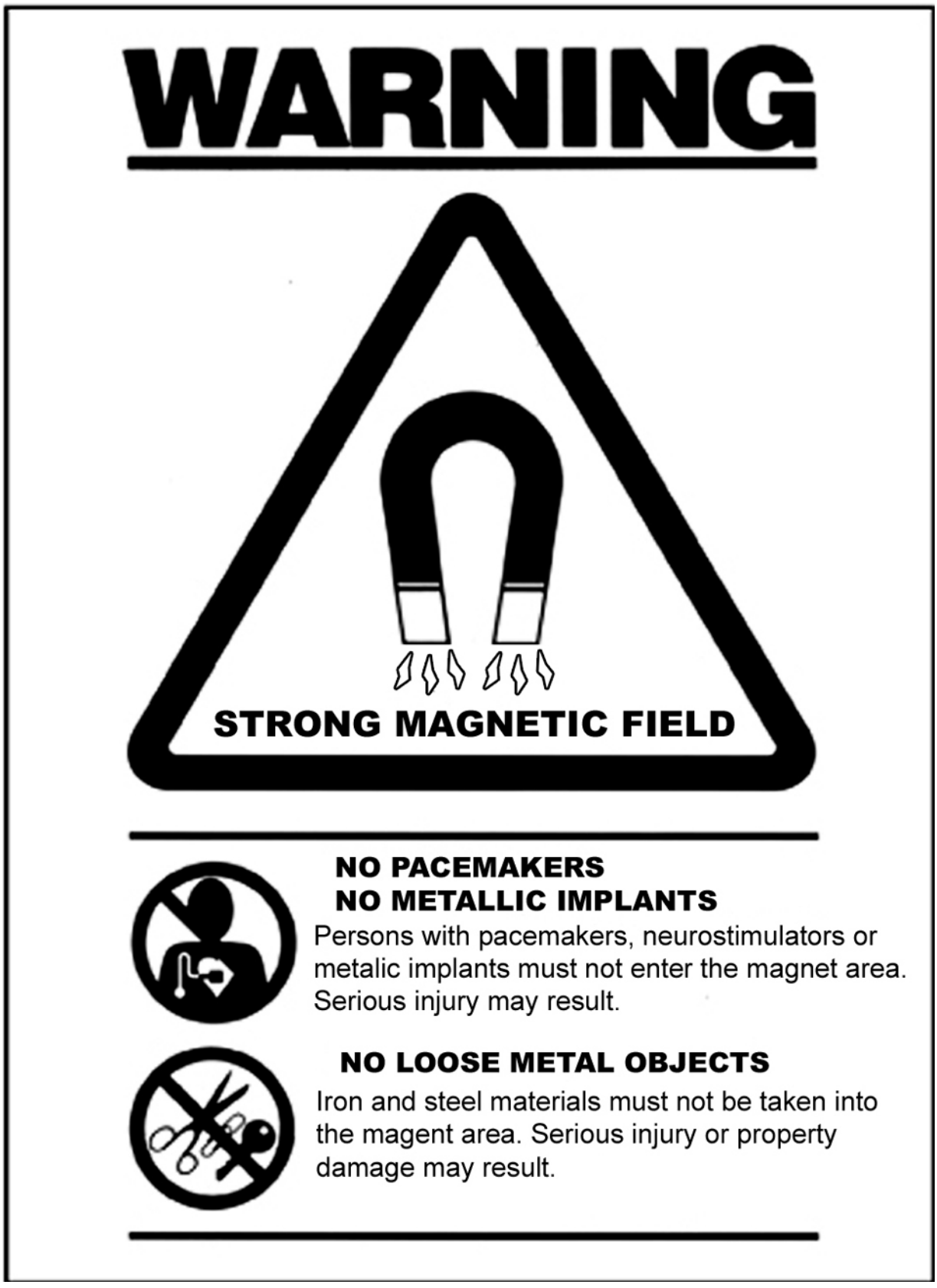
GE Healthcare

Signa HDxt, HDx 3.0T Upgrades
Pre-Installation

OPERATING DOCUMENTATION

5159905
Revision 6.0


WARNING
STRONG MAGNETIC FIELD
NO PACEMAKERS
NO METALLIC IMPLANTS
Persons with pacemakers, neurostimulators or metalic implants must not enter the magnet area. Serious injury may result.
NO LOOSE METAL OBJECTS
Iron and steel materials must not be taken into the magent area. Serious injury or property damage may result.

Important Information

LANGUAGE

ПРЕДУПРЕЖДЕНИЕ
(BG)

Това упътване за работа е налично само на английски език с изключенията на случаите, когато се изисква изрично по друг начин от местното законодателство, или от споразумение на местно ниво.

- Ако доставчикът на услугата на клиента изиска друг език, задължение на клиента е да осигури превод.
- Не използвайте оборудването, преди да сте се консултирали и разбрали упътването за работа.
- Неспазването на това предупреждение може да доведе до нараняване на доставчика на услугата, оператора или пациента в резултат на токов удар, механична или друга опасност.

警告
(ZH-CN)

本维修手册仅提供英文版本，除非当地法律或本地供应协议另有明确要求。

- 如果客户的维修服务人员需要非英文版本，则客户需自行提供翻译服务。
- 未详细阅读和完全理解本维修手册之前，不得进行维修。
- 忽略本警告可能对维修服务人员、操作人员或患者造成触电、机械伤害或其他形式的伤害。

VÝSTRAHA
(CS)

Tento provozní návod existuje pouze v anglickém jazyce, pokud není jinak výslovně vyžadováno místními zákony nebo odsouhlaseno na místní úrovni.

- V případě, že externí služba zákazníkům potřebuje návod v jiném jazyce, je zajištění překladu do odpovídajícího jazyka úkolem zákazníka.
- Nesnažte se o údržbu tohoto zařízení, aniž byste si přečetli tento provozní návod a pochopili jeho obsah.
- V případě nedodržování této výstrahy může dojít k poranění pracovníka prodejního servisu, obslužného personálu nebo pacientů vlivem elektrického proudu, respektive vlivem mechanických či jiných rizik.

ADVARSEL

(DA)

Denne servicemanual findes kun på engelsk, medmindre andet kræves i henhold til lokal lovgivning eller lokal aftale.

- Hvis en kundes tekniker har brug for et andet sprog end engelsk, er det kundens ansvar at sørge for oversættelse.
- Forsøg ikke at servicere udstyret uden at læse og forstå denne servicemanual.
- Manglende overholdelse af denne advarsel kan medføre skade på grund af elektrisk stød, mekanisk eller anden fare for teknikeren, operatøren eller patienten.

WAARSCHUWING

(NL)

Deze onderhoudshandleiding is enkel in het Engels verkrijgbaar, tenzij expliciet vereist door plaatselijke regelgeving of overeengekomen op lokaal niveau.

- Als het onderhoudspersoneel een andere taal vereist, dan is de klant verantwoordelijk voor de vertaling ervan.
- Probeer de apparatuur niet te onderhouden alvorens deze onderhoudshandleiding werd geraadpleegd en begrepen is.
- Indien deze waarschuwing niet wordt opgevolgd, zou het onderhoudspersoneel, de operator of een patiënt gewond kunnen raken als gevolg van een elektrische schok, mechanische of andere gevaren.

WARNING

(EN)

This service manual is available in english only except as otherwise expressly required by local law or agreed to at a local level.

- If a customer's service provider requires a language other than english, it is the customer's responsibility to provide translation services.
- Do not attempt to service the equipment unless this service manual has been consulted and is understood.
- Failure to heed this warning may result in injury to the service provider, operator or patient from electric shock, mechanical or other hazards.

HOIATUS

(ET)

See teenindusjuhend on saadaval ainult inglise keeles, kui kohalikud seadused ei ütle teisiti või kui kohalikes õigusaktides ei ole otseselt teisiti ette nähtud.

- Kui klienditeeninduse osutaja nõuab juhendit inglise keelest erinevas keeles, vastutab klient tõlketeenuse osutamise eest.
- Ärge üritage seadmeid teenindada enne eelnevalt käesoleva teenindusjuhendiga tutvumist ja sellest aru saamist.
- Käesoleva hoiatuse eiramine võib põhjustada teenuseosutaja, operaatori või patsiendi vigastamist elektrilöögi, mehaanilise või muu ohu tagajärjel.

VAROITUS

(FI)

Tämä huolto-ohje on saatavilla vain englanniksi, ellei paikallinen laki nimenomaan toisin vaadi tai jos toisin on sovittu paikallisella tasolla.

- Jos asiakkaan huoltohenkilöstö vaatii muuta kuin englanninkielistä materiaalia, tarvittavan käännöksen hankkiminen on asiakkaan vastuulla.
- Älä yritä korjata laitteistoa ennen kuin olet varmasti lukenut ja ymmärtänyt tämän huolto-ohjeen.
- Mikäli tätä varoitusta ei noudateta, seurauksena voi olla huoltohenkilöstön, laitteiston käyttäjän tai potilaan vahingoittuminen sähköiskun, mekaanisen vian tai muun vaaratilanteen vuoksi.

ATTENTION

(FR)

Sauf exigence contraire des lois locales ou accord contraire au niveau local, ce manuel d'installation et de maintenance n'est disponible qu'en anglais.

- Si le technicien d'un client a besoin de ce manuel dans une langue autre que l'anglais, il incombe au client de le faire traduire.
- Ne pas tenter d'intervenir sur les équipements tant que ce manuel d'installation et de maintenance n'a pas été consulté et compris.
- Le non-respect de cet avertissement peut entraîner chez le technicien, l'opérateur ou le patient des blessures dues à des dangers électriques, mécaniques ou autres.

WARNUNG
(DE)

Diese Serviceanleitung existiert nur in englischer Sprache, sofern nichts anderes gesetzlich vorgeschrieben oder auf lokaler Ebene vereinbart wurde.

- Falls ein fremder Kundendienst eine andere Sprache benötigt, ist es aufgabe des Kunden für eine Entsprechende Übersetzung zu sorgen.
- Versuchen Sie nicht diese Anlage zu warten, ohne diese Serviceanleitung gelesen und verstanden zu haben.
- Wird diese Warnung nicht beachtet, so kann es zu Verletzungen des Kundendiensttechnikers, des Bedieners oder des Patienten durch Stromschläge, mechanische oder sonstige Gefahren kommen.

ΠΡΟΕΙΔΟΠΟΙΗΣΗ
(EL)

Το παρόν εγχειρίδιο σέρβις διατίθεται μόνο στα αγγλικά, εκτός αν η τοπική νομοθεσία απαιτεί κάτι άλλο ή υπάρχει διαφορετική συμφωνία σε τοπικό επίπεδο.

- Εάν ο τεχνικός σέρβις ενός πελάτη απαιτεί το παρόν εγχειρίδιο σε γλώσσα εκτός των αγγλικών, αποτελεί ευθύνη του πελάτη να παρέχει τις υπηρεσίες μετάφρασης.
- Μην επιχειρήσετε την εκτέλεση εργασιών σέρβις στον εξοπλισμό αν δεν έχετε συμβουλευτεί και κατανοήσει το παρόν εγχειρίδιο σέρβις.
- Αν δεν προσέξετε την προειδοποίηση αυτή, ενδέχεται να προκληθεί τραυματισμός στον τεχνικό σέρβις, στο χειριστή ή στον ασθενή από ηλεκτροπληξία, μηχανικούς ή άλλους κινδύνους.

FIGYELMEZTETÉS
(HU)

Ezen karbantartási kézikönyv kizárólag angol nyelven érhető el, kivéve ha a helyi rendelkezések ezt kifejezetten elő nem írják, illetve ha helyi szinten erről külön megállapodás nem születik.

- Ha a vevő szolgáltatója angoltól eltérő nyelvre tart igényt, akkor a vevő felelőssége a fordítás elkészíttetése.
- Ne próbálja elkezdeni használni a berendezést, amíg a karbantartási kézikönyvben leírtakat nem értelmezték.
- Ezen figyelmeztetés figyelmen kívül hagyása a szolgáltató, működtető vagy a beteg áramütés, mechanikai vagy egyéb veszélyhelyzet miatti sérülését eredményezheti.

AÐVÖRUN
(IS)

Þessi þjónustuhandbók er eingöngu fáanleg á ensku, nema annað sé sérstaklega krafist, löglega eða samþykkt á landsgrundvelli.

- Ef að þjónustuveitandi viðskiptamanns þarfnast annas tungumáls en ensku, er það skylda viðskiptamanns að skaffa tungumálaþjónustu.
- Reynið ekki að afgreiða tækið nema að þessi þjónustuhandbók hefur verið skoðuð og skilin.
- Brot á sinna þessari aðvörun getur leitt til meiðsla á þjónustuveitanda, stjórnanda eða sjúklings frá raflosti, vélrænu eða öðrum áhættum.

AVVERTENZA
(IT)

Il presente manuale di manutenzione è disponibile soltanto in inglese, eccetto quando espressamente richiesto dalle normative locali o convenuto a livello locale.

- Se un addetto alla manutenzione richiede il manuale in una lingua diversa, il cliente è tenuto a provvedere direttamente alla traduzione.
- Procedere alla manutenzione dell'apparecchiatura solo dopo aver consultato il presente manuale ed averne compreso il contenuto.
- Il mancato rispetto della presente avvertenza potrebbe causare lesioni all'addetto alla manutenzione, all'operatore o ai pazienti provocate da scosse elettriche, urti meccanici o altri rischi.

警告
(JA)

このサービスマニュアルには英語版しかありません。ただし使用国の法令に別異の定めがある、あるいは現地で別段の合意がある場合を除きます。

- サービスを担当される業者が英語以外の言語を要求される場合、翻訳作業はその業者の責任で行うものとさせていただきます。
- このサービスマニュアルを熟読し理解せずに、装置のサービスを行わないでください。
- この警告に従わない場合、サービスを担当される方、操作員あるいは患者さんが、感電や機械的又はその他の危険により負傷する可能性があります。

경고
(KO)

현지 법률에 따라 명시적으로 요구하거나 현지 수준에서 합의한 경우를 제외하고 본 서비스 매뉴얼은 영어로만 이용하실 수 있습니다.

- 고객의 서비스 제공자가 영어 이외의 언어를 요구할 경우, 번역 서비스를 제공하는 것은 고객의 책임입니다.
- 본 서비스 매뉴얼을 참조하여 숙지하지 않은 이상 해당 장비를 수리하려고 시도하지 마십시오.
- 본 경고 사항에 유의하지 않으면 전기 쇼크, 기계적 위험, 또는 기타 위험으로 인해 서비스 제공자, 사용자 또는 환자에게 부상을 입힐 수 있습니다.

BRĪDINĀJUMS
(LV)

Šī apkalpes rokasgrāmata ir pieejama tikai angļu valodā, izņemot gadījumus, kad vietējie likumi nepārprotami nosaka citādi vai panākta vienošanās vietējā līmenī.

- Ja klienta apkalpes sniedzējam nepieciešama informācija citā valodā, nevis angļu, klienta pienākums ir nodrošināt tulkošanu.
- Neveiciet aprīkojuma apkalpi bez apkalpes rokasgrāmatas izlasīšanas un saprašanas.
- Šī brīdinājuma neievērošana var radīt elektriskās strāvas trieciena, mehānisku vai citu risku izraisītu traumu apkalpes sniedzējam, operatoram vai pacientam.

ĮSPĖJIMAS
(LT)

Šis eksploatavimo vadovas yra tik anglų kalba, išskyrus tuos atvejus, kai vietiniai įstatymai tiesiogiai numato kitokius reikalavimus arba vietiniu lygiu sutarta kitaip.

- Jei kliento paslaugų tiekėjas reikalauja vadovo kita kalba – ne anglų, suteikti vertimo paslaugas privalo klientas.
- Nemėginkite atlikti įrangos techninės priežiūros, jei neperskaitėte ar nesupratote šio eksploatavimo vadovo.
- Jei nepaisysite šio įspėjimo, galimi paslaugų tiekėjo, operatoriaus ar paciento sužalojimai dėl elektros šoko, mechaninių ar kitų pavojų.

ADVARSEL

(NO)

Denne servicehåndboken finnes bare på engelsk, bortsett fra dersom det motsatte uttrykkelig er fastsatt av lokal lovgivning eller det er inngått annen avtale lokalt.

- Hvis kundens serviceleverandør trenger et annet språk, er det kundens ansvar å sørge for oversettelse.
- Ikke forsøk å reparere utstyret uten at denne servicehåndboken er lest og forstått.
- Manglende hensyn til denne advarselen kan føre til at serviceleverandøren, operatøren eller pasienten skades på grunn av elektrisk støt, mekaniske eller andre farer.

OSTRZEŻENIE

(PL)

Niniejszy podręcznik serwisowy dostępny jest jedynie w języku angielskim, chyba że lokalne przepisy lub umowy wyraźnie stanowią inaczej.

- Jeśli dostawca usług klienta wymaga języka innego niż angielski, zapewnienie usługi tłumaczenia jest obowiązkiem klienta.
- Nie próbować serwisować wyposażenia bez zapoznania się z niniejszym podręcznikiem serwisowym i zrozumienia go.
- Niezastosowanie się do tego ostrzeżenia może spowodować urazy dostawcy usług, operatora lub pacjenta w wyniku porażenia prądem elektrycznym, zagrożenia mechanicznego bądź innego.

ATENȚIE

(RO)

Acest manual de service este disponibil numai în limba engleză, cu excepția cazului în care este o cerință obligatorie stipulată de legislația națională sau convenită la nivel local.

- Dacă un furnizor de servicii pentru clienți necesită o altă limbă decât cea engleză, este de datoria clientului să furnizeze o traducere.
- Nu încercați să reparați echipamentul decât ulterior consultării şi înțelegerii acestui manual de service.
- Ignorarea acestui avertisment ar putea duce la rănirea depanatorului, operatorului sau pacientului în urma pericolelor de electrocutare, mecanice sau de altă natură.

ОСТОРОЖНО!
(RU)

Данное руководство по техническому обслуживанию предлагается только на английском языке, за исключением тех случаев, когда наличие руководства на национальном языке является требованием местного законодательства или когда выпуск такого руководства согласован с местным представительством.

- Если сервисному персоналу клиента необходимо руководство не на английском, а на каком-то другом языке, клиенту следует самостоятельно обеспечить перевод.
- Перед техническим обслуживанием оборудования обязательно обратитесь к данному руководству и поймите изложенные в нем сведения.
- Несоблюдение требований данного предупреждения может привести к тому, что специалист по техобслуживанию, оператор или пациент получит удар электрическим током, механическую травму или другое повреждение.

UPOZORNENIE
(SK)

Tento návod na obsluhu je k dispozícii len v angličtine, okrem prípadov, kedy tak výslovne vyžadujú miestne zákony alebo je dohodnuté na miestnej úrovni.

- Ak zákazníkov poskytovateľ služieb vyžaduje iný jazyk ako angličtinu, poskytnutie prekladateľských služieb je zodpovednosťou zákazníka.
- Nepokúšajte sa o obsluhu zariadenia, kým si neprečítate návod na obluhu a neporozumiete mu.
- Zanedbanie tohto upozornenia môže spôsobiť zranenie poskytovateľa služieb, obsluhujúcej osoby alebo pacienta elektrickým prúdom, mechanické alebo iné ohrozenie.

ATENCION
(ES)

Este manual de servicio sólo existe en inglés, salvo que la legislación local exija de forma expresa lo contrario, o así se haya acordado a nivel local.

- Si el encargado de mantenimiento de un cliente necesita un idioma que no sea el inglés, el cliente deberá encargarse de la traducción del manual.
- No se deberá dar servicio técnico al equipo, sin haber consultado y comprendido este manual de servicio.
- La no observancia del presente aviso puede dar lugar a que el proveedor de servicios, el operador o el paciente sufran lesiones provocadas por causas eléctricas, mecánicas o de otra naturaleza.

VARNING

(SV)

Den här servicehandboken finns bara tillgänglig på engelska om inte annat uttryckligen krävs av lokal lag eller har överenskommits på lokal nivå.

- Om en kunds servicetekniker har behov av ett annat språk än engelska, ansvarar kunden för att tillhandahålla översättningstjänster.
- Försök inte utföra service på utrustningen om du inte har läst och förstår den här servicehandboken.
- Om du inte tar hänsyn till den här varningen kan det resultera i skador på serviceteknikern, operatören eller patienten till följd av elektriska stötar, mekaniska faror eller andra faror.

DİKKAT

(TR)

Aksi, yerel bir yasa tarafından açıkça gerekli görülmediği veya yerel bir seviyede kabul edilmediği takdirde, bu servis kilavuzunun sadece ingilizcesi mevcuttur.

- Eğer müşteri teknisyeni bu kılavuzu ingilizce dışında bir başka lisandan talep ederse, bunu tercüme ettirmek müşteriye düşer.
- Servis kılavuzunu okuyup anlamadan ekipmanlara müdahale etmeyiniz.
- Bu uyarıya uyulmaması, elektrik, mekanik veya diğer tehlikelerden dolayı teknisyen, operatör veya hastanın yaralanmasına yol açabilir.

AVISO

(PT-BR)

Este manual de assistência técnica encontra-se disponível unicamente em inglês, salvo disposições em contrário previstas pela legislação local ou acordadas no âmbito local.

- Se outro serviço de assistência técnica solicitar a tradução deste manual, caberá ao cliente fornecer os serviços de tradução.
- Não tente reparar o equipamento sem ter consultado e compreendido este manual de assistência técnica.
- A não observância deste aviso pode ocasionar ferimentos no técnico, operador ou paciente decorrentes de choques elétricos, mecânicos ou outros.

ATENÇÃO

(PT-PT)

Este manual de assistência técnica só se encontra disponível em inglês, salvo requisição expressa pela legislação local ou acordo efectuado a nível local.

- Se qualquer outro serviço de assistência técnica solicitar este manual noutro idioma, é da responsabilidade do cliente fornecer os serviços de tradução.
- Não tente reparar o equipamento sem ter consultado e compreendido este manual de assistência técnica.
- O não cumprimento deste aviso pode colocar em perigo a segurança do técnico, do operador ou do paciente devido a choques eléctricos, mecânicos ou outros.

UPOZORENJE

(SR)

Ovo servisno uputstvo je dostupno samo na engleskom jeziku, sem ako lokalni zakon to izričito zahteva ili je dogovoreno na lokalnom nivou.

- Ako klijentov serviser zahteva neki drugi jezik, klijent je dužan da obezbedi prevodilačke usluge.
- Ne pokušavajte da opravite uređaj ako niste pročitali i razumeli ovo servisno uputstvo.
- Zanemarivanje ovog upozorenja može dovesti do povređivanja servisera, rukovaoca ili pacijenta usled strujnog udara ili mehaničkih i drugih opasnosti.

Revision History

Revision	Date	Description
1	23 February 2006	Initial Signa HDx 3.0T upgrades product release
2	30 March 2006	**System Configuration Chapter:** per HDx Program Lead Hardware Integrator Release 12.x to Release 14.x Upgrade Catalogs illustration: 3T RFS Cabinet added Model Numbers 5110607-2; 3T EXCITE System Cabinet Model Numbers deleted 2357500-2 (1.5T EXCITE II model). added catalogs for various language keyboard and 23 inch monitor.
		Room Layout Chapter: added IPCM option equipment. MR System Interconnects Routing Requirements/Recommendations table: Row titled Entire MR System: recommendation for use of access flooring deleted Magnet Room (changed to “recommended for use in ONLY the Equipment Room “); Row titled Magnet Room: deleted “e.g. aluminum” from 1st bullet and Note. “seismic anchor holes” changed to BRACKETS MOUNTING HOLES and brackets callout to “BRACKETS SUPPLIED WITH CABINET FOR MOUNTING, IF REQUIRED.”
		Site Environment Chapter: added IPCM Option Chilled Air Blower (CAB) values to Maximum Heat Output For Air Cooling table.
		RF Shielded Room Chapter: RF Shielded Room Requirements table, row titled Construction, Note text deleted 'e.g. aluminum'. requirements reordered for clarity and completeness. Also added Notice pertaining to Penetration Panel mounting hardware must not loosen over time to maintain RF attenuation requirement. ”Magnet Room floor Requirements and Recommendations” table changes: • Table row titled Floor Design: Bullet stating 42.125 dimension finished floor to center of Magnet opening added missing minus (-) for tolerance +/- value. Access flooring Notice deleted “e.g. aluminum”. • Through out table deleted “e.g. aluminum” for Notice! pertaining to removable panels known source of RF Noise. • **Entire Floor Levelness row contents revised, Magnet Mounting recess area requirements including tolerance (+/-) values changed and recommendation added.** • Majority of Floor Construction row revised: Magnet Mounting Recessed area required with and without VibroAcoustic Damping Option and clarified requirements for both configurations. Added RF Shield material seams MUST NOT be under projected areas for VibroAcoustic Damping Option mats. Added Access flooring Notice. • Added tables with illustrations & references of revised Magnet Load Pattern with & without VibroAcoustic Damping Option.
		Shipping and Delivery Data Chapter: deleted 1.5T MNS Amp Cabinet info.
		Tools and Test Equipment Chapter: Added 3T shim related tools: -Shim case / cable kit 2135558, LCC300 Shim Camera Kit 2386028, LCC300 Passive Shimming Kit 2386029. Updated several part numbers: -Field Plotting Kit 46-251865G5 -Magnet Ramping Equipment Kit part number updated to 46-260703G5 -Non-Magnetic Tool Kit replaced by new Titanium Non-Magnetic Tool Kits.
3	22 August 2006	**Room Layout Chapter:** MR System Interconnects Routing Requirements/Recommendations table reformatted to number requirements and updated requirements to be consistent with revised Magnet Room floor requirement of metal access floor tiles not allowed anywhere: Row titled Entire MR System;: recommendation for use of access flooring deleted.; Row titled Magnet Room: deleted access floor note and added metal floor access tiles not allowed with reference to Magnet Room Floors requirement in RF Shielded Room chapter. added side Service Access Requirement. added section with reference to *Direction 5182674 GE Healthcare Signa MRI Scanners Customer Site Storage Requirements* for size and weight of surface coils and phantoms that require customer provided storage locations. SPT Phantom Set Shipping/Storage Cart information included in Customer Site Storage Requirements subsection.
		Site Environment Chapter: Ventilation Requirements/Recommendations table reformatted for 1 column with numbered list of requirements. Incorporated Magnet Room ventilation switch placement requirement (removed from RF Shielded Room Chapter).
		Interconnect Data Chapter: Reformatted Introduction section so subsections are now included in direction table of contents.

Revision	Date	Description
		RF Shielded Room Chapter: major changes incorporated: • Rewrote entire section to simplify requirements, used feedback from Project Managers - Installations and Zone Support Engineers. • Same levelness dimension requirements for all Magnet Room floor areas. • Metal access floor time are NOT allowed in Magnet Room. • Illustration revised to show recessed area with Vibroacoustic mats projected locations.
4	5 April 2007	Interconnect routing requirements moved to Table titled “MR System Interconnects Routing Requirements/Recommendations”, row titled “Magnet Room” from RF Shielded Room Requirements table. Also reworded moved requirements: - added anchors to mechanical fasteners list and clarified mechanical fastener not allowed within 2 ft (0.61 m) of Gradient Cables; - added unsecured or overlapped electrically conductive materials not allowed withing 2 ft (0.61m of Gradient Cables. [Resolution for iTrak 13067413, iTrak 13066436]. RF Shielded Room Requirements table, Construction row deleted note concerning access floor since that material is not allowed in Magnet Room [iTrak 13076809].
		Room Layout dimensions revised for new OW Table configuration.
		Site Environment requirements changed to DC Lighting required in Magnet Room and additional rewording for clarification of requirements [iTrak 13068863].
5	25 July 2008	Update Preinstall introduction; Pre-Installation Checklist updated and moved to final chapter in book; Glossary moved to Appendix; Cabling and Interconnection Updates: MCAT - PQR13131624, PCN 290178; Van Manufacturer Update; Proximity Limits Table; Update Minimum Room Size: Site Deviation Process; Update Two Magnet Installation Drawing Missing "Magnet Interaction"; Update BRM Cart Drawing Update length; VibroMat/Surface Mount: PQR13172417, 13066434, 13066774; White Pixel: CSO and PQR13173912, 13066429; Water Chiller Update to simplify PQR13151021; EMC Update; Removed Altitude Chapter; Design Center Issues PQR13101088; Acoustic Specifications: PQR13121153; Cryogenic Venting/Cryogen Vent Sidewall Exit; Update for HDxt
6	01 May 2009	Updated for : iTraks: 13210075: Removed high-resistance flooring requirement; 13209995; 13248165, requirement 3.8.6.a is for 1.5T Twin and 3.0T only. Sprs MRIhc 40347 and MRIhc 40422: Update to Required Power section. Other: Updated the following sections to match DV formatting, 2, 3.3, 4.5.1, 8.6.5.4. Removed “Tools and Test Equipment” section; Combined “Power Interconnects” section into Power Distribution” section to remove repeated information.

