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Magnetic Resonance Imaging (MRI)
VA Design Guide

Final Draft

Department of Veterans Affairs
Veterans Health Administration
Office of Facilities Management
Facilities Quality Office
Standards Service
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VA DESIGN GUIDE
MAGNETIC RESONANCE IMAGING

DEPARTMENT OF VETERANS AFFAIRS
VETERANS HEALTH ADMINISTRATION
OFFICE OF FACILITIES MANAGEMENT
STANDARDS SERVICE 202.565.6775

Foreword

The material contained in the Magnetic Resonance Imaging Design Guide is the culmination of a partnering effort by the Department of Veterans Affairs Veterans Health Administration and the Facilities Quality Office. The goal of the Design Guide is to ensure the quality of VA facilities while controlling construction and operating costs.

This document is intended to be used as a guide and as a supplement to current technical manuals and other VA criteria in the planning of Magnetic Resonance Imaging. The Design Guide **is not to be used as a standard design, and use of this Design Guide does not limit the project Architect's and Engineer's responsibilities to develop a complete and accurate project design that best meets the user's needs and the applicable code requirements.**

Lloyd H. Siegel, FAIA
Director, Facilities Quality Office

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Contents

Section 1
Introduction, Acknowledgments, Abbreviations, and Legend of Symbols

Magnetic Resonance Imaging
Introduction

The Magnetic Resonance Imaging (MRI) Service Design Guide is intended to be a graphic consolidation of existing Department of Veterans Affairs standards and criteria. It contains data from the following sources:

- PG-18-1 Master Construction Specifications
- H-18-3 Construction Standards
- PG-18-4 Standard Details
- PG 7610 Equipment Guide List
- PG-18-6 List of Equipment Symbols
- PG 7610 Space Planning Criteria
- PG-18-13 Barrier-Free Design Handbook
- PG-18-14 Room Finish and Door Hardware Schedule
- Various Technical Criteria (Design Manuals) pertaining to Architectural, HVAC, Plumbing, and Electrical.
- Consensus information from various VA medical centers.
- MRI Service Program Division

The Design Guide refers to the above mentioned sources when data is either too detailed or too broad to be included in this guide.

The Design Guide for MRI was developed as a design tool to assist the medical center staff and the contracting officers in better understanding the choices that designers ask them to make, and to help designers understand the functional requirements necessary for proper operation of the MRI.

The Guide Plate contained in the MRI Design Guide is intended to illustrate VA's furniture, equipment and personnel space needs. It is not meant to limit design opportunities.

This Design Guide is not intended to be project-specific. While it does contain spaces required in MRI, it is not possible to foresee future requirements. The project-specific space program is the basis for an individual project design. It is important to note that the guide plate is a generic graphic representation only.

Equipment manufacturers should be consulted for actual dimensions and utility and shielding requirements. Use of this Design Guide does not supersede the project architects' and engineers' responsibilities to develop a complete and accurate design that meets the user's needs and appropriate code requirements.

Magnetic Resonance Imaging
Abbreviations

A	Amperes
AC/HR	Air Changes per Hour
ADA	Americans with Disabilities Act
AFF	Above Finished Floor
AI	Acquisition and Installation
A&MM	Acquisitions and Material Management
AR	As Required
AT	Acoustical Ceiling Tile
C	Degrees Celsius
CC	Contractor Furnished and Installed, Construction Funds
CF	Construction Funds, VA Furnished, Installed by VA or Contractor
CFM	Cubic Feet per Minute
CLG	Ceiling
CM	Construction Management Office
CMU	Concrete Masonry Unit
CP	Carpet (without cushion broadloom)
CS	Construction Standard
CT	Ceramic Tile
DISC SW	Disconnect Switch
EtO	Ethylene Oxide Gas
EPO	Emergency Power Off
EXH	Exhaust
F	Degrees Fahrenheit
FC	Foot-candle
FD	Floor Drain
FIXT	Fixture
FLUOR	Fluorescent
HAC	Housekeeping Aids Closet
HVAC	Heating, Ventilation, and Air Conditioning
HP	Horsepower
HR	Hour
ICU	Intensive Care Unit
KW	Kilowatt
LB	Pound/Pounds
LLTS	Lounge, Lockers, Toilets, and Showers
MCS	Master Construction Specifications
MTD	Mounted
NA	Not Procured with Activation Funds
NFPA	National Fire Protection Association
NSF	Net Square Feet
NSM	Net Square Meters
OSD	Open Site Drain
PCP	Portland Cement Plaster
PH	Phase
PL	Plaster
PREP	Preparation
PSIG	Pounds per Square Inch Gauge
QT	Quarry Tile
RB	Resilient Base
SC	Special Coating (High Build Glazed Coating)
SD	Standard Detail
SF	Square Feet, Square Foot
SPD	Supply, Processing, and Distribution
SOPC	Satellite Outpatient Clinic
SS	Stainless Steel
TELEC	Telecommunications
UFAS	Uniform Federal Accessibility Standards
V	Volts
VA	Department of Veterans Affairs
VACO	Veterans Affairs Central Office
VAMC	Veterans Affairs Medical Center
VC	VA Furnished and Contractor Installed - Medical Care Appropriation for Equipment and Construction Appropriations for Installation
VCT	Vinyl Composition Tile
VHA	Veterans Health Administration
VV	VA Furnished and Installed-VHA Appropriation
W	Watts
W/SF	Watts per Square Feet

Magnetic Resonance Imaging
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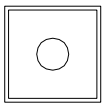
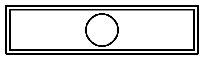
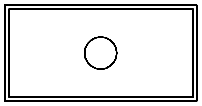
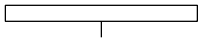
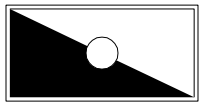
Legend of Symbols

System	Description of Symbol	Gr. Symbol
Power Receptacles	DUPLEX RECEPTACLE, NEMA 5-20R - 20 AMP - MOUNTED 450MM (18") AFF UNLESS OTHERWISE NOTED	
	DUPLEX RECEPTACLE, NEMA 5-20R - 20 AMP - MOUNTED ABOVE COUNTER TOP	A
	DUPLEX RECEPTACLE WITH GROUND FAULT INTERRUPTER, NEMA 5-20R - 20 AMP - MOUNTED 450MM (18") AFF UNLESS OTHERWISE NOTED	GFI
	DUPLEX RECEPTACLE WITH GROUND FAULT INTERRUPTER, NEMA 5-20R - 20 AMP - MOUNTED ABOVE COUNTER TOP	GFI-A
	WEATHERPROOF DUPLEX RECEPTACLE WITH GFI, NEMA 5-20R - 20 AMP - MOUNTED 450MM (18") AFF UNLESS OTHERWISE NOTED	WP
	QUADRAPLEX OUTLET, NEMA 5-20R - 20 AMP - MOUNTED 450MM (18") AFF OR QUADRAPLEX OUTLET, NEMA 5-20R - 20 AMP - PEDESTAL-MOUNTED	
	QUADRAPLEX OUTLET, NEMA 5-20R - 20 AMP - MOUNTED ABOVE COUNTER TOP	A
	QUADRADUPLEX OUTLET WITH GROUND FAULT INTERRUPTER, NEMA 5-20R - 20 AMP - MOUNTED 450MM (18") AFF UNLESS OTHERWISE NOTED	GFI
	QUADRADUPLEX OUTLET WITH GROUND FAULT INTERRUPTER, NEMA 5-20R - 20 AMP - MOUNTED ABOVE COUNTER TOP	GFI-A
	DUPLEX RECEPTACLE, NEMA 5-20R - 20 AMP - EMERGENCY POWER - MOUNTED 450MM (18") AFF UNLESS OTHERWISE NOTED	
	QUADRAPLEX RECEPTACLE, NEMA 5-20R - 20 AMP - EMERGENCY POWER	
	SPECIAL RECEPTACLE	
	TELEVISION OUTLET	TV
	ELECTRICAL STRIP MOLD - NEMA 5-20R RECEPTACLES AT 600MM (2'-0") INTERVALS	
	BATTERY POWERED CLOCK	C
	CIRCUIT BREAKER	CB

Legend of Symbols (cont.)

