREMENTS

Prior to system delivery, you must ensure that site accesses meet the provisions discussed later in this subsection.

CRI provides protective covering (aluminum sheets) for false floor and tiled areas during the moving-in process.

2.3.1 SHIPPING AND INSTALLATION

The CRAY-2 computer is shipped, moved, and installed with all printed circuit modules and power supplies in place. Figure 2-1 illustrates the shipping configuration of the mainframe. Two specially designed lifts secured to the mainframe elevate the unit for mobility. A false base attached to the mainframe base provides protection for coolant connectors, power, and input/output drop cables.

Figure 2-2 illustrates the shipping configuration of the coolant reservoir. Again, two specially designed lifts elevate the reservoir for mobility.

Access routes to the computer room must be able to support rolling casters with 1000 lb (454 kg) loads. This load support requirement applies especially to inclines, where the equipment is more vulnerable to possible damage. The slope of any incline negotiated during the installation of CRI computer equipment must not exceed 1 unit in height to 6 units in length.

Installation of CRI computer equipment requires doorway openings with minimum clearances of 80 in. (203 cm) in height and 60 in. (152 cm) in width along the access route to the computer room. If a doorway is located close to an incline, the door height requirement may be greater.

You must also verify that adequate clearance and load support capability exists along the access route for the installation of the CRI support equipment. Refer to the appropriate section of the Cray Support Equipment Site Planning Reference Manual, publication HR-0082, for details.

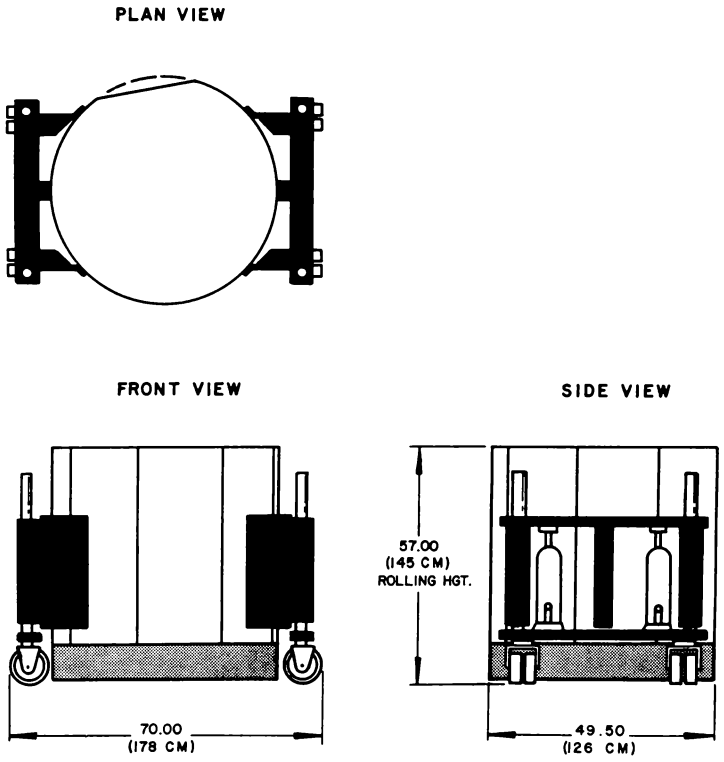


Figure 2-1. CRAY-2 Mainframe Shipping Configuration

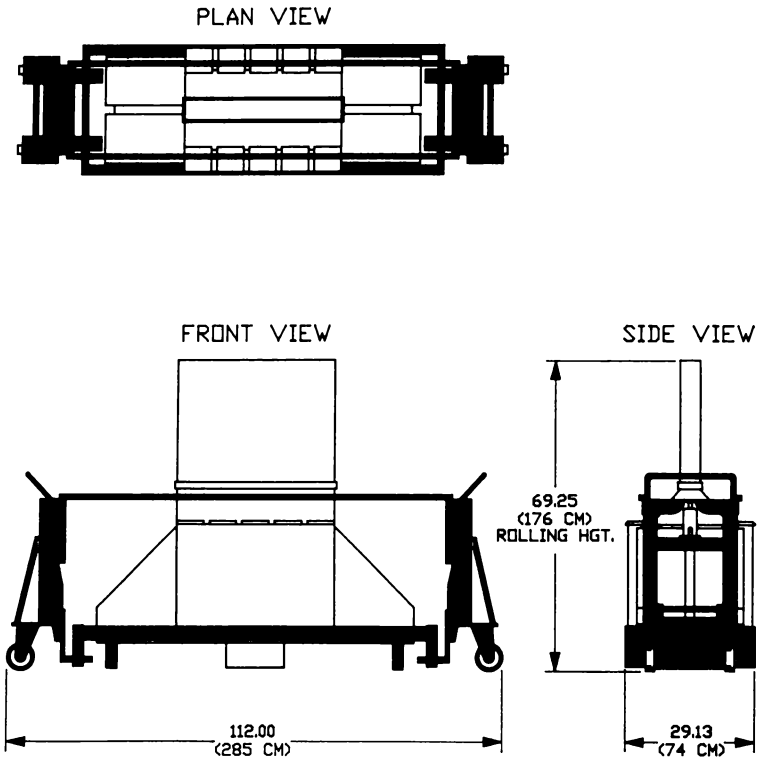


Figure 2-2. Coolant Reservoir Shipping Configuration

2.4 ELECTRICAL REQUIREMENTS

CRI makes every effort to improve its hardware's immunity to power failures and interruptions; however, a system of this complexity may, if subjected to repeated power fluctuations or interruptions, suffer a higher component failure rate than it would with a stable power source. You are encouraged to make every effort to provide a stable power source so that hardware reliability is not adversely affected.

The following electrical services are required for the CRI computer equipment:

- 460±10% Vac, 3-phase, 60±3 Hz
- 208 Vac, 3-phase, 60 Hz
- 120 Vac, 1-phase, 60 Hz

The 208/120 Vac, 60-Hz electrical service must conform to the following limits:

• Voltage tolerance:	+5% to -10%
• Voltage unbalance:	5% maximum (line to line, line to neutral)
• Voltage harmonics:	5% total, 3% largest
• Voltage deviation (sine wave):	+5% to -10%
• Voltage modulation:	3% maximum
• Frequency tolerance:	±1%
• Frequency rate of change:	Less than 1.0 Hz/sec during any 10-cycle period
• Transient surges:	+5%
• Transient sags:	-5%

Total power requirements depend on the system configuration and expansion allowances. CRI will provide documentation during the initial site planning meeting that estimates the power requirements based on your specific system configuration.

2.4.1 EXCEPTIONAL ELECTRICAL REQUIREMENTS

If your facility's electrical services are 50 Hz (and not 60 Hz as defined in subsection 2.4, Electrical Requirements), you must provide the following:

- 397±5% Vac, 3-phase, 50±3 Hz
- 208/120 Vac, 60 Hz (as defined in subsection 2.4, Electrical Requirements)

When a CRI computer system is installed in a location supplying only 50-Hz power, CRI will provide the MGSs in models equipped for operation at 50 Hz.

The 208/120 Vac, 60-Hz requirement may require that you provide a 50-Hz to 60-Hz frequency convertor. When selecting the frequency converter, it should be sized in accordance with your anticipated system expansion plans.

2.4.2 EQUIPMENT-GROUNDING REQUIREMENTS

All CRI computer equipment requires two grounding systems: a protective power safety-ground system and a signal-ground reference system. In addition, the computer room environment must be maintained so that the CRI computer equipment does not malfunction or become damaged as a result of electrostatic discharge (ESD).

The power safety-ground system protects personnel from shock hazards and protects the computer equipment from damage due to electrical malfunctions. The signal-ground reference system provides controlled circuit paths for radio frequency interference (RFI) between associated computer equipment and the surrounding environment.

CRI provides an equipment grounding document during the initial site planning meeting. The document describes the power safety-ground system requirements and identifies alternative methods for providing the signal-ground reference system. In addition, the document discusses ESD precautions and maintenance of the facility's grounding systems.

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

All CRI computer equipment is supplied with braided ground straps. You are responsible for connecting the ground straps to the signal-ground reference system.