Table of Contents

CHAPTER 1 PRE-INSTALLATION INTRODUCTION....21
1 Pre-Install Manual Introduction....21
1.1 Document Purpose....21
1.2 Intended User....21
1.3 Document Overview....21

CHAPTER 2 SYSTEM CONFIGURATION....23
1 Upgrades 3.0T Configurations Introduction....23
2 Signa HDx 3.0T Upgrades....24
2.1 16 Channel Upgrade....24
2.2 32 Channel Upgrade....25
3 Signa EXCITE HD Release 12.x to Signa HDxt Upgrades....26
4 Signa EXCITE 11.x to Signa HDxt Upgrades....31
5 Signa Pre-EXCITE with 3.0T94 to Signa HDxt Upgrades....36
6 Additional System Options....38
7 Relocatable Upgrade....39
8 Van Manufacturers Contact Information....40

CHAPTER 3 ROOM LAYOUTS....41
1 Magnetic Field Proximity Limits....41
2 Multiple MR Systems....42
2.1 Two Magnet Site Layout....42
2.2 Equipment Room Shared by Multiple MR Systems....43
2.2.1 Introduction....43
2.2.2 Equipment Cabinets Relative Locations....43
2.2.3 Penetration Panels Locations....45
2.2.4 Excess System Cable Requirements....46
3 Minimum Delivery Route Sizes and Capacity....47
4 MR System Interconnects Routing....48
5 Flooring....49

6 Upgrades Special Siting Considerations....50
6.1 System Monitoring and Support Connectivity....50
6.2 Customer Site Storage Requirements....51
6.3 IPCM Option For LCC300 Magnets ONLY....53
7 Floor Loading....54
7.1 MR System Components....54
8 Upgrade Component Dimensions....55
8.1 Component Dimensions....55
8.2 IPCM Option....56
8.3 Broadband RF Amplifier Cabinet For 8KW MNS Option....58
8.4 Operator Workspace....59
8.5 32 Channel Cabinet Option....62
8.6 3T94 Magnet Enclosure Bridge....63
8.7 Pneumatic Patient Alert....64
8.8 HFD/PDU Cabinet (MR3)....65
8.9 RFS Cabinet (MR2)....66
8.10 Penetration Panel....67

CHAPTER 4 MAGNETIC FIELD CONSIDERATIONS....69
1 Upgrades Magnetic Field Considerations....69

CHAPTER 5 SITE ENVIRONMENT....71
1 Introduction....71
2 IEC EMC Compliance....72
3 Temperature and Humidity Specifications....73
3.1 System Suite....73
4 Air Cooling Specifications....74
4.1 Requirements....76
4.2 Recommendations....76
5 Lighting....78
6 MR Suite Acoustic Specifications....79
6.1 Acoustic Specifications....79

6.2 Structureborne Vibration Control Specifications....79
7 Water Cooling Requirements....81
8 Room Ventilation Requirements....82
9 Alarm Devices, Water Sensors and Thermostats....84
9.1 System Cabinet....84
9.2 RFS Cabinet....84
9.3 Water Sensor Alarm and Floor Drain....84
9.4 Pneumatic Patient Alert....84
10 Ambient Radio Frequency Interference (RFI)....85
11 Pollution....86

CHAPTER 6 POWER REQUIREMENTS....87
1 Facility Power Requirements....87
2 Critical Power Requirements....89
3 Power Distribution System....94
3.1 Main Disconnect Panel (MDP) Requirements....94
3.2 Power Distribution Unit (PDU) Requirements....95
4 Grounding....96
4.1 Facility Ground....96
4.2 System Ground....97
5 Power Source Monitoring....99
6 Emergency Power....100
7 DC Lighting Controller (Facility Option) Requirements....101
8 IPCM Option Power Requirements....102

CHAPTER 7 MR SYSTEM INTERCONNECTS....103
1 MR System Interconnects Specifications....103
1.1 Introduction....103
1.2 Component Designators....103
1.3 Definition of Terms....103
1.4 Usable Cable Lengths....103
1.5 Cable Group Lengths Provided....104

CHAPTER 8 RF SHIELDED ROOM....107
1 RF Shielded Room Requirements....107
1.1 RF Shielding Background....107
1.1.1 Discrete Frequency....107
1.1.2 Broadband RF Noise....107
1.2 RF Shielded Room Requirements....108
2 Vents....110
2.1 HVAC....110
3 Plumbing....111
3.1 Water....111
3.2 Medical Gases....111
3.3 Sprinklers....111
4 Electrical....112
4.1 Electrical Lines and Filters....112
4.2 Room Lighting....114
5 RF Penetration Panel....115
6 Physical Considerations....119
6.1 Introduction....119
6.2 Doors and Other Openings....120
6.3 Walls....121
6.4 Magnet Room Floor Requirements....122

CHAPTER 9 SHIPPING AND DELIVERY....125
1 MR System Shipping and Receiving....125

CHAPTER 10 SITE PLANNING REMINDERS....127
1 General Pre-Installation Reminders....127

CHAPTER 11 APPENDICIES....131
1 Glossary....131
2 RF Shielded Enclosure Test Guidelines....134
2.1 Introduction....134

2.1.1 Purpose of Test Plan....134
2.1.2 Not used....134
2.2 Applicable Documents....134
2.3 Test Sample Set-Up....134
2.4 Shielding Effectiveness....135
2.5 Measurement Procedure....135
2.5.1 Test Position....135
2.5.2 Frequency Range....135
2.5.3 Free Field Calibration....135
2.6 Enclosure Power Reference Isolation....135
2.7 Test Equipment....136
2.8 Data Recording and Verification....136
2.9 Test Report....136
3 Acoustic Background and Design Guidelines....138
3.1 Acoustic Background....138
3.1.1 Airborne....138
3.1.2 Structureborne....138
3.2 Acoustic Design Guidelines....139
3.2.1 Magnet Room....139
3.2.2 Inter-Spacial Areas....139
3.2.2.1 Wall Construction....139
3.2.2.2 High Bay RF Room....141
3.2.2.3 Miscellaneous Plumbing, RF Windows and RF Doors....141

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Chapter 1 Pre-Installation Introduction

1 Pre-Install Manual Introduction

WARNING

PERSONNEL INJURY OR EQUIPMENT FAILURE
FAILURE TO IMPLEMENT ALL REQUIREMENTS AND ADHERE TO ALL SPECIFICATIONS IN THIS MANUAL MAY RESULT IN PERSONAL INJURY, EQUIPMENT DAMAGE, SCAN FAILURE, OR WARRANTY VOID.

THE IMPLEMENTATION OF ALL REQUIREMENTS AND ADHERENCE TO ALL SPECIFICATIONS IN THIS MANUAL IS THE RESPONSIBILITY OF THE CUSTOMER OR THEIR ARCHITECT AND ENGINEERS. REFER ANY QUESTIONS TO THE GE HEALTHCARE PROJECT MANAGER OF INSTALLATION (PMI).

NOTICE

The site must comply with all local and National codes and regulations.

1.1 Document Purpose

This pre-installation manual provides the necessary information to prepare a site for system installation. Specifically, this manual provides information:

1. For the site to meet system requirements
2. For the effective arrangement and interconnection of system components

1.2 Intended User

The primary user of this manual is the installation or architectural planner who has knowledge of the following:

1. MR nomenclature, system functions, and general characteristics
2. National and local building codes
3. Customer site procedures (medical, MR, safety, etc.)
4. Any special architectural requirements (e.g., seismic codes)

1.3 Document Overview

This manual describes requirements and specifications for the following:

1. General System Requirements
2. Shipping and Delivery

3. Magnet Room
4. Equipment Room
5. Control Room
6. Interconnects

Chapter 2 System Configuration

1 Upgrades 3.0T Configurations Introduction

NOTE: The upgrade information in this manual does not include changing the existing system magnet. If a new magnet is being planned, then a site must comply with the specifications in the appropriate MR system configuration latest released revision of the pre-installation manual.

Magnetic Resonance (MR) 3.0T system upgrades to Signa HDxt hardware that may have site impacts are documented throughout this manual. A specific upgrade hardware content is dependent on the configuration of the system being upgraded. Refer to the appropriate section listed below for an overview of the upgrade hardware content; refer to the remainder of this manual for upgrade requirements.

- Signa HDxt 15x Upgrades:
  - 16 Channel Upgrade
  - 32 Channel Upgrade
- Signa EXCITE HD 12.x to Signa HDxt Upgrades
- Signa EXCITE 11.x to Signa HDxt Upgrades
- Signa Pre-EXCITE with 3.0T94 to Signa HDxt Upgrades

NOTE: Only catalogs that include hardware are documented in this manual.

NOTICE

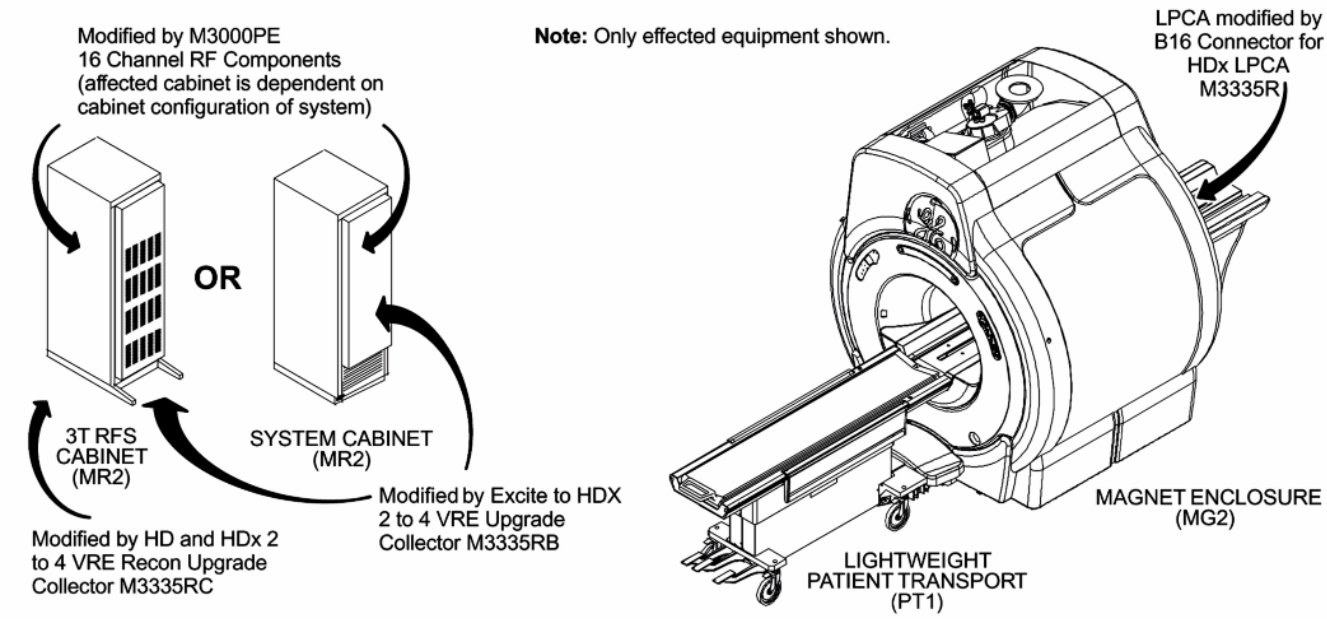
The upgrades documented in this manual do not include changing the existing system magnet. If a new magnet is being planned, then a site must comply with the specifications in the appropriate MR system configuration latest released revision of the pre-installation manual.

2 Signa HDx 3.0T Upgrades

2.1 16 Channel Upgrade

Illustration 2-1 shows the equipment modified.

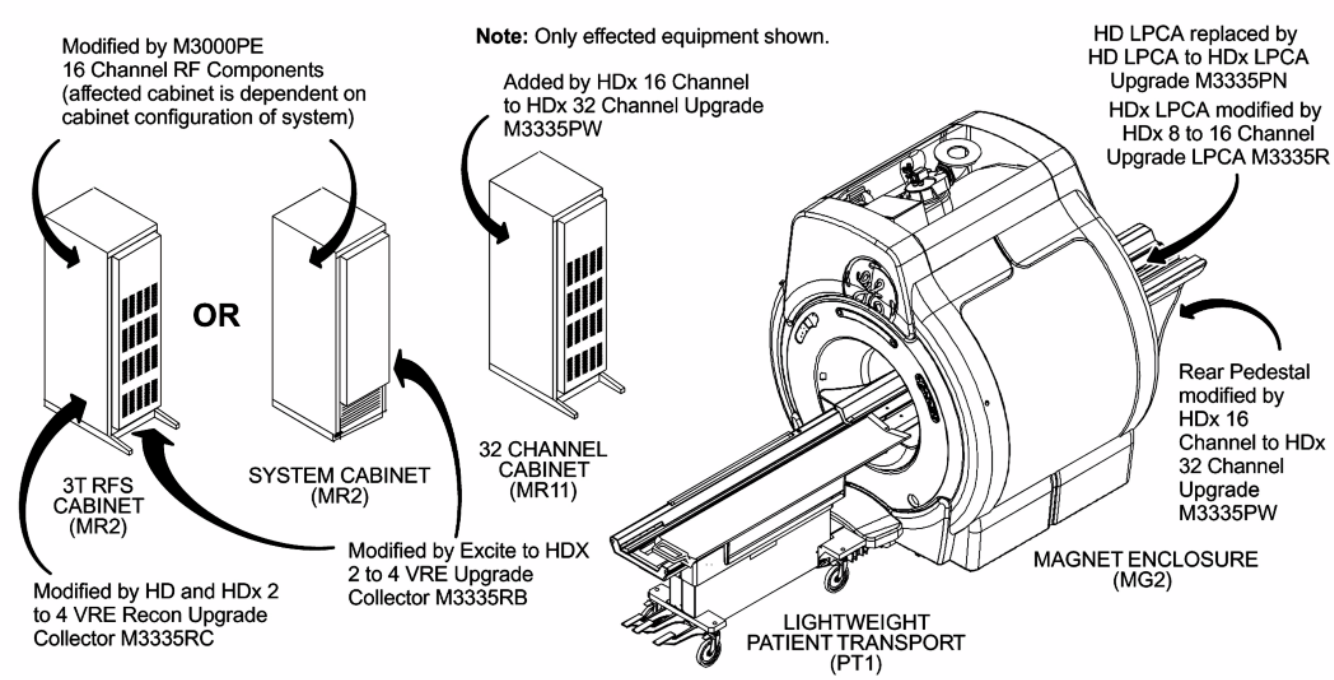
Illustration 2-1: Signa HDxt 3.0T 16 Channel Upgrade Modified Equipment



2.2 32 Channel Upgrade

Illustration 2-2 shows the equipment modified.

Illustration 2-2: Signa HDxt 3.0T 32 Channel Upgrade Modified Equipment



3 Signa EXCITE HD Release 12.x to Signa HDxt Upgrades

NOTICE

Signa EXCITE 3.0T (Release 11.x) systems upgraded to EXCITE HD Release 12.x cabinet configuration is not the same as a new (forward production) Signa EXCITE HD 3.0T. The Signa EXCITE HD upgrades modified many of the Release 11.x existing system equipment cabinets. Therefore, determine the Release 12.x configuration of the system to determine the Release 15.x upgrade catalogs required.

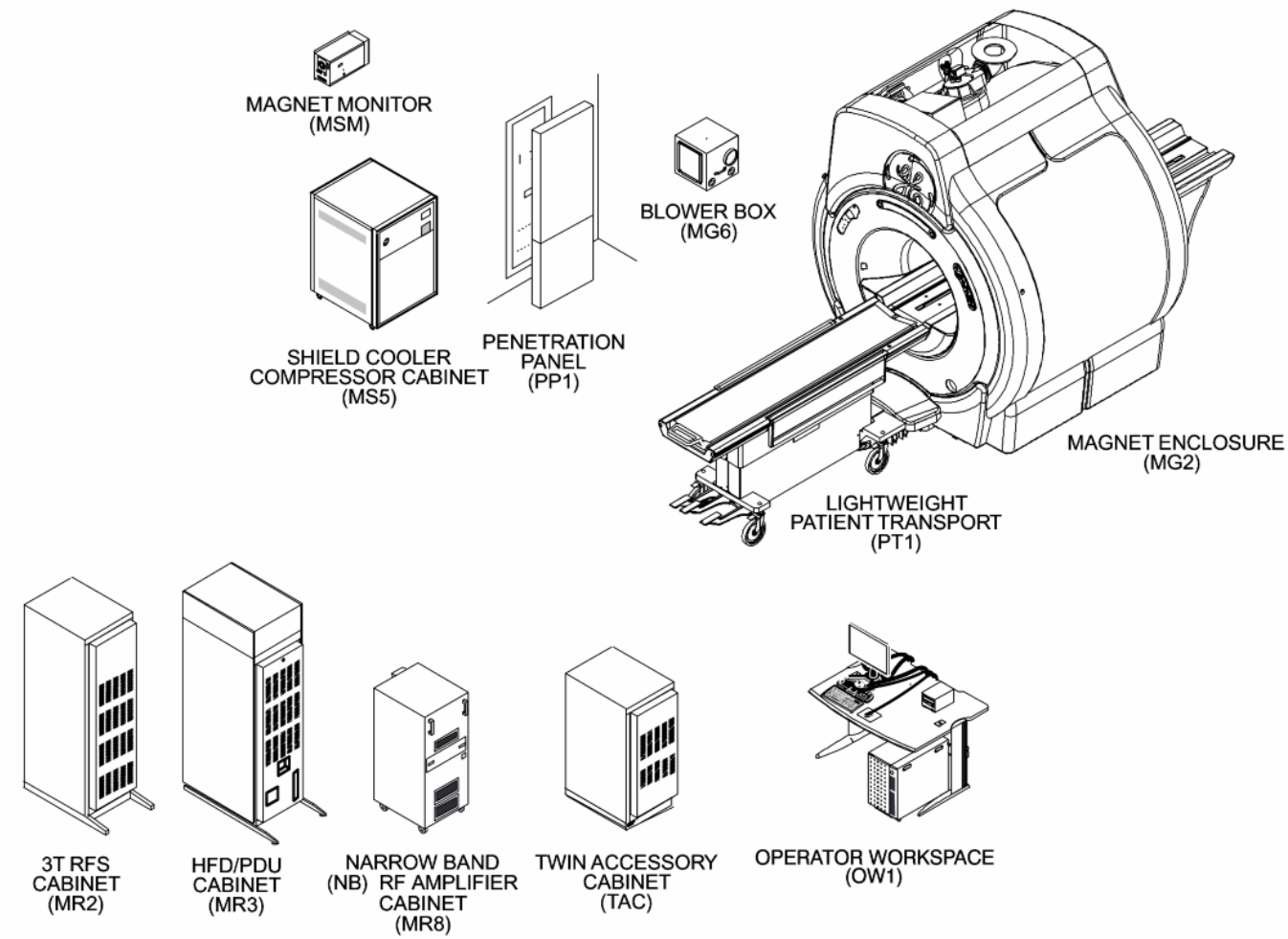
The HDxt 3.0T (Release 15.x) upgrade for an existing Signa EXCITE 3.0T (Release 11.x) system with LCC300 Magnet or an existing Signa 3.0T with EXCITE Technology (Release 11.x) with 3T/94 Magnet performs modifications to the existing system equipment and cabinets. Table 2-1 lists the illustration that shows the Major Equipment configuration for the various Signa EXCITE HD forward production or upgraded systems.

Table 2-1: Signa EXCITE HD (Release 12.x) to Signa HDxt (Release 15.x) Major Equipment Configurations

Existing Signa EXCITE HD (Release 12.x) Configuration	Upgraded Signa HDxt Final System Major Equipment
Forward production Signa EXCITE HD 3.0T	Illustration 2-3
Release 11.x Signa EXCITE 3.0T with LCC300 Magnet upgraded to EXCITE HD	Illustration 2-4
Release 11.x Signa EXCITE 3.0T with 3T94 Magnet upgraded to EXCITE HD	Illustration 2-5

Illustration 2-6 shows the equipment modified and added by the upgrade.

Illustration 2-3: Signa EXCITE HD 3.0T Forward Production Release 12.x Upgraded to Release 15.x Major Equipment

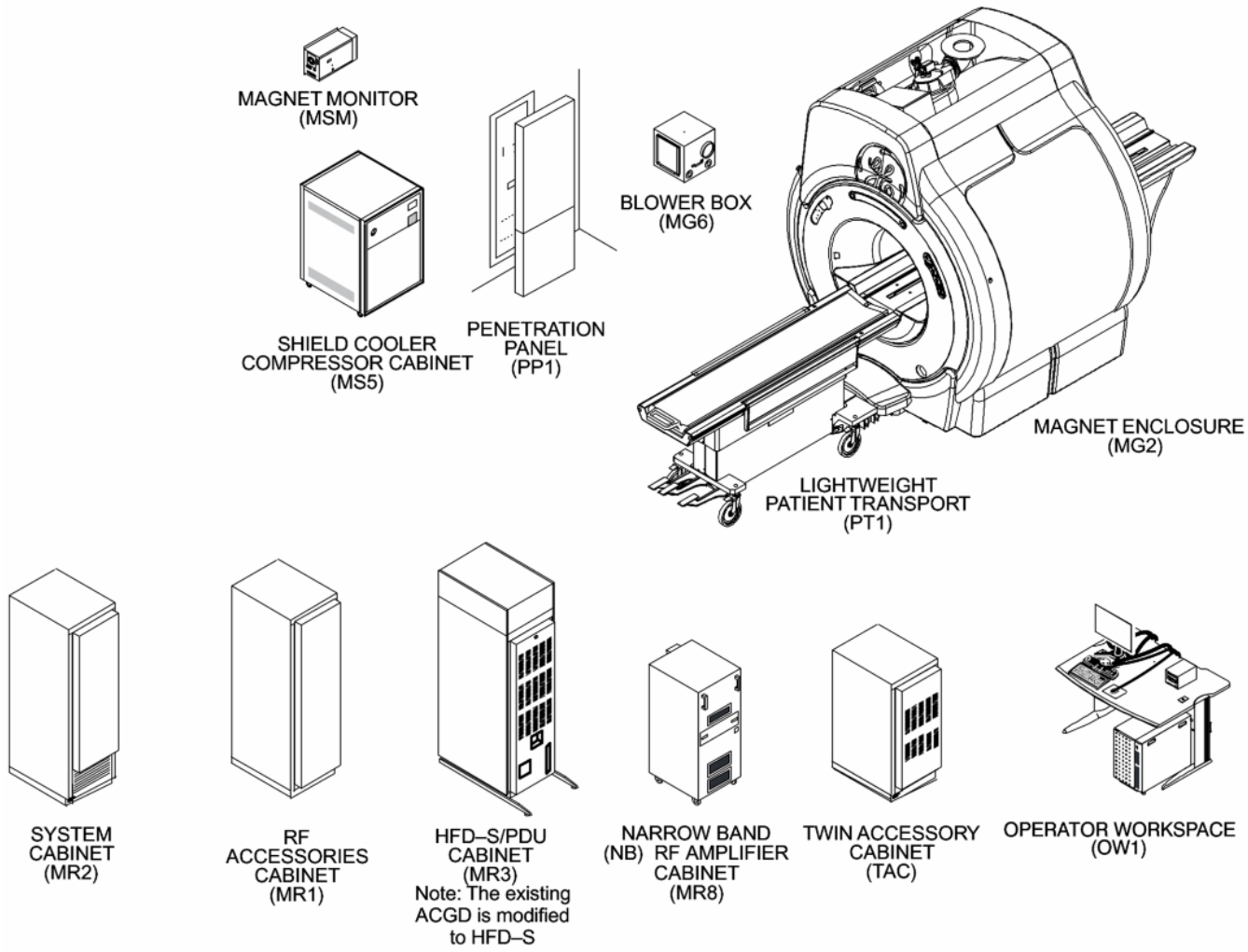


Existing System Support Equipment Retained (not shown)

System retains their exisiting equipment for:

- Main Disconnnect Panel
- Shield Cooler Compressor water cooling equipment
- Gradient Coil water cooling equipment
- MNS Option equipment.

Illustration 2-4: Release 11.x Signa EXCITE 3.0T with LCC300 Magnet Upgraded to EXCITE HD Upgraded to Release 15.x Major Equipment

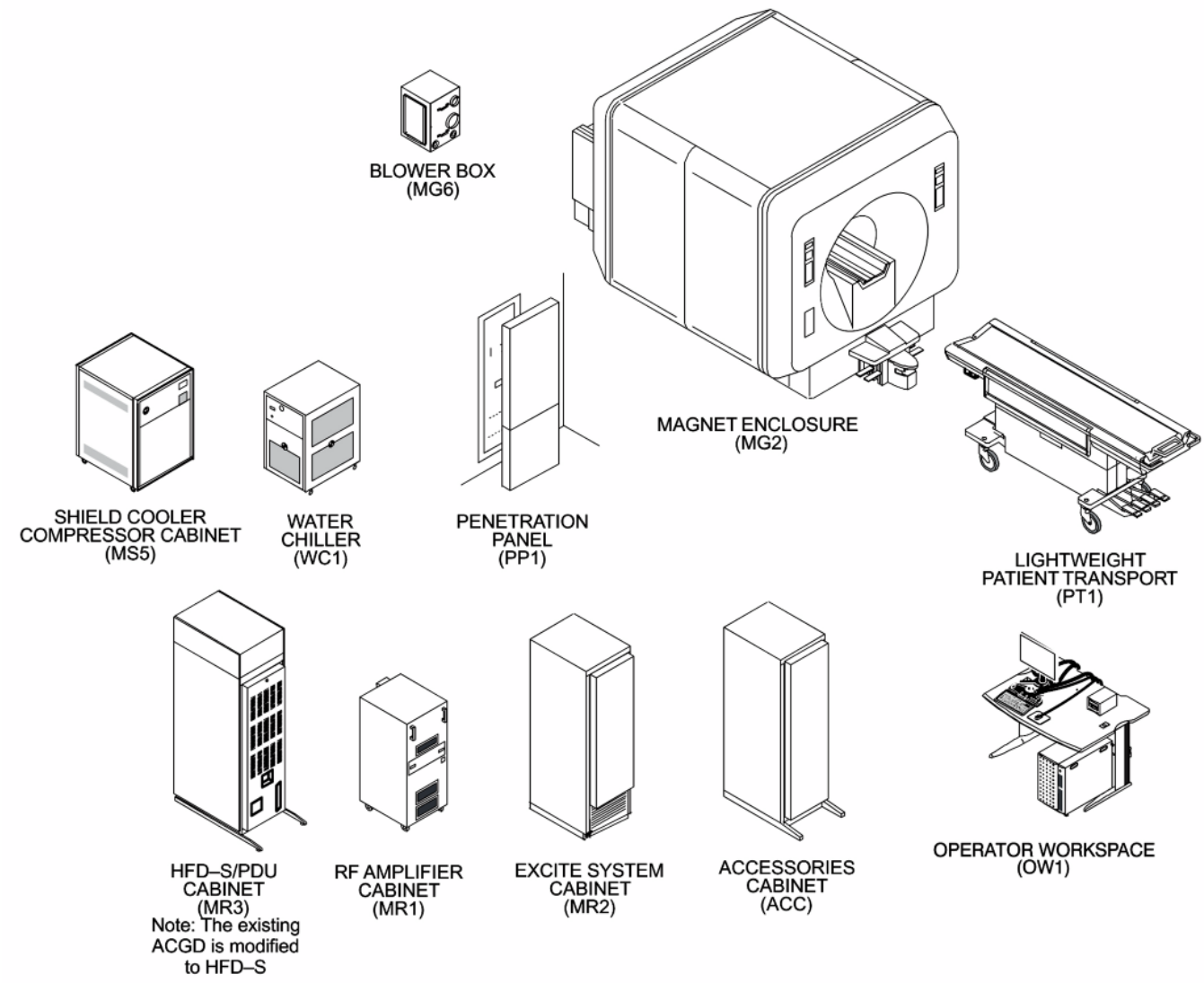


Existing System Support Equipment Retained (not shown)

System retains their exisiting equipment for:

- Main Disconnnect Panel
- Shield Cooler Compressor water cooling equipment
- Gradient Coil water cooling equipment
- MNS Option equipment.

Illustration 2-5: Release 11.x Signa EXCITE 3.0T with 3.0T94 Magnet Upgraded to EXCITE HD Upgraded to Release 15.x Major Equipment

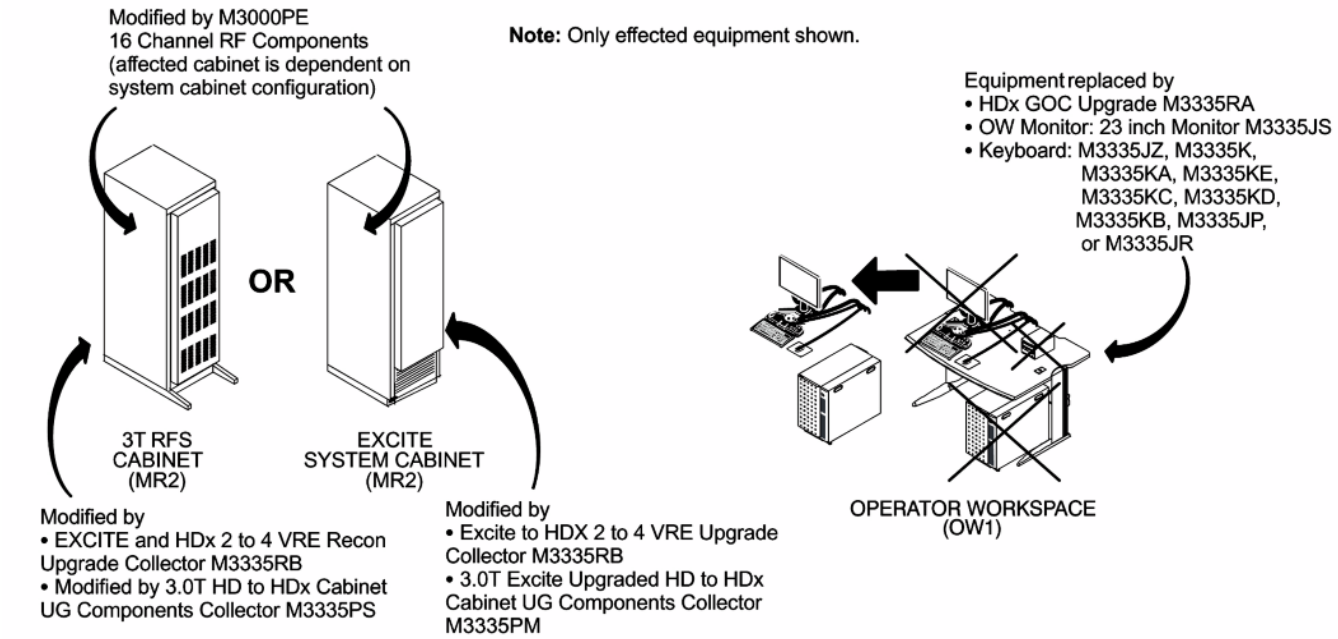


Existing System Support Equipment Retained (not shown)

System retains their exisiting equipment for:

- Main Disconnnect Panel
- Shield Cooler Compressor water cooling equipment
- MNS Option equipment.

Illustration 2-6: Signa EXCITE HD 3.0T Release 12.x to Release 15.x Upgrade Modified Equipment



4 Signa EXCITE 11.x to Signa HDxt Upgrades

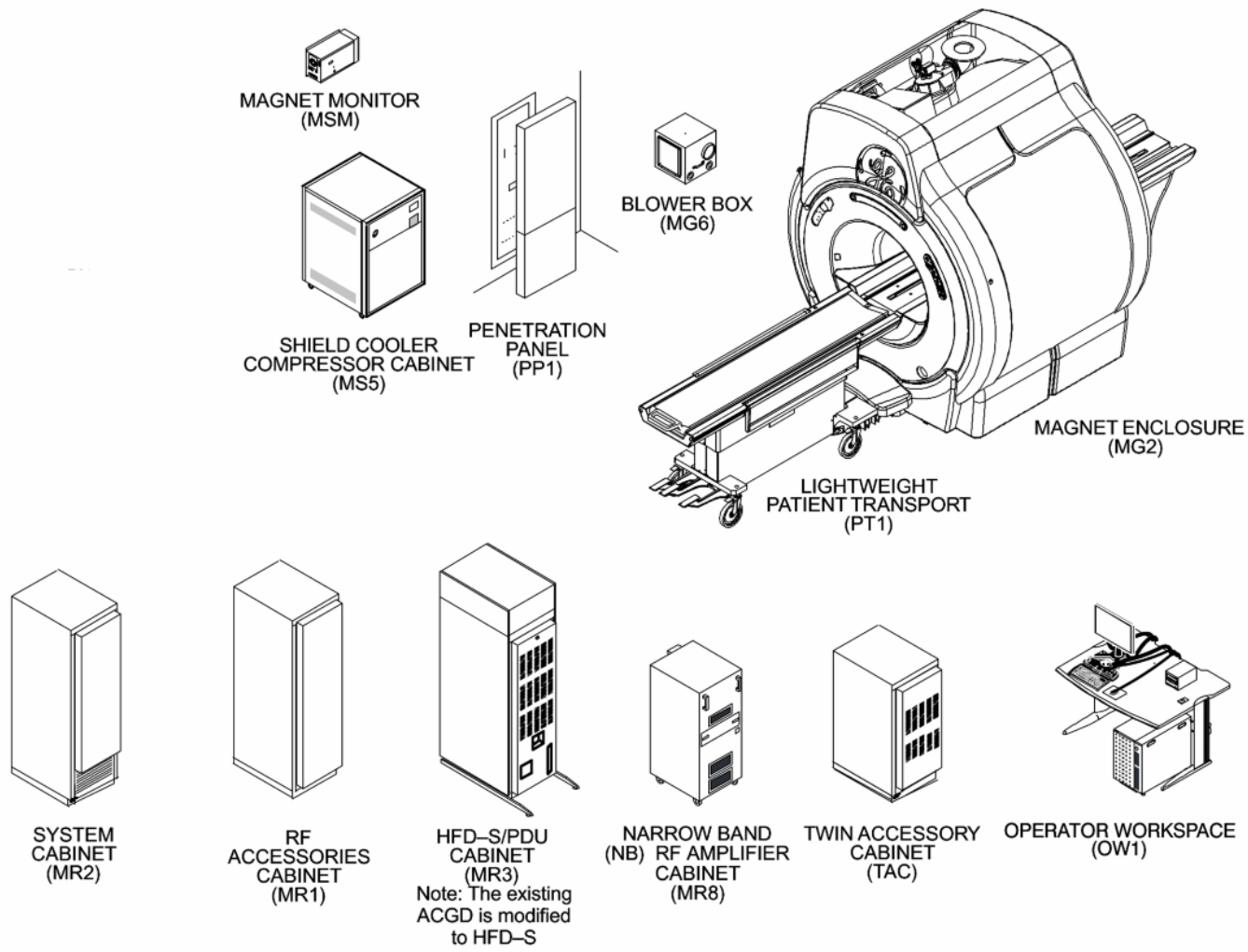
NOTICE

Release 11.x systems upgraded to Release 15.x final cabinets configuration is not the same as a new Signa HDxt 3.0T. Many of the existing system equipment cabinets are modified by the Signa HDxt upgrade.