System	Description of Symbol	Gr. Symbol
Switches	SINGLE POLE SWITCH	
	SINGLE POLE SWITCH - SUFFIX OF "a", "b", OR "c" INDICATES SEPARATE CONTROL OF FIXTURE(S) WITH SAME DESIGNATION	
	DIMMER SWITCH	
	THREE-WAY SWITCH	
	DOOR SWITCH	
	FUSED OR UNFUSED DISCONNECT SWITCH	
	EMERGENCY POWER OFF (EPO) PUSH BUTTON	
Lighting	600mm x 600mm (2' x 2') FLUORESCENT FIXTURE	
	300mm x 300mm (1' x 4') FLUORESCENT FIXTURE	
	600mm x 1200mm (2' x 4') FLUORESCENT FIXTURE	
	WALL-MOUNTED FLUORESCENT FIXTURE	
	600mm x 1200mm (2' x 2') FLUORESCENT FIXTURE - EMERGENCY POWER	
	600mm x 1200mm (2' x 4') FLUORESCENT FIXTURE - EMERGENCY POWER	
	WALL-MOUNTED FLUORESCENT FIXTURE - EMERGENCY POWER	
	WALL MOUNTED LIGHT FIXTURE - TYPE AS NOTED	
	LIGHT FIXTURE - TYPE AS NOTED	

Legend of Symbols (cont.)

System	Description of Symbol	Gr. Symbol
Communi-cations	TELEPHONE OUTLET - MOUNTED 450 mm (18") AFF UNLESS OTHERWISE NOTED	
	WALL-MOUNTED TELEPHONE OUTLET - MOUNTED 1200 mm (48") AFF UNLESS OTHERWISE NOTED	W
	COMPUTER TERMINAL OUTLET - VERIFY EXACT NEEDS - PROVIDE SIGNAL AND POWER OUTLET AS REQ'D	
	SPEAKER - CEILING-MOUNTED	S
	INTERCOM OUTLET	I
	NURSE CALL DOME LIGHT - CEILING-MOUNTED	N
	NURSE CALL DOME LIGHT - WALL-MOUNTED	N
	NURSE CALL DUTY STATION	N D
	EMERGENCY NURSE CALL	N E
	NURSE CALL STAFF STATION	N S
	VOLUME CONTROL - WALL MOUNTED	V
Sp. Outlets	JUNCTION BOX - PURPOSE AND LOCATION AS NOTED	J
Mechanical	SUPPLY AIR DIFFUSER	
	EXHAUST AIR REGISTER OR GRILLE	
	THERMOSTAT	T
Plumbing	COMBINATION FAUCET HOSE BIBB	
	MEDICAL GAS OUTLET	

Section 2
Narrative

Magnetic Resonance Imaging
Narrative

I. General Considerations

A. Overview

1. Current Direction

Magnetic Resonance Imaging (MRI) is a specialized diagnostic imaging tool employing a strong magnetic field and the application of a radio frequency pulse to measure vector deflection of selected atomic nuclei.

MRI is particularly useful in providing images of soft tissues.

MRI is contra-indicated for patients with cardiac pacemakers or ferro-magnetic aneurysmal clips.

The emitted magnetic field can effect CRT's and information systems. Therefore, great care must be employed in selecting a site location for the MRI.

Patient volume can be anticipated to be primarily 80-90% outpatient volume.

When shared among multiple medical centers, mobile MRI units (docked to areas with appropriate patient and staff spaces) may be a viable alternative to fixed MRI units.

2. Trends

Magnetic Resonance Angiography technology is increasingly used.

MRI in combination with computed Axial Tomography (CT) for comprehensive screening of diseases that are difficult to diagnose in early stages (such as multiple sclerosis) is also increasingly used.

II. Functional Considerations

A. Operations

1. Services

Magnetic Resonance Imaging is a program under Radiology Service. MRI should be coordinated with associated and complimentary diagnostic services to assure coordination of patient care.

a. Imaging Process

MRI is performed on inpatients and outpatients on a regular and scheduled basis. Services are also performed on an unscheduled basis for emergency patients.

MRI uses strong magnetic fields to induce molecular resonance which creates radio frequencies. These frequencies allow a computer image to be created by the analysis of measurements of frequencies emitted by resonating cell structures.

The image is electronically enhanced, recorded on video, stored on tape or optical disk and reproduced as a laser image. The image can also be outputted to paper or film copy.

2. Patient Care Concept

MRI remains a centralized function due to the high cost of the technology, the highly specialized space criteria (dictated by permanently installed equipment), and the specialized staffing requirements.

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3. Level of Care

A single MRI will most often be Hospital Based, as this location provides the most universal and hopefully convenient location.

4. Patient Base

VA MRI Facilities need to demonstrate an ability to generate sufficient workload to justify the substantial cost. This is based on a cost benefit analysis.

VA MRI facilities are focused upon serving the Veteran, and may participate in sharing agreements, joint ventures, and referrals. Also, efforts are made to include the veteran's family and the general public.

5. Medical Records

Diagnostic evaluations generated within the department become part of the veteran's Consolidated Health Record (CHR) with actual films and/or electronic data stored locally within the MRI Facility or in Radiology Film Storage.

Evaluations are also communicated to the ordering physician in either hard copy or electronic form (as required).

Image manipulation, interpretation, archiving, retrieval and distribution procedures may occur within the MRI Facility or may be consolidated with Radiology. These techniques include varying levels of electronic and film record storage requirements and will effect final space requirements.

6. Patient Protocol

Outpatient and inpatient procedures are ordered by physicians and scheduled by the department during regular business hours.

Unscheduled and off-hour procedures will depend on the level of care to be provided.

7. Special Requirements

Teaching facilities will require more technical support space, including spaces for small observation groups, interpretation areas, and image manipulation areas.

Coordination with related departments, facilities, and program missions is required to verify space needs. These may include prep, recovery, exam, and stretcher holding spaces.

Such departments may include:
- Hospital-Nursing Care;
- Long Term Care Facilities;
- Ambulatory Services;
- Emergency;
- Surgery; and
- Satellite Facilities.

B. Space Planning Issues

1. Flexibility

Certain technical space requirements impose special constraints on the siting and design of MRI facilities. These may include:
- Magnetic field generated by MRI magnets;
- The sensitivity of Imaging process to radio frequencies (RF's);
- The size and weight of the magnet;
- cryogen service; and
- Venting requirements.