2.5 POWER WIRING REQUIREMENTS

Approximately 6 to 8 weeks prior to delivery of the CRAY-2 computer system, CRI will ship the MGSs and subfloor junction boxes (J-box #1 and J-box #2) to your facility.

You must prepare the facility and supply all power wiring, circuit breakers, circuit breaker panels, and so on, necessary for installation of this support equipment. Refer to the Cray Support Equipment Site Planning Reference Manual, publication HR-0082, for detailed site planning information on the support equipment. In addition, you must perform all necessary wiring preparations to make the support equipment ready for final connection upon delivery of the computer system.

During installation of the computer system, CRI personnel will perform the mechanical reassembly of the computer equipment, attach all dielectric-coolant and chilled-water hoses, and install all associated logic cabling. You are required to supply and connect all remaining 50/60-Hz and 400-Hz power and control wiring needed to complete the installation.

Figure 2-3 is a block diagram of the basic power wiring for the CRAY-2 computer system.

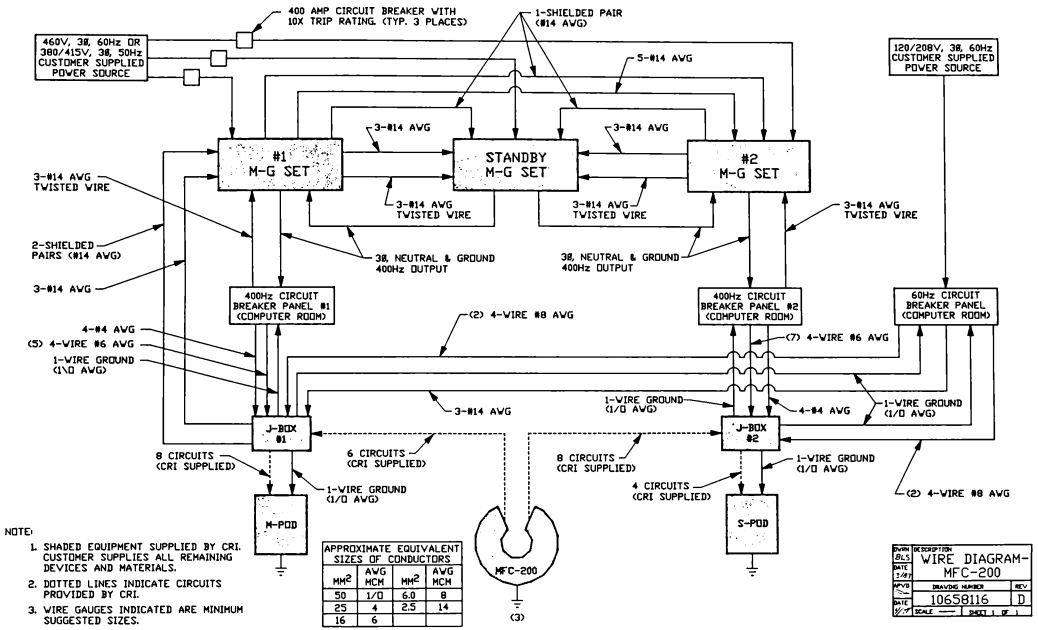


Figure 2-3. Basic Power Wiring for a CRAY-2 Computer System

The following information provides additional block diagram details:

- Figure 2-3 is a guide for your electrical design engineer and must not be used as a bid document or working drawing.

- The component arrangements shown in figure 2-3 do not represent actual layout of equipment.

- The circuits (flexible conduit and wiring) from the CRAY-2 mainframe chassis (MFC) to the subfloor J-boxes, and from the J-boxes to the
  M- and S-pod are supplied by CRI and terminated by you at the time of computer system installation.

- All wiring shall be prepared according to applicable local and national codes. Wire gauges indicated in figure 2-3 are given to suggest minimum size requirements and are to be used for reference only.

- Actual wire sizes must be selected to ensure that the maximum voltage drop from the MGS 400 Hz output to J-box #1 and #2 does not exceed 2%.

- All circuit breakers, circuit breaker panels, magnetic contactors, main power disconnect switches, junction boxes, power wiring, wiring raceways, and conduits required will be furnished and installed by you.

- Aluminum or nonferrous conduit or raceways must be used for all 400-Hz power distribution.

- Circuit breakers used for 400-Hz power distribution may be 60-Hz rated, but must be sized for 400-Hz application.

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

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

- All power cords or conduits terminating at floor-mounted computer equipment must be secured with approved fittings at the equipment entrance. Refer to specific equipment sections in this manual for detailed requirements.

- All CRI equipment must be earth-grounded. Refer to subsection 2.4.2, Equipment Grounding Requirements, and to specific equipment sections for detailed requirements.

- Detailed point-to-point diagrams for all wiring connections to the mainframe, M-pod, S-pod, J-boxes, and MGSs are included within the CRI site planning documentation supplied to you early in the site planning process.

2.6 CHILLED-WATER SUPPLY REQUIREMENTS

Installation of a CRAY-2 computer system requires that the facility provide an adequate source of clean chilled water. A CRI water quality specification is provided during the initial site planning meeting.

Chilled water temperature (measured at the M-pod and S-pods inlet) must not vary more than ±5 °F (2.8 °C) from the required 50 °F (10 °C) temperature. Rate of change must not exceed 5 °F (2.8 °C) per 15-minute cycle.

CRI provides flow rate and pressure drop values for the M- and S-pods, based on your system configuration and 50 °F (10 °C) water supply temperature, within the supportive documentation provided by site planning. The preferred operating pressure (inlet side) of the chilled-water system is 45 psig or less. Pressure must not exceed 100 psig.

2.7 CHILLED-WATER PIPING REQUIREMENTS

A customer supplied and installed chilled-water manifold is required to distribute chilled water to the individual heat exchangers contained within the M- and S-pods. The preferred construction and location of the manifold, in relation to the M- and S-pods, is detailed in section 5, Heat Exchanger Pods and Reservoir.

CRI will supply and install flexible water hoses to connect the chilled-water manifolds to the heat exchangers.

2.7.1 DIELECTRIC COOLANT PIPING REQUIREMENTS

CRI will supply and connect all flexible coolant hoses between the CRAY-2 mainframe, the M- and S-pods, and the coolant reservoir.

Figure 2-4 illustrates the standard arrangement of equipment and the interconnecting hoses. To ensure that adequate space exists in the underfloor area, you must maintain a zone clear of underfloor obstructions in this area. This zone must extend at least 7 in. (18 cm) from the underside of the raised tile floor.

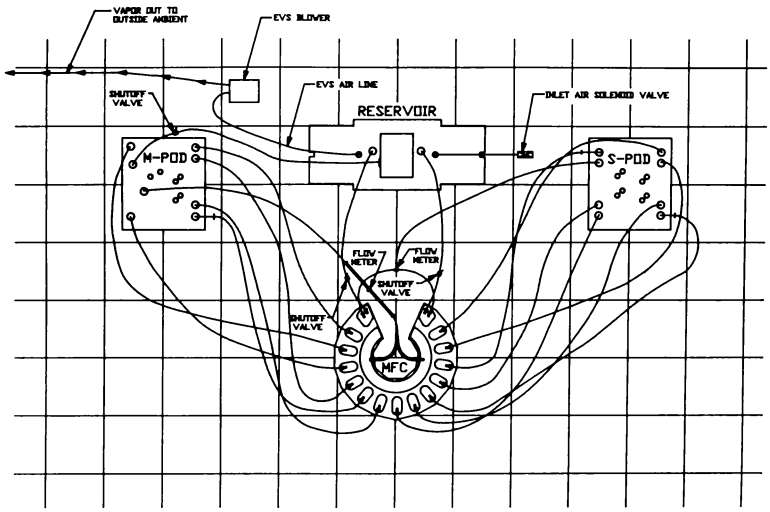


Figure 2-4. CRAY-2 Flexible Dielectric-Coolant Hoses

2.8 DIELECTRIC COOLING

The CRAY-2 computer system uses a dielectric fluid to cool the computer mainframe. Heat, dissipated from the integrated circuits and power supplies within the confines of the mainframe, is absorbed by the dielectric fluid. The dielectic fluid is circulated through the mainframe by pumps located within the M- and S-pod cabinets. (Refer to section 5 for further information.) The M- and S-pod cabinets also contain heat exchangers in which the dielectric fluid conducts the heat to your chilled water system.