The HDxt 3.0T (Release 15.x) upgrade for an existing Signa EXCITE 3.0T (Release 11.x) system with LCC300 Magnet or an existing Signa 3.0T with EXCITE Technology (Release 11.x) with 3T/94 Magnet performs modifications to the existing system equipment and cabinets. Illustration 2-7 and Illustration 2-8 the systems major equipment after a Release 11.x to Release 15.x upgrade is completed.

- Release 11.x with LCC300 Magnet see Illustration 2-9
- Release 11.x with 3.0T/94 Magnet see Illustration 2-10

Illustration 2-7: Release 11.x Upgrade To Release 15.x System With LCC300 Magnet Major Equipment

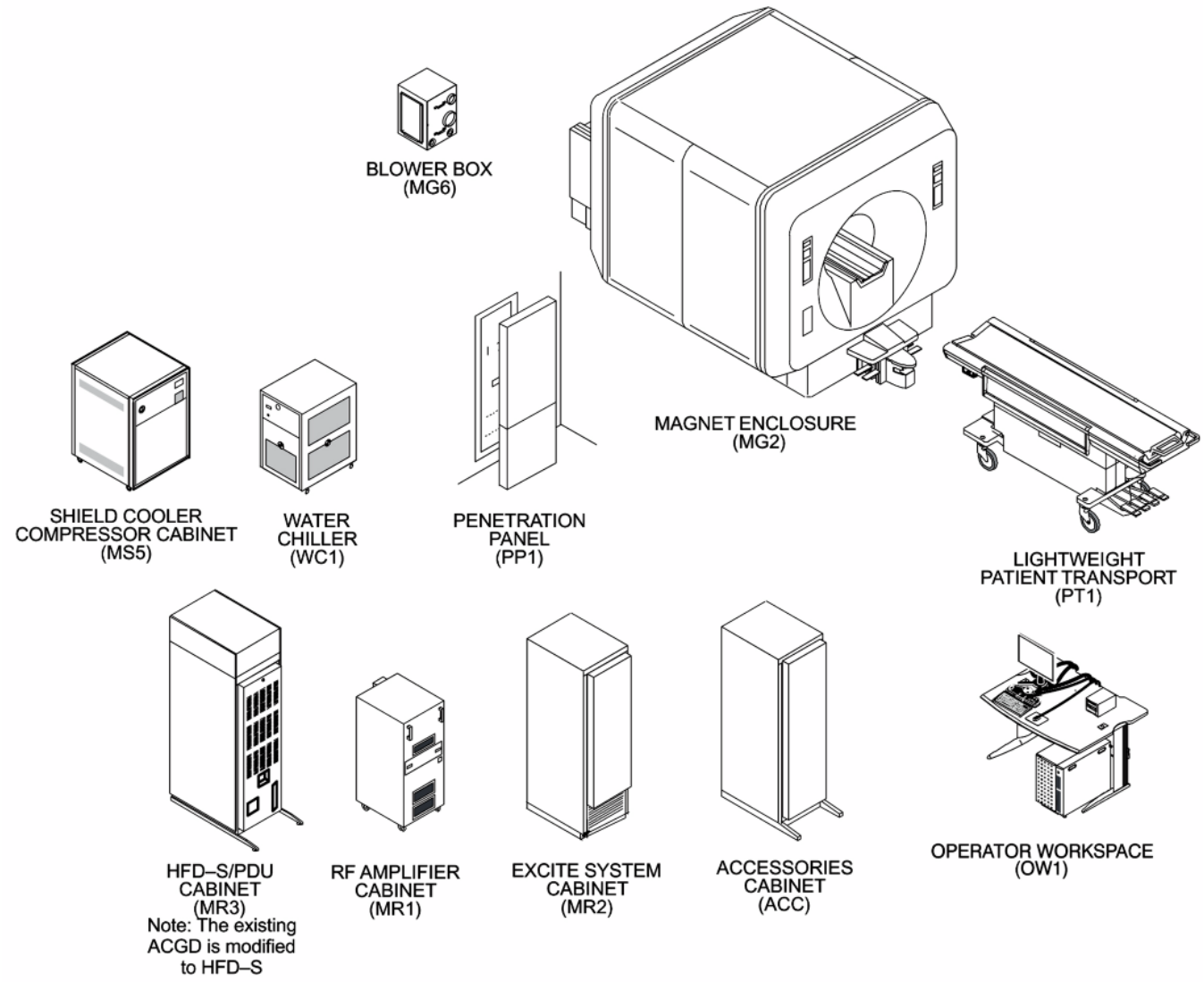


Existing System Support Equipment Retained (not shown)

System retains their exisiting equipment for:

- Main Disconnnect Panel
- Shield Cooler Compressor water cooling equipment
- Gradient Coil water cooling equipment
- MNS Option equipment.

Illustration 2-8: Release 11.x Upgrade To Release 15.x System With 3T94 Magnet Major Equipment



Existing System Support Equipment Retained (not shown)

System retains their exisiting equipment for:

- Main Disconnnect Panel
- Shield Cooler Compressor water cooling equipment
- MNS Option equipment.

Illustration 2-9: Release 11.x To Release 15.x System With LCC300 Magnet HDxt Upgrade Modified Equipment

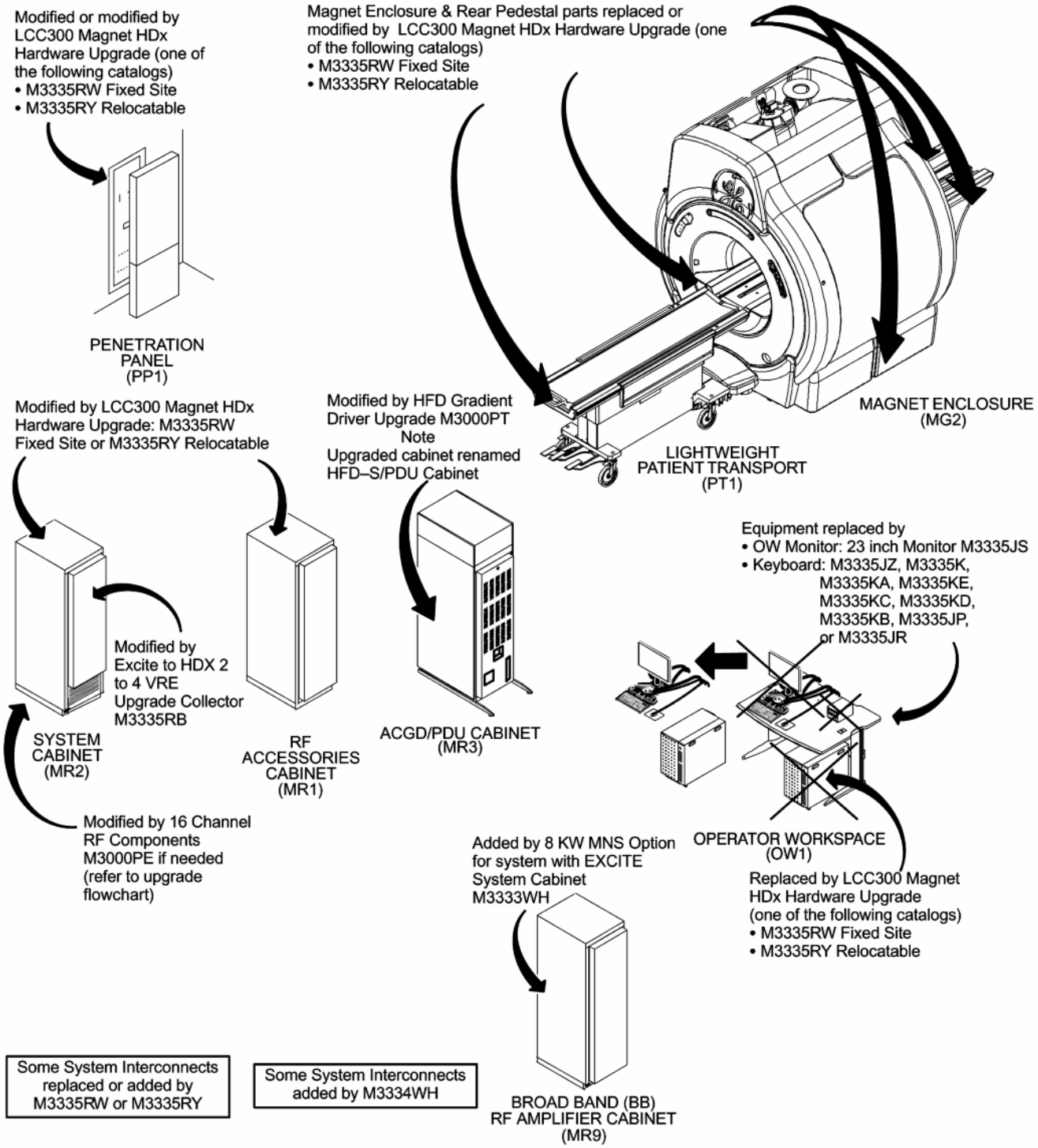
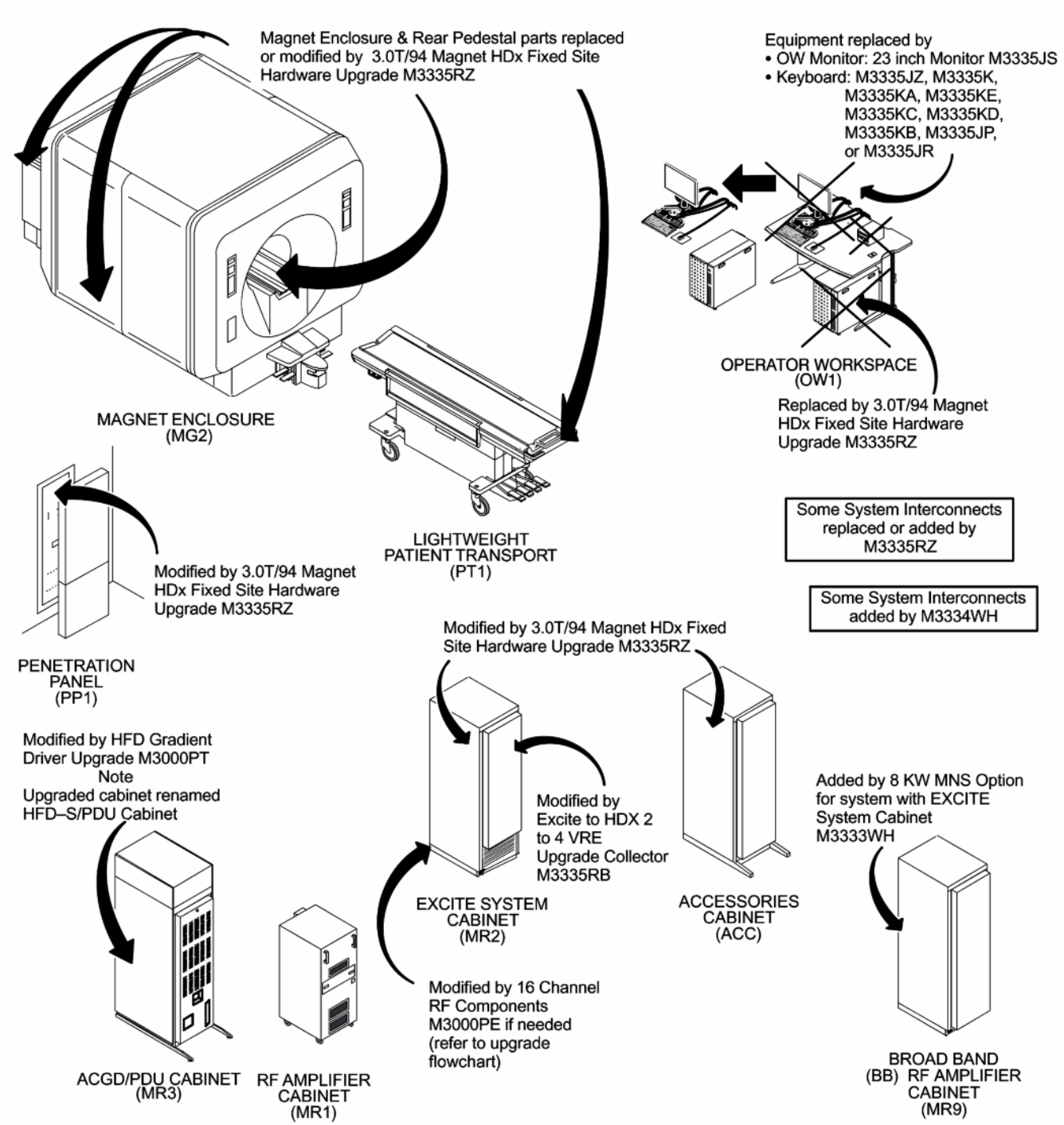


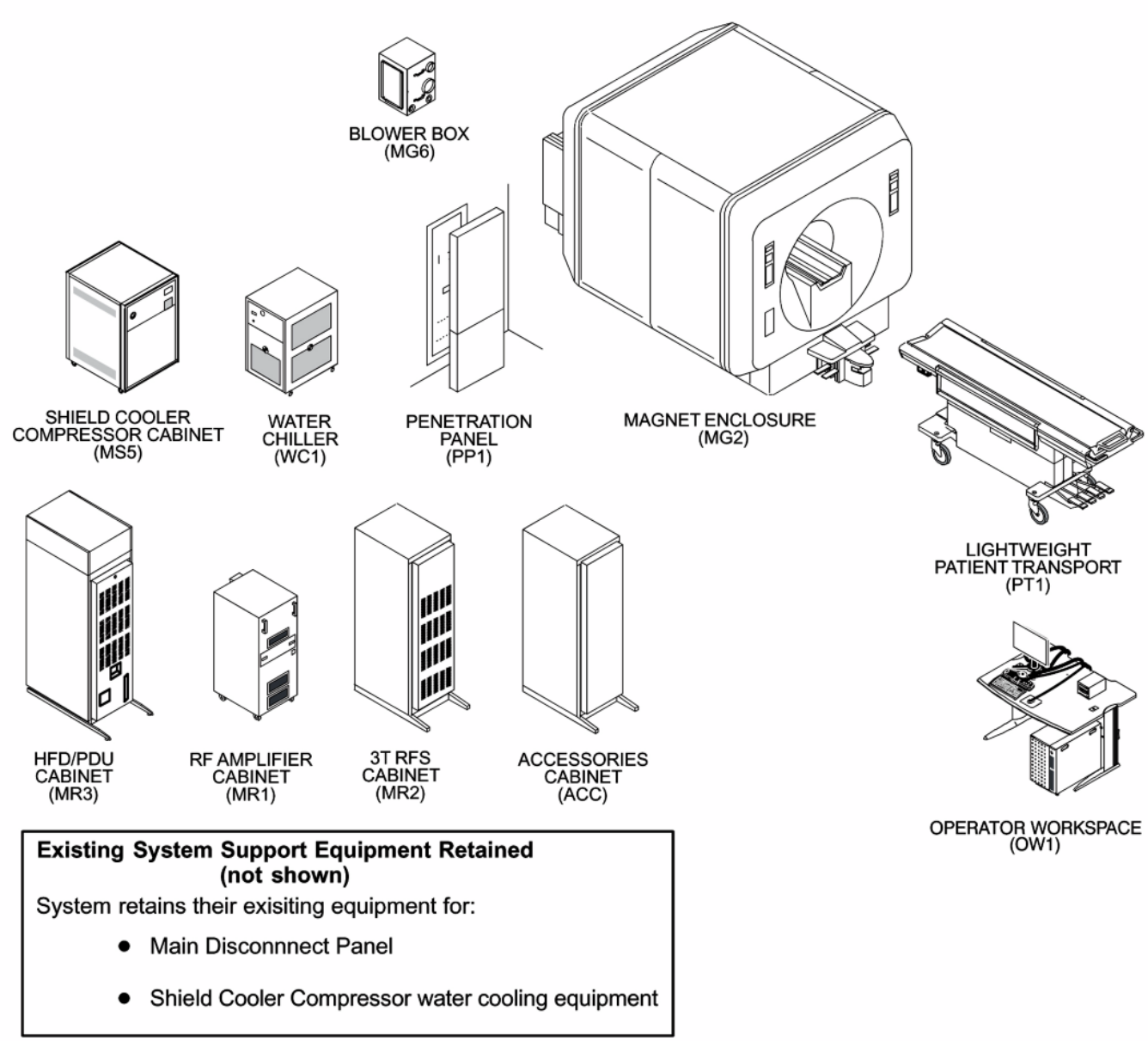
Illustration 2-10: Release 11.x To Release 15.x System With 3.0T94 Magnet HDxt Upgrade Modified & Added Equipment



5 Signa Pre-EXCITE with 3.0T94 to Signa HDxt Upgrades

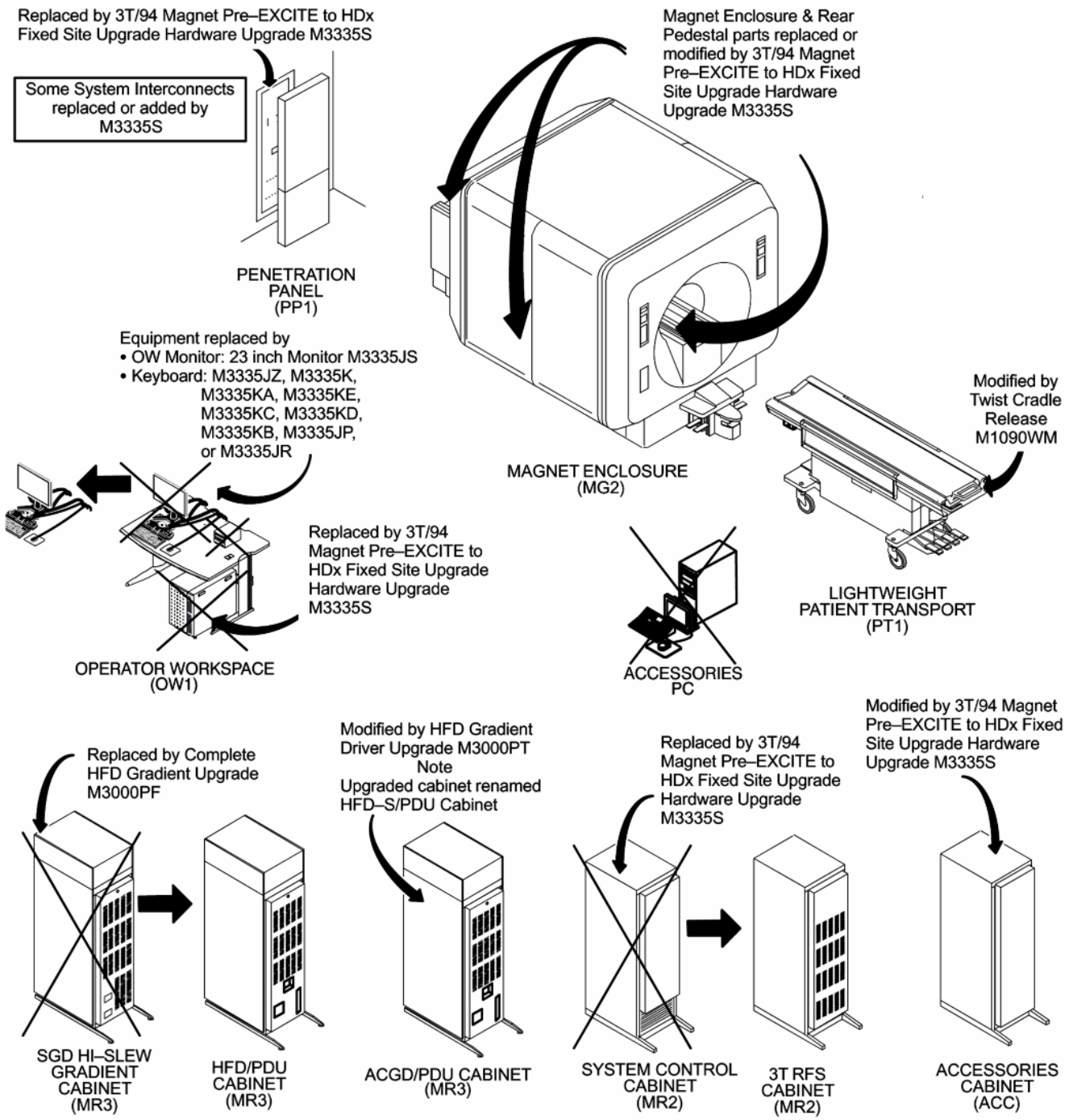
Illustration 2-11 shows the Pre-EXCITE Signa with 3.0T94 Magnet system's major equipment after HDxt (Release 15.x) upgrade.

Illustration 2-11: Pre-EXCITE SIGNA 3T94 VH3 Upgraded to Release 15.x System Major Equipment



The equipment modified and added is shown in Illustration 2-12.

Illustration 2-12: Pre-EXCITE Signa with 3.0T94 Existing Hardware Replaced or Modified by HDxt Upgrade



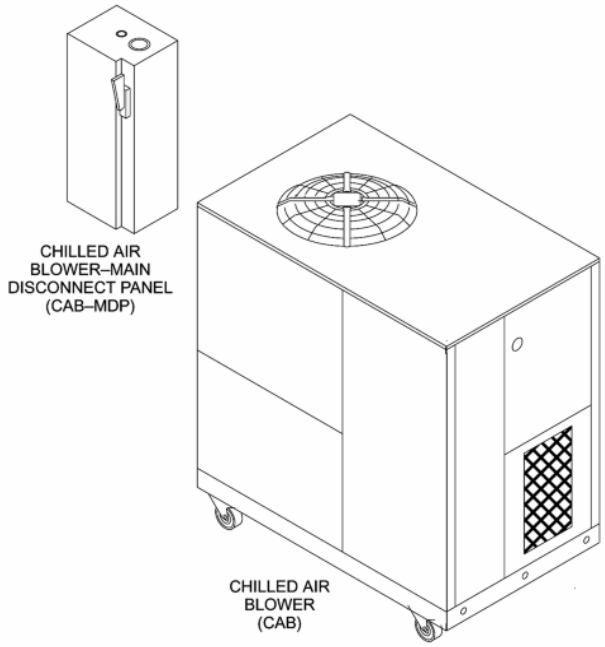
6 Additional System Options

This section lists options not listed in the upgrade catalogs flowcharts that have site planning impact.

- Integrated Patient Comfort Module (IPCM) Option (M3033LH) for LCC300 Magnet ONLY: The IPCM option adds a bore liner to the inside diameter of the RF Body Coil. The bore liner directs chilled air from the Chilled Air Blower (CAB) to the inside diameter of the RF Body Coil. The IPCM Option provides the following hardware components:
  - Chilled Air Blower (CAB) shown in Illustration 2-13
  - Chilled Air Blower Main Disconnect Panel (CAB-MDP) shown in Illustration 2-13

    NOTE: The CAB-MDP requires an additional power feed, not powered from the MR System MDP or PDU.
  - Thermal bore liner assembly
  - Modified penetration panel waveguide
  - Bridge with notched sides
  - Bore liner hardware including hoses and connectors
  - IPCM option key

Illustration 2-13: IPCM Cabinet and Panel



7 Relocatable Upgrade

Relocatable MR system upgrade catalogs are listed in the previous upgrade sections.

In addition to the system, the van may also need to be upgraded to accommodate the MR system upgrades. It is the customer's responsibility to arrange with the appropriate van manufacturer for any upgrade to be performed.

- Customer must contact van manufacturer to determine if the modular building upgrade is needed, obtain quote of costs and timing, and schedule for van/system upgrade. Refer to Van Manufacturers Contact Information.
- Customer is responsible for working with the van manufacturer for modular building upgrade costs.
- MR system check and final calibrations will be performed by GE Field Service.

8 Van Manufacturers Contact Information

- Ellis & Watts
  4400 Glen Willow Lake Lane
  Batavia, OH 45103
  Telephone: 513-752-9000
  FAX: 513-752-4983 USA
- PDC Facilities
  700 Walnut Ridge Drive, PO Box 900
  Hartland, WI 53029-0900
  Telephone: 262-367-7700
  FAX: 262-367-7744 USA
- SMIT Mobile Equipment
  Buys Ballotstraat 6
  3261 La Oud-Beijerland
  Holland
  Telephone: (31) 186-6-14322
  FAX: (31) 186-6-19367
- Oshkosh Specialty Vehicles
  16745 South Lathrop Avenue
  Harvey, IL 60426
  Telephone: 708-596-2480
  FAX: 708-596-2480 USA
  http://www.oshkoshsv.com//contactus.aspx

Chapter 3 Room Layouts

1 Magnetic Field Proximity Limits

The table below lists stationary equipment known to be sensitive to high magnetic fields. The table is provided as a guide only. Actual Gauss limits are equipment specific and must be determined during the site planning process. Refer to Magnetic Field to define the magnetic field plots. Also refer to Changing Magnetic Environment Specifications for requirements for moving object sensitivity, including automobiles, elevators cages, etc.

Table 3-1: Magnetic Proximity Limits

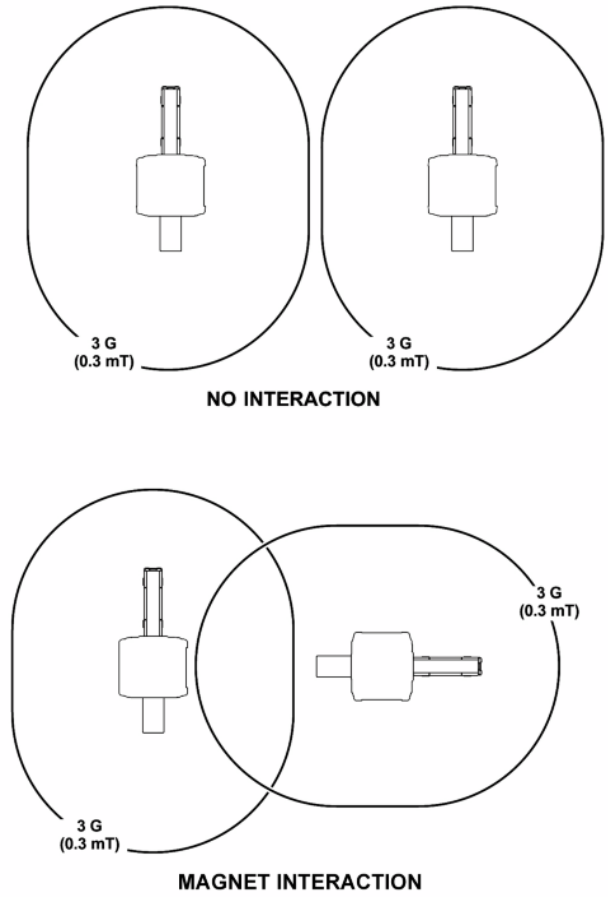
Gauss (mT) Limit	Equipment	
0.5 gauss (0.05mT)	Nuclear camera	
1 gauss (0.1mT)	Positron Emission Tomography scanner	Video display (tube)
	Linear Accelerator	CT scanner
	Cyclotrons	Ultrasound
	Accurate measuring scale	Lithotriptor
	Image intensifiers	Electron microscope
	Bone Densitometers	Nuclear Camera (Discovery NM530c)
3 gauss (0.3mT)	Power transformers	Main electrical distribution transformers
5 gauss (0.5mT)	Cardiac pacemakers	Biostimulation devices
	Neurostimulators	
10 gauss (1mT)	Magnetic computer media	Telephone switching stations
	Hard copy imagers	Water cooling equipment
	Line printers	HVAC equipment
	Video Cassette Recorder (VCR)	Major mechanical equipment room
	Film processor	Credit cards, watches, and clocks
	X-ray tubes	
	Large steel equipment, including:	
	Emergency generators	Air conditioning equipment
	Commercial laundry equipment	Fuel storage tanks
	Food preparation area	Motors greater than 5 horsepower
50 gauss (5mT)	Metal detector for screening	Telephones
	LCD panels	
No Limit	Digital Detectors	
Note: Recommended limits given above are based on general MR site planning guidelines. Actual susceptibility of specific devices may vary significantly depending on electrical design orientation of the device relative to the magnetic field and the degree of interference considered unacceptable.		

2 Multiple MR Systems

2.1 Two Magnet Site Layout

Sites planning to install multiple magnets, independent of the MR supplier, must ensure the 3 gauss lines of each magnet do not cross. Crossover of one MR magnets 3 Gauss line into another MR magnet 3 gauss line will result in service or down time for both machines when shim or magnet ramps are performed.

Illustration 3-1: Two Magnet Installation



2.2 Equipment Room Shared by Multiple MR Systems

2.2.1 Introduction

When an Equipment Room is shared by more than one MR system of the same field strength there is a potential for cross-talk of RF energy between the MR systems. RF cross-talk may cause noise artifacts in images. Proper planning and installation of the multiple systems in the shared Equipment Room can reduce the potential for cross-talk.

The potential for cross-talk exists when the RF transmit cables and equipment of two or more MR systems are located in the same Equipment Room. For example, when one system is transmitting, the other system could be in receive mode and therefore pick up the RF energy being transmitted.

NOTE: Cross-talk may also occur between GE Healthcare and non-GE MR Systems with the same field strength.

NOTICE

The RF Shield of the Magnet Room for each system must meet the RF Attenuation specifications in Chapter 8, RF Shielded Room Specifications.