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Although specialized facilities are required, generic guidelines should be applied to accommodate a wide range of MRI technology to maximize equipment selection options.

2. Efficiency

Economies of shared functions, facilities, and staff are increasingly facilitated by MRI systems. “Self shielded” magnets allow MRI technology to be located near operations which are sensitive to magnetic fields and near fixed and moving metallic objects such as building structure, elevators and vehicular traffic.

3. Human Factors

Patient dignity and self-determination are accommodated while considering operational efficiencies.

Patient's vulnerability to stress from noise, lack of privacy, poor lighting and other causes can have harmful effects on the healing process. This is a well known and documented phenomenon.

An inherent opportunity exists in the design of Magnetic Resonance Imaging Facilities to address these issues and put forth creative solutions that enhance patient comfort and contribute to positive outcomes.

A prime objective should be to de-emphasize the institutional image of traditional health care facilities and to surround the patient (and family members) with architectural finishes and furnishings that are familiar and non-threatening.

Good planning and design appeal to the spirit and sensibilities of patients and care providers alike.

Magnetic Resonance Imaging facilities should be healing environments that allow the building itself to become a part of the therapy. The technical requirements should be addressed in an integrated manner to support these concepts.

Patient privacy is to be accommodated without sacrificing facility utilization.

Security is addressed by planning, design, and detail considerations.

Handicapped access is accommodated by the application of UFAS and ADA design standards to space and fixed equipment layouts.

4. Technical and Environmental

MRI shielding considerations include control of magnetic fields and the isolation from external radio frequency interference.

Magnetic Shielding and Magnetic Field siting considerations will vary with magnetic field strength and with the features of the equipment and manufacturer selected.

The environment effects on field homogeneity and the effects of Magnetic Field on other technologies and surrounding must be considered.

Employment of a registered health physicist should be undertaken when the program is put together, as his/her recommendations will determine shielding of equipment, thickness of walls, etc.

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C. Functional Space Relationships

1. Work Flow

a. Patient

Provide a single point of control for inpatients and outpatients.

b. Staff and Administrative Functions

Staff and Administrative areas are located outside of patient traffic areas.

Staff functions may be located within the department or in a convenient location shared with another department (usually Radiology Service).

c. Patient Records and Work Orders

Patient records and Work Orders should move among the administrative, film processing, viewing, and interpretative functions should be separated from the patient traffic wherever possible.

d. Clean and Soiled Materials

Locate Clean and Soiled Utility Functions close to the Patient areas that they support and also away from patient traffic.

2. Organizational Concepts

a. Functional Plan

Reception is strategically located to control access to the patient areas and to secure the MRI from unauthorized access

The MRI Control Area and the Electronics Room need to be Adjacent to the MRI Procedure Room

b. Building Systems Integration

Coordinate locations of depressed slabs and structure for equipment, electrical access, and magnetic and/or radio frequency shielding.

Evaluate need for computer access flooring on a project basis.

Consider size and weight of magnet when establishing locations. This could relegate locations on the lower or the lowest floors of the facility.

The radiation problem must also be considered in relation to adjacent areas.

c. Organization To Minimize Magnetic Shielding and Field Constraints

Both magnetically shielded and unshielded MRI systems require consideration of magnetic fields when establishing room and equipment layouts.

Steel-support structures arranged in a fashion not symmetrical to the magnetic field impose special requirements for shielding.

Installation within multiple story facilities may impose planning and structural restrictions on spaces above and below.

3. Location / External Relationships

a. Patient Access / Wayfinding

MRI Facilities should be located convenient to parking, ambulatory care, and inpatient access.

Location with other diagnostic facilities assists in wayfinding and coordination of patient services.

b. Functional Adjacencies

The MRI facility benefits from a location near Radiology as they may share staff and facilities

c. Service Access

Magnet installation and replacement requires crane access and a direct route for magnet passage.

Cryogen venting during quenching is accomplished by a direct vent to outdoors.

Cryogen replenishment is accomplished via cryogen dewars which may be stored on site. Access is required around and above the magnet for cryogen service.

III. Technical Considerations

A. Architectural

1. Interior Materials and Finishes

a. Partitions

Interior partitions should primarily be painted gypsum wallboard on metal studs. Partitions around physician offices, exam rooms and treatment rooms should have sound attenuation batts between the studs in accordance with VA Construction Standard H-18-3 and Standard 34-1, “Noise Transmission Control”.

Partitions and doors around the MRI Gantry Room should provide radio frequency (RF) shielding and be constructed of non-magnetic materials.

Coordinate RF Shielding requirements with the equipment manufacturer and have them reviewed by a registered health physicist.

b. Floors

Floors in offices, conference rooms and waiting areas should be carpet with a 100 mm (4”) high resilient base.

Floors in toilet rooms should be ceramic tile with a ceramic tile base. If metal toilet stalls are used, be certain they are remotely located

Floors in most other spaces should be vinyl composition tile with a 100 mm (4”) high resilient base.

Floors in MRI Gantry Rooms require a 40 mm (1-1/2”) deep depression to accommodate the RF shielding.

A computer/access floor system may be required in the MRI computer room and part of the Gantry Room. The access floor system should be of non-magnetic materials.

c. Ceilings

Ceilings should be primarily lay-in acoustic ceiling tile. The ceiling suspension system in the MRI Gantry Room should also be of non-magnetic materials.

Non-magnetic materials should be used in the vicinity of the gantry room.

d. Protection

Wall and corner guards should be used in corridors and other areas where wall damage from cart traffic is anticipated.

2 Interior Doors and Hardware

Interior doors should be 45 mm (1 3/4") thick, solid-core, flush-panel wood doors or non-magnetic hollow metal doors and hollow metal frames.

Doorjambs should have hospital type sanitary stops that stop 200 mm (8") from the floor to facilitate mopping. Hollow metal doors should be used where high impact is a concern and where fire rated doors are required. Non-magnetic kick / mop plates should generally be applied to both sides of the doors. Handicapped accessible hardware should be used throughout.

All metal in the vicinity of the gantry room shall be non-magnetic.

Refer to VA Program Guide PG-08-14, "Room Finishes, Door and Hardware Schedule" for additional information.

B. Equipment

1. Casework

Casework systems should be chosen to provide flexibility in planning and utilization purposes.

Casework systems should incorporate components dimensioned for ease of multiple re-use installation applications.

Casework systems should be planned without corner installations and filler panels.

2. Information Management Systems

Information Management Systems shall include elements such as:

- image retrieval
- processing / storage
- treatment planning
- patient registrations
- patient charges
- physician's order entry
- patient/staff movement

They also may require additional shielding.

These systems' elements will require access to the main facility's "information backbone" as well as the departmental Local Area Network (LAN). All components should be planned for compatibility.

3. Therapy Systems

Imaging systems' requirements will vary for each facility and the technology may be deferred in selection/procurement. Design requirements will be as instructed by the Contracting Officer.

4. Film Processing

Film processing requirements will vary for each facility. Design criteria for "digital laser" and the integrated use of Picture Archiving and Communications Systems (PACS), will be as instructed by the Contracting Officer.

C. Heating, Ventilation and Air Conditioning

1. Operation

Air conditioning systems should be provided to heat, cool and ventilate the individual space, as required to satisfy the VA design criteria. Follow TB Criteria in the HVAC Design Manual for hospital projects.