2.8.1 DIELECTRIC FLUID HOSES

Flexible hoses are required to complete the dielectric-fluid circuitry between the mainframe, M-pod, S-pod, and reservoir. CRI will supply and install all of the associated flexible hoses for the dielectric fluid. Figure 2-4 schematically illustrates the standard arrangement of equipment and the interconnecting hoses. In order to ensure that adequate space exists in the underfloor area, you must maintain a zone clear of underfloor obstructions in this area. This zone must extend downward, at least 7 in. (18cm) from the underside of the raised tile floor.

2.8.2 UNDERFLOOR PREPARATIONS

In addition to providing adequate underfloor space for dielectric-fluid hoses and cabling, you are also required to provide an underfloor containment structure for fluid constraint.

Major leaking of the dielectric fluid is not anticipated. In the event of a leak, however, the dielectric fluid will pool under the computer room false flooring. It is required that you prepare subflooring surface with a dam to contain the coolant within the immediate area of the CRAY-2 computer system. The subfloor dam prevents the dielectric fluid from spreading throughout the computer room subfloor and allows CRI to expediently recoup the fluid. CRI will provide a document describing the suggested design and subfloor preparation for the dam.

2.8.3 DIELECTRIC FLUID

The dielectric fluid used to cool the CRAY-2 mainframe is a formulation of fluorochemicals commonly known as Fluorinert. This dielectric coolant is among the most stable fluids known. Because of strong bonding between the atoms in its molecules, it can withstand a high degree of chemical, thermal, and radiation stress.

The dielectric coolant is nonflammable and is exceedingly resistant to chemical attack. It is not altered by a variety of strong acids, strong bases, oxidizing, or reducing agents. The dielectric coolant will, however, decompose into toxic gases when subjected to high temperatures.

To ensure the safety of personnel and facilities, certain precautionary measures are required and must be implemented by you. The CRAY-2 system contains an automatic ventilating system which vents decomposition gases to the outside atmosphere in the event of an electrical short circuit within the mainframe. You are required to provide the appropriate air duct and associated accommodations for attachment to the ventilating system as described in subsection 2.9. Refer to subsection 6.1.7 for ventilation requirements associated with the CRAY-2 module test station.

In addition, you must ensure that the fresh air change requirement specified in subsections 2.1 and 2.11.2 is accommodated and maintained and that smoking is not allowed with the CRAY-2 computer room, module test station room, or the area utilized for Fluorinert storage.

CRI publication HR-0306, Safe Handling of the Dielectric Coolant, discusses Fluorinert properties, stabilities, and precautionary requirements in detail. A copy of this publication is available upon request. CRI recommends that computer operators and all others working in the computer room read this document and watch its accompanying videotape, "Fluorinert Safety".

2.9 CRAY-2 SYSTEM VENTILATION REQUIREMENTS

During normal operation, the CRAY-2 dielectric-cooling system is completely closed to the computer room environment. In the remote event of an electrical short circuit (that may cause decomposition of dielectric coolant) an external ventilation system (EVS) is provided as part of the cooling system (refer to figure 2-5). Refer to subsection 2.8 for details regarding the properties of the dielectric coolant.

2.9.1 VENTILATION SYSTEM DESCRIPTION

In the remote event of a significant electrical short circuit, the computer system will automatically power off, an alarm will sound, and the the EVS blower will energize. The decomposition gases formed in the mainframe will be safely exhausted into the atmosphere.

The CRI supplied ventilation system includes a sensor to detect short circuits, a high pressure blower, an inlet air solenoid, and a ventilation hose for connection of the reservoir to the blower inlet.

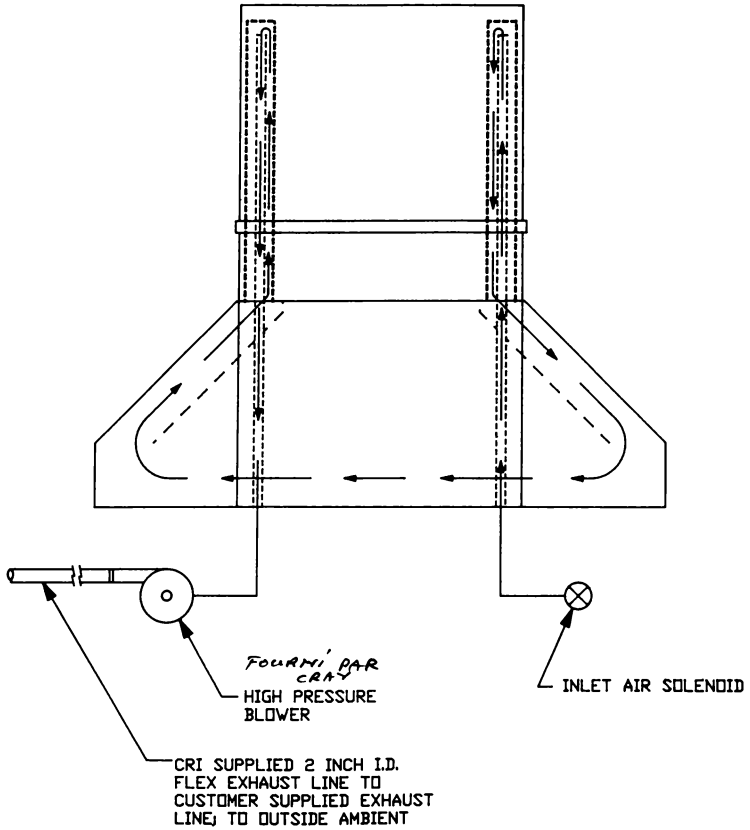


Figure 2-5. CRAY-2 External Ventilation System (EVS)

The customer must provide a 2-in. (5.1-cm) inside diameter exhaust line from the blower exhaust to the ambient outside air at a safe venting location.

Design considerations for routing the exhaust line from the blower discharge to the outside ambient air must take into account a maximum equivalent length of 300 ft (91.5 m) of straight pipe (including directional changes and exhaust louvers).

2.9.2 INPUT POWER REQUIREMENTS

Input power to the ventilation system is provided by power drop cables from the M-pod.

The ventilation system and audible alarm are automatically energized by the CRAY-2 monitor system at the detection of a short circuit. The ventilation system may also be manually energized.

2.9.3 BLOWER LOCATION

Actual blower location will be specified by the CRI site planning documentation package supplied to you.

2.10 COMPUTER ROOM FLOOR

The computer room must be prepared with a false floor a minimum of 12 in. (30.5 cm) high to accommodate routing of the various power lines, signal lines, and coolant and chilled-water hoses. All CRI computer equipment requires floor cutouts for power wiring, signal cable, and, in some cases, coolant and chilled-water hose entrance. In addition, some equipment requires reinforcement of the flooring due to concentrated floor loading conditions. Refer to specific equipment types in sections 4 and 5.

The size of the false floor tile discussed in the manual is 24-in. (61 cm) square. False floor tiles other than 24-in. square will require review by CRI site planning personnel for placement of equipment, floor cutouts, and chilled-water piping.

2.11 SYSTEM SUPPORT PERSONNEL REQUIREMENTS

CRI provides fully trained field engineers (FEs) and software analysts on a contractual basis for support of the computer system. CRI personnel residing on-site generally include a field engineer-in-charge (EIC) and one or more FEs, as well as a analyst-in-charge (AIC) and one or more additional analysts.

2.11.1 FIELD ENGINEERING OFFICE

The FEs require a quiet office environment and the following items as a minimum:

- One office, approximately 150 ft^2 (14 m^2), or two offices, approximately 75 ft^2 to 100 ft^2 (7 m^2 to 9 m^2) each
- Two locking desks
- Two 3-shelf bookcases
- One 4-drawer file cabinet
- One typewriter table
- Three chairs
- One telephone

Additional items may be required due to the system and its configuration.

The FE office should be located adjacent to or as close to the computer room as possible.

2.11.2 FIELD ENGINEERING REPAIR SHOP

Also required by the field engineers is a maintenance repair shop. This repair shop requires adequate lighting and power outlets for tools and test equipment. The shop environment must be maintained within the specifications outlined in subsection 2.1, Computer Room Environment. The repair shop area requires one fresh air change per hour. The module test and repair stations, described in section 6, will be located in this area.