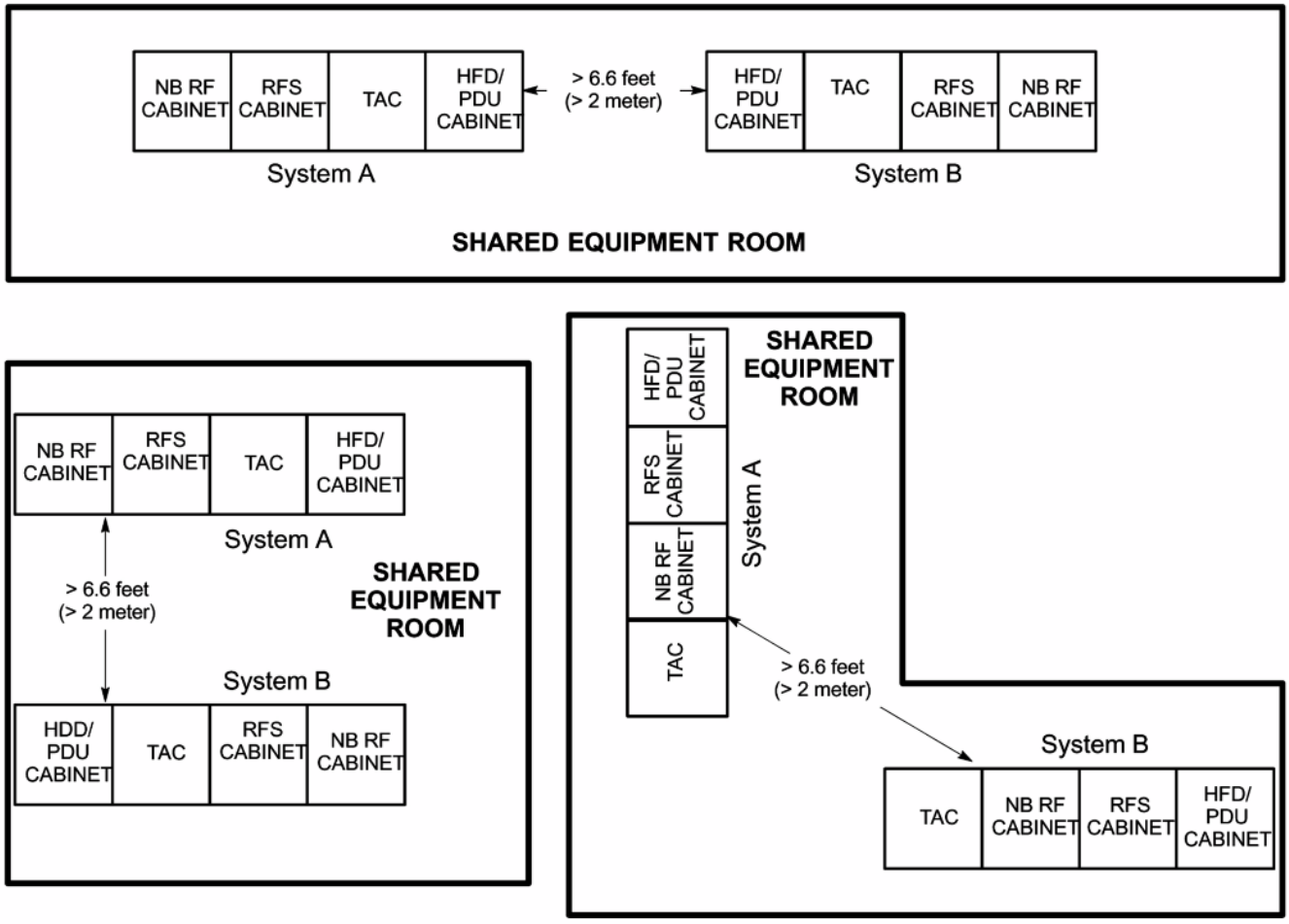
The following subsections provide requirements for shared Equipment Room design, layout, and installation which reduce the potential for RF cross-talk.

2.2.2 Equipment Cabinets Relative Locations

The following are requirements for locating equipment cabinets of one MR system relative to the other MR system equipment cabinets.

- Maximize separation distance between the RF transmitter (RF Amplifier) of one MR system and the RF receiver (RRF Chassis) of the other MR system of the same field strength.
- The RF transmitter (RF Amplifer) of one MR system and the RF receiver (RRF Chassis) of the other MR system of the same field strength must be separated by a minimum of > 6.6 feet (2 meters) in all directions, see Illustration 3-2 and Illustration 3-3.
- Signa HDx 3.0T (Release 14.x) and Signa EXCITE 3.0T (Release 12.x): the RF Amplifier is located in the NB RF Amp Cabinet and the RRF Chassis is located in the RFS Cabinet.

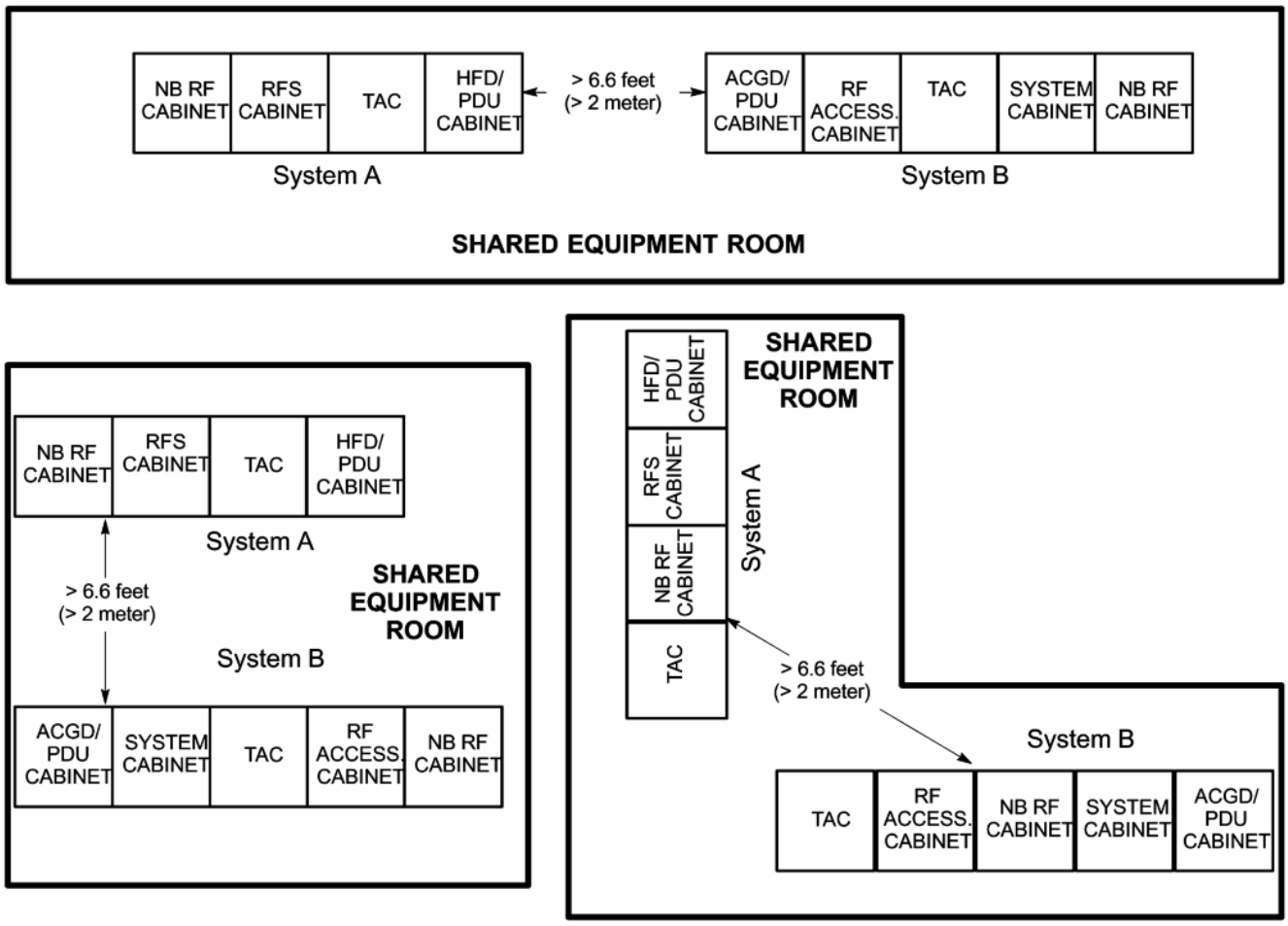
Illustration 3-2: Multiple Forward Production Release 15.x & Forward Production Release 12.x Electronics Cabinets Spacing



System A: Forward Production HDx 3.0T Release 14.x or Forward Production EXCITE HD 3.0T Release 12.X

System B: Forward Production HDx 3.0T Release 14.x or Forward Production EXCITE HD 3.0T Release 12.X

Illustration 3-3: Multiple Forward Production Release 15.x & Upgraded Release 12.x Electronics Cabinets Spacing



System A: Forward Production HDx 3.0T Release 14.x or Forward Production EXCITE HD 3.0T Release 12.X
System B: Upgraded HD to HDx 3.0T Release 14.x or EXCITE 3.0T Release 11.X

2.2.3 Penetration Panels Locations

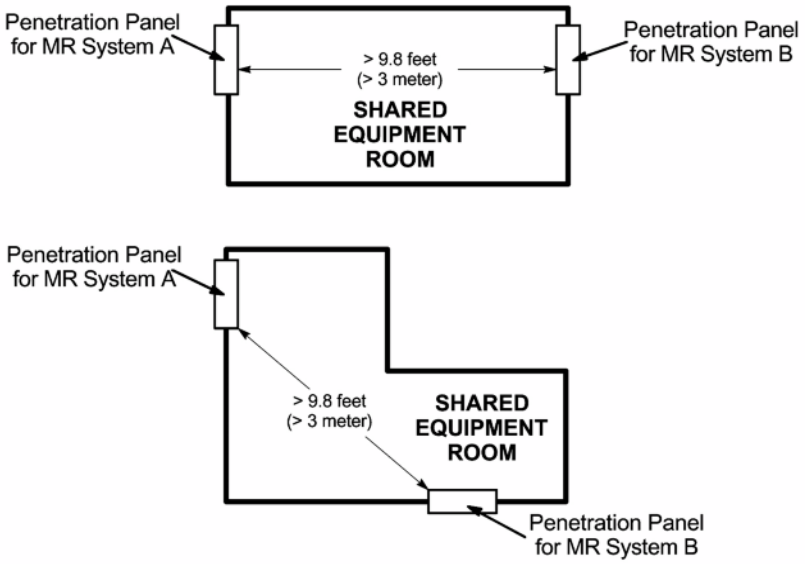
The following are requirements for locating the RF Shielded Room Penetration Panel of one MR system relative to the other MR system RF Shielded Room Penetration Panel.

NOTICE

All Penetration Panels must be located outside the 200 Gauss line.

There must be > 9.8 feet (3 meters) separation between the Penetration Panels of each system sharing the Equipment Room space, see Illustration 3-4.

Illustration 3-4: Multiple MR Systems Penetration Panel Spacing

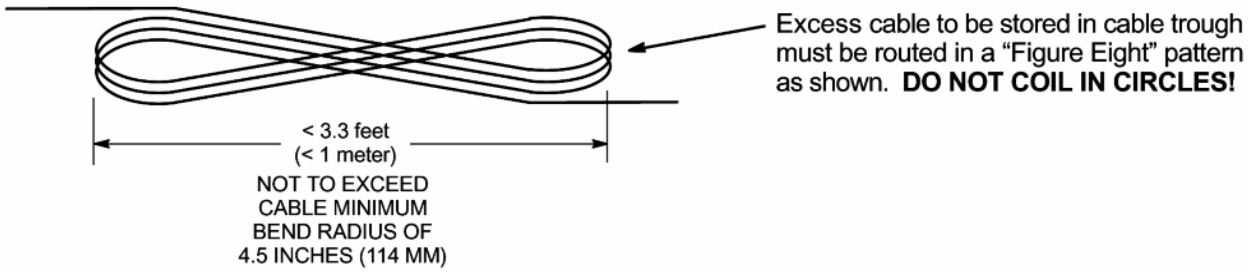


2.2.4 Excess System Cable Requirements

The following are requirements for locating and managing excess RF Receive and Transmit cables of the MR systems sharing the Equipment Room.

- In the shared Equipment Room there must be > 6.6 feet (2 meters) separation between the RF receive cables of one system and the RF transmit cable of the other system.
- There must be > 6.6 feet (2 meters) separation between the system interconnect cables of each system sharing the Equipment Room space.
- Transmit cables in the Equipment Room must be cut to length to minimize excess cable length reducing the potential for signal coupling with other cables. No excess transmit cable can be stored in the Equipment Room.
- Receive cables excess length must be stored in a “figure 8" with overall dimension of <3.3 feet (<1 meter), see Illustration 3-5.

Illustration 3-5: Proper Storage Of Excess Receive Cables



3 Minimum Delivery Route Sizes and Capacity

Enter descriptive content here.

Table 3-2 lists minimum actual clearance opening dimensions for doors and hallways required by the MR system upgrade equipment. Installation or replacement of components listed in Table 3-2 must be taken into consideration when determining hallway and door dimensions. Clearance for maneuvering around corners or turns must also be taken into consideration. Refer to Chapter 9, Shipment for upgrade components shipping dimensions.

Table 3-2: Minimum Hallway/Door Dimensions

Component	Minimum Hallway/ Door Width*		Minimum Hallway/ Door Height*		Comments
	in.	mm	in.	mm	
Operator Workspace Table	32	813	80	2032	
Equipment Cabinets	36	914	80	2032	
Note * Minimum hallway and door dimensions are actual clearance openings. Width and height of rigging equipment is not included in above dimension.					

Table 3-3: Component Dimensions For Installation/Replacement

Component	Approximate Weight lbs (kg)	Overall Dimensions W x D x H in. (mm)	Comments
Split Bridge for LCC300 Magnet Enclosure	40 (18)	21.5 x 77.3 x 7 (546 x 1969 x 177.8)	Room dimensions in front of the Magnet MUST allow for bridge installation/servicing and Gradient Coil Replacement.
Bridge for 3T94 Magnet Enclosure	90 (39)	19.5 x 159 x 6 (495 x 4039 x 152.4)	Room dimensions in front of the Magnet MUST allow for bridge installation/servicing and Gradient Coil Replacement.

4 MR System Interconnects Routing

The customer, architect/consultant, and contractor must meet the requirements in Table 3-4.

NOTE: Existing cable troughs and covers must be meet the requirements in this section.

Table 3-4: MR System Interconnects Routing Requirements/Recommendations

Area	Requirements
Entire MR System	1. Must protect fiber optic interconnects, water lines, hoses and tubing from physical damage including liquids (i.e. condensation, coolants, etc.) 2. MR system cable routing must accommodates cable connector. a. Raceway or conduit for routing interconnects must be sized to allow for the dimension of the connectors. b. Raceway or conduit always to be sized to allow the cable to pass through with all other cables already installed. 3. The MR system interconnect cables are FT4 or equivalent rated, not plenum rated. 4. If the area under any access floor is used for an air plenum then the cables may have to be in raceway depending on local and national codes. 5. MR system interconnects must be accessible for equipment servicing.
Magnet Room	1. Metal access floor tiles are NOT allowed anywhere in the Magnet Room, refer to requirements in Chapter 8, Magnet Room Floors. 2. Only non-magnetic metal material can be used when routing cables in the Magnet Room. 3. Any electrically conductive materials utilized for interconnects routing (i.e. raceway, access flooring) must comply with Chapter 8, RF Shielded Room Requirements to minimize the possibilities of electrical discharge which can cause RF broadband noise. a. All electrical and mechanical connections and fasteners including screws, nails, nuts, bolts, clips clamps, concrete anchors, seismic anchors, etc. must be tightened and secured to supplier specifications so as not to become a potential broadband noise source. b. No mechanical fasteners are allowed within 2 feet (0.61 m) of the Gradient Cables inside the RF Shield due to the potential of screws and metal interaction becoming a source of broadband noise. c. Unsecured or overlapped electrically conductive materials (e.g., cable routing dividers, trough/duct z-joints) must not be located within 2 feet (0.61 m) of the Gradient Cables. d. RF broadband noise can be avoided with quality design and construction that will remain solid over time and usage (i.e. no loose or micro vibrating materials). e. Liners must be continuous lengths, no butt joints, or seams. f. Metal covers must be continuous. g. All fasteners must be solid locking devices such as t-nuts, PEM nuts or welded nuts; no self tapping screws allowed (e.g., fastening metal covers to liners). 4. Floor or wall ducts/raceways used in the Magnet Room must meet the requirements in Chapter 8, RF Shielded Room Requirements and Chapter 8, Floors. 5. Cable routing methods must not interfere with an unobstructed path from the Patient Table to the area directly behind the Magnet Enclosure Rear Pedestal for MR personnel usage.
Recommendations	
• Raceway or conduit for routing interconnects should be oversized to allow for the possiblity of additional cables being added as the system is upgraded in the future. • Conduit should not be used for running the majority of GE MR system cables in the Magnet Room due to the number and size of conduits needed.	

5 Flooring

Flooring consists of all materials above the structural floor support including subflooring and equipment support/mounting. Refer to Table 3-5 for requirements and recommendations.

Table 3-5: MR System Flooring Requirements/Recommendations

Area	Requirements	Recommendations
Entire MR System	• Flooring materials must support the MR system equipment weight, refer to Floor Loading. • Floors must support the equipment and any transport device needed to move the equipment. • Flooring throughout the system including Magnet Room must be in accordance with local and national codes. • Floor design must consider the MR system interconnect cables are FT4 or equivalent rated, not plenum rated.	The area under access flooring if used for an air plenum is recommended to provide a minimum 10 in. (254mm) of clear space. Cabling, plumbing (water lines), etc. routed under the access floor may affect air flow and needs to be considered if used as an air conditioning plenum.
Magnet Room	Refer to Chapter 8, Magnet Room Floors	

6 Upgrades Special Siting Considerations

6.1 System Monitoring and Support Connectivity

One of the system monitoring and support connectivity configurations listed inTable 3-6 must be provided for system installation and serviceability purposes. The broadband network connection and telephone lines are to be provided and paid for by the customer.

Table 3-6: System Monitoring & Support Connectivity Requirements

Configuration	Connection Type	Use/Location
Broadband Network Connection & Telephone Line **(Recommended)**	Two Broadband Internet Accessible connections with individual Static IP addresses See Note 1	One access located near the Operator Workspace (OW) in the Control Room (RJ45 wall mounted connection minimum speed of 10Mbps).
		One access located near the Magnet Monitor (MSM1) in the Equipment Room for remote monitoring of magnet pressure levels. This Broadband connection must not lose power when the MR system is shutdown (RJ45 wall mounted connection minimum speed of 10Mbps, with Internet access).
	One voice-grade telephone line (voice line)	Available for Service Personnel use, located in the Control Room
Multiple telephone lines **(Alternate)**	One voice-grade telephone line (voice line)	Available for Service Personnel use, located in the Control Room
	One line must be a dedicated direct-distance-dialing voice-grade line (data line)	Access located near the Operator Workspace (OW) in the Control Room. See Notes 2 & 3. (Standard RJ-11 connection is required)
	One line must be a dedicated direct-distance-dialing voice-grade line (data line)	Access located near the Magnet Monitor (MSM1) in the Equipment Room for remote monitoring. See Notes 2 & 3. (Standard RJ-11 connection is required)

Notes

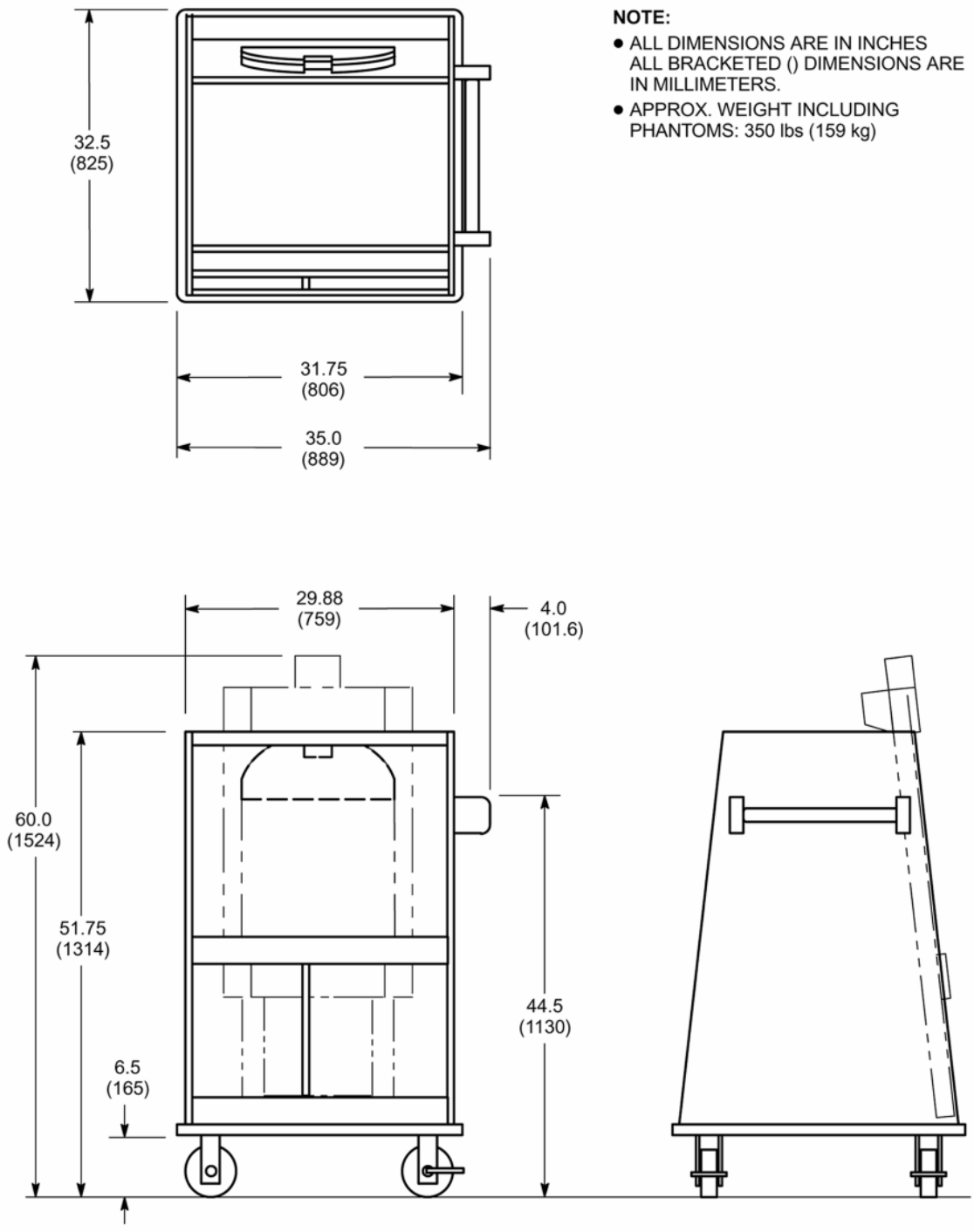
1. **For Europe:** An ISDN Connection with static IP address may be substituted for Broadband Internet Accessible connections.
2. A dedicated direct-distance-dialing voice-grade telephone line can be shared for Operator Workspace (OW) and Magnet Monitor (MSM1) requirement through the use of a multiplexer box. The following multiplexer boxes are available for customer purchase.
   46-328475P1 4 Line Phone Multiplexer box; 115 VAC input power
   46-328475P3 4 Line Phone Multiplexer box; 220 VAC input power
   If the customer chooses not to purchase the multiplexer box then the customer must provide an additional line for each requirement as stated in this table.
3. If a Multiplexer Box is used then the Magnet Monitor MUST be Channel 1 to allow for call out after a power outage.

6.2 Customer Site Storage Requirements

The MR system has several system accessories such as system phantoms and surface coils. There are many optional surface coils available. Storage space for system accessories and supplies must be planned for and included in room layout drawings. Contact the GE Healthcare Project Manager of Installation for specific information.

SPT Phantom Set Shipping and Storage Cart is provided as part of the MR system. System Performance Test (SPT) provides the customer and GE Service with a means to quickly verify whether critical parameters affecting image quality are within specifications. The test uses a set a phantoms and a nesting plate for proper positioning of the phantoms on the Patient Table. The phantom set and nesting plate are provided on a cart which protects the pieces during shipment and storage at site. The cabinet is not magnetic therefore it can be stored inside the Magnet Room if so desired and moved to the Patient Table for ease of positioning the phantoms. SeeIllustration 3-6 for cart dimensions information.

Illustration 3-6: SPT Phantom Set Shipping/Storage Cart



6.3 IPCM Option For LCC300 Magnets ONLY

Integrated Patient Comfort Module (IPCM) Option consists of hardware and software that can be used in combination with fMRI scanning. The IPCM Option hardware consists of the Chilled Air Blower (CAB), CAB Main Disconnect Panel (CAB-MDP), Bore Liner hardware, modified Penetration Panel waveguide, Bridge with notched sides, Bore Liner hardware including hoses and connectors, and IPCM Option Key.

The CAB provides chilled air to the 2 piece Bore Liner via an air hose routed through the Penetration Panel (provided waveguide) to the back end of the Rear Pedestal. At the Rear Pedestal additional provided hardware, hoses and connectors are used to connect the air hose to both pieces of the Bore Liner.

NOTE: The CAB-MDP is not powered from the MR system MDP or PDU and therefore requires facility provided power. The CAB-MDP must also be connected to the MR system MDP Emergency Power Off control circuit via a customer supplied cable.

The CAB-MDP requires customer supplied facility power. Customer supplied Emergency Power Off control wiring is required between the CAB and CAB_MDP. Refer to Chapter 6, IPCM Option Power Requirements for power specifications.

The CAB requires airflow clearance for front, back, and top during operation. Refer to IPCM Option for dimensions information.

7 Floor Loading

NOTICE

It is the responsibility of the customer to obtain any and all approvals necessary for the construction of equipment support and seismic anchoring.

7.1 MR System Components

Refer to weight and dimensions shown in the illustrations of the upgrade components for the upgrade catalogs listed in Component Dimensions.

8 Upgrade Component Dimensions

8.1 Component Dimensions

To assist in completing your room layout, refer toTable 3-7 for the list of component illustrations and the upgrade catalog numbers which provide the new components. Included are items which may impact site layout or need to be taken into consideration when determining delivery route. Modifications to existing cabinets are not included. Catalogs may list the same equipment but differ due to other modification hardware.