The air conditioning systems serving the MRI area should be designed to operate at full capacity which will be determined by local conditions. A dedicated computer-type AC unit should be considered to cool and heat the computer equipment room. The engineers/designers should verify the AC requirements with equipment supplier.

Client requirements must coordinate with the final system.

All ductwork downstream of the radio frequency shielding (RF) shall be non-ferrous type and should be equipped with radio frequency dampers. Provide a dedicated vent line located above the magnet isocenter.

2. Capacities

The number of people and the air conditioning load noted on the room design standard sheet establishes a base for the design guide and its use in planning.The engineers/designers should verify the actual number of people and the air conditioning load to agree with the project requirements.

Similarly, engineers/designers should verify equipment AC loads shown or per actual equipment furnished on a project.

The percent of outside air should be based on the space's total supply air quantities.

3. Air Quality and Distribution

Corridors should not be used to supply or to exhaust/return air from rooms. Corridor air may be used to ventilate toilet rooms, and small electrical or telephone closets opening directly on corridors. Exfiltration / infiltration from positive/ negative pressure rooms adjacent to a corridor should be considered in balancing air flow..

The transferred air should be more than 2.8m^3/min (100cfm) per undercut door.

Care should be taken to minimize the short-circuiting of air between supply and return and or/exhaust openings in interior rooms.

The MRI Gantry Room shall be provided with duct-mounted temperature and relative humidity sensors with remote adjustment capability. The sensors shall be located in the return air duct.

4. Exhaust System

Provide a dedicated exhaust system to emergency exhaust the cryogen discharge into the room. The fan shall be activated via an oxygen sensor located inside the MRI Gantry Room.

5. Seismic

Where required, install the HVAC systems with seismic provisions as outlined in the VA HVAC Design Manual for Hospital Projects.

Refer to VA Construction Standard Handbook PG-18-03 (CD-54), "Natural Disaster Resistive Design Non-Structural" for additional information.

6. Noise Level

Select HVAC equipment, ductwork and air distribution devices to achieve noise levels listed in the VA HVAC Design Manual for Hospital Projects.

D. Plumbing

1. Water and Waste Systems

The plumbing systems should be provided to satisfy the departmental plumbing needs.

The department's domestic cold water should be piped to all plumbing fixtures and equipment requiring this utility. A hot water return system should be provided to ensure the design temperature at the farthestoutlet.

The department's plumbing fixtures and drains should be drained by gravity through soil, waste, and vent stacks. In addition, the department's special waste should be drained through corrosion-resistant, flame- retardant piping into either a local or centralized acid dilution tank.

2. Medical Gas Systems

The department's medical gas outlets are shown to establish a base for the design guide and its use in planning. The engineers/designers shall verify the medical gas location and quantities for individual projects.

All equipment shall be non-magnetic.

3. Seismic

Where required, the plumbing and medical gas systems should be installed with seismic provisions, as outlined in the VA Plumbing Design Manual for Hospital Projects.

Refer to VA Handbook H-18-03 (CD-54), "Natural Disaster Resistive Design Non-Structural" for additional information.

4. Fire Protection

The recommended fire protection for the MRI Gantry and Computer Equipment Rooms are either preaction or dry pipe systems in lieu of the standard wet system.

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E. Electrical

1. Illumination

Illumination is typically provided utilizing recessed fluorescent luminaries with acrylic prismatic lenses. The fixtures typically use F32T8 lamps in compliance with the National Energy Policy Act of 1992. Lamps have a minimum color rendering index (CRI) of 85 and a color temperature of 4100 degrees Kelvin (K), which is close to the "cool white" color temperature of 4150 degrees K.

Lighting intensities conform to the VA design criteria, the IES Lighting Handbook and IES publication CP-29, "Lighting for Health Care Facilities". IES CP-29 is currently being updated and will be replaced by IES

Recommended Practice RP-29 in the future.

Lighting is typically controlled by wall-mounted switches located at the entrance to the room. Larger spaces may utilize multiple switching by separate switches for lighting of individual zones or areas.

Power load densities for lighting are listed by use for the mechanical HVAC load calculation purposes. Load densities should be verified for the actual design, as they may vary depending on the room configuration, fixture types, lamps and ballasts used.

2. Power

MRI power requirements have to be coordinated with the equipment manufacturer.

General purpose duplex receptacles are typically provided on each wall of a room or space.

Workstations with personal computers (PC's) are typically provided with quadraplex receptacles for the PC, monitor, and printer.

Junction boxes are provided for equipment requiring a hardwired connection. Provide non-magnetic boxes in the gantry room.

Certain modular casework units are provided with a utility access module with surface-mounted electrical strip mold which also provides a chase for wiring. Conduits and junction boxes are provided to connect to the utility access module for power wiring.

Duplex receptacles on the critical branch of the emergency power system are provided for selected pieces of equipment (such as refrigerators) to allow for limited operation during a power outage.

F. Life Safety

1. Purpose

The life safety program should be developed to provide a reliable system to protect the building occupants, fire-fighting personnel, building contents, building structure, and building function.

This can be accomplished by limiting the development and spread of a fire emergency to the area of origin and thereby reduce the need for total occupant evacuation.

The design aspects of the facility which relate to the fire and life safety include:

- Structural fire resistance;
- Building compartmentalization;
- Fire detection, alarm and suppression;
- Smoke control and exhaust;
- Firefighter access and facilities; and
- Emergency power.

New hospital construction and renovated areas of existing facilities are required to be fully protected by an automatic fire suppression system.

The minimum width of corridors and passageways in MRI areas is 1100 mm (44") in areas to be used only by staff. The minimum width of corridors in areas that will also be used by inpatients is 2400 mm (96").

Provide handrails on both sides of the corridors in patient areas.

Nurses' stations are permitted to be open to the corridor.

Waiting areas are also permitted to be open to the corridors.

Refer to the latest editions of NFPA 101 "Life Safety Code", the Uniform Building Code and additional standards published by the National Fire Protection Association (NFPA).

G. Energy Conservation

1. Air Conditioning

All air conditioning systems that are considered should be compared to a basic system with respect to both life cycle cost and energy usage. The basic system should be that system having the lowest cost. The systems with the lowest life cycle cost should be selected.

Coordinate the selected system with the VA HVAC Design Manual for Hospital projects for additional information.

H. Communications

1. Telephone

Telephone outlets are typically provided at each workstation or in each room. Desk outlets are 450 mm (18") AFF and wall phone outlets are 1200 mm (48") AFF.

Certain modular casework units are provided with a utility access module that houses communication outlets and provides a chase for cabling. Conduits and junction boxes are provided to connect to the utility access module for telephone service.

2. Automatic Data Processing (ADP)

ADP, or computer outlets, are typically provided at each workstation with a personal computer (PC) and/or printer. Desk outlets are 450 mm (18") AFF.

Magnetic Resonance Imaging
Narrative

Certain modular casework units are provided with a utility access module that houses communication outlets and provides a chase for cabling. Conduits and junction boxes are provided to connect to the utility access module for ADP service.

3. Public Address

The MRI department will not have an independent public address (PA) system. The department will be included as part of the hospital-wide PA system. Speakers are typically located in corridors and public spaces. The actual system configuration will depend on the overall design layout and the functional requirements.