The repair shop must include the following items as a minimum:

- One workshop, approximately 150 ft^2 (14 m^2)
- One workbench with power outlets

- One workbench chair
- Three parts cabinets, approximately 36 in. x 72 in. (91 cm x 183 cm)
- Two 3-shelf bookcases
- One worktable, 30 in. x 60 in. (76 cm x 152 cm)
- One chair
- One telephone with data quality telephone line
- One 4-drawer file cabinet

Additional items may be required due to the system and its configuration.

The FE repair shop should be adjacent to or as close to the computer room as possible.

2.11.3 SOFTWARE ANALYST'S OFFICE

You must provide the software analyst a quiet office environment with the following items as a minimum:

- One office, approximately 150 ft^2 (14 m^2), or two offices approximately 75 ft^2 to 100 ft^2 (7 m^2 to 9 m^2) each
- Two locking desks
- Two 3-shelf bookcases
- One 4-drawer file cabinet
- One worktable 30 in. x 60 in. (76 cm x 152 cm)
- Four chairs
- Two telephones
- One terminal connected to the Cray computer system
- One terminal connected to your front-end systems

The software analyst's office should be located as close as possible to the computer room.

2.11.4 MODEM

CRI systems support personnel use a modem data communications link as a diagnostic aid in their troubleshooting and maintenance activities.

Providing that site security restrictions allow the use of this device, you should contact the local telephone company well in advance of the system delivery to arrange for installation of the telephone line required for the modem. Arrangements should be made with CRI to take care of the monthly service charges.

The modem supplied is a U.D.S. Model 212A. The following information may be helpful when talking with the telephone company representatives:

- The modem uses a standard telephone with a voice grade line; jack type = RJ11C
- Touch tone/rotary dial = touch tone preferred
- Ringer equivalence = 0.3b
- FCC registration number = AK-396F-68998-MD-E
- External/internal clock = internal
- Grounding = chassis ground to signal ground
- Transmit level = -9 dBm
- Force answer/originate = originate
- 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 = permanent
- Synchronous/asynchronous = asynchronous
- 9-bit/10-bit/11-bit character = 10-bit character

This equipment should be in place before the installation of the computer system. The telephone must be located within 15 ft (4.6 m) of the maintenance control console.

SYSTEM CONFIGURATIONS 3

The CRAY-2 computer system and associated equipment units are available with a number of options in a variety of system configurations. This arrangement makes it possible to configure a CRAY-2 series computer system which is well suited to most applications while allowing for a wide range of expansion capabilities through additional memory, disk storage units, I/O channel and interface adaptations, and so on.

Configurations vary from facility to facility, depending upon the application requirements of each customer. For site planning purposes, you must know the number and type of equipment to be included in the initial system. It is also advantageous to know future system expansion plans.

Table 3-1 lists the available equipment types and quantities for the CRAY-2 computer system. The range of quantities defines minimum to maximum capabilities. A detailed description of each equipment type is given in the appropriate site planning manual. The table includes references to the section within this manual or the appropriate CRI site planning manual.

Table 3-1. CRAY-2 Computer System Configuration

Quantity	Equipment	Refer To
1	CRAY-2 mainframe chassis (MFC)	Section 4
1	Master heat exchanger pod (M-pod)	Section 5
1	Support heat exchanger pod (S-pod)	Section 5
1	Coolant reservoir	Section 5
1	Module test station	Section 6
1	Module repair station	Section 6
1	Maintenance control console (MCC-200)	HR-0080
1	Line printer	HR-0080
2-36	Disk drive units	HR-0080
1-3	Front-end interfaces	HR-0080
3	Motor-generator sets (MGSs)	HR-0082

CRAY-2 MAINFRAME CHASSIS (MFC) 4

The CRAY-2 mainframe chassis (MFC) is a dielectric-cooled unit (refer to figure 4-1). The memory, computer logic, and DC power supplies are architecturally integrated into a compact, semicircular mainframe composed of 14 vertical columns.

4.1 WEIGHT

The MFC's dry weight is approximately 3500 lb (1575 kg). The operational weight of the MFC is approximately 5500 lb (2475 kg). Floor loading for the MFC is approximately 3 lb/sq in. (2109 kg/m).

4.2 LOCATION

The MFC must be the focal point of all associated equipment arranged within the computer room.

The MFC must be located within the constraints of the dielectric-liquid piping and with consideration of the false floor grid size and structure. Access requirements are described in section 7, Equipment Separation Limits.

Expansion plans must also be considered when planning the location of the MFC.

4.3 ACCESS REQUIREMENTS

Adequate access to the computer for maintenance activities is required. The facility should allow a minimum of 4-ft (1.2-m) clearance around the MFC for the movement of maintenance personnel, equipment, and removal of false floor tiles for access to the underfloor dielectric coolant hoses.

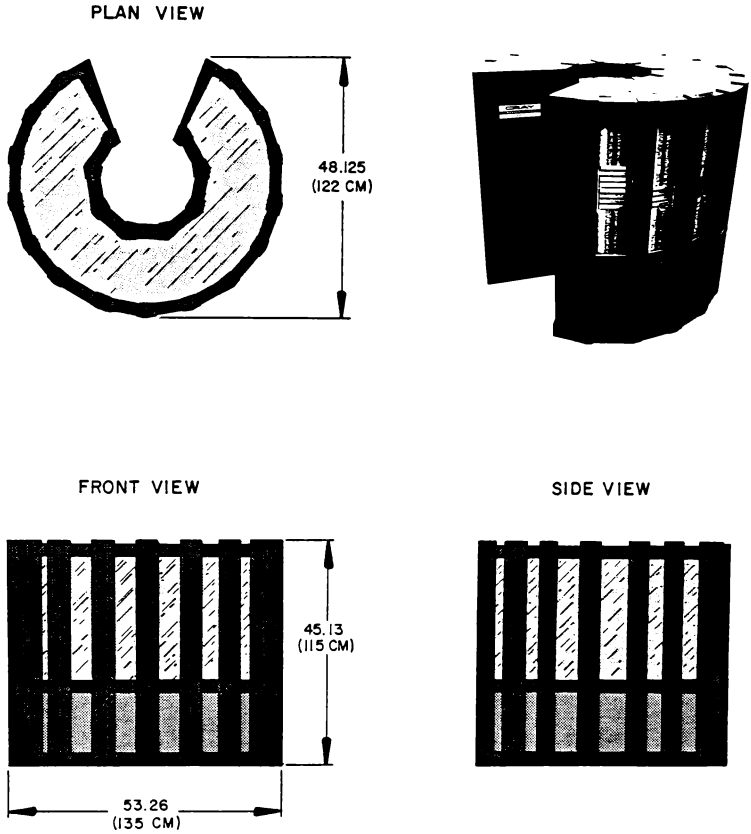


Figure 4-1. CRAY-2 Mainframe Chassis (MFC)

4.4 COOLING REQUIREMENTS

The MFC is a dielectric-cooled unit that dissipates heat from the integrated circuits contained throughout the logic and the memory sections and from the modular self-contained power supplies.

To protect the integrated circuits and power supplies from overheating, the mainframe incorporates direct-contact, forced-convection cooling using a liquid dielectric coolant. Other major components of the cooling system are contained within the M-pod, S-pod and coolant reservoir (refer to subsection 5.1 and 5.2) and underfloor dielectric-coolant piping (refer to subsection 2.7.1).

Formation of condensation on the MFC and attached coolant lines is not anticipated as long as the environment is maintained within the parameters outlined in subsection 2.1, Computer Room Environment.

When in operation, the CRAY-2 computer system contains approximately 250 gal. (948 l) of dielectric coolant.

4.5 ROOM HEAT LOADING CHARACTERISTICS

Room heat loading effects produced by the MFC are negligible.

4.6 FLOOR PREPARATION

The MFC requires the preparation of a number of floor cutouts. Cutouts must be located within 1/8 in. (0.32 cm) of the specified dimensions. Figures 4-2 through 4-8 illustrate the floor preparation requirements.

The tile size and stringer style of the computer room raised floor system will determine how many stringers interfere with the floor penetrations and require removal. Additional floor support pedestals may be required to restore the structural integrity of the floor system in areas where stringers are removed.