Table 3-7: Component Information Listed By Upgrade Catalog

Upgrade Catalog	Equipment	Dimension Information Location
M3033LH	Integrated Patient Comfort Module (IPCM) Option	IPCM Option
M3334WH	Broadband RF Amplifier Cabinet	Broadband RF Amplifier Cabinet For 8KW MNS Option
M3335JP M3335JR M3335JZ M3335K M3335KA M3335KB M3335KC M3335KD M3335KE	Keyboard	Operator Workspace
M3335JS	Host Display Monitor	Host Display Monitor illustration in Operator Workspace
M3335PW	32 Channel Cabinet	32 Channel Cabinet Option
M3335RA	GOC Cabinet	Operator Workspace
M3335S	3T94 Magnet Enclosure Bridge	3T94 Magnet Enclosure Bridge
	GOC Cabinet, mouse and pad, SCSI Tower	Operator Workspace
	Pneumatic Patient Alert	Pneumatic Patient Alert
	HFD/PDU Cabinet	HFD/PDU Cabinet (MR3)
	3.0T RFS Cabinet	RFS Cabinet (MR2)
	Penetration Panel	Penetration Panel

8.2 IPCM Option

Magnetic Field Limit: 30 Gauss (3 mT)

Illustration 3-7: Chilled Air Blower (CAB)

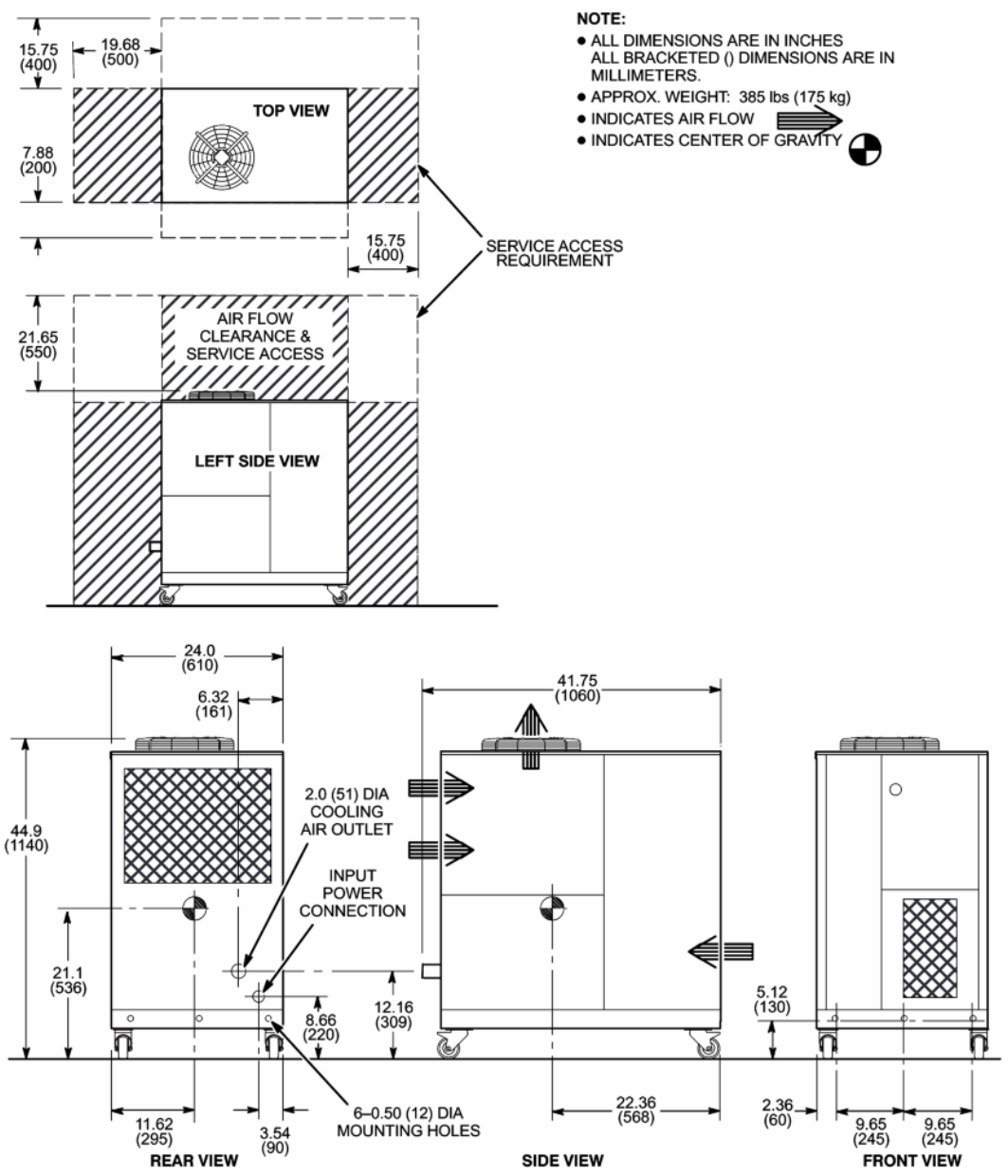
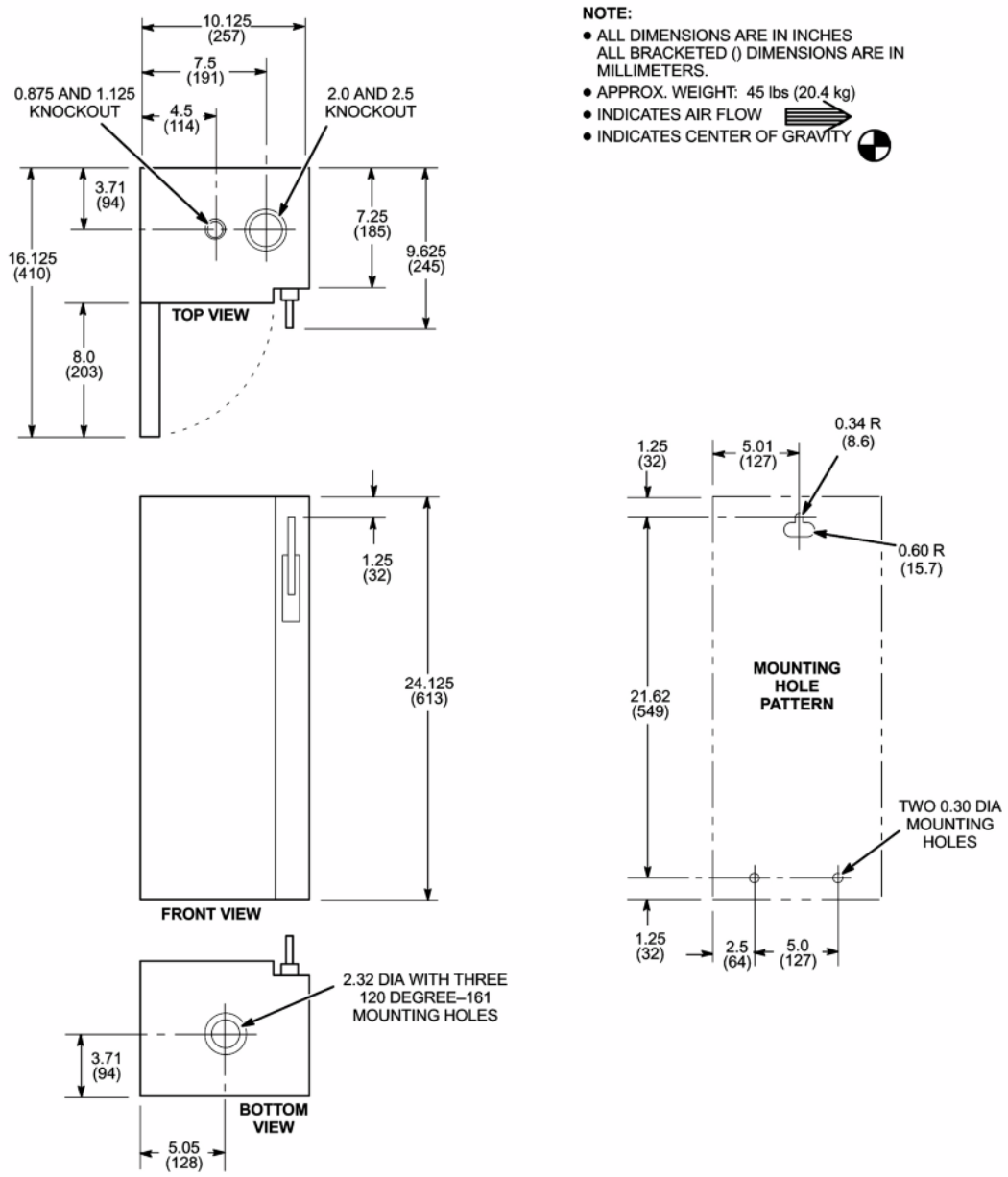


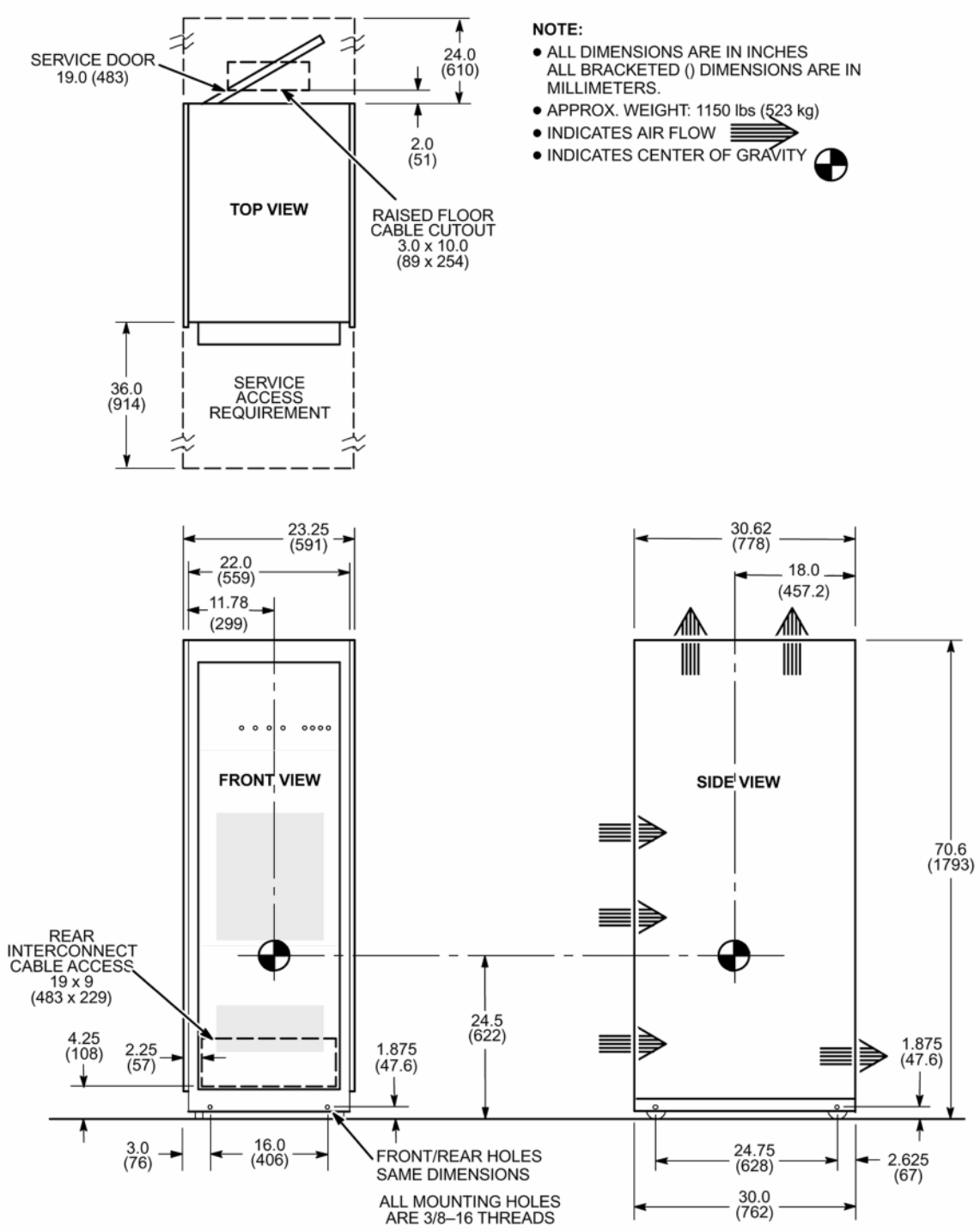
Illustration 3-8: Chilled Air Blower-Main Disconnect Panel (CAB-MDP)



8.3 Broadband RF Amplifier Cabinet For 8KW MNS Option

Magnetic Field Limit: 50 Gauss (5 mT)

Illustration 3-9: Broadband (BB) RF Amplifier Cabinet (MR9) - 8KW MNS Option



8.4 Operator Workspace

Magnetic Field Limit: 50 Gauss (5 mT)

Illustration 3-10: Operator Workspace (OW1) Overall Dimensions

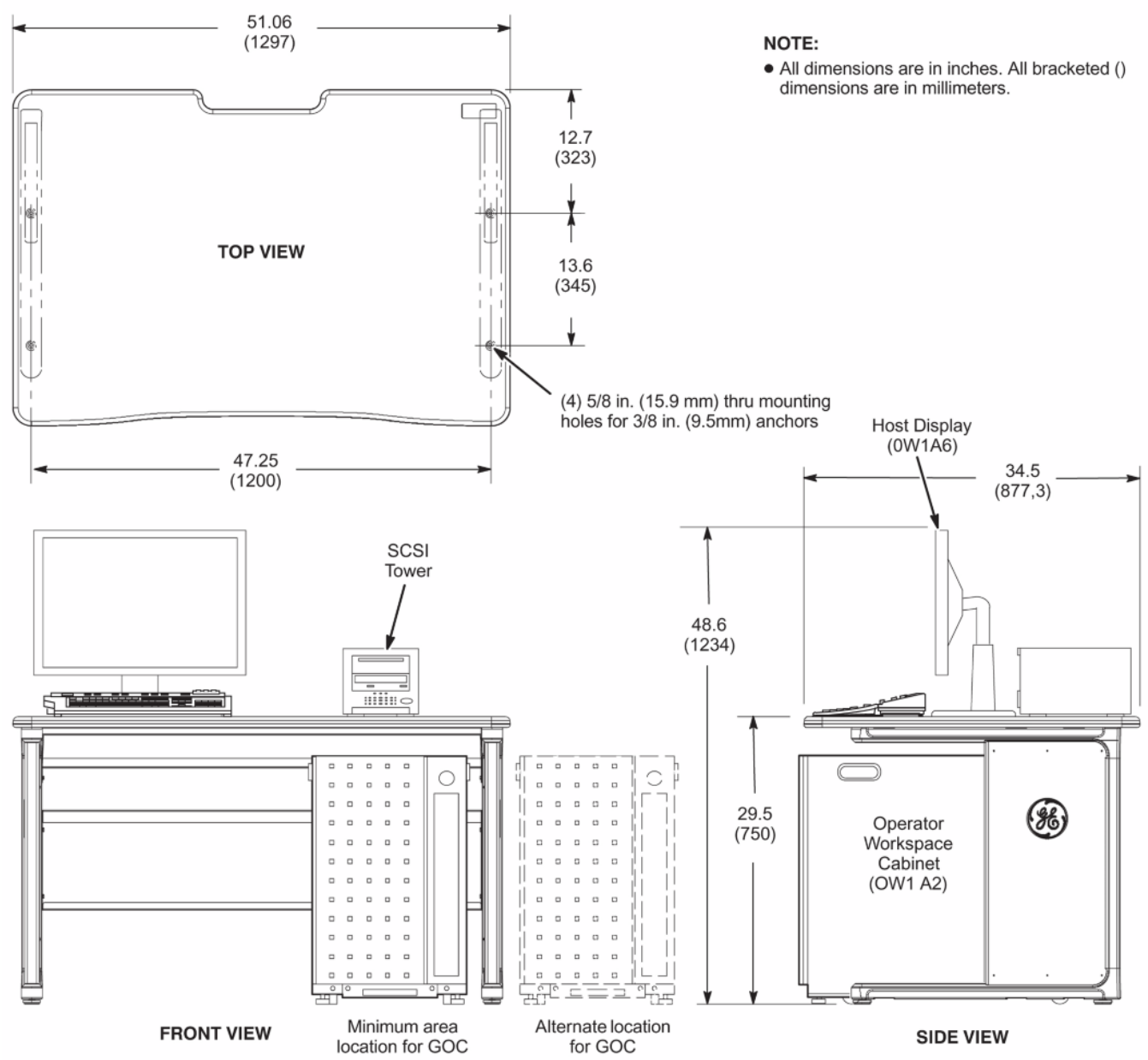


Illustration 3-11: GOC Computer Cabinet (OW1 A2)

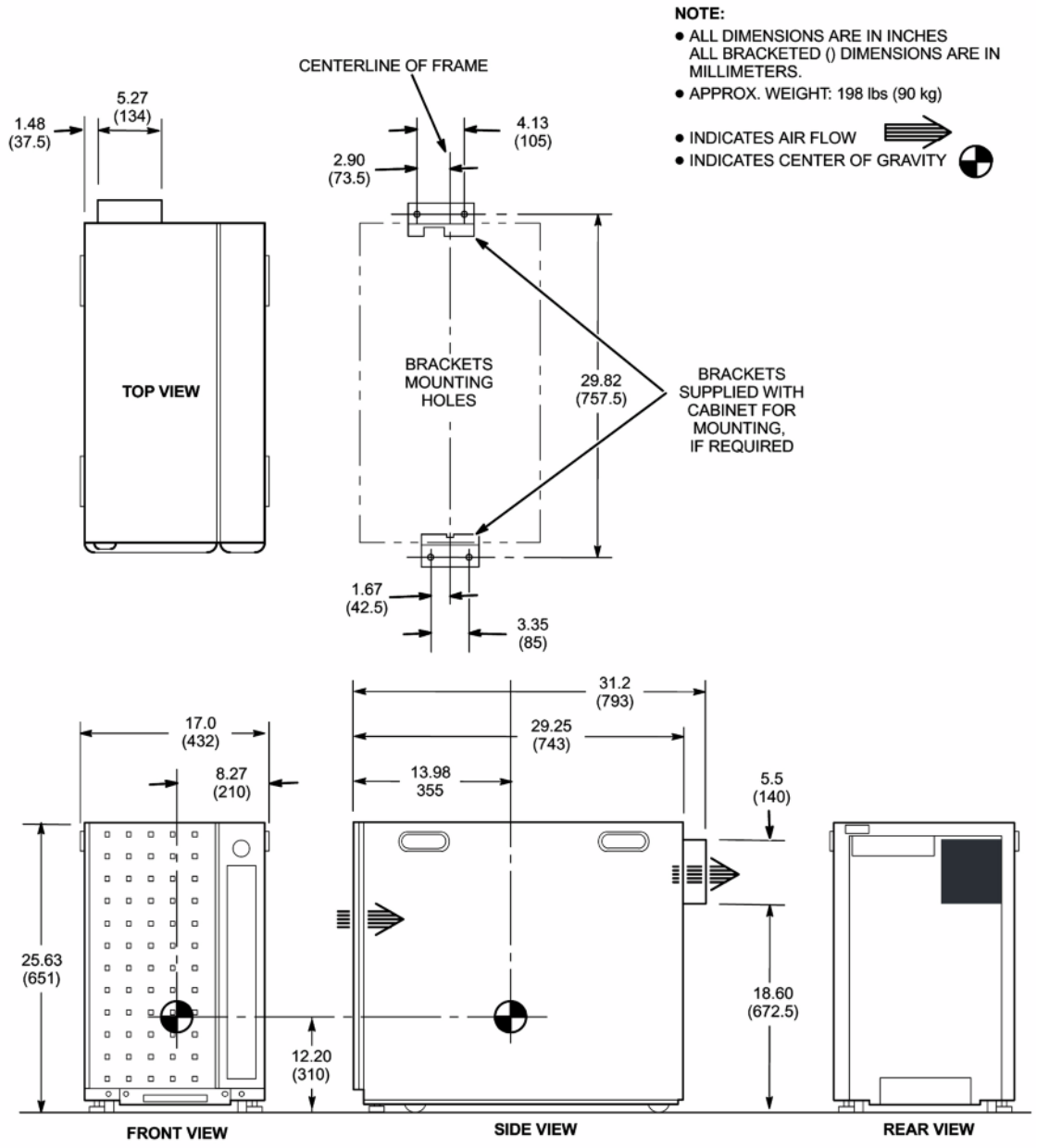


Illustration 3-12: Operator Workspace Components Position on Table Top - Host Display

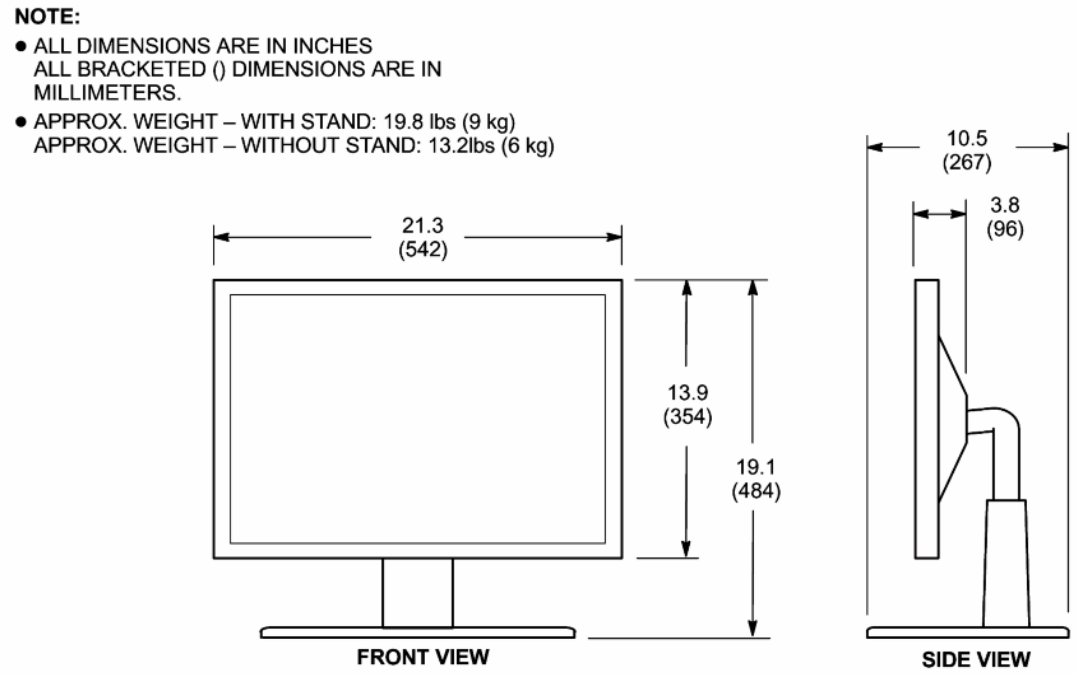
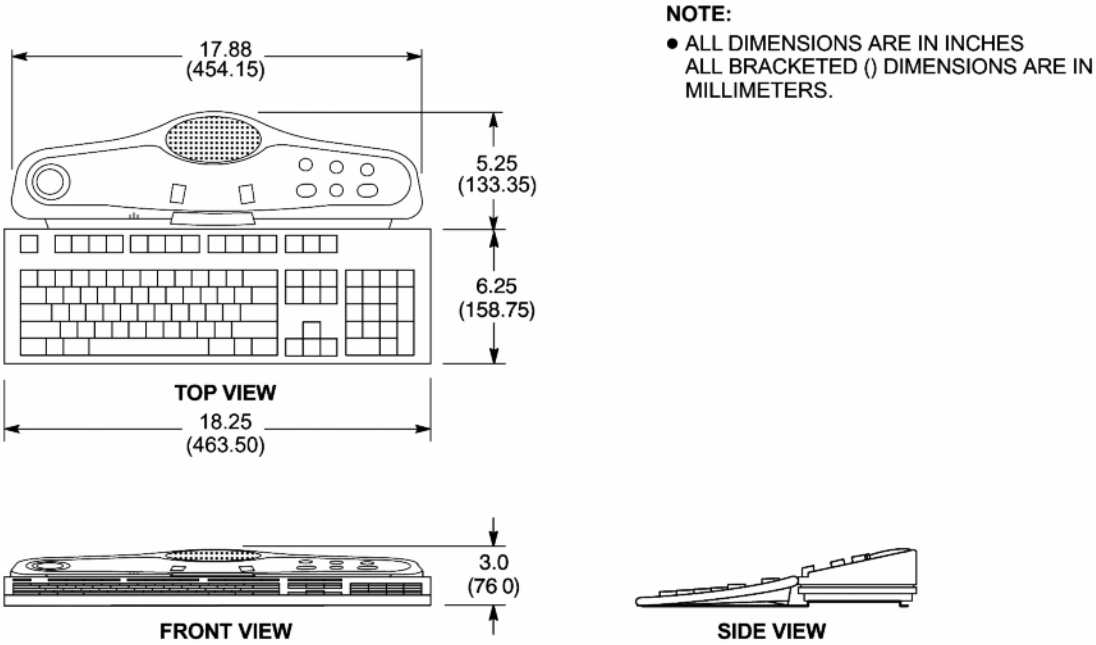


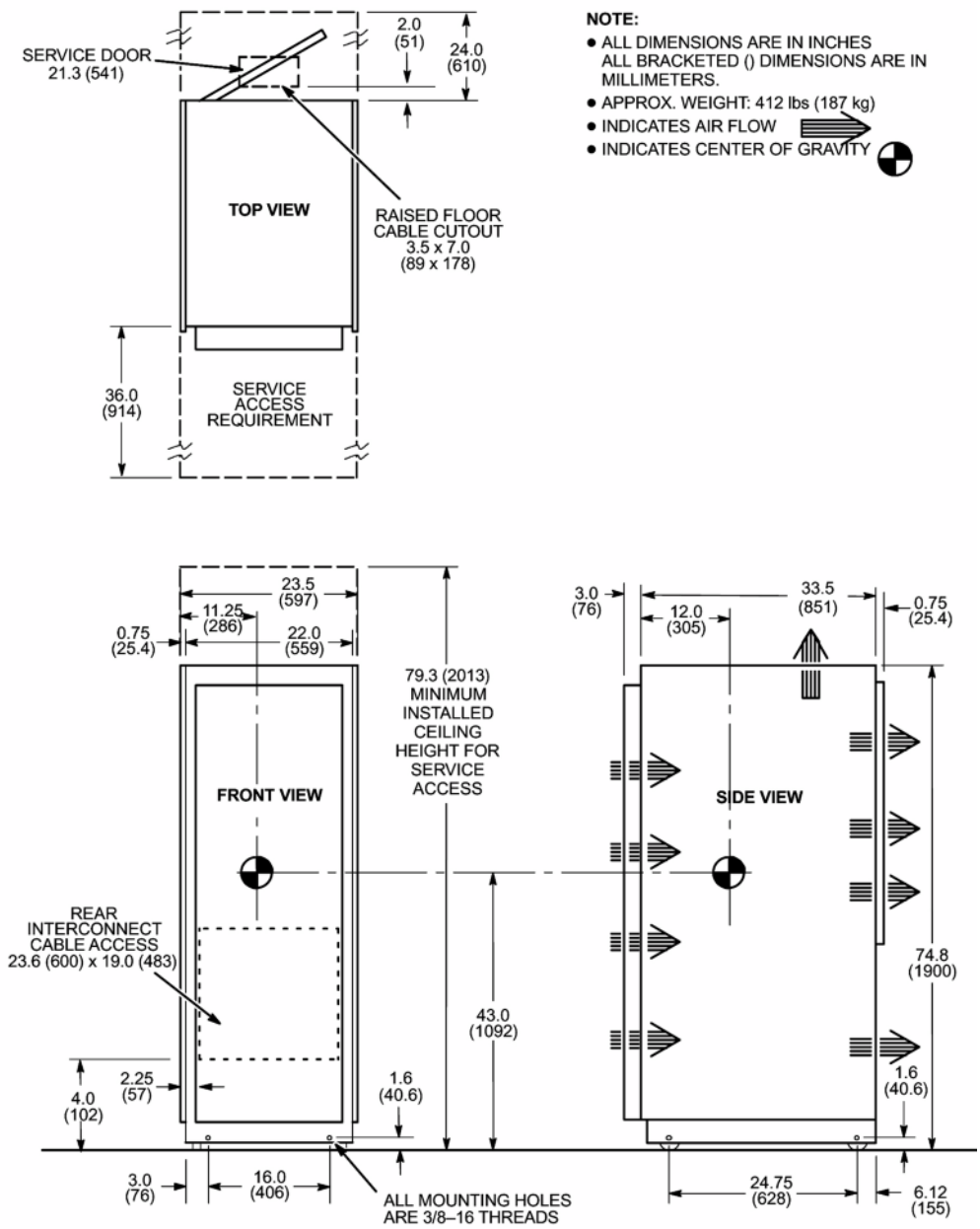
Illustration 3-13: Operator Workspace Components Position on Table Top - Keyboard



8.5 32 Channel Cabinet Option

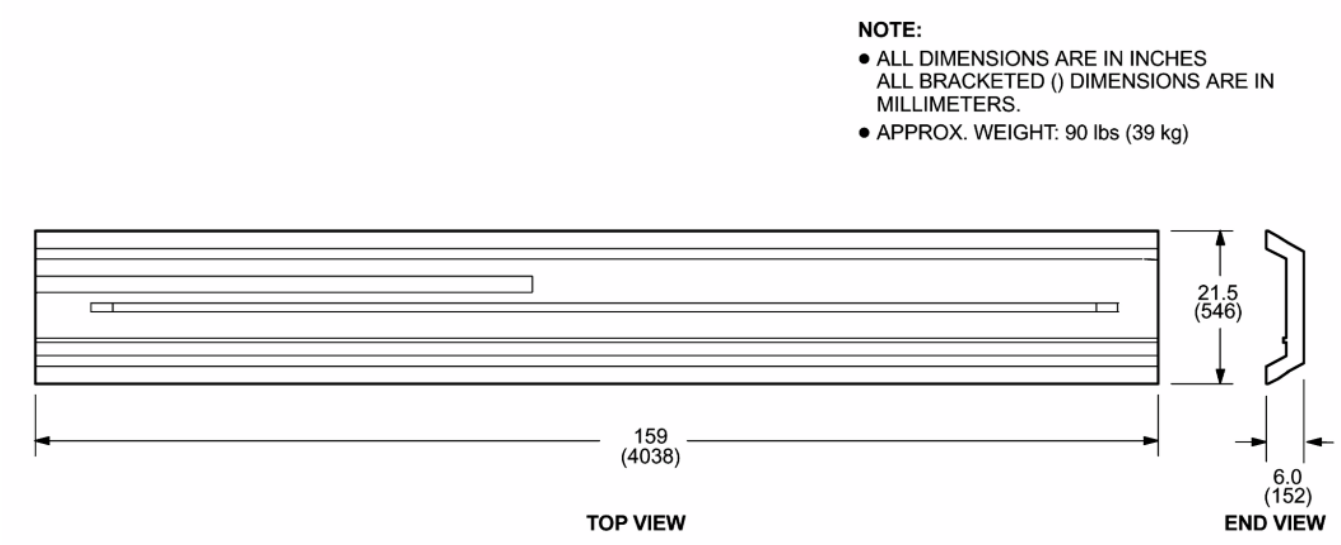
Magnetic Field Limit: 30 Gauss (3 mT)

Illustration 3-14: 3.0T 32 Channel Cabinet



8.6 3T94 Magnet Enclosure Bridge

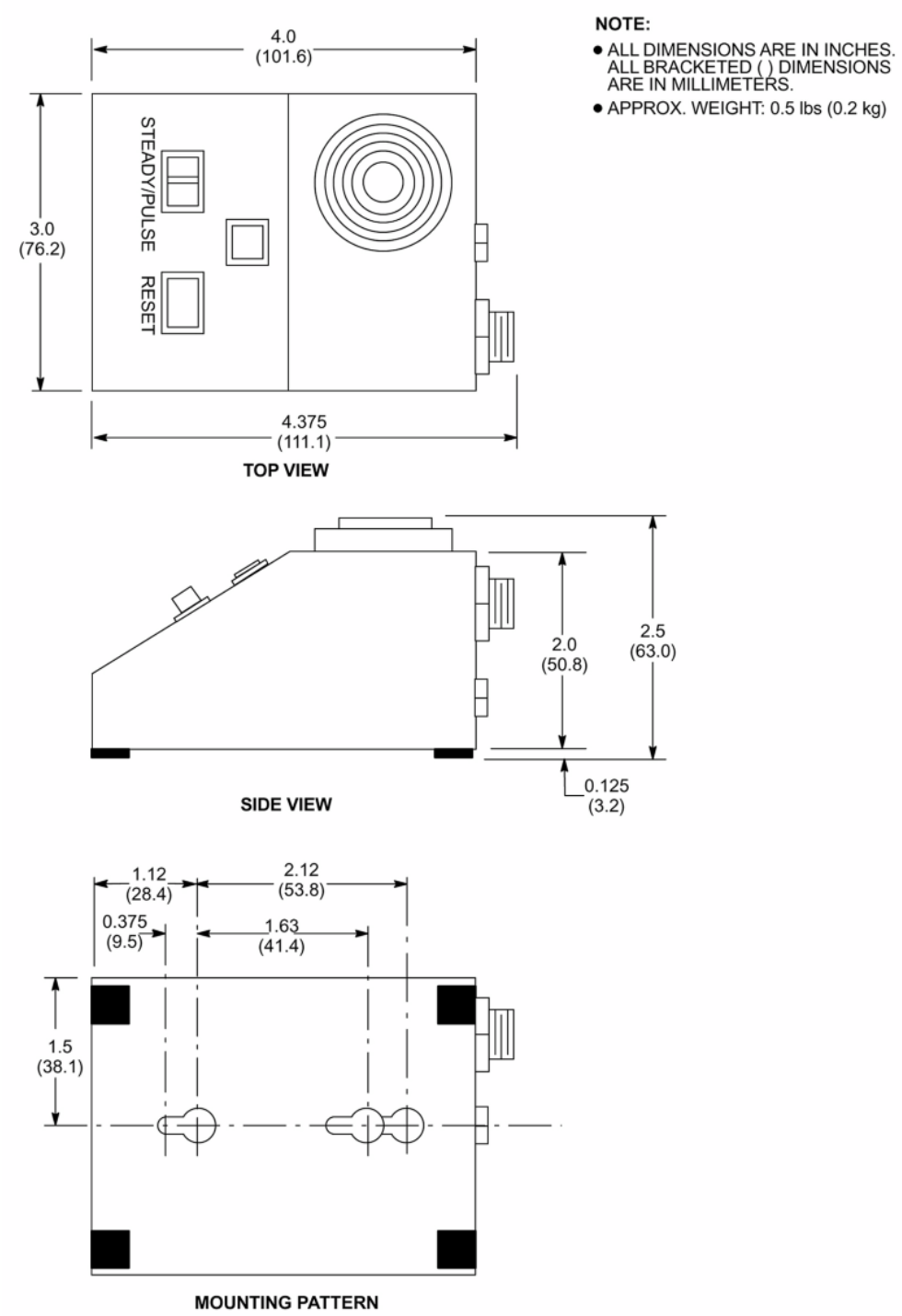
Illustration 3-15: 3T94 Magnet Enclosure Bridge



8.7 Pneumatic Patient Alert

Magnetic Field Limit: 100 Gauss (10 mT)