I. Waste Management

1. Medical Waste

Medical waste is generated in exam and treatment spaces where it is bagged, collected, and transported to the soiled utility rooms. Then it is held in separate containers pending transport to the medical waste handling facility.

2. General Waste

General Waste is generated in all spaces and is held in containers for collection and sorting into carts or it is bagged and placed in a waste chute and transported to the waste handling facility.

3. Recycling

Methods for sorting, collecting, transporting and disposing of recyclable products must be specifically analyzed for each facility and location.

The optional use of disposable and reusable products should be considered.

4. Soiled Linen

Soiled reusable linens are generated in exam rooms, treatment spaces, and patient and staff gowning areas. They are collected in carts or hampers (depending on volume) in the soiled utility rooms; or they are bagged and transported to (a) central collection area(s) via soiled linen chutes or carts.

Disposable linens are included with either general recyclable waste or medical waste as appropriate.

5. Utensils

Reusable utensils include bed pans, urinals, emesis basins and other stainless steel items, which are used in exam and treatment areas. Then they are transported to the soiled utility room where they are reprocessed (if steam washers are available) or collected for reprocessing and transported to the Sterile Processing Department.

6. Space Requirements

Space requirements will vary with the selection of waste collection and recycling methods/systems. Space requirements need to be analyzed for each optional method or system considered for new and existing facilities.

Magnetic Resonance Imaging
Narrative

While space needs are determined by PG 7610 on a departmental basis, space provisions for waste collection needs to be distributed and dedicated to a variety of uses in order to accommodate the implementation of the system and method selected.

J. Transportation

1. Patient

Gowning areas with lockers for inpatient and outpatient and control of ferrous materials should be provided.

a. Outpatient

Convenient access from patient parking and primary care entrance should be considered.

Passenger elevator access to MRI facilities should be located off main entrance levels.

Techniques like clear access routes, public spaces, landmarks, and signage facilitate wayfinding.

b. Inpatient

Stretcher and wheelchair patients should be provided access from inpatient areas.

Inpatient and outpatient traffic should be separated where possible.

Inpatient access from hospital service elevators is required.

Inpatients arrive at a control point common with outpatients.

Inpatients access patient holding through a dedicated route, which is separated from outpatient waiting.

2. Staff

Staff access should be separated from patient waiting and holding areas.

Staff lounge and locker areas should be located away from inpatient and outpatient traffic and gantry rooms.

3. Records

MRI utilizes digital imaging and retrieval techniques which may reduce the need for storage and retrieval of films.

Viewing, interpretation and video image manipulation areas should have data communication access.

MRI film records, which should be accessible by cart traffic, are usually combined with radiology records.

4. Specimens

Specimens are normally not drawn in this department.

5. Pharmaceuticals

Pharmaceuticals, including narcotics, are transported by pharmacy personal to the department in locked carts.

Narcotics are delivered to a narcotics locker which is usually located in a clean supply or patient prep area and is remotely alarmed to the nearest nursing station.

6. Materials

Clean supplies are transported by exchange carts which are stored in the Clean Supply Room.

Magnetic Resonance Imaging
Narrative

Supplies are transported by Service Elevator and through hospital corridors separated from patient traffic where possible.

Deliveries are scheduled during hours when patient visits are not scheduled.

7. Linen

Disposable linens are delivered as part of clean supplies.

8. Sterile Supplies

The use of sterile supplies is minimal and is accommodated by prepackaged or disposable items delivered with clean supplies.

9. Food

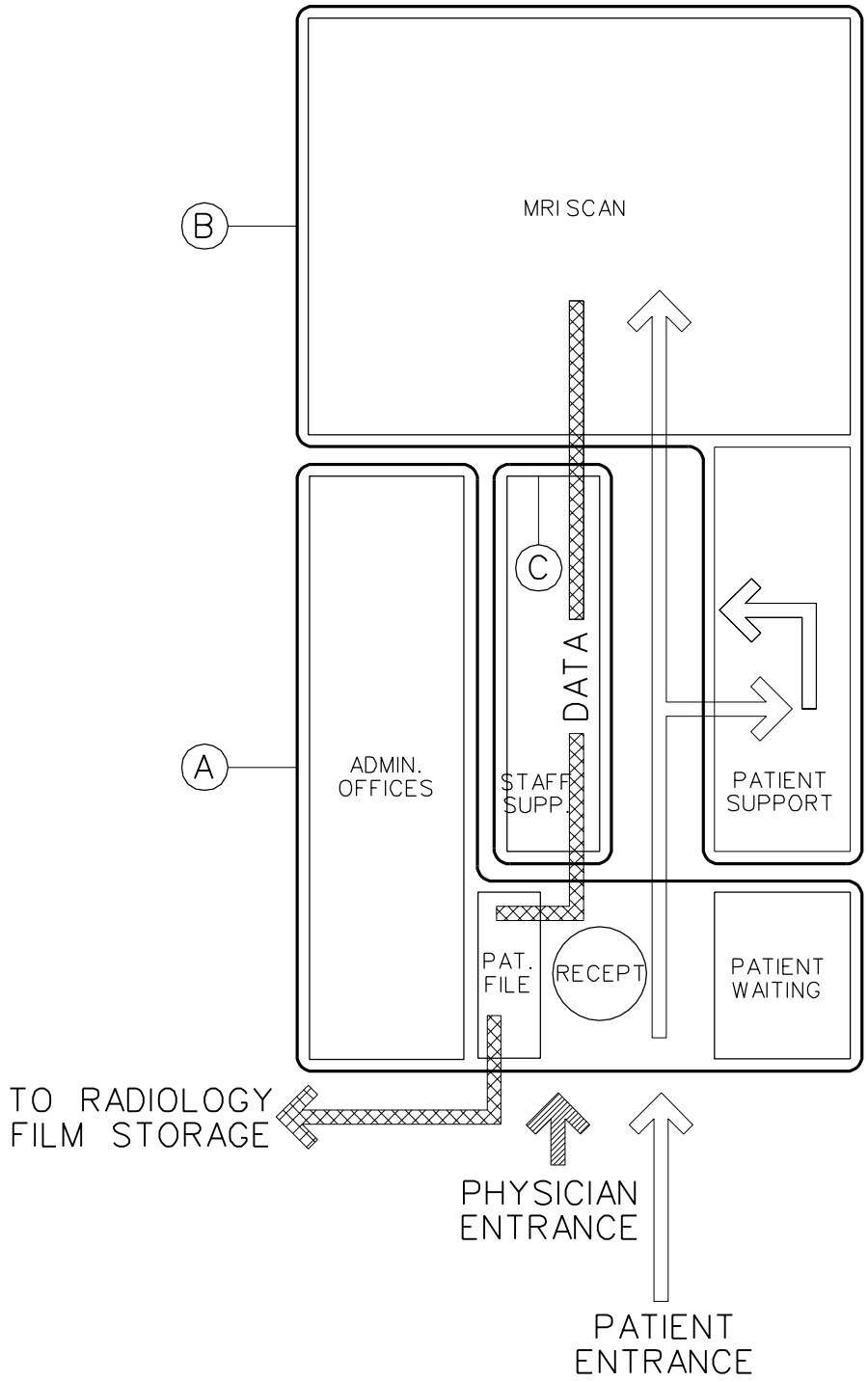
Meal and Nourishment deliveries to MRI are not required.