CRI will provide a full-scale template to locate and mark all associated MFC floor cutouts. All floor tiles and supporting floor stringers located within the base area must be prepared for the floor cutouts, holes, and additional underfloor support pedestals, prior to system delivery. Floor cutout preparation is reviewed during the final site planning meeting. All floor cutouts must be free of burrs.

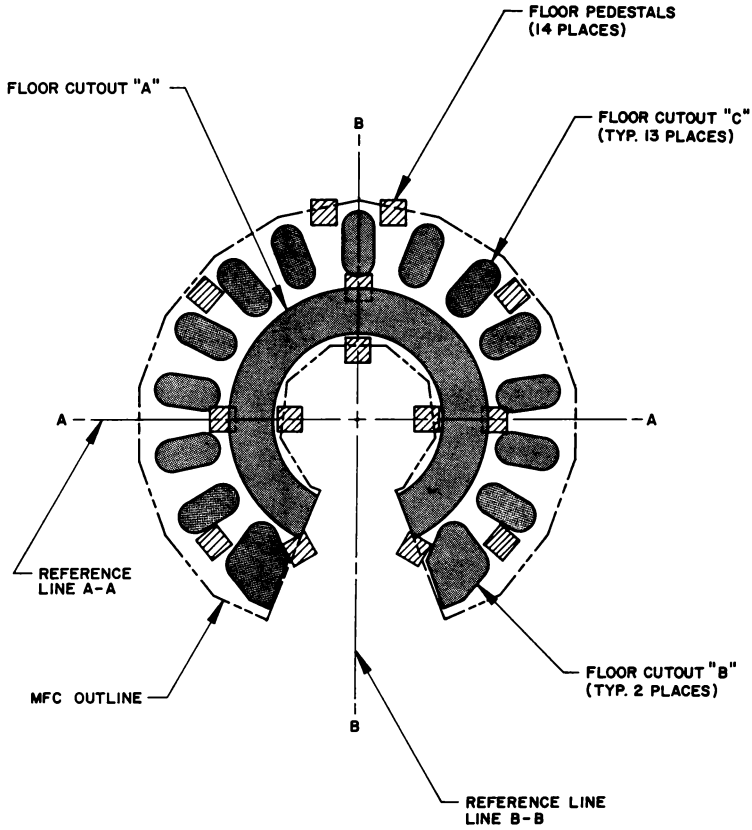


Figure 4-2. MFC Floor Preparation Requirements

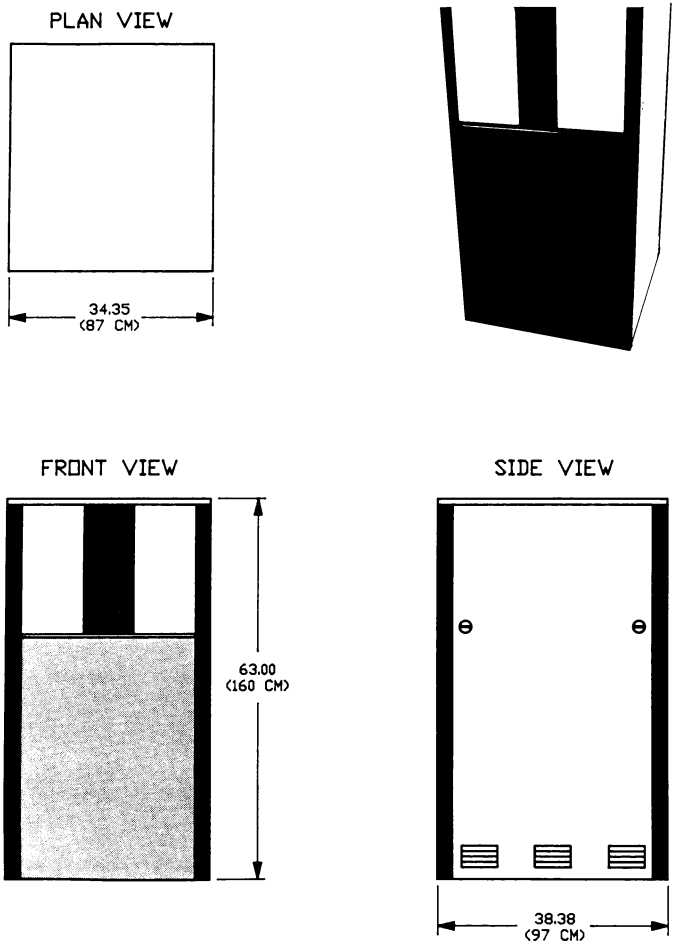


Figure 5-2. Support Heat Exchanger Pod (S-pod)

5.1.2 LOCATION

The M- and S-pods must be located in the computer room near the MFC as illustrated in the standard equipment arrangement (refer to section 7). This arrangement ensures that dielectric-cooling hoses, 400-Hz power cables, and control cable drops will be of adequate length.

5.1.3 ACCESS REQUIREMENTS

The M- and S-pods must be positioned to allow a minimum clearance of 3 ft (0.9 m) between the sides and front of the cabinets and any other equipment or wall surface. The pods also require a minimum clearance of 1 ft (0.3 m) between the rear of the cabinet and any other equipment or wall surface to ensure proper air circulation.

5.1.4 COOLING REQUIREMENTS

The M-pod and S-pod are partially air-cooled units using ambient room air for cooling purposes. If your facility uses a positive-pressurized, cool-air system in the underfloor area of the computer room, air grilles or perforated floor tiles must be placed in the floor immediately adjacent to the sides of the pods. If your facility uses a negative-pressurized, underfloor air system in the computer room, you must provide other means to ensure that cool air is supplied to the inlet air openings at the sides of the cabinet.

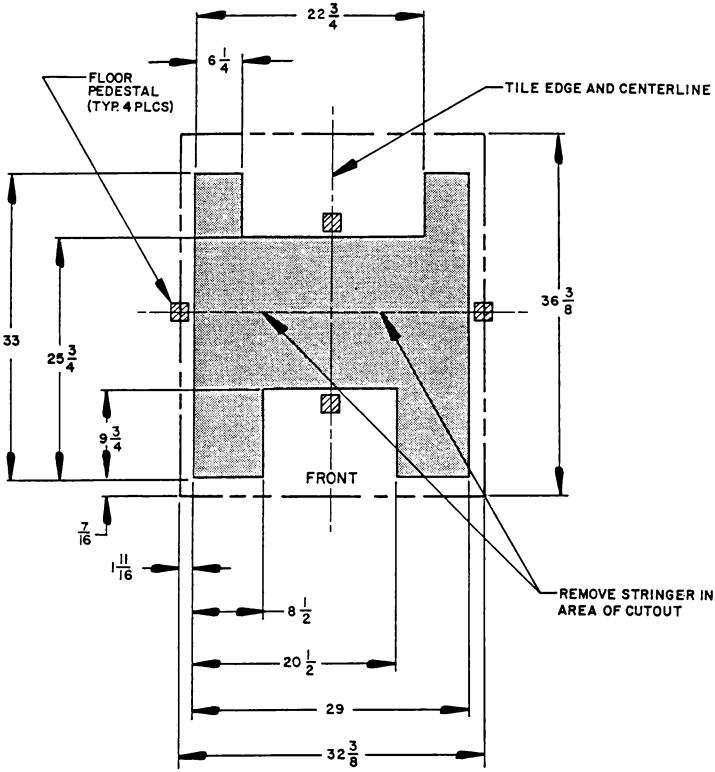
5.1.5 COMPUTER ROOM HEAT LOADING CHARACTERISTICS

The computer room heat loading effect of the M-pod is approximately 10,800 BTU/hr (3169 w).

The computer room heat loading effect of the S-pod is approximately 13,317 BTU/hr (3903 w).

5.1.6 FLOOR PREPARATION

The M- and S-pods require a floor cutout for the connection of power cables, control cables, dielectric coolant and chilled-water hoses (refer to figure 5-3). Location of the cutout must be within 1/8 in. (0.32 cm) of the specified dimensions.