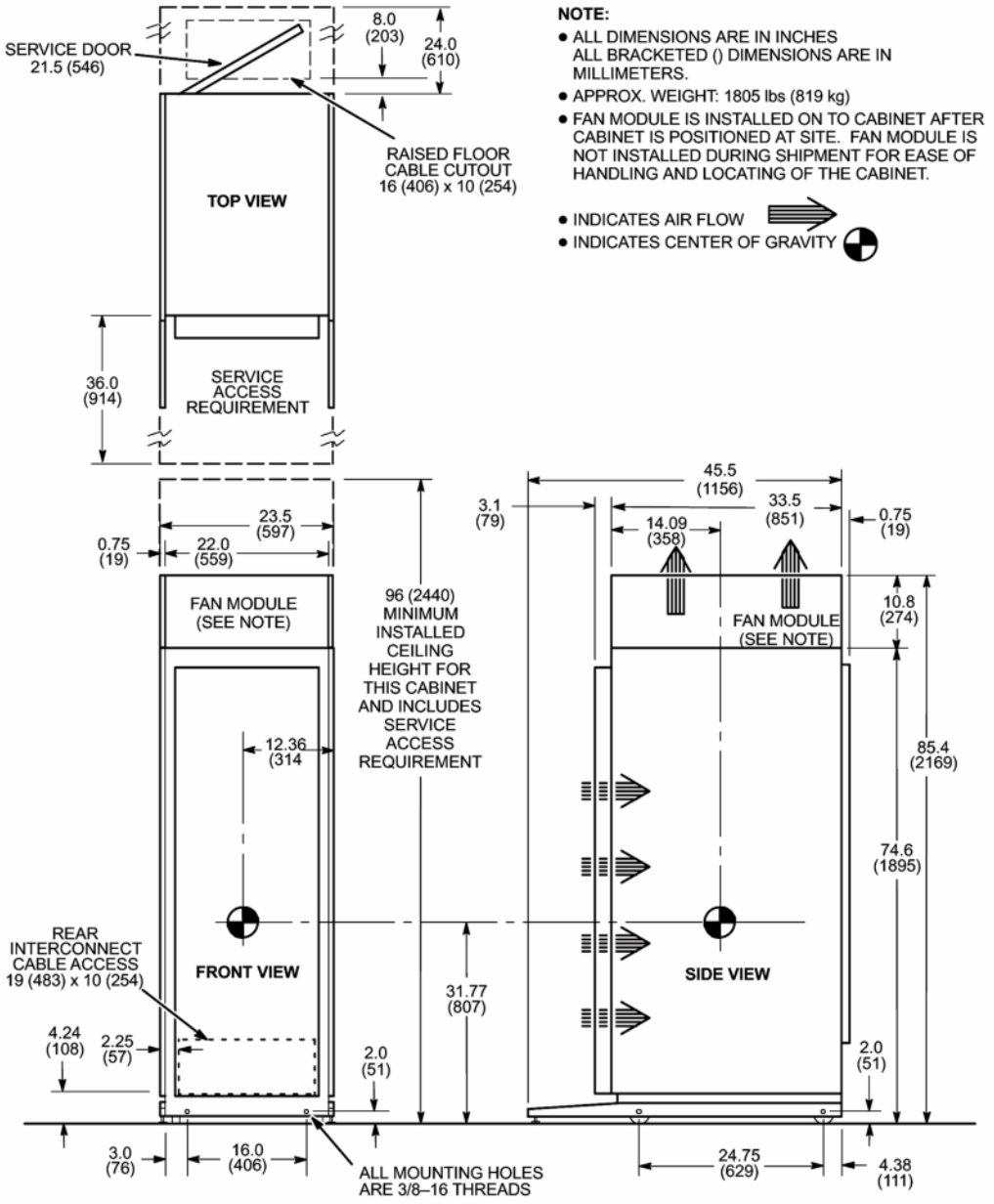
Illustration 3-16: Pneumatic Patient Alert Control Box (PA1)



8.8 HFD/PDU Cabinet (MR3)

Magnetic Field Limit: 50 Gauss (5 mT)

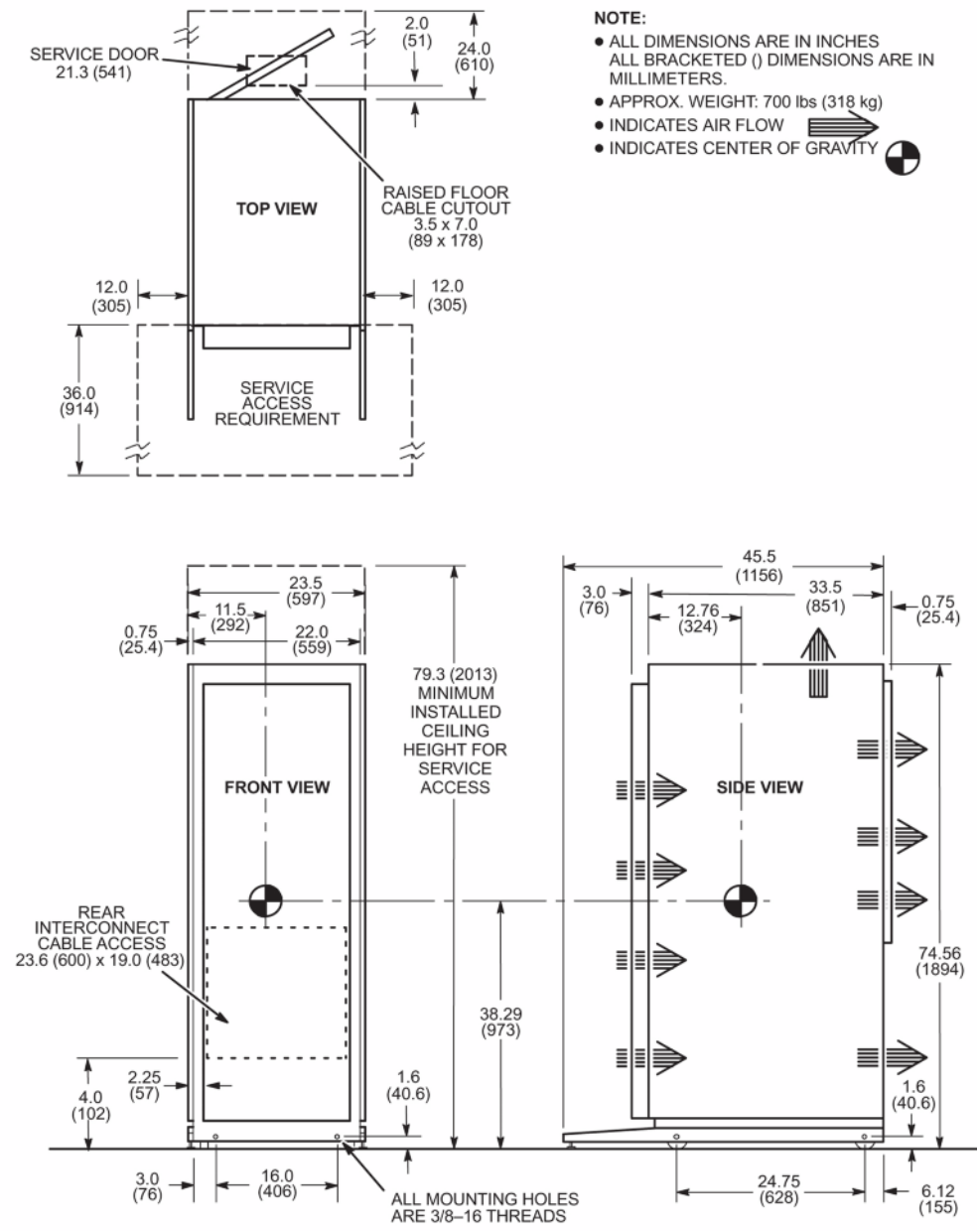
Illustration 3-17: HFD/PDU Cabinet (MR3)



8.9 RFS Cabinet (MR2)

Magnetic Field Limit: 30 Gauss (3 mT)

Illustration 3-18: HDxt 3.0T RFS Cabinet

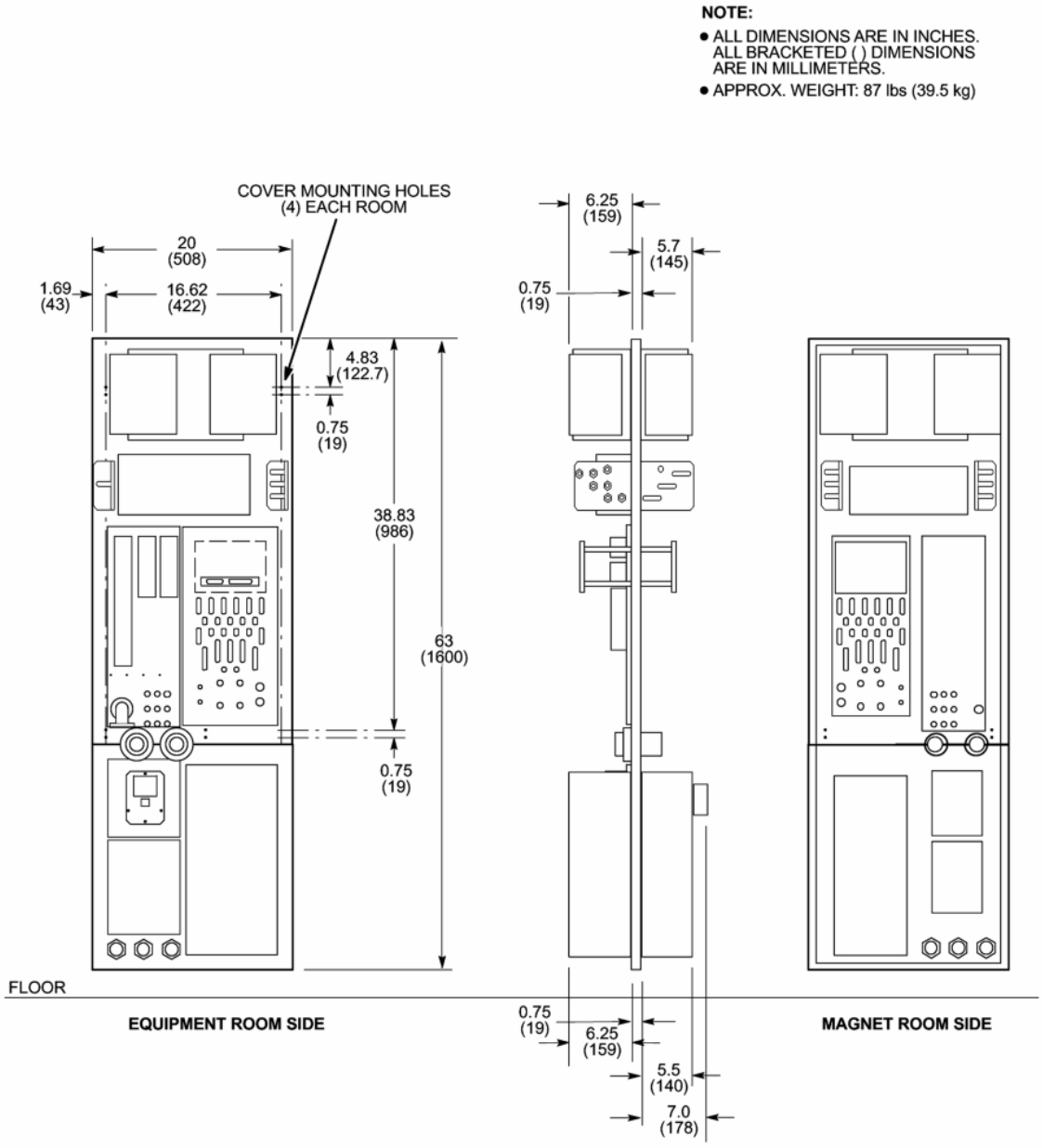


8.10 Penetration Panel

Magnetic Field Limit: 200 Gauss (20 mT)

NOTE: The entire Penetration Panel must be outside the 200 Gauss (20 mT) line.

Illustration 3-19: Penetration Panel (PP1)



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Chapter 4 Magnetic Field Considerations

1 Upgrades Magnetic Field Considerations

The upgrade catalogs documented in this manual do not change the existing magnet. Magnetic Field Considerations remain the same as specified in the latest revision of the existing system pre-installation document.

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Chapter 5 Site Environment

1 Introduction

CAUTION

Equipment Failure
Failure to maintain the required temperature or humidity at all times (i.e., both working and non-working hours) may result in equipment failure, scanning failure, or warranty void.

Ensure the HVAC system has the correct capacity for the room size, equipment heat output, and environmental conditions to maintain proper temperature and humidity.

The magnet, equipment room and operators rooms must be designed to maintain specific environmental limits for proper use of the MR System.

2 IEC EMC Compliance

Per IEC 60601-1-2 Edition 2 Medical Electrical Equipment requires special precautions regarding Electromagnetic Compatibility (EMC) and must be installed and put into service according to the EMC information provided in the following tables. Full declaration is stored on-site in the user manual delivered with the system.

The MR system is designed and tested to the following standards:

Table 5-1: Guidance And Manufacturer's Declaration – Electromagnetic Emissions

Emisions Test	Type of Test	Compliance Level
CISPR 11	Conducted Emissions	Class A Group 2
	Radiated Emissions	Class A Group 2
IEC 61000-4-3	E-Field RF Immunity	80-2500 MHz, 5 V/m with AM 80% @ 1kHz or 2 Hz

Table 5-2: Guidance And Manufacturer's Declaration – Electromagnetic Immunity

Immunity test	IEC 60601 test level	Compliance Level
Electrostatic discharge (ESD) IEC 61000-4-2	±8 kV air	Air 2, 4, 6, 8, 10kV
	±6 kV contact	Contact 2, 4, 6, 8kV
		Coupling Plane 2, 4, 6, 8kV
Electrical fast transient / burst IEC 61000-4-4	±2 kV for power supply lines	Power Lines 3kV
	±1 kV for input/output lines	Interconnect Cables 1.5kV
Surge IEC 61000-4-5	±2 kV common mode	Common Mode ±2 kV
	±1 kV differential mode	Differential ±1 kV
Power Frequency (50/60Hz) magnetic field IEC 61000-4-8	3 A/m	4.5A/m at 50 Hz. and 60 Hz.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5 % UT (>95 % dip in UT) for 5 sec	5 sec @ >-95%, Each phase individually
Conducted RF IEC 61000-4-6	V1 = 3 Vrms 150 kHz to 80 MHz	0.15-80 MHz @5 VRMS with AM 80% @ 1kHz 1% Frequency steps
Radiated RF IEC 61000-4-3	E1 = 3 V/m 80 MHz to 2,5 GHz	80-2500 MHz, 5 V/m with AM 80% @ 1kHz or 2 Hz

3 Temperature and Humidity Specifications

This section lists the temperature and humidity specifications for the MR suite. Refer to Air Cooling for heat load specifications.

3.1 System Suite

CAUTION

Equipment Failure
Failure to maintain the required temperature or humidity at all times (i.e., both working and non-working hours) may result in equipment failure, scanning failure, or warranty void.

Ensure the HVAC system has the correct capacity for the room size, equipment heat output, and environmental conditions to maintain proper temperature and humidity.

Use the specifications listed in Table 5-3 for designing your HVAC (heating, ventilation, and air conditioning) system. Proper insulation and moisture barrier should be installed within the environmental controlled space (e.g. area above drop ceiling) for humidity, condensation, and temperature control.

Table 5-3: Temperature And Humidity Specifications

Area	Temperature		Humidity		Max. Room Gradient °F (°C)
	Range °F (°C)	Change °F/Hr (°C/Hr)	Range %	Change %/Hr	
Equipment Room at Inlet to Equipment	59-89.6* (15-32)*	5 (3)	30-75*	5	5 (3)**
Magnet Room	59-69.8 (15-21)	5 (3)	30-60*	5	5 (3)
Operator's Control Room	59-89.6* (15-32)*	5 (3)	30-75*	5	5 (3)
Note * Non-condensing humidity with 50% nominal at 65°F (18.3°C). ** Room temperature gradient specification applies from floor to height of top discharge of equipment cabinets.					

4 Air Cooling Specifications

The following table contains the heat output of the equipment listed in the typical site location. These values do not include people, lights and non-MR equipment. Actual site average values will vary depending on system use (e.g., protocols used, patient load, etc.). Note any variations of equipment location for your site when calculating your cooling requirements for each room.

Table 5-4: G3 System with LCC300 Magnet Maximum Heat Output For Air Cooling *

MR Component	Magnet Room See Note 1 listed below		Equipment Room See Note 2 listed below		Operator/Control Room	
	BTU/hr	Watt	BTU/hr	Watt	BTU/hr	Watt
RF/Gradient Body Coil Assembly, Magnet Enclosure Equipment	8189	2400				
Patient Blower Box	1366	400				
Penetration Panel			324	95		
GE Main Disconnect Panel			900	264		
NB RF Amp Cabinet			21,336	6253		
3.0T RFS Cabinet			10,263	3005		
HFD/PDU Cabinet			34,120	10,000		
Twin Accessory Cabinet			2354	690		
Magnet Monitor			205	60		
Operator Workspace with LCD Color Display (See Note 3)					4950	1450
Shield/Cryo Cooler Compressor (Water Cooled)			Heat dissipation to air neglible requires water cooling, See Note 4			
Air-Cooled Cryocooler Compressor External Transformer			28,320 820	8300 240		
Water cooled GWHX** option for providing Gradient Coil water cooling (requires site provided cooling for Shield Cooler Compressor) (See Note 4)			1707	500		
MRCC** option for providing Gradient Coil water cooling (See Note 4)			57,320	16,800		
MRCC** option for providing Shield/Cryo Cooler Compressor water cooling (See Note 4)			52,550	15,400		
Magnet Monitor UPS ** & Modem **			450	132		
3T MNS Cabinet for 4KW MNS option **			5118	1500		
BB RF Amp Cabinet **			24,600	7205		
BrainWave HW Lite Cabinet ** (see Note 5)			2337	685		
DC Lighting Controller Panel **			1024	300		

MR Component	Magnet Room See Note 1 listed below		Equipment Room See Note 2 listed below		Operator/Control Room	
	BTU/hr	Watt	BTU/hr	Watt	BTU/hr	Watt
DC Lighting Controller Autotransformer **			171	50		
Chilled Air Blower (CAB) for IPCM Option **			14,330	4200		
3.0T 32 Channel Cabinet **			1281	375		

Notes

* Maximum heat output is defined for temperature and humidity as defined in Temperature and Humidity Specifications.

** Optional equipment

1. Magnet Room must be an individual temperature zone controlled by a separate thermostat to allow for adjustments to meet room specifications as listed in Temperature and Humidity Specifications. It is recommended that cool inlet air be directed towards the Blower Box intake which contain a patient cooling fan.
2. FOR EQUIPMENT ROOM ONLY: Although the air cooling load averaged over a 12 hour working day is approximately 1/2 of the maximum value, the Equipment Room HVAC system must be sized such that Maximum Room Gradient, Temperature Range, Temperature Change per Hour, and Humidity specifications per Temperature and Humidity Specifications are not exceeded at any point during the working day. Actual heat output is site specific and dependent on the specific MR system configuration and customer usage of the MR system and options.
3. Operator Workspace equipment includes the following: LCD Color Monitor, GOC Computer Cabinet, Workspace Cabinet, Mouse and Mouse Pad, LCD Panel, and Keyboard.
4. The MR System requires water cooling for the Gradient Coil and the Shield/Cryo Cooler Compressor.
   - Gradient Coil water cooling must be supplied by cooling equipment (MRCC or GWHX) supplied with the MR system to prevent contamination/damage to the coil and for proper image quality.
   - The Shield/Cryo Cooler Compressor water cooling can be provided by a second MRCC or by customer provided facility water cooling. MRCC can be located outdoor or indoor.
5. Addition of 3rd party provided audio-visual equipment to the BrainWave HW Lite Cabinet may increase cabinet heat maximum output to 2781 BTU/Hr (815 Watts).

Table 5-5: 3T System with 3.0T94 Magnet System Maximum Heat Output For Air Cooling *

MR Component	Magnet Room See Note 1 listed below		Equipment Room See Note 2 listed below		Operator/Control Room	
	BTU/hr	Watt	BTU/hr	Watt	BTU/hr	Watt
RF/Gradient Body Coil Assembly, Shim Coils, 3T94 Magnet Enclosure Equipment	14,000	4100				
Patient Blower Box	3415	1000				
Penetration Panel			324	95		
GE Main Disconnect Panel			900	264		
NB RF Amp Cabinet			21,336	6253		
RFS Cabinet			8640	2532		
BB RF Amp Cabinet*			24,600	7205		
HFD/PDU Cabinet			34,120	10,000		
Accessory Cabinet			24,600	7205		

MR Component	Magnet Room See Note 1 listed below		Equipment Room See Note 2 listed below		Operator/Control Room	
	BTU/hr	Watt	BTU/hr	Watt	BTU/hr	Watt
Operator Workspace with LCD Color Display (See Note 3)					4950	1450
Air-Cooled Cryocooler Compressor External Transformer			28,320 820	8300 240		
Shield/Cryo Cooler Compressor (Water Cooled)			Heat dissipation to air neglible requires water cooling, See Note 4			
Water Chiller (WC1) for Gradient Coil			14,000	4100		

Notes

* Maximum heat output is defined for temperature and humidity as defined in Temperature and Humidity Specifications.

** Optional equipment

1. Magnet Room must be an individual temperature zone controlled by a separate thermostat to allow for adjustments to meet room specifications as listed in Temperature and Humidity Specifications. It is recommended that cool inlet air be directed towards the Blower Box intake which contain a patient cooling fan.
2. FOR EQUIPMENT ROOM ONLY: Although the air cooling load averaged over a 12 hour working day is approximately 1/2 of the maximum value, the Equipment Room HVAC system must be sized such that Maximum Room Gradient, Temperature Range, Temperature Change per Hour, and Humidity specifications per Temperature and Humidity Specifications are not exceeded at any point during the working day. Actual heat output is site specific and dependent on the specific MR system configuration and customer usage of the MR system and options.
3. Operator Workspace equipment includes the following: LCD Color Monitor, GOC Computer Cabinet, Workspace Cabinet, Mouse and Mouse Pad, LCD Panel, and Keyboard.
4. The MR System requires water cooling for the Gradient Coil and the Shield/Cryo Cooler Compressor.
   - Gradient Coil water cooling must be supplied by cooling equipment (WC1) supplied with the MR system to prevent contamination/damage to the coil and for proper image quality.
   - The Shield/Cryo Cooler Compressor water cooling requires customer provided facility water cooling.

4.1 Requirements

The Magnet Room must be an individual temperature zone controlled by a separate thermostat to allow for adjustments to meet room temperature specification as listed in Temperature and Humidity Specifications. It is recommended that cool inlet air be directed towards the Enclosure Rear Pedestal and Blower Box air intake for patient cooling.

4.2 Recommendations

A dedicated air conditioner with a dual compressor is preferred to avert shutdowns during repair of the primary air conditioner. Due to the large variation in heat loads, the compressors should be equipped with unloaders or hot gas bypass to prevent moisture stripping of the evaporator coils.

It is recommended that a temperature and humidity recorder be used during preinstallation and during actual installation and placed near the Gradient Cabinet air inlets to establish the true criteria. Refer to cooling table calculator in this section for each room's cooling requirements.

GE recommends the use of a 12 inch high raised flooring system for the equipment room (10 inch minimum clearance from floor slab to underside of access flooring). Care must be taken in locating

the air conditioning supply vents in the floor. The air conditioning supply vents should be located directly in front of the cabinet inlets

5 Lighting

Magnet Room Lighting requirements are listed in Table 5-6

Table 5-6: Magnet Room Direct DC Lighting Requirements

Requirements
 **NOTICE** **Fluorescent lighting is not allowed in the Magnet Room due to the RF noise generated by the fluorescent light tubes.** 1. Direct Current (DC) lighting is required in the magnet room to avoid RF broadband noise impacts to image quality. NOTE: Sites previously designed to the GE Pre-Installation Manuals released between 2000 and 2007, and did install AC Lighting, will be allowed to continue to use the AC lighting they have in place. The expectation is that the sites which have installed AC Lighting have MR Systems that are sensitive to AC lighting broadband noise. These sites are expected to have found site specific incandescent bulbs that emit low levels of RF noise; low levels that are not measurable nor do they impact image quality . This subset of sites can continue to use AC Lighting provided their system is RF broadband noise free. In cases where the AC lighting broadband noise surfaces as am image quality concern, the site may then have no choice other then to replace the AC lighting with a DC controlled system. 2. Illumination of 300 lux around the front of the magnet for patient access. 3. Need to provide 300 lux above the magnet service work (non-magnetic, portable lighting is acceptable). 4. The AC ripple from the DC power should be not greater than 5%. 5. Discrete switch or variable lighting level DC Lighting Controller (GE option available refer to Chapter 6, DC Lighting Controller (Facility Option)) must be used for selectable light levels. Dimmers (i.e. SCR, rheostats, etc.) are not allowed. 6. Lighting fixtures selection and installation must comply with requirements in Chapter 8, RF Shielded Room Requirements to minimize the possibilities of electrical discharge. 7. Light fixtures must have a ground wire from its power source and be grounded to the RF Shielded Room at the RF Common Ground Stud as shown in illustration in Chapter 6, Grounding System Ground subsection. 8. Light Emitting Diode (LED) lighting, if used, must meet the following: a. Power source must be located external to the Magnet Room RF Shield. b. All wiring, filters, and ground requirements must be met, refer to Chapter 6, Grounding System Ground subsection. 9. Battery chargers (e.g. emergency lighting) are required to be located outside the Magnet Room.
Comments
• Short filament length is recommended, linear lamps are not recommended because of the filament length and high incidence of filament failure. • Track lighting fixtures do not comply with light fixtures requirement listed above.

6 MR Suite Acoustic Specifications

6.1 Acoustic Specifications

Acoustic information is only provided as a guide. The actual room noise level may vary based on room design, optional equipment, and usage.

Table 5-7: Acoustic Specifications

	GE Equipment Acoustic Output	Notes
Control Room	55 dBA	
Equipment Room	75 dBA	The 75 dBA level is for GE equipment only. The Equipment room acoustic level must not exceed 85 dBA
Magnet Room	127 dBA	

Refer to acoustic guidelines in Acoustic Design Guidelines

NOTE: All GE equipment acoustic output values are for base equipment configuration in each room.

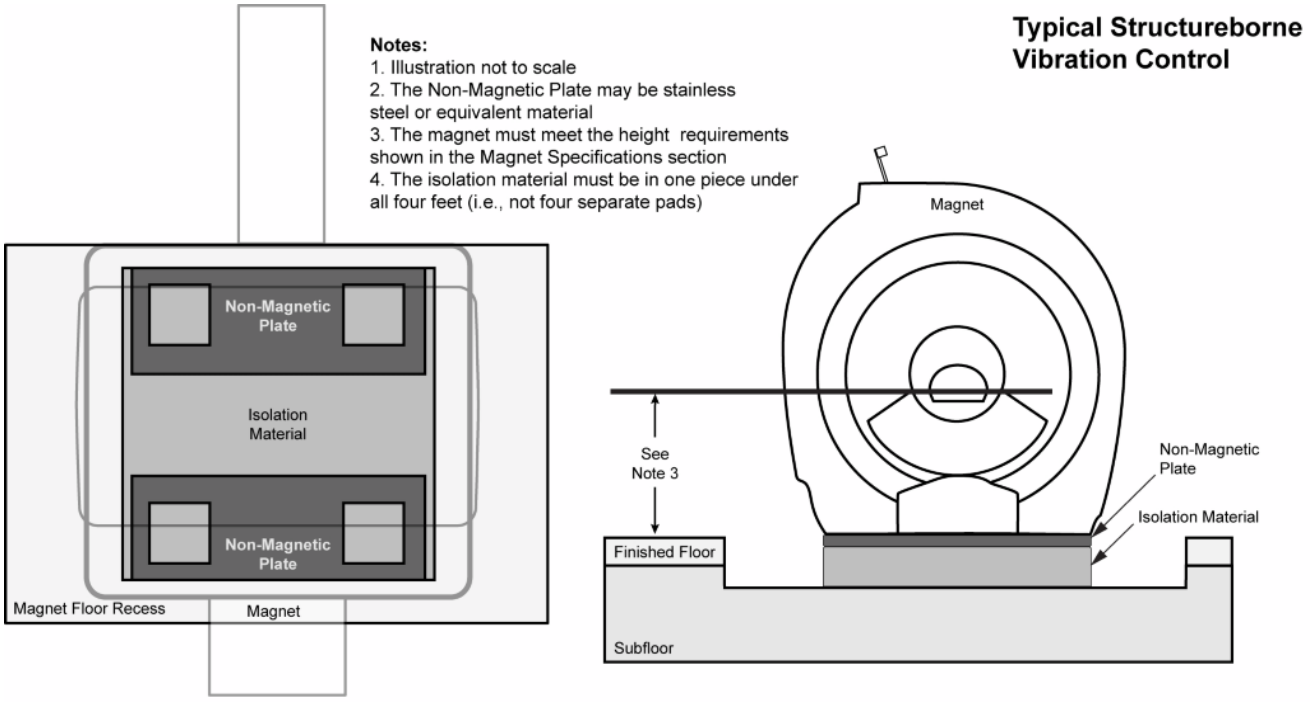
6.2 Structureborne Vibration Control Specifications

Structureborne acoustic issues tend to occur at MR installations above the ground floor of the facility. Two options to mitigate structureborne acoustic transmission are:

- GE Healthcare provides an available VibroAcoustic Damping Option. Contact the GE Healthcare Project Manager of Installation for information
- The customer may design and implement a custom solution. See Illustration 5-1 for a typical example

NOTE: The amount of vibration attenuation provided by the VibroAcoustic Damping Option will be site dependent.

Illustration 5-1: Customer Designed Structureborne Vibration Control Example



7 Water Cooling Requirements

The upgrade catalogs documented in this manual do not change the existing MR system water cooling specifications.

8 Room Ventilation Requirements

1. Sufficient air ventilation in the Magnet Room must be maintained for patient comfort during scans and to maintain proper oxygen level during cryogen replenishment.
2. An exhaust fan to be placed above RF shielding with appropriate wave guide filtering for quick removal of helium gas if large amounts of helium disperse into magnet room. Inert gas containers, such as dewars, are not air tight.
3. The Magnet Room exhaust fan intake vent must be located at the highest ceiling point near the magnet cryogen vent.
4. The Magnet Room exhaust fan to exhaust to safe outside area and be independent of cryogenic venting.
5. The Magnet Room exhaust fan and air inlet must be sized for a minimum of 1200 CFM (34 m^3/minute) and minimum of room 12 air exchanges per hour. See Illustration 5-2 and Illustration 5-3
6. Two manual exhaust fan controls connected parallel, one to be located near the Operator Workspace and second control located in the Magnet Room.
    a. The Magnet Room ventilation switch should be mounted near the Magnet Room door and is the responsibility of the architect and mechanical contractor.
    b. Refer to the illustrations below for exhaust fan recommended set-up or recommended set-up with optional Oxygen Monitor.
7. Exhaust fan (customer supplied) to be installed and operating before magnet is moved into room.
8. Annual customer inspection and cleaning / maintenance of the exhaust fan system (fan, inlet grill/filter, ducts, etc.) is needed to meet the minimum airflow requirement to an outside area.
9. Provide minimum 2 ft x 2 ft (0.61 m x 0.61 m) or 576 sq in. (372,100 sq mm) pressure equalizing waveguide vent in the magnet room ceiling or in the wall (with waveguide top edge located at ceiling) to prevent positive or negative pressures from interfering with opening of the magnet room door
10. Minimum 5-7% of outside makeup air to be vented into the Magnet Room. For example, with an air input rate of 1200 cubic feet per minute (CFM) (34 cubic meters per minute), there must be a minimum of 60 CFM (1.7 cubic meters per minute) (5%) of outside makeup air..