10. Waste

Waste is collected by housekeeping staff and transported to the Soiled Utility Room where it is disposed of as indicated by the Waste Management narrative on page 2-10.

Section 3
Relationship Diagrams

Magnetic Resonance Imaging Functional Diagram



(A) - ADMINISTRATION

OFFICES, ADMINISTRATIVE
ADMINISTRATIVE SUPPORT
    STAFF LOCKERS/LOUNGE
    TOILET, STAFF
RECEPTION
    OFFICE, SEC./RECEPT.
PATIENT RECORDS FILING
PATIENT WAITING

(B) - PATIENT CARE

MRI SCAN
    GANTRY ROOM
    CONTROL ROOM
    COMP./EQUIP. ROOM
    INDEPEND. VIEWING ROOM
    DIGITAL ARCHIVAL STORAGE
PATIENT SUPPORT
    PATIENT DRESSING ROOM
    TOILET ROOM, WHEELCHAIR
    EXAM/PREP/RECOV. AREA
    STRETCHER WAITING/HOLD

(C) - STAFF SUPPORT

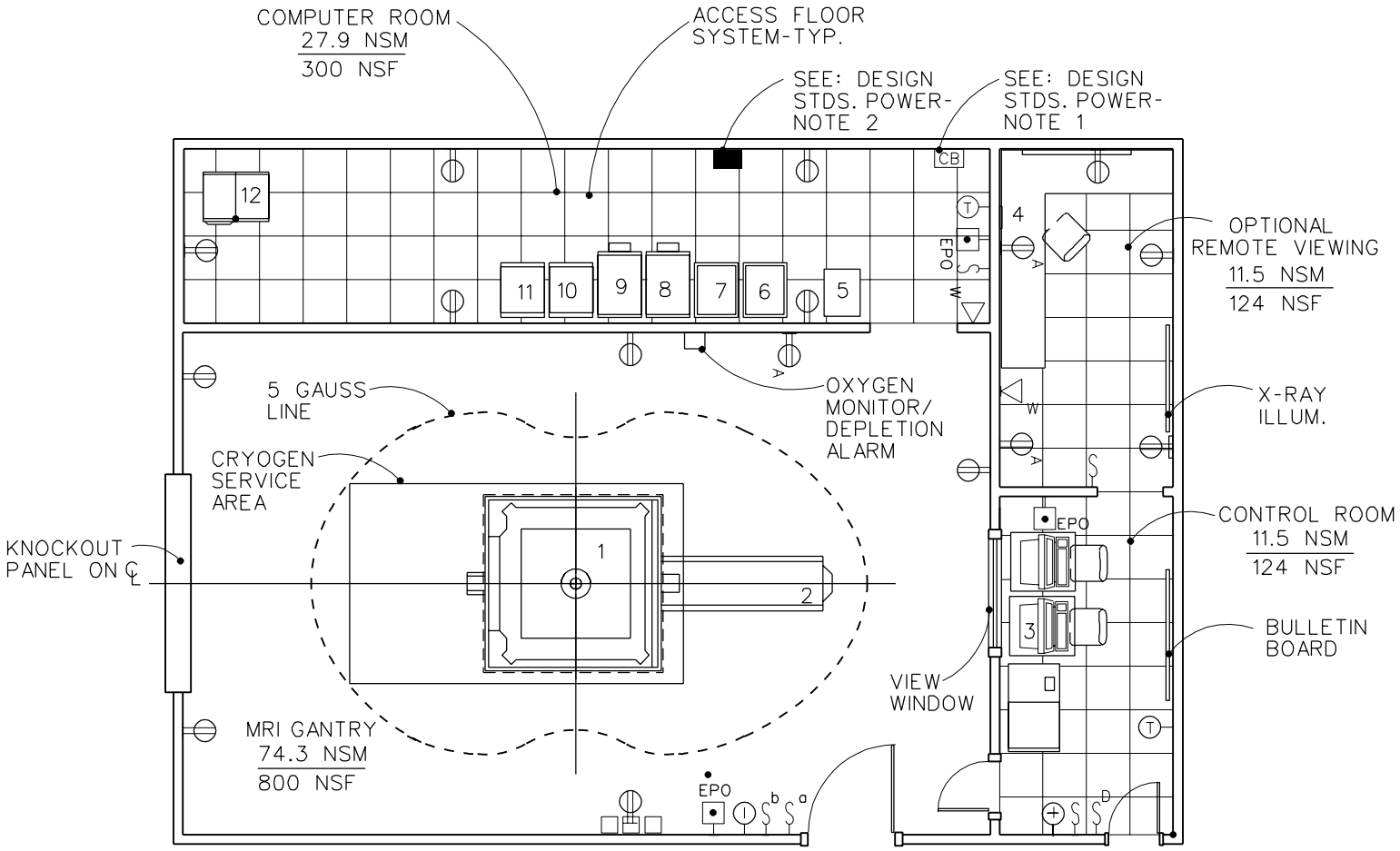
FILM PROCESSING AREA
STORAGE ROOM
SPECTROSCOPY RESEARCH
VIEWING/CONSULTATION
CLEAN SUPPLY
SOILED UTILITY
HOUSEKEEPING AIDS CLOSET