Inches-to-Centimeters Conversion Table

7/16	in. = 1.11 cm.		22 3/4	in. = 57.79 cm.	
1 11/16	in. = 4.29 cm.		25 3/4	in. = 65.41 cm.	
6 1/4	in. = 15.88 cm.		29	in. = 73.66 cm.	
8 1/2	in. = 21.59 cm.		32 3/8	in. = 82.23 cm.	
9 3/4	in. = 24.77 cm.		33	in. = 83.82 cm.	
20 1/2	in. = 52.07 cm.		36 3/8	in. = 92.39 cm.	

Figure 5-3. M-pod and S-pod Cutout Dimensions

Floor preparation also requires you to remove two floor stringers and install four underfloor support pedestals. All cutouts and holes must be free of burrs.

The M- and S-pods are designed to rest on a surface that is flat within 1/16 in. (0.16 cm) over the pod area. Edging material must not protrude above the surface of the floor tiles.

CRI will provide a full-scale template to locate and mark the M- and S-pod floor cut-outs.

5.1.7 POWER WIRING REQUIREMENTS

All 400-Hz power cables connecting the heat exchanger pods to J-box #1 and J-box #2 are CRI supplied and customer installed at the time of system installation.

5.1.8 CHILLED-WATER PIPING REQUIREMENTS

Installation of the CRAY-2 computer system requires a chilled-water distribution manifold. You must provide and install this manifold. Figure 5-4 illustrates the standard manifold design.

As illustrated, the manifold allows for seven supply connections (three for the M-pod and four for the S-pod) and seven return connections. The connection ports required are standard 1-in. O.D. (2.5 cm) hose barbs. Each port must be fitted with a manual gate valve.

As illustrated, pressure, temperature, and flow monitors are required in the supply and return line. A pressure operated bypass valve is also required to regulate the pressure differential across the supply and return lines.

The entire manifold must be insulated to prevent condensation in the underfloor area.

The approximate total volume required to fill the heat exchanger pods and associated chilled-water hosing is 30 gal. (114 l).

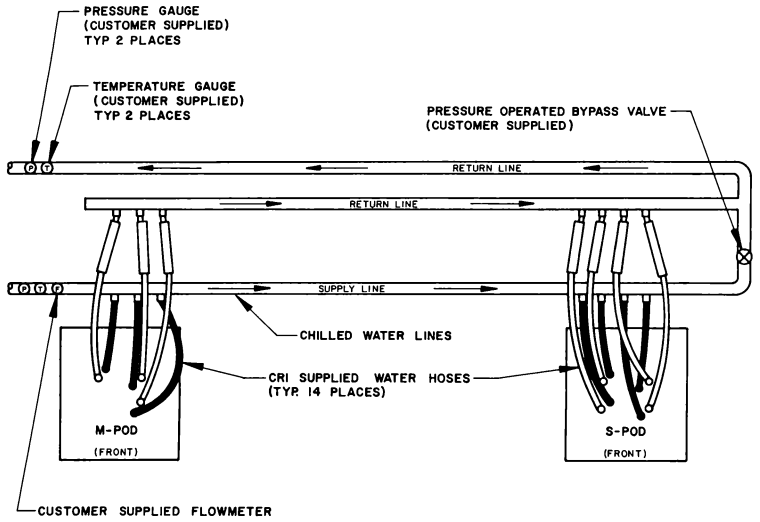


Figure 5-4. Chilled-water Manifold

5.1.9 DIELECTRIC COOLANT PIPING REQUIREMENTS

CRI will supply and install all flexible dielectric-coolant hoses between the M- and S-pods, the MFC, and the coolant reservoir. (Refer to subsection 2.7.1, Dielectric Piping Requirements, for a detailed description of CRI-installed dielectric-coolant lines.)

5.2 CRAY-2 COOLANT RESERVOIR

The CRAY-2 coolant reservoir (refer to figure 5-5) holds the MFC's dielectric coolant during mainframe maintenance.

A pump housed within the M-pod allows filling of the MFC with dielectric coolant from the coolant reservoir or draining the dielectric coolant from the MFC into the coolant reservoir. The pump ON/OFF control circuitry and flow rate monitoring are incorporated into the M-pod main control panel.

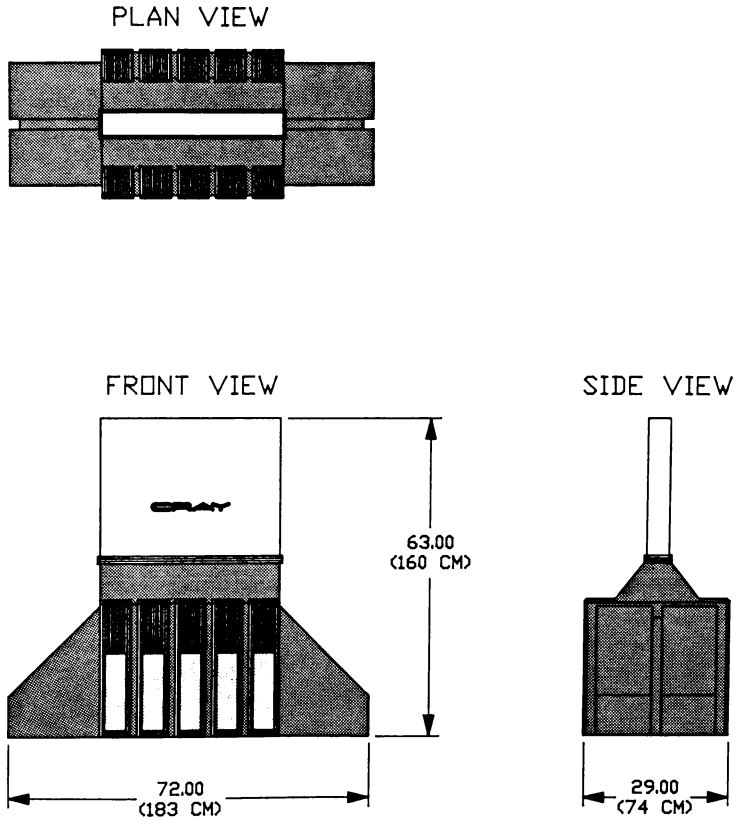


Figure 5-5. CRAY-2 Coolant Reservoir

The dielectric-coolant reservoir contains two standpipes that are connected to standpipes within the MFC. These loops maintain the MFC as an open system, acting as pressure relief lines when filling the MFC, or vacuum relief lines when draining the MFC.

The reservoir contains a second set of standpipes used for system ventilation (refer to subsection 2.9, CRAY-2 System Ventilation Requirements).

5.2.1 WEIGHT

The maximum operational weight of the dielectric-coolant reservoir is approximately 3200 lb (1440 kg).

The shipping weight of the coolant reservoir is approximately 1100 lb (495 kg).

5.2.2 LOCATION

The dielectric-coolant reservoir must be located in the computer room near the MFC as illustrated in the standard equipment arrangement (refer to section 7). This arrangement ensures satisfaction of dielectric hose length requirements.

5.2.3 ACCESS REQUIREMENTS

The dielectric-coolant reservoir must be positioned to allow at least a 2-ft (0.6-m) clearance between all sides of the reservoir and any other equipment or wall surface.

5.2.4 ROOM HEAT LOADING CHARACTERISTICS

Room heat loading effects of the dielectric-coolant reservoir are negligible.

5.2.5 FLOOR PREPARATION

The dielectric-coolant reservoir requires several floor cutouts to provide for attachment of dielectric-coolant hoses (refer to figure 5-6.) Location of holes and cutouts must be within 1/8 in. (0.32 cm) of the specified dimensions.

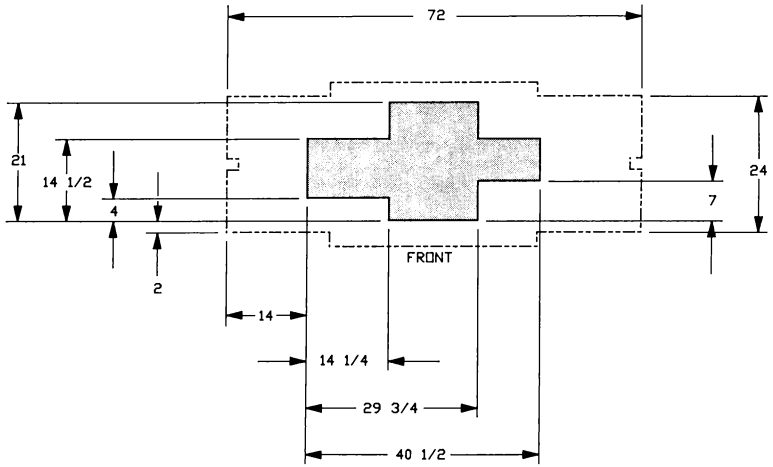
Floor preparation also requires removal of one floor stringer and installation of seven underfloor support pedestals (refer to figure 5-7). All cutouts and holes must be free of burrs.