Illustration 5-2: Exhaust Fan Set-Up

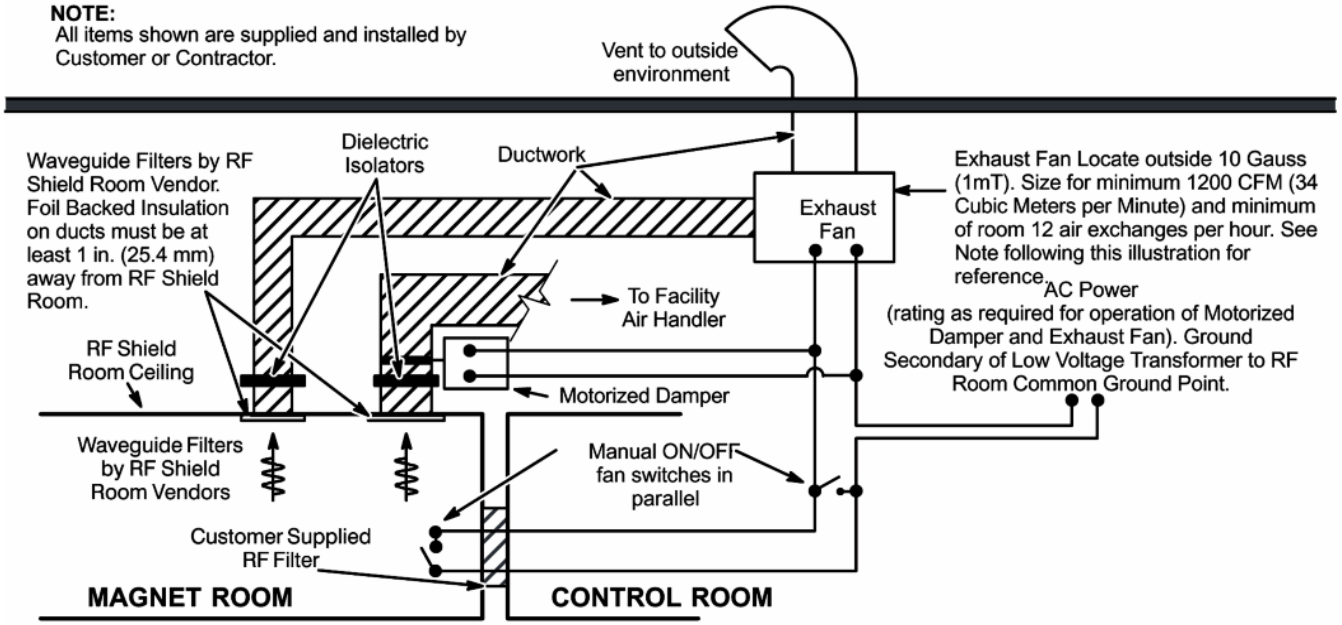
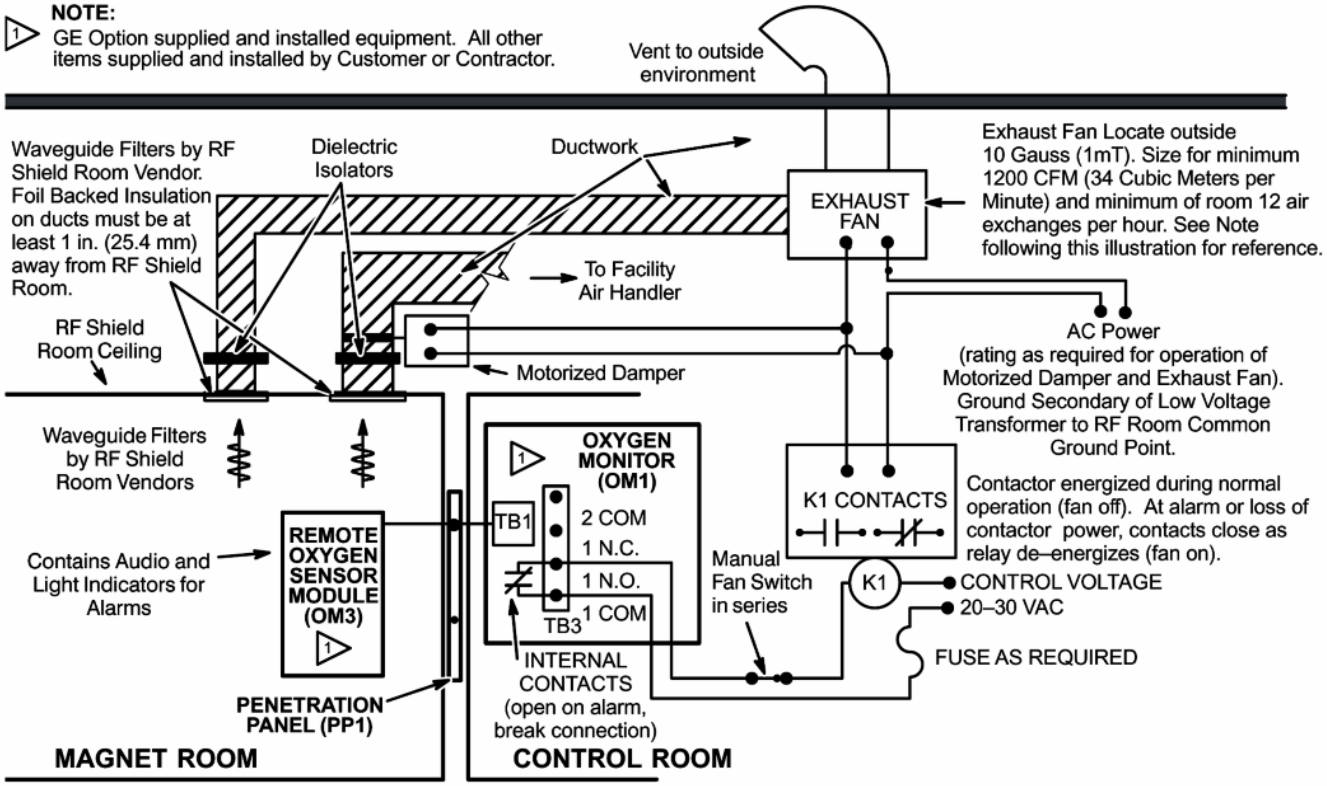


Illustration 5-3: Exhaust Fan Set-Up With Optional Oxygen Monitor



9 Alarm Devices, Water Sensors and Thermostats

9.1 System Cabinet

EXCITE (Release 11.x) systems upgrading to Release 15.x retain their EXCITE System Cabinet.

9.2 RFS Cabinet

Pre-EXCITE systems upgrading to Release 15.x will install an RFS Cabinet during the upgrade.

9.3 Water Sensor Alarm and Floor Drain

It is recommended that customer supplied water sensor alarms and floor drain be located on floors where water cooled cabinets are positioned, especially under raised flooring.

9.4 Pneumatic Patient Alert

The Pneumatic Patient Alert Control Box provides an audible and visual alarm near the operator when the patient depresses the hand held squeeze bulb. The control box is to be mounted with consideration for ease of use by operator, remaining in sight of operator, and remaining within 5 ft (1.5 m) of an electrical outlet. Note, an outlet on the Operator Workspace may be used. Options for control box location include mounting box vertically (on a wall or other vertical surface), horizontally (place box on a counter top, desk top, or other horizontal surface), or under a shelf within sight of operator.

10 Ambient Radio Frequency Interference (RFI)

The MR System utilizes spatially encoded radio frequency information to create the MR image. Therefore, it is sensitive to ambient RFI. To protect the MR from ambient RFI (as well as the local environment from Magnetic Resonance RF), all sites require a 100 dB RF Shield, refer to Chapter 8, RF Shielded Room Requirements for exact requirements. It is very unlikely that local signals will affect an MR System with a properly designed and installed RF Shield. During the site evaluation visit, GE notes the location of nearby sources of RFI and will advise if further information or on-site testing is required. Most sites do not require on-site testing. Listed in Table 5-8 are the recommended centerband and bandwidth frequencies to be used when measuring radio frequency interference. This table includes those frequency bands which are important for both proton imaging and spectroscopy.

Table 5-8: 3.0T System Radio Frequency Survey Specifications

Isotope	Bandcenter MHz	Bandwidth Hz
^{1}H	127.72	681,183
^{19}F	120.23	641,229
^{31}P	51.75	276,010
^{23}Na	33.80	180,291
^{13}C	32.13	171,335

When required, RFI site surveys are to be performed by cycling through the preceding frequency bands and a broad band range of 150MHz ± 10MHz. Special emphasis, however, should be placed on the 1H band since this is used in proton imaging. The RFI site survey should be performed for a length of time necessary to determine, within a reasonable degree of certainty, that the RFI noise at the site will not exceed the 100 db attenuation provided by the RF shielded room. Note that any RFI site survey no matter how thorough, will not preclude the possibility of future or unmeasured RFI caused by new or intermittent sources.

The ambient RF noise measured should be less than 100 millivolt per meter (100 dB microvolt per meter). When a RFI site survey is required, it must be completed before the purchase and installation of the RF shielded room.

To ensure that 100 millivolt (or greater) RF noise peaks outside the bandwidths specified above do not actually extend into these bandwidths and exceed the 100 millivolt limit, adjust the resolution of the test equipment (spectrum analyzer) according to the equation:

$$BW\ (resolution) = f_0 / 50$$

where: BW = Bandwidth (resolution)

f_0 = Center frequency (for 1H: at 3.0 Tesla 127.72 MHz)

11 Pollution

The site must be clean prior to delivery of the equipment. Although individual components have filters for optimum air filtration, care should be taken to keep air pollution to a minimum.

When cleaning tile floors, do not use steel wool which could enter cabinet enclosures and cause internal shorts.

The computer/equipment area requires that the air be filtered to remove 90 percent of all particles down to 10 microns and 80 percent of all particles from 10 to 5 microns in size.

Chapter 6 Power Requirements

1 Facility Power Requirements

1. The facility is responsible for supplying system power and cabling to the Main Disconnect Panel (MDP). Associated transformers and cables must be correctly sized for system power requirements
2. Facility power is required at Magnet delivery and continuously thereafter
3. If a customer supplied Main Disconnect Panel (MDP) is used, it must have correctly sized wires and rated components to meet the MR system power requirements
4. If an uninterruptible power supply (UPS) is used, it must meet system power requirements

Table 6-1: Required Customer Power

Signa HDxt 3.0T System					
MR Component	**Voltage (VAC)**	**Frequency**	**Phase**	**Max. Amps**	**Comments**
Main Disconnect Panel (MDP) See Notes 1, 2, 3, & 4	480Y/277 VAC ± 10% or 400Y/230 VAC ± 10%	60 Hz 50 Hz	(3+GND) See Comments	See Note 5	Recommend input configuration: 3 phase Grounded WYE with Neutral and Ground (5 wire system). Note, Neutral must be terminated prior to PDU or inside the Main Disconnect Panel and not brought to the PDU or its cabinet. (See Note 6) Optional input configuration: 3 phase DELTA with Ground (4 wire) input, recommend corner Grounded Delta configuration.
Magnet Rundown Unit	100-120 or 200-240	50/60 Hz	1	1.0	Hard wired in unit. Power must be available 24 hours per day / 7 days per week.
Magnet Monitor	100/120 or 200/220	50/60 Hz	1	0.75	Receptacle required. Power must be available 24 hours per day / 7 days per week. Also see Note 6.
Service Receptacle in Magnet Room	110-120 See Comments	50/60 Hz	1	2.0	Receptacle required for small power tools. Local voltage and portable transformers for voltages values.
* Remote Magnet Rundown Unit	100-120 or 200-240	50/60 Hz	1	1.0	Hard wired in unit
* O^2 Monitor	110-120 or 200-240	50/60 Hz	1	3.0	Hard wired in monitor
* Integrated Patient Comfort Module (IPCM) for G3 Magnet ONLY	200-240	50/60	1	30.0	Refer to IPCM Option Power Requirements
	200-277	60	1	30.0	

Signa HDxt 3.0T System					
MR Component	**Voltage (VAC)**	**Frequency**	**Phase**	**Max. Amps**	**Comments**

Notes

* Optional equipment.

1. Power phase conductors, neutral (if present), and ground conductor must be routed inside the same raceway, cable tray, trench cable or cord
2. Signa TwinSpeed MDP controls power to the following system equipment:
   - Power Distribution Unit
   - Coldhead MRCC (option to provide water cooling for Shield/Cryo Cooler Compressor)
   - Gradient MRCC
   - Shield/Cryo Cooler Compressor
   - Magnet Monitor equipment including the Magnet Monitor, Modem, Uninterruptible Power Supply (UPS*) (optional) for Magnet Monitor, Multiplexer Box (optional).
3. MDP power circuits for MRCC if providing Shield/Cryo Cooler Compressor water cooling, Magnet Monitor, and Shield/Cryo Cooler Compressor Cabinet, along with cooling for these units, are required immediately upon magnet arrival to minimize cryogen consumption. If permanent site power is not ready, temporary power drop line and cooling must be made available. If site voltage is not any of the voltages listed above, customer must provide transformer and secondary circuit breaker to provide correct voltage and/or configuration.
   MDP power circuits for MRCC if providing Shield/Cryo Cooler Compressor water cooling, Magnet Monitor, and Shield/Cryo Cooler Compressor Cabinet, along with cooling for these units, are required immediately upon magnet arrival to minimize cryogen consumption. If permanent site power is not ready, temporary power drop line and cooling must be made available. If site voltage is not any of the voltages listed above, customer must provide transformer and secondary circuit breaker to provide correct voltage and/or configuration. Refer to Facility Options for listing of step up transformers options.
4. The complete MR System Digital Energy SG Series UPS 100 KVA (E4502FB) option requires 480 VAC, 3-phase, 4 wire + ground, 60 Hz input power.
5. Maximum amps dependent on voltage selected. Refer to Critical Power Requirements for configuration.
6. PDU Module is located in the lower portion of the HFD/PDU Cabinet (MR3) or HFD-S/PDU Cabinet (MR3).

Table 6-2: Required Customer Power

Signa HDxt with 3.0T94 Magnet					
MR Component	**Voltage (VAC)**	**Frequency**	**Phase**	**Max. Amps**	**Comments**
Power Distribution Unit (PD1) Module located in the lower portion of HFD/PDU Cabinet (MR3) See Note 1	480Y/277 VAC ± 10% or 400Y/230 VAC ± 10%	60 Hz 50 Hz	(3+GND) See Comments	See Note 2	Recommend input configuration: 3 phase Grounded WYE with Neutral and Ground (5 wire system). Note, Neutral must be terminated prior to PDU or inside the Main Disconnect Panel and not brought to the HFD/ PDU Cabinet. Optional input configuration: 3 phase DELTA with Ground (4 wire) input, recommend corner Grounded Delta configuration.
Other system Components	Systems with 3.0T94 : other system components which require power are not impacted by the upgrade, refer to Direction 2221775 Signa 3.0T/94 & VH3 Pre-installation for power requirements.				

Notes

* Optional equipment.

1. Power phase conductors, neutral (if present), and ground conductor must be routed inside the same raceway, cable tray, trench cable or cord.
2. Maximum amps dependent on voltage selected. Refer to Critical Power Requirements for configuration.

2 Critical Power Requirements

The power requirements for the upgraded system is dependent on the system configuration: magnet type, MR system cooling equipment configuration present at site, and system Power Distribution Unit (PDU) present. After the HDxt upgrade the system will have the PDU located either a HFD/PDU Cabinet or a HFD-S/PDU Cabinet (an upgraded ACGD/PDU Cabinet). Information below includes the PDU requirements.

NOTICE

Signa HDx 3.0T With 3.0T94 Magnet: After the HDxt upgrade the system will have the PDU located in the lower portion of either a HFD/PDU Cabinet or a HFD-S/PDU Cabinet (an upgraded ACGD/PDU Cabinet). System components beyond the PDU in the HFD/PDU Cabinet which require power are not impacted by the upgrade, refer to Direction 2221775 Signa 3.0T/94 & VH3 Pre-installation for other system component power requirements.

Table 6-3: Critical Power Requirements

Parameter	Requirements
Configuration	• Recommend input configuration 3 phase solidly Grounded WYE with Neutral and Ground (5 wire system). Note: Neutral must be terminated prior to or inside the Main Disconnect Panel • Optional input configuration 3 phase DELTA with Ground (4 wire) input, recommend corner Grounded Delta configuration.
Frequency	50 ± 3 Hz or 60 ± 3 Hz
Regulation	4% maximum at system maximum power demand (averaged over 5 seconds) from source to PDU (i.e. includes all feeders and transformer to utility)
Phase Balance	Difference between the highest phase line-to-line voltage and the lowest phase line-to-line voltage must not exceed 2%
Daily Voltage Variation	10% from nominal under worst case line and load regulation
PDU Voltage	200/208/380/400/415/480 VAC 10%
Shield/Cryo Cooler Compressor Voltage	380/400/415 VAC 50 Hz or 460/480 VAC 60Hz
Coldhead MRCC Voltage	380/400 VAC 10% 50 Hz or 460/480 VAC 10% 60Hz
Magnet Monitor equipment Voltage	100/120 or 200/220 VAC
Voltage Transients	Phase-to-phase voltages must be within 2% of the lowest phase-to-phase voltage. Maximum allowable transient voltage above or below nominal waveshape not to exceed 200 V at a maximum duration of 1 cycle and frequency of 10 times per hour.
Facility Zero Voltage Reference Ground	• Main facility ground conductor to Main Disconnect Panel (MDP) must be copper • Main facility ground wire must be insulated • Ground impedance to earth at power source must be 2 ohms or less • Main facility ground wire must be bonded at every distribution box in an approved grounding block

Parameter	Requirements
Maximum Momentary Demand	**For Signa HDx 3.0T With LCC300 Magnet & MRCC or GWHX System Cooling Equipment:** The power demands specified as a function of the duration of the power demand. The power demands specified as a function of the duration of the power demand. **For all systems:** The power system feeding the Signa system must be designed to meet the specifications of less than 4% regulation when loaded at the 5.0 second allowable consumption. For short intervals the Signa system power demands can exceed the 5.0 second value and the line voltage delivered to the system will sag below the 4% regulation. The Signa system is designed to tolerate these short voltage sags.
Average (while scanning) Power Demand	**For Signa HDx 3.0T With LCC300 Magnet & MRCC or GWHX System Cooling Equipment:** **For Signa HDx 3.0T With LCC300 Magnet & TSCC or TGWC System Cooling Equipment:** Refer to Table 6-7
Standby (no scan) Power Demand	**For Signa HDx 3.0T With LCC300 Magnet & MRCC or GWHX System Cooling Equipment:** 27.7 kVA at 0.9 lagging Power Factor including 4.4 kVA for PDU, 9.8 kVA for 2 MRCC units for system water cooling, 9kVA (continuous operation) for Shield/Cryo Cooler Cabinet, and 1.5 kVA 1 phase for Magnet Monitor equipment (4.5 kVA 3 phase equivalent). **For Signa HDx 3.0T With LCC300 Magnet & TSCC or TGWC System Cooling Equipment:** 26.9 kVA at 0.9 lagging Power Factor including 4.4 kVA for PDU, 9 kVA for for system cooling equipment, 9kVA (continuous operation) for Shield/Cryo Cooler Cabinet, and 1.5 kVA 1 phase for Magnet Monitor equipment (4.5 kVA 3 phase equivalent).

Table 6-4: System With TRM Coil Peak Power Demand

Cooling Equipment □	MR System Cooling Equipment For Both Gradient Coil & Shield/Cryo Cooler Compressor Water Cooling See Note 1	MR System Cooling Equipment For Gradient Coil ONLY See Note 2	
System Equipment □	2 MRCC Units	1 MRCC Unit	1 GWHX Unit
PDU draw for 5.0 sec	~61.2 kVA	~61.2 kVA	~61.2 kVA
PDU draw for 1.0 sec or less See Note 3	~65 kVA	~65 kVA	~65 kVA
Magnet Monitor See Note 4	4.5 kVA	4.5 kVA	4.5 kVA
Shield/Cryo Cooler Compressor	9 kVA	9 kVA	9 kVA
System Cooling equipment (configuration indicated in column heading)	15.8 kVA	7.9 kVA	0 kVA See Note 5
TOTAL for 5.0 sec	~90.5 kVA	~82.6 kVA	~74.7 kVA
TOTAL for 1.0 sec or less	~94.3 kVA	~86.4 kVA	~78.5 kVA

Cooling Equipment □	MR System Cooling Equipment For Both Gradient Coil & Shield/Cryo Cooler Compressor Water Cooling See Note 1	MR System Cooling Equipment For Gradient Coil ONLY See Note 2	
System Equipment □	2 MRCC Units	1 MRCC Unit	1 GWHX Unit

Notes

1. Two MRCC units are used to provide water cooling for the Gradient Coil and for the Shield/Cryo Cooler Compressor.
2. Customer provided water cooling for the Shield/Cryo Cooler Compressor is required when either 1 MRCC or the GWHX is used to provide Gradient Coil water cooling. Customer provided water cooling equipment power demands are not included in the values in this table.
3. The PDU draw on the line will not exceed list values. The ACGD Power Supply may provide up to 170 kVA for 0.003 seconds from supply internal capacitance but the supply will recharge capacitors at a power level less than 65 kVA.
   The PDU draw on the line will not exceed list values. The ACGD Power Supply may provide up to 170 kVA for 0.003 seconds from supply internal capacitance but the supply will recharge capacitors at a power level less than 65 kVA.
4. The Magnet Monitor equipment power is 1.5 kVA 1 phase on an unbalanced leg of 3 phase input (4.5 kVA 3 phase equivalent).
5. The GWHX is powered from the PDU and therefore included in the PDU draw value.

Table 6-5: System With TRM Coil Peak Power Demand

Cooling Equipment □	TSCC See Note 1			TGWC See Note 2		
System Equipment □	Outdoor TSCC	Indoor Water Cooled TSCC	Indoor Air Cooled TSCC	Outdoor TGWC	Indoor Water Cooled TGWC	Indoor Air Cooled TGWC
PDU draw for 5.0 sec	~61.2 kVA	~61.2 kVA	~61.2 kVA	~61.2 kVA	~61.2 kVA	~61.2 kVA
PDU draw for 1.0 sec or less See Note 3	~70 kVA	~70 kVA	~70 kVA	~70 kVA	~70 kVA	~70 kVA
Magnet Monitor See Note 4	4.5 kVA	4.5 kVA	4.5 kVA	4.5 kVA	4.5 kVA	4.5 kVA
Shield/Cryo Cooler Compressor	9 kVA	9 kVA	9 kVA	9 kVA	9 kVA	9 kVA
System Cooling equipment (configuration indicated in column heading)	23 kVA	20 kVA	22.7 kVA	16 kVA	0 kVA See Note 5	11.6 kVA
TOTAL for 5.0 sec	~98.7 kVA	~948.7 kVA	~97.4 kVA	~90.7 kVA	~74.7 kVA	~86.3 kVA
TOTAL for 1.0 sec or less	~106.5 kVA	~103.5 kVA	~106.2 kVA	~99.5 kVA	~83.5 kVA	~95.1 kVA

Notes

1. TSCC provides water cooling for the Shield/Cryo Cooler Compressor and Gradient Coil.
2. TGWC provides water cooling for Gradient Coil ONLY. Customer/site provided water cooling is required for Shield/Cryo Cooler Compressor. Customer provided water cooling equipment power demands are not included in the values in this table.
3. The PDU draw on the line will not exceed list values. The HFD Power Supply may provide up to 170 kVA for 0.003 seconds from supply internal capacitance but the supply will recharge capacitors at a power level less than 65 kVA.
4. The Magnet Monitor equipment power is 1.5 kVA 1 phase on an unbalanced leg of 3 phase input (4.5 kVA 3 phase equivalent).
5. The GWHX is powered from the PDU and therefore included in the PDU draw value.

Table 6-6: System With TRM Coil Average (Continuous) Scanning Power Demand

Cooling Equipment □	MR System Cooling Equipment For Both Gradient Coil & Shield/Cryo Cooler Compressor Water Cooling See Note 1	MR System Cooling Equipment For Gradient Coil ONLY See Note 2	
System Equipment □	2 MRCC Units	1 MRCC Unit	1 GWHX Unit
PDU draw See Note 3	48.1 kVA	48.1 kVA	49.5 kVA
Magnet Monitor	4.5 kVA	4.5 kVA	4.5 kVA
Shield/Cryo Cooler Compressor	9 kVA	9 kVA	9 kVA
System Cooling equipment (configuration indicated in column heading)	12.4 kVA	6.2 kVA	0 kVA See Note 4
TOTAL See Note 5	74.0 kVA	67.8 kVA	63.0 kVA

Notes

1. Two MRCC units are used to provide water cooling for the Gradient Coil and for the Shield/Cryo Cooler Compressor.
2. Customer provided water cooling for the Shield/Cryo Cooler Compressor is required when either 1 MRCC or the GWHX is used to provide Gradient Coil water cooling. Customer provided water cooling equipment power demands are not included in the values in this table.
3. The PDU is rated for 50 kVA continuous power.
4. The GWHX is powered from the PDU and therefore included in the PDU draw value.
5. GE pre-engineered Main Disconnect Panel (MDP) is rated continuous power draw is 77 kVA but MDP continuous draw does not exceed listed demands.

Table 6-7: System With TRM Coil Average (Continuous) Scanning Power Demand

Cooling Equipment □	TSCC See Note 1			TGWC See Note 2		
System Equipment □	Outdoor TSCC	Indoor Water Cooled TSCC	Indoor Air Cooled TSCC	Outdoor TGWC	Indoor Water Cooled TGWC	Indoor Air Cooled TGWC
PDU draw See Note 3	48.1 kVA	48.1 kVA	48.1 kVA	48.1 kVA	49.5 kVA	48.1 kVA
Magnet Monitor	4.5 kVA	4.5 kVA	4.5 kVA	4.5 kVA	4.5 kVA	4.5 kVA
Shield/Cryo Cooler Compressor	9 kVA	9 kVA	9 kVA	9 kVA	9 kVA	9 kVA
System Cooling equipment (configuration indicated in column heading)	18.3 kVA	14.0 kVA	13.0 kVA	15.0 kVA	0 kVA See Note 4	8.8 kVA
TOTAL See Note 5	79.9 kVA	75.6 kVA	74.6 kVA	76.6 kVA	63.0 kVA	70.4 kVA

Cooling Equipment □	TSCC See Note 1			TGWC See Note 2		
System Equipment □	Outdoor TSCC	Indoor Water Cooled TSCC	Indoor Air Cooled TSCC	Outdoor TGWC	Indoor Water Cooled TGWC	Indoor Air Cooled TGWC

Notes

1. TSCC provides water cooling for the Shield/Cryo Cooler Compressor and Gradient Coil.
2. TGWC provides water cooling for Gradient Coil ONLY. Customer/site provided water cooling is required for Shield/Cryo Cooler Compressor. Customer provided water cooling equipment power demands are not included in the values in this table.
3. The PDU is rated for 50 kVA continuous power.
4. The Water Cooled TGWC is powered from the PDU and therefore included in the PDU draw value.
5. GE pre-engineered Main Disconnect Panel (MDP) is rated continuous power draw is 77 kVA but MDP continuous draw does not exceed listed demands.

3 Power Distribution System

3.1 Main Disconnect Panel (MDP) Requirements

WARNING

PERSONNEL INJURY OR EQUIPMENT DAMAGE
CUSTOMER SUPPLIED MAIN DISCONNECT PANEL DESIGN MUST HAVE CORRECTLY SIZED WIRES AND RATED COMPONENTS TO MEET THE MR SYSTEM POWER REQUIREMENTS.

WARNING

IF AN UNINTERRUPTIBLE POWER SUPPLY (UPS) PROVIDES POWER TO THE ENTIRE MR SYSTEM THEN THERE IS A NEED TO MAKE SURE THE UPS OPERATION PARAMETERS ARE COMPATIBLE WITH THE SIGNA SYSTEM POWER AND REGULATION DEMANDS.

WARNING

THE MDP CIRCUIT FOR THE SHIELD COOLER COMPRESSOR CABINET AUTO RESTART FUNCTION MUST BE CONTROLLED BY THE EMERGENCY OFF FUNCTION.

Upgraded MR System With LCC300 Magnet

After the MR system upgrade is installed the PDU will be located in the lower portion of the HFD-S/PDU Cabinet (an upgraded ACGD/PDU Cabinet). The Main Disconnect must meet the PDU requirements stated in Critical Power Requirements.

Upgraded MR System With 3.0T94 Magnet

After the MR system upgrade is installed the PDU will be located in the lower portion of either a HFD/PDU Cabinet or a HFD-S/PDU Cabinet (an upgraded ACGD/PDU Cabinet). The Main Disconnect must meet the PDU requirements stated in Critical Power Requirements.

3.2 Power Distribution Unit (PDU) Requirements

The Power Distribution Unit (PDU) is located in the lower section of the HDF/PDU cabinet (MR3) and has the following requirements:

1. The largest allowable phase conductor the PDU will accept is 3/0 AWG (83 mm2). Larger feeder wires can be connected to the MDP with 3/0 AWG (83 mm2) between the MDP and PDU
2. The ground conductor between the MDP and PDU must be at least 1/0 AWG copper (or the same size as the feeder wire) whichever is larger. Lug connector for the ground wire must be provided by the contractor (recommended Amp Inc. number 36919 lug)
3. The resistance between any two grounded devices in the MR system (e.g., PDU and MDP) must not exceed 0.1 ohm
4. Neutral, if present, must be terminated prior to or inside the Main Disconnect Panel (MDP) and not brought to the PDU Module in the HFD/PDU Cabinet (MR3)
5. When the full MR system UPS option [Signature 5000 Series 3 UPS 100KVA (E4502FB)] is installed, the feeder wiring from the UPS to the PDU Module must be sized to maintain voltage regulation of <5% at 100KVA.