Section 4

Design Guide Plates and Data Sheets: Patient Care Areas

Guide Plate Series Plate Number

Magnetic Resonance Imaging System Equipment & Utility Plan



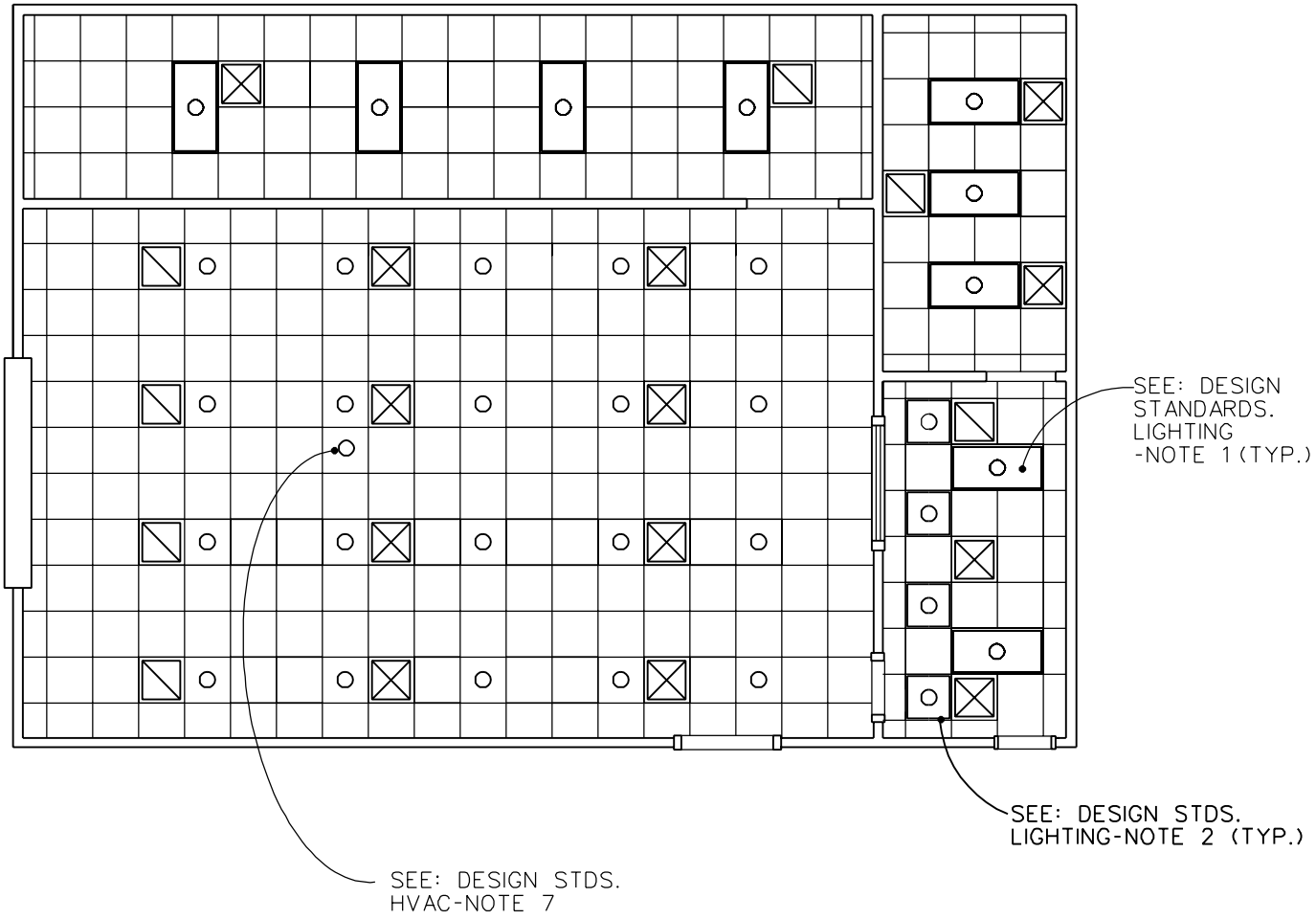
NOTES:
1 Viewing Room can be remotley located;
2 Gantry Room & Cryogen Storage Adjacent;.
3 Patient Privacy Rooms Across Hall;
4 All Equipment in Gantry Area must be non-magnetic (Including Stretcher); and
5 See Function Diagriam Plate 3-1 for ancilliary Areas.

SCHEDULE
1 MAGNET
2 PATIENT TABLE
3 OPERATOR'S CONSOLE
4 REMOTE VIEWING CONSOLE
5 MAIN COMPUTER CABINET
6 SYSTEM CONTROL CABINET
7 GRADIENT AMP CABINET
8 ADDITIONAL GRADIENT AMP CABINET (OPTIONAL)
9 GRAM CABINET (OPTIONAL)
10 RF/PENETRATION CABINET
11 COMPACT POWER DISTRIBUTION UNIT
12 WATER CHILLER

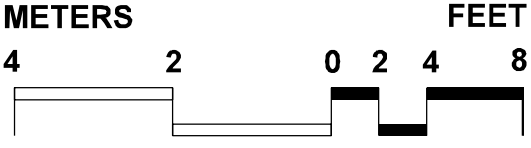
124.5 NSM
1340 NSF

METERS 4 2 FEET 0 2 4 8

Magnetic Resonance Imaging System
Reflected Ceiling Plan



NOTES:
1 No Flourescent Fixtures in MRI Gantry Room;
2 Ceiling Hight in MRI Ganrty Room 3130 mm (Verify with Manufacturer); and
3 In High Seismic Areas Verify Concrete Slab Requirements in MRI Gantry Room.



Magnetic Resonance Imaging
Design Standards

ARCHITECTURAL

Ceiling:	Acoustic Ceiling Tile
Ceiling Ht:	Coordinatew/ Equipment Manufacturer up to 3130mm (13')
Wall Finish:	Paint
Wainscot:	---
Base:	Resilient Base
Floor Finish:	Vinyl Composition Tile
Slab Depr:	Access Floor System 40 mm (1-1/2") slab depression for RF Shielding in Gantry Room

Notes:
1. 1200 mm (4'-0") wide RF door into Gantry Room coordinated radio frequency and magnetic shielding requirements with equipment manufacturer

SPECIAL EQUIPMENT

None

ELECTRICAL LIGHTING

General: Control Room: 30 fc - 1.0 W/sf
Remote Viewing: 30 fc-1.5W/sf
Control Room: 30 fc -.90 W/sf
Gantry Room: 30 fc - 2.5 W/sf

Notes:
1. 600 mm x 1200 mm (2'x4') recessed fluorescent light fixture, acrylic prismatic lens, W/2-F32T8 lamps, 4100 deg. k, CRI-85 (minimum).
2. Recessed, lensed incandescent down light with 100w, A-21 lamp.

POWER

General: 3200W (receptacles)
Emergency:

Notes:
1. 480v, 3P, flush-mounted circuit breaker with shunt trip for MRI system. Coordinate rating with system supplier.
2. 480v, 3P, flush mounted circuit breaker with shunt trip for computer room's A/C unit (when provided). Coordinate rating with system supplier.
3. DC power supply (rectifier) for MRI Gantry Room lighting. Rating as required for room lighting load.

COMMUNICATIONS

ADP:	---
Radio:	---
Telephone:	Yes
Intercom:	Yes
Public Addr:	---
Notes:	---

HEATING, VENTILATING AND AIR CONDITIONING

Dry Bulb Temp Cooling:	21 ^{0}C (70^0 F) for computer room, 24 ^{0}C (76 ^{0}F) all others
Dry Bulb Temp Heating:	21 ^{0}C (70 ^{0}F) for computer room, 25 ^{0}C (78^0 F) all others
Minimum % Outside Air:	15%
100% Exhaust Air:	Required only in emergency for MRI Gantry
Noise Criteria	NC 35 in Gantry NC 40 in others
Steam:	Yes
Relative Humidity/Cooling:	50%
Relative Humidity/Heating:	45% 40% +/- 5 in computer room
Minimum Air Changes/Hr.:	12 for MRI Gantry 4 for all others
Room Pressure:	Positive for Gantry Rm Equal for all others
AC Load-Equipment:	4400W (15,000 Btu/hr) for Gantry 2400W (8000 Btu/hr) all others
AC Load Lighting:	27 W/m^2 (2.5 W/sf) Gantry 17 W/m^2 (1.5 W/sf) all others
Number of People:	6 for MRI, 3 for all others
Special Exhaust:	---

Notes:
1. The HVAC system serving the Gantry Room needs to be capable of handling 100% O.A.

Magnetic Resonance Imaging
Design Standards

HEATING, VENTILATING AND AIR CONDITIONING (cont'd)

Notes:
2. Provide temperature and humidity sensor in the return exhaust ductwork with remote adjustment capabilities for the Gantry Room.
3. Provide a dedicated AC unit to serve the Computer Room. .
4. Provide 2 low level exhaust outlets located 175 mm (7") above finished floor in the gantry room.
5. Provide nonferrous piping, ductwork, and hangers material inside the shielding enclosure, as well as in all associated dampers.
6. Provide an automatic emergency 100% exhaust system in the Gantry Room.
7. Provide separate vent from magnet to outside for cryogen boil-off.
8. Provide chilled water supply and return to the building central chilled water system for environmental and computer room units
9. Provide a dedicated air cooled closed loop water cooling equipment for backup to the environmental and computer AC units.
10. Provide local and central high temperature alarms for the computer equipment.
11. Provide wave guide damper for all ductwork penetrating the RF shielding enclosure

PLUMBING AND MEDICAL GAS

Cold Water:	Yes
Hot Water:	Yes
Laboratory Air:	---
Laboratory Vacuum:	---
Sanitary Drain:	Yes
Reagent Grade Water:	---
Medical Air:	Yes
Medical Vacuum:	Yes
Oxygen:	Yes

Notes:
1. Provide nonferrous piping and hangers material inside the shielding enclosure.