The reservoir is designed to rest on a surface that is flat within 1/16 in. (0.16 cm) over the reservoir area. Edging material must not protrude above the tile surface in the area beneath the reservoir.

CRI will provide a full-scale template to locate and mark all associated cutouts.

5.2.6 DIELECTRIC-COOLANT PIPING REQUIREMENTS

CRI will supply and install all flexible dielectric-coolant hoses for the connection of the dielectric-coolant reservoir to the MFC and M-pod at the time of system installation. (See subsection 2.7.1, Dielectric Coolant Piping Requirements, for a more detailed description of CRI-installed piping.)



Inches-to-Centimeters Conversion Table	
2 in. = 5.08 cm.	14 1/2 in. = 36.83 cm.
4 in. = 10.16 cm.	24 in. = 60.96 cm.
7 in. = 17.78 cm.	29 3/4 in. = 75.57 cm.
14 in. = 35.56 cm.	72 in. = 182.88 cm.
14 1/4 in. = 36.20 cm.	

Figure 5-6. Reservoir Floor Cutouts

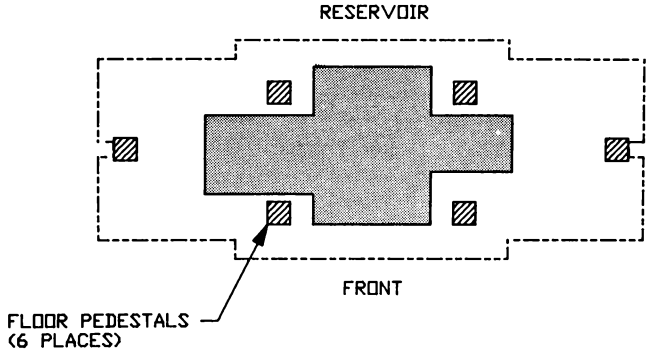


Figure 5-7. Reservoir Pedestal Locations

CRAY-2 MODULE TEST STATION (MTS-200) AND MODULE REPAIR STATION (MRS-200) 6

The following section describes the module test and repair stations for the CRAY-2 computer system.

6.1 CRAY-2 MODULE TEST STATION (MTS-200)

Miscellaneous support equipment for the CRAY-2 computer system may include a module test station (MTS-200).

The test station is not part of the CRAY-2 computer system but is part of the field engineering equipment, which remains CRI property if the computer system is acquired by you under a purchase contract.

The MTS-200 (refer to figure 6-1) is a free-standing, self-contained field support station for diagnostic testing of the various logic and memory modules used in the CRAY-2 computer system. The test station consists of a maintenance control console interfaced to a high-speed buffer that writes to and reads from the module under test at normal system operating speeds. A single module tank and associated support hardware are also included in the test station to provide cooling for the module under test during full power tests.

6.1.1 WEIGHT

The MTS-200 operational weight is approximately 600 lb (270 kg).

6.1.2 LOCATION

The MTS-200 should be located in the field engineering repair shop area. The MTS-200 is equipped with casters for easy installation. Doorways throughout the facility and into the engineering shop area must be at least 36 in. (91 cm) wide. Hallways should be wide enough to turn this 36 in. by 72 in. (91 cm by 183 cm) unit in order to enter rooms.

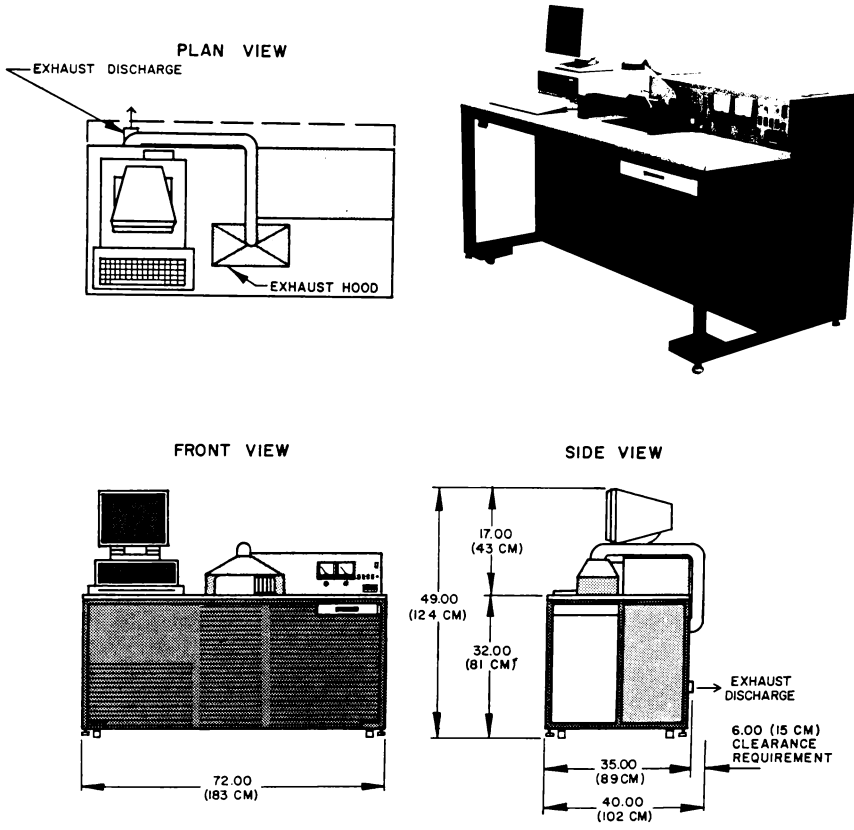


Figure 6-1. CRAY-2 Module Test Station (MTS-200)

6.1.3 ACCESS REQUIREMENTS

There must be access room in front of the test station for an operator's chair and for module testing activities. Adequate clearance of approximately 6 in. (15 cm) must also be maintained at the rear of the tester for proper air circulation.

6.1.4 ROOM HEAT LOADING CHARACTERISTICS

The MTS-200 is a fan-cooled unit which uses ambient room air for cooling. The room heat loading by this unit is approximately 11,000 BTU/hr (3200 w).

6.1.5 INPUT POWER REQUIREMENTS

The MTS-200 is equipped with a 15-ft (4.57-m) power drop cable. You must provide a mating receptacle. The National Electrical Manufacturer's Association (NEMA) designation of the required receptacle will be specified in CRI-supplied site planning documentation.

6.1.6 EARTH-GROUNDING REQUIREMENTS

In addition to providing and installing a mating power receptacle, you must also make provisions for the installation of an earth-grounding strap as stated in subsection 2.4.2, Equipment-grounding Requirements.

6.1.7 VENTILATION REQUIREMENTS

A fixed-ventilation hood is provided for the module under test when conducting a full power test. The hood is designed for operator protection in the remote possibility of a module short circuit resulting in thermal decomposition of the dielectric coolant (refer to subsection 2.8, Dielectric Coolant).

CRI provides a centrifugal blower mounted within the MTS-200. You are required to provide a 4-in. (10.16-cm) exhaust duct within 5 ft (1.52 m) of the blower discharge as illustrated in figure 6-1. CRI will provide flexible duct to connect the blower discharge to the duct. The maximum allowable duct run is 100 ft (30.5 m) of straight duct.

6.2 MODULE REPAIR STATION (MRS-200)

Support equipment for the computer system includes a module repair station (MRS-200).

The MRS-200 is not part of the computer system but is part of the field engineering equipment, which remains CRI property if the computer system is aquired by you under a purchase contract.

The MRS-200 (refer to figure 6-2) is a free standing, self-contained field support station used for teardown, repair, restacking, and plugability testing. Associated tools and module hardware is also housed within the station.