Magnetic Resonance Imaging
Equipment Guide List

SYMBOL	QTY	AI	DESCRIPTION

General Notes

NOTE: *ALL MATERIALS INSTALLED, LOCATED WITHIN OR INTENDED TO ENTER THE GANTRY AREA, MUST BE NON-MAGNETIC EXCEPT FOR RECOMMENDED MAGNET SHIELDING MATERIALS ON OR IN WALLS, FLOORS OR CEILINGS.*

NOTE: *ALL PENETRATIONS (THROUGH THE RF SHIELDED ROOM FOR PLUMBING, ELECTRICAL, MECHANICAL) OR ANY CONDUCTIVE BUILDING MATERIAL SHALL BE ELECTRICALLY ISOLATED AND RFI FILTERED IN ACCORDANCE WITH MANUFACTURERS STANDARDS.*

NOTE: *CONDUCTIVE CONNECTIONS ARE TO BE MADE OUTSIDE THE RF ROOM.*

NOTE: *PROVIDE NON-MAGNETIC MATERIAL FOR AIR, OXYGEN AND VACUUM OUTLETS FROM PORTABLE SUPPLY, ONLY WHEN APPROVED FOR A SPECIFIC PROJECT BY VHA.*

Gantry Room

NOTE*: INTERCOM STATION, CONNECTED TO STATION IN THE CONTROL ROOM.*

NOTE: *INTERCOM, STATION, NON-MAGNETIC MATERIAL (PG-18-1, MCS 16760*

NOTE: *COMPUTER/ACCESS FLOORING, NON-MAGNETIC MATERIALS)*

NOTE*: CONNECTIONS, PLUMBING, ELECTRICAL OR MECHANICAL AS REQUIRED*

NOTE: *LIGHTING SYSTEM, DC, FOR INCANDESCENT LIGHT FIXTURES, NON-MAGNETIC MATERIAL, MULTI-CIRCUIT LIGHT FIXTURES*

NOTE: *OUTLET, INTERCOM (EMPTY CONDUIT SYSTEM) (PG 18-1, MCS 16111)*

NOTE: *RADIO FREQUENCY COPPER GROUND PLANES, LOCATED ON THE FINISHED FLOOR SURFACE, FROM THE MAGNET TO THE ELECTRONIC CABINETS*

NOTE: *SHIELDING, MAGNETIC (ACTIVE OR PASSIVE)*

NOTE: *SHIELDING, RADIO FREQUENCY (RF)*

NOTE: *SYSTEM EMERGENCY OFF BUTTON PANEL, GUARD COLLAR, FLUSH MOUNTED, LOCATED NEAR EXIT FROM GANTRY ROOM, APPROX., 1524 MM (60") ABOVE FINISHED FLOOR*

AR	CC	MODULAR CASEWORK
AR	VC	GANTRY, MAGNET, PATIENT COUCH, SIZES AS REQUIRED
1	VC	OXYGEN MONITOR AND ALARM, WALL MOUNTED, APPROX., 279 MM X 178 MM X 229 MM (11" X 7" X 9") LOCATED APPROX., 1524 MM (60") ABOVE FINISHED FLOOR

Magnetic Resonance Imaging
Equipment Guide List

SYMBOL	QTY	AI	DESCRIPTION

Control Room

NOTE: *PROCESSOR, UTILITIES SERVICE INCLUDING MECHANICAL AND ELECTRICAL SERVICES, MAINSWITCH, PER MANUFACTURER STANDARDS.*

NOTE: *COMPUTER/ACCESS FLOORING, AS REQUIRED.*

NOTE: *CONNECTIONS, PLUMBING, ELECTRICAL OR MECHANICAL AS REQUIRED*

NOTE: *INTERCOM, STATION PG-18-1, MCS 16760)*

NOTE: *LOW LEVEL DIMMED INCANDESCENT LIGHTING SYSTEM IN ADDITION TO GENERAL FLUORESCENT ILLUMINATION SYSTEM (PG-18-1, MCS 16510)*

NOTE: *OUTLET, INTERCOM (EMPTY CONDUIT SYSTEM) (PG-18-1, MCS 16111)*

NOTE: *SYSTEM EMERGENCY OFF BUTTON PANEL, GUARD COLLAR, WALL MOUNTED, LOCATED NEAR EXIT FROM CONTROL ROOM, APPROX., 1524 MM (60") ABOVE FINISHED FLOOR*

1	VV	CHAIR, ROTARY, WITH ARMS
1	VC	CONSOLE, OPERATOR'S WITH COMPUTER TERMINAL AND IMAGE DISPLAY MONITORS, FOR CONTROLLING ACQUISTION, PROCESSING, DISPLAY AND MANIPULATION OF DATA
1	VV	BULLETIN BOARD, 914 MM X 610 MM (36" X 24")
AR	CF	MODULAR CASEWORK
1	VV	RECEPTACLE, WASTE, 330 MM (13") DIAMETER

Computer / Equipment Room

NOTE: *VARIOUS CABINETS, DISTRIBUTION SYSTEMS AS REQUIRED BY MANUFACTURER.*

NOTE: *COMPUTER/ACCESS FLOORING, AS REQUIRED.*

NOTE: *CONNECTIONS, PLUMBING, ELECTRICAL OR MECHANICAL AS REQUIRED*

NOTE: *SHUNT TRIP CIRCUIT BREAKER, AS REQUIRED.*

NOTE: *SYSTEM EMERGENCY OFF BUTTON PANEL, GUARD COLLAR, WALL MOUNTED, LOCATED NEAR EXIT FROM COMPUTER/EQUIPMENT ROOM, APPROX., 1524 MM (60") ABOVE FINISHED FLOOR*

AR	VV	COMPUTER, SYSTEM HARDWARE

Magnetic Resonance Imaging
Equipment Guide List

SYMBOL	QTY	AI	DESCRIPTION

Remote Viewing Room

NOTE: *CONNECTIONS, PLUMBING, ELECTRICAL OR MECHANICAL AS REQUIRED.*

NOTE: *LOW LEVEL DIMMED INCANDESCENT LIGHTING SYSTEM IN ADDITION TO GENERAL FLUORESCENT ILLUMINATION SYSTEM (PG -18-1, MCS 16510).*

AR	VV	CHAIR, ROTARY, WITH ARMS
1	VV	CLOCK, BATTERY OPERATED
AR	VC	CONSOLE, WITH COMPUTER TERMINAL AND IMAGE DISPLAY MONITORS (AS APPROVED ON PROJECT BASIS BY VHA)
1	VV	HOOK, COAT, WALL MOUNTED
1	VV	ILLUMINATOR, X-RAY, 120 VOLT, 20 AMP, WALL MOUNTED, APPROX., 508 MM X 1499 MM (20" X 59")
1	VV	RECEPTACLE, WASTE, 330 MM (13") DIAMETER