6.2.1 WEIGHT

The repair station's operational weight is approximately 300 lb. (135 kg).

6.2.2 LOCATION

The MRS-200 should be located in the maintenance engineering shop area provided for the CRI field engineers.

6.2.3 ACCESS REQUIREMENTS

There must be access room in front of the repair station for an operator's chair and for module repair activities.

6.2.4 INPUT POWER REQUIREMENTS

The MRS-200 is equipped with two 6-ft. (1.8 m) drop cord power cables. You must provide and install mating power receptacles. At your option, the mating power receptacles may be either the box-mounted or in-line type.

The drop cord power plugs furnished with the MRS-200 are specified by the NEMA type designation in the CRI-supplied site planning documentation and will apply to your particular installation.

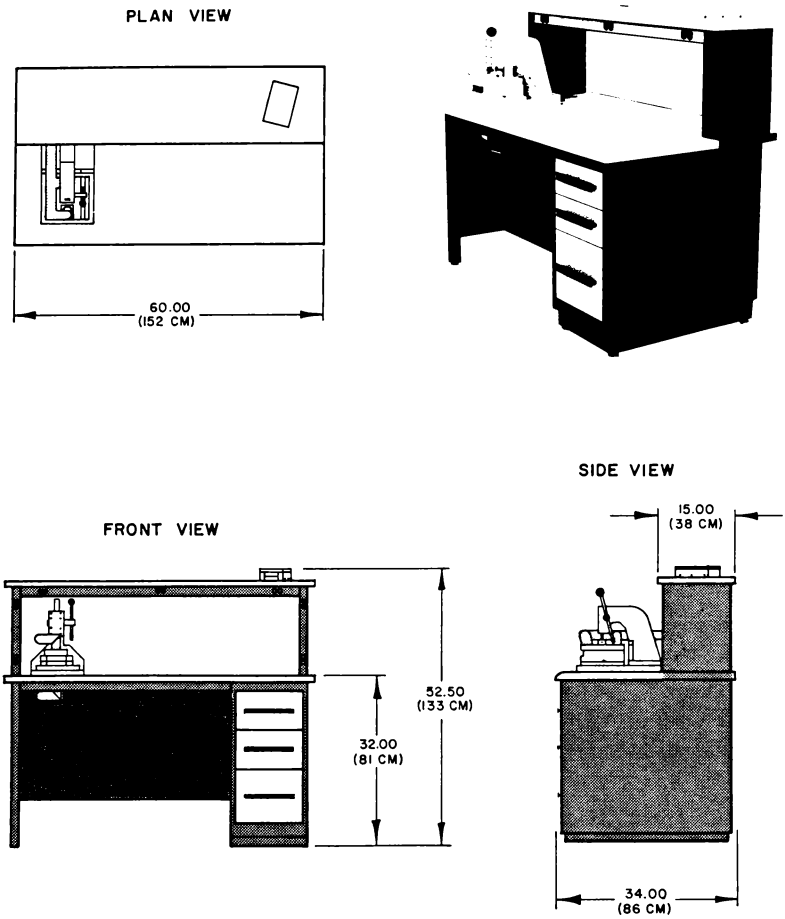


Figure 6-2. CRAY-2 Module Repair Station (MRS-200)

7.2 FLOOR PLAN ARRANGEMENTS

Figure 7-2 illustrates the standard arrangement of the CRAY-2 computer system. The illustrated standard orientation and arrangement of the mainframe; heat exchanger pods, and reservoir is required to ensure satisfaction of the dielectric-cooling hose, 400-Hz power cable drop, and control cable length restrictions.

This floor plan represents a computer room of 624 ft^2 (56.16 m^2). The equipment units are located on a 12-x-13 grid, which represents 24-in. square (60.96-cm) computer room floor tiles. A triangular symbol located on each of the equipment units indicates the operator's access to the equipment unit.

Motor-generator sets are not illustrated in figures 7-1 and 7-2 due to their probable remote locations.

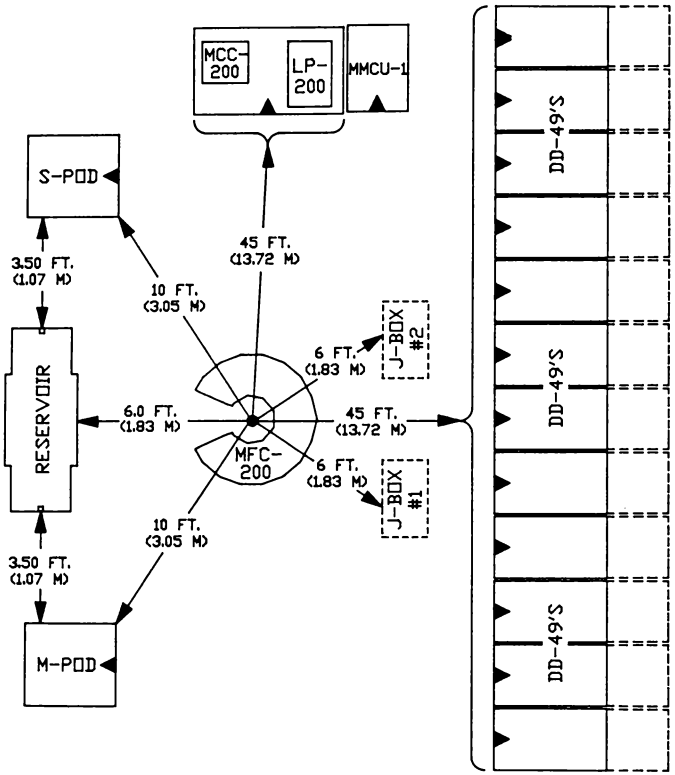


Figure 7-1. Equipment Separation Limits for a CRAY-2 Computer System

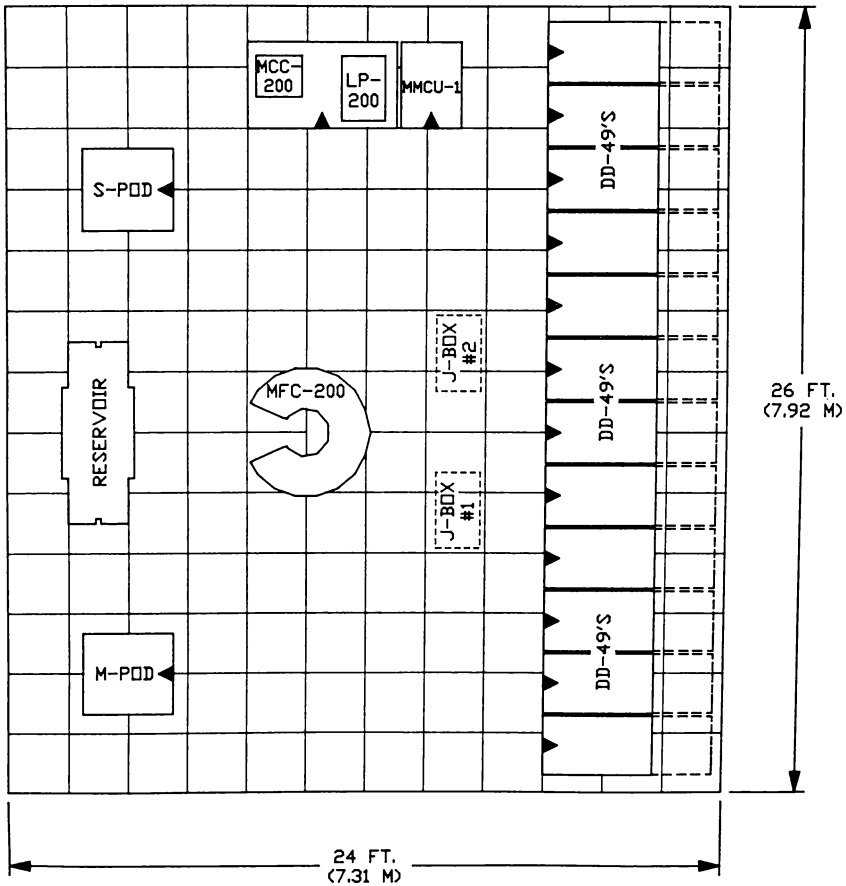


Figure 7-2. Typical Computer Room Floor Plan for a CRAY-2 Computer System

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