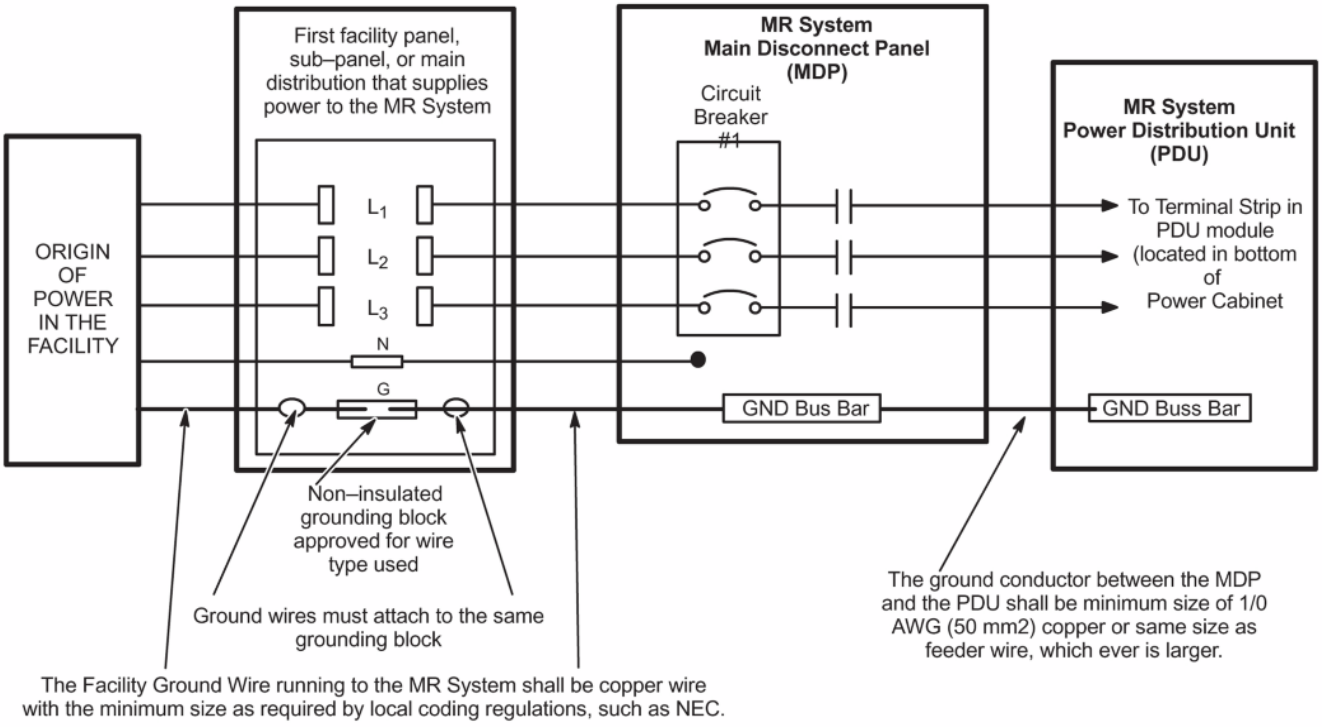
4 Grounding

4.1 Facility Ground

The ground for the MR system shall originate at the system power source, ie. transformer or first access point of power into the facility, and be continuous to the MR system Main Disconnect Panel (MDP) in the room. This ground can be spliced with “High Compression Fittings" and should be terminated at each distribution panel it passes through. When it is broken for a connection to a panel, it shall be connected into an approved non-insulated grounding block with the incoming and outgoing ground in this same grounding block, which is then connected to the steel panel, never using the steel or other material of the panel as the block. See Illustration 6-1.

The connection at the power source shall be at the grounding point of the “Neutral - Ground" if a “Wye" transformer is used, or typical grounding points of separately derived system. In the case of an external facility, it shall be bonded to the facility ground point at the service entrance.

Illustration 6-1: Ground Wire To MR System & Ground Connection At Distribution Panel



Ground Wire

The main facility ground conductor to the MDP shall be copper wire and the minimum size as required by the local coding regulations, such as the NEC. A dedicated copper ground wire the same size as the feed wires or 1/0 AWG (which ever is larger) must be run from the MR system MDP to the PDU. See Illustration 6-1. The ground wire impedance from the MR system disconnect, including the ground rod, shall not have an impedance greater than 2 ohms to earth as measured by one of the applicable techniques described in Section 4 of ANSI/IEEE Standard 142 - 1982 which can be accomplished using 3-point Fall Of Potential (3 point measurement) method or

Clamp-On Ground Resistance measurement which requires a ground measurement device such as AEMC 3730.

4.2 System Ground

The MR system is designed with minimum ground loops to prevent noise currents and natural disturbances from flowing through the low-level signal reference path.

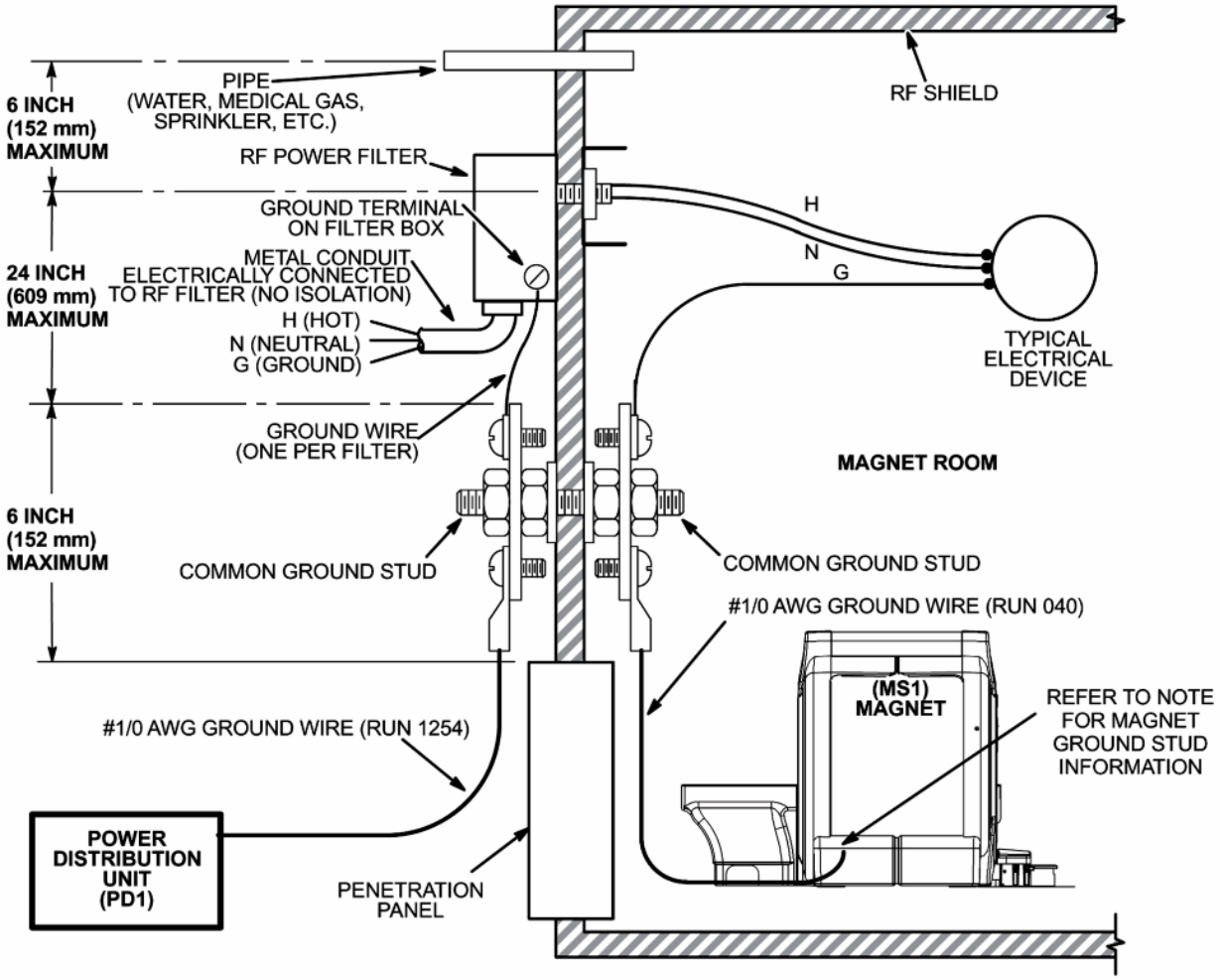
The three major grounding points in the MR system are: the system ground point (bus) in the System PDU (PD1), the enclosure ground points (ground studs located in each cabinet or enclosure), and the RF shielded room common ground point. This RF shielded room common ground point is to be located within 6 in. (152 mm) of the GE supplied Penetration Panel. Refer to Chapter 8, Electrical for a further description of the RF shielded room common ground point.

To ensure patient safety and system performance, the conditions defined in Illustration 6-2 must be met when running power lines into the Magnet Room.

Any modifications or non-MR equipment grounds added to the MR ground system must be approved by your GE Service Representative in order to ensure safety and performance.

Illustration 6-2: MR Magnet Room Grounding Requirements And Typical Diagram

NOTE:
- ALL ITEMS SHOWN ARE CUSTOMER SUPPLIED EXCEPT POWER DISTRIBUTION UNIT, MAGNET, AND ONE #1/0 AWG GROUND WIRE BETWEEN MAGNET GROUND STUD AND RF COMMON GROUND POINT AND ONE #1/0 AWG GROUND WIRE BETWEEN PD1 AND RF COMMON GROUND POINT.
- **RESISTANCE BETWEEN ANY TWO GROUNDED DEVICES *MUST NOT EXCEED 0.1 OHM* TO ENSURE EQUAL POTENTIAL GROUND SYSTEM WITHIN MAGNET ROOM.**
- **LOCATE FILTERS WITHIN 2 FEET (600 mm) OF RF COMMON GROUND STUD WHICH MUST BE LOCATED WITHIN 6 INCHES (152 mm) OF PENETRATION PANEL.**
- ALL EXTERNAL CONDUIT MUST BE **METAL AND ELECTRICALLY CONNECTED** TO THE RF POWER FILTERS (REGARDLESS OF FILTER VOLTAGE) PER NEC 2005 OR 2002 ARTICLE 250.110.
- RF POWER FILTERS OF 30 VOLTS OR LESS MAY BE LOCATED ANYWHERE ON THE RF SHIELD **PROVIDED THE INCOMING CONDUIT IS METALLIC** PER NEC 2005 OR 2002 ARTICLE 725.21**, THESE FILTERS MUST ALSO BE LOCATED WITHIN 24 INCHES (609 mm) OF THE RF COMMON GROUND STUD .**
- ALL CONDUITS IN THE RF ROOM MUST BE **METAL**. STEEL IS ACCEPTABLE PROVIDED IT IS ADEQUATELY ANCHORED PER NEC 2005 ACTICLE 517.13 (A) & (B).
- ALL ELECTRICAL DEVICES (IE. OUTLETS, LIGHT FIXTURES, ETC.) MUST HAVE A GROUND WIRE FROM ITS POWER SOURCE AND BE GROUNDED TO RF ROOM SHIELD AT THE RF COMMON GROUND STUD AS SHOWN BELOW.
- ALL METALLIC PIPES ENTERING THE RF ROOM, EXCLUDING CRYOGENIC VENT AND FLOOR DRAINS, MUST BE LOCATED WITHIN 30 INCHES (762 MM) OF THE RF COMMON GROUND.
- LCC MAGNET HAS 4 GROUND STUDS, ONE ON EACH FOOT. HOWEVER, THERE IS ONLY ONE #1/0 AWG GROUND WIRE TO BE CONNECTED TO ONLY ONE OF THE GROUND STUDS.



5 Power Source Monitoring

The facility input power for the proposed system should be checked using a power line disturbance monitor for average line voltage, surges-sags, impulses, and frequency. Some of the recommended line analyzers which are designed for unattended monitoring are the Dranetz Models 656A or 658 and RPM Models 1651, 1656, or 1658.

Analysis should span a period to include two weekends so as to cover several days of normal use. The possibility of “brown-out" conditions which may be experienced in summer must be considered. Any existing power problems with large power consuming systems (x-ray units, CT scanners, etc.) or other computer installations at the proposed site should be reviewed as they may affect the MR system. Results of this analysis should be reviewed with your GE representative to determine if line conditioning is needed.

6 Emergency Power

Primary power should be distributed from the customer's emergency life-safety power branch to an emergency lighting source in the Magnet Room. All input power lines must be filtered upon entrance into the RF shielded room (Magnet Room) and grounded according to the requirements listed under System Grounding heading in Grounding. Always check national and local codes for other emergency power requirements.

7 DC Lighting Controller (Facility Option) Requirements

Direct current (DC) powered lighting is required in the Magnet Room per Chapter 5, Lighting. A constant lighting level DC Light Controller is available from GE as well as a variable DC lighting controller system. The wiring diagrams for these units are shown in Illustration 6-3 and Illustration 6-4. The input power, interconnect cabling, RF shielded room filters, lighting fixtures, and conduit are customer furnished.

The DC lighting systems output is rated nominally 115 VDC. Determining whether the 20 or 28 Amp system is required can be calculated by: **I = Total Lamp Wattage ÷ 115V**. If **I ≤ 20** then a 20 Amp system can be used. If **I ≥20 but <28** then use the 28 Amp system.

Illustration 6-3: DC Lighting Controller (Facility Option) Wiring Diagram

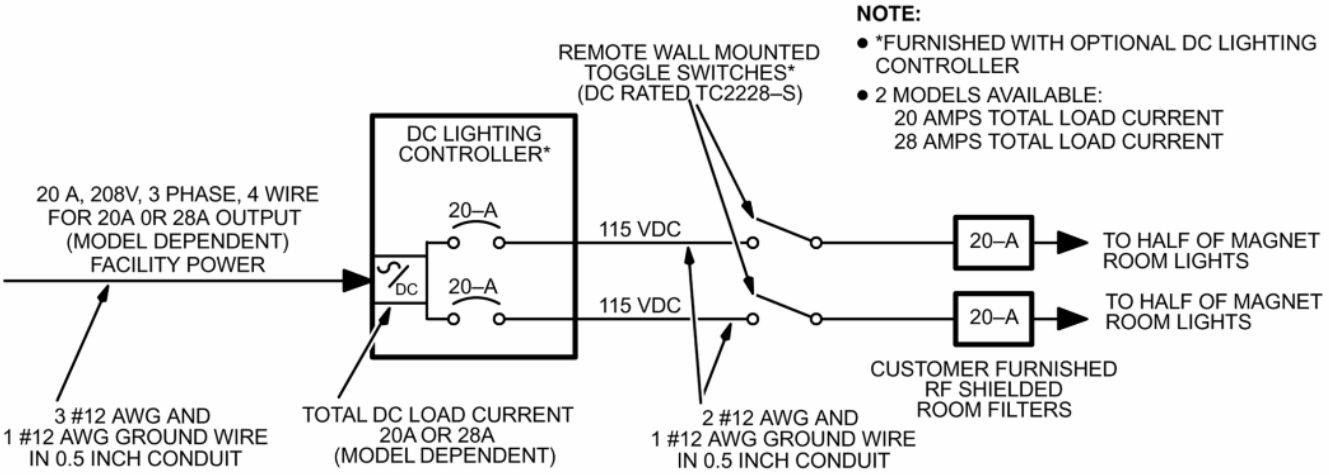
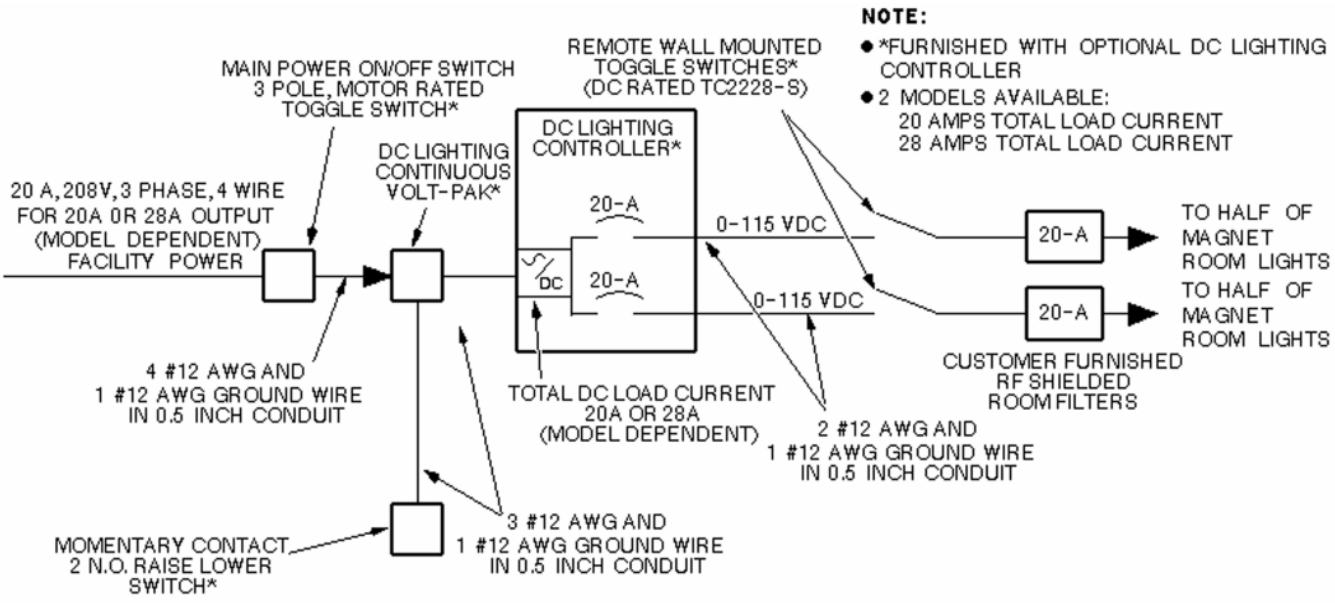


Illustration 6-4: Variable DC Lighting Controller (Facility Option) Wiring Diagram



See DC Lighting Controller Option for equipment specifications.

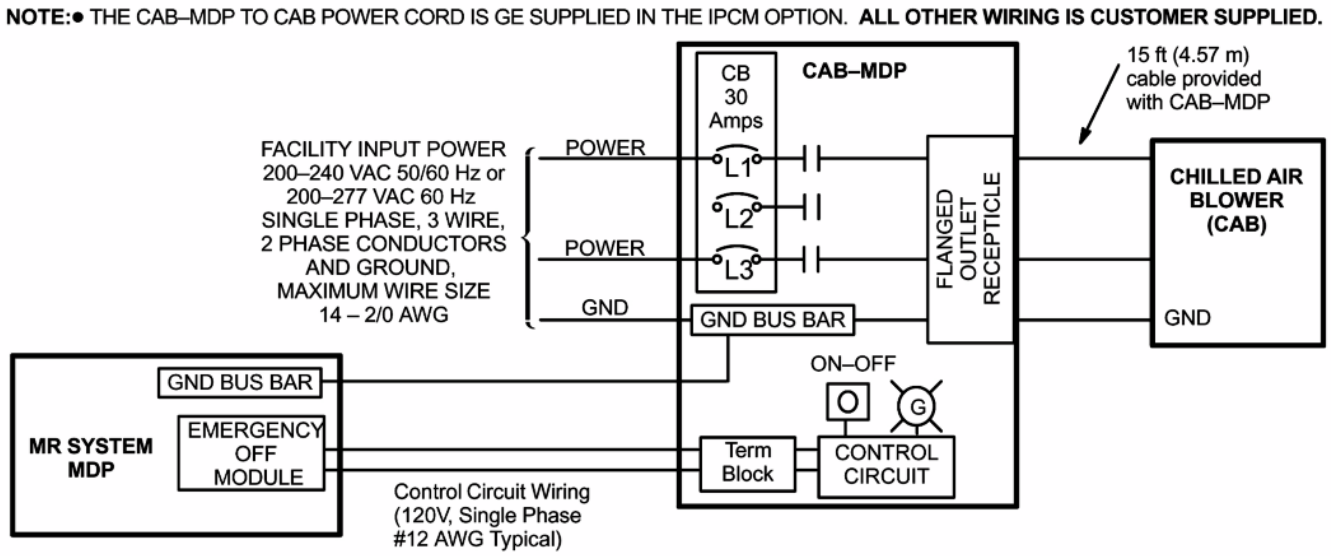
8 IPCM Option Power Requirements

The IPCM Option hardware consists of the Chilled Air Blower (CAB), CAB Main Disconnect Panel (CAB-MDP), Bore Liner hardware, modified Penetration Panel waveguide, Bridge with notched sides, Bore Liner hardware including hoses and connectors, and IPCM Option Key.

The Chilled Air Blower (CAB) provides chilled air to the 2 piece Bore Liner via an air hose routed through the Penetration Panel (provided waveguide) to the back end of the Rear Pedestal. At the Rear Pedestal additional provided hardware, hoses and connectors are used to connect the air hose to both pieces of the Bore Liner.

The CAB-MDP is not powered from the MR system MDP or PDU and therefore requires facility provided power. The CAB-MDP must also be connected to the MR system MDP Emergency Power Off control circuit via a customer supplied cable. Refer to Illustration 6-5 for IPCM Main Disconnect Panel set-up.

Illustration 6-5: IPCM Main Disconnect Panel Set-up



Chapter 7 MR System Interconnects

1 MR System Interconnects Specifications

1.1 Introduction

The sections in the Interconnect Data Chapter contain details of GE supplied MR system interconnections and customer supplied components for the MR system install.

1.2 Component Designators

GE uses a Component Designator System to identify system components. All subsystem cabinets and other components are referred to by their component designators in the diagrams and tables of the Interconnect Data sections.

1.3 Definition of Terms

The definition of terms used in the interconnects details tables throughout this chapter are:

1.4 Usable Cable Lengths

Usable Length

Amount of cable/wire/hose/etc. available for site routing point to point of the FROM and TO equipment. The interconnect cable/wire/hose total length MINUS any required takeup at or within both the FROM and TO equipment determines the usable length.

Group Number

Area

Cross-sectional area of the combined cables in a group.

NOTE: The group area was found by adding up the circular cross-sectional areas of all individual cables within a group. It does not take any fill factors or space between cables into account. Adhere to applicable electrical codes for fill factors.

Between Units (From/To)

Component Designators as found in interconnects list tables throughout this section.

Run Number

Unique number assigned to each GE-supplied cable.

NOTE: The Run Number must be used when making special cable order inquiries.

Cable Diameter

Diameter of an individual cable

Plug Pulling Diameter x Length

Cable plug dimensions (e.g., 2.0 x 3.25 indicates a plug with dimensions of 2.0 in. diameter and 3.25 in. length). If a cable has more than one connector on an end, the number of connectors is indicated at after the dimensions (e.g., 2.0 x 3.25 x 2).

1.5 Cable Group Lengths Provided

The table below lists the specific usable length provided for each interconnect Group to determine the fixed site cable catalog that will best meet the specific site layout requirements.

Table 7-1: Cable Groups Length Provided by Fixed Site Cable Catalogs

Location	Group	Between Units		Usable Length		
		From	To	M3335NY M3335AG ft (m)	M3335NZ M3335AH ft (m)	M3335P M3335AJ ft (m)
L1	42	PP1	EO1	68 (20.7) allows EO1 take-up of 15 ft (4.57 m)		
	45	PP1	MG2/3	19 (5.79)	19 (5.79)	40 (12.2)
				See Note 1, 2 and 3.		
	48	MS4	MS1	81 (24.7) - See Note 3.		
	78	RF Com-mon Ground Stud	MS1	19 (5.79)	19 (5.79)	40 (12.2)
				Minus take-up at RF Common Ground Stud		
	85	PP1	MG3	19 (5.79)	19 (5.79)	40 (12.2)
	87	PP1	MG6	16 (4.88)	16 (4.88)	37 (11.3)
	88	MG6	MG3	11 (3.35) allows 2 ft (0.6 m) take-up at MG6. See Note 4.		
L2	11	TAC	PP1	21 (6.40)	55 (16.76)	21 (6.40)
	12	TAC	PP1	43* (13.11*)	50* (15.24*)	43* (13.11*)
				*Group 8 and Group 12 are both cut to length at site from the total usable length of cable supplied.		
	23	MR2	PP1	25 (7.62)	55 (16.8)	25 (7.62)
	30	PD1	PP1	59 (17.98)		
	31	MR3	PP1	25 (7.62)	61 (18.59)	25 (7.62)
	75	MS5	PP1	42 (12.8) - See Note 3.		
	77	PD1	RF Common Ground Stud	83 (25.3)		
	81	EO2	PP1	30 (9.14)	50 (15.24)	30 (9.14)
	95	MSM1	PP1	67 (20.42) allows 8 ft (2.44 m) take-up at MSM1. See Note 1.		
L1/L2	71	MS5	MS1	42 (12.80) runs are routed through waveguides in PP1. Runs have a 8 in. (203.2 mm) bend radius. See Note 3.		

Location	Group	Between Units		Usable Length		
		From	To	M3335NY M3335AG ft (m)	M3335NZ M3335AH ft (m)	M3335P M3335AJ ft (m)
	72	MR2	MG2/3	46 (14.0)	88 (26.8)	88 (26.8) 68 (20.7)
				These runs are RF Transmit Cables, and must be cut to length and connected via PP1 at the site. Usable length provided for routing in Equipment Room and Magnet Room.		
	86	MRCC/ GWHX See Usable Length	MG2	To determine FROM connection for length requirements and details, refer to appropriate configuration.		
L3	5	PD1	MR8	24 (7.315)		
	6	PD1	MR2	16 (4.88)		
	8	MR3	TAC	43* (13.11*)	50* (15.24*)	43* (13.11*)
				*Group 8 and Group 12 are both cut to length at site from the total usable length of cable supplied.		
	9	PD1	TAC	16 (4.88)		
	10	PD1	GWHX	Refer to appropriate configuration		
	15	MS5	MRCC Unit #2	Refer to appropriate configuration		
	17	MDP	MUX	6 (1.8)		
	19	MR2	MR8	24 (7.315)		
	20	MR2	MR3	16 (4.88)		
	28	MSM1 & MSM3	MSM4	6 (1.8) minus take-up at each end - ONLY USED WITH UPS OPTION FOR MAGNET MONITOR: Customer provided phone line, cable diameter and plug pull information are estimates.		
	29	MDP	MSM4	6 (1.8) minus take-up at each end		
	32	MDP	MSM1 & MSM3	6 (1.8) minus take-up at each end		
	36	MSM3	MUX	6 (1.8) minus take-up at each end - ONLY NEEDED WHEN MULTIPLEXER FOR PHONE LINE IS USED		
	38	MR3	TAC	16 (4.88)		
L3 cont.	51	MRCC Unit #1	RCP	Refer to appropriate configuration		
	52	MRCC Unit #2	RCP	Refer to appropriate configuration		
	69	MDP	MS5	27 (8.23) allows 3 ft (0.91 m) take-up at MDP. See Note 6		
	94	MSM1	MS5	49 (14.94) allows 8 ft (2.44 m) take-up at MSM1		
	96	MSM1	MR2	50 (15.24) allows 8 ft (2.44 m) take-up at MSM1		
L4	79	OW1	PA1	5 (1.5) minus take-up at PA1		

Location	Group	Between Units		Usable Length		
		From	To	M3335NY M3335AG ft (m)	M3335NZ M3335AH ft (m)	M3335P M3335AJ ft (m)
	80	PA1	MG2	72 (21.9.5) allows 5 ft (1.52 m) take-up at PA1. See Note 5. Pneumatic tubing is continuously routed from PA1 through PP1 and MG3 to MG2.		
	92	PP1	OW1	80 (24.4)		
L5	34	MSM1	OW1	75 (22.9)		
	43	MR2	RF Door Switch	83 (25.3) allows 15 ft (4.57 m) take-up at RF Door Switch		
	90	PD1	OW1	80 (24.4)		
	91	MR2	OW1	80 (24.4)		

Notes

1. 3.0T Magnet Catalog (M3335PF) provides Magnet Monitor interconnects and Shield/Cryo Cooler Compressor to Magnet interconnects included in this Group.
2. 3.0T Magnet Catalog (M3335PF) provides some Penetration Panel to Magnet Enclosure interconnects included in this Group.
3. 3.0T Magnet Catalog (M3335PF) provides Shield/Cryo Cooler Compressor to Magnet interconnects in this Group.
4. 3.0T Fixed Site Collector Catalog (M3335MW) provides Group 88 interconnect.
5. If installation requires pneumatic tubing greater than listed between the squeeze bulb, located on the front of the Magnet Enclosure, and the Patient Alert Control Box (PA1), located near the Operator Workspace, an Extender Kit (46-317758P2) must be ordered. The Extender Kit consists of a small Extender Box (to be mounted in Equipment Room) and 95 feet (29.0 meter) of pneumatic tubing.
6. If the air-cooled cryocooler compressor option is selected, see Air-Cooled Cryocooler Compressor Requirements and Specifications.

Chapter 8 RF Shielded Room

1 RF Shielded Room Requirements

NOTE: The following information applies to areas of the site impacted by the MR system upgrade.

Improvements in MR imaging technology have increased imaging capabilities. MR procedures require a stable RF environment to achieve high resolution image quality. RF sources both inside and outside the Magnet Room have the potential to adversely affect image quality. Therefore the Magnet Room must be properly RF shielded to prevent external RF sources from entering the room. In addition, the selection of materials and construction methods of the RF Shield must be designed and installed to minimize the generation of adverse signals within the RF Shield and Magnet Room.

1.1 RF Shielding Background

RF sources which can adversely affect image quality may be generated by discrete frequency or broadband noise (RF) sources.

1.1.1 Discrete Frequency

Discrete RF interferences are narrowband and are fixed frequency in nature. The Magnet Room must be RF shielded from RF sources so external RF energy does not degrade the MR system RF receivers at the system imaging frequencies, refer to Chapter 5, Ambient Radio Frequency Interference (RFI). Some potential sources for discrete frequency signals are radio station transmitters, mobile or hand-held RF transmitting devices, etc.

1.1.2 Broadband RF Noise

Broadband RF noise is a single transient or continuous series of transient disturbances caused by an electrical discharge, for system imaging frequencies refer to Chapter 5, Ambient Radio Frequency Interference (RFI). Low humidity environmental conditions will have higher probability of electrical discharge, refer to Chapter 5, Temperature and Humidity Specifications. The electrical discharge can occur due to electrical arcing (micro arcing) or merely a static discharge. Some potential sources capable of producing electrical discharge include:

- loose hardware/fasteners vibration or movement (electrical continuity must always be maintained)
- flooring material including raised access flooring (panels & support hardware) and carpeting
- electrical fixtures
  - lighting fixtures
  - track lighting
  - emergency lighting
  - battery chargers
  - outlets
- ducting for HVAC and cable routing

- RF Shield seals (walls, doors, windows, etc.).

1.2 RF Shielded Room Requirements

The Magnet Room RF Shield must meet the requirements defined inTable 8-1 for the system to produce high quality MR images.

NOTE: The RF Attenuation and Ground Isolation are intended to control discrete RF signals and RF interference sources. The remaining parameters contained inTable 8-1 are intended to minimize potential broadband noise sources.

Table 8-1: RF Shielded Room Requirements

Parameter (See Note *)	Requirements (See Note *)
RF Attenuation	100dB (150MHz ± 10MHz) planewave, refer to Chapter 11, RF Shielded Enclosure Test Guideline Frequency Range subsection.
Ground	1. Ground Isolation: 1,000 ohms or greater 2. Primary Ground: All RF Shield components (walls, floor, ceiling, etc) must be electrically bonded together to form one common ground plane which is connected to the Facility Grounding Conductor. The RF Shield must be grounded back to the facility ground via the RF Common Ground Stud connection to the MR system PDU. **NOTE:** Introduction of facility power into the RF Shielded Room must not compromise the RF Shield Primary Ground. 3. Secondary Ground (Other grounds that connect the outside of the RF Shield Room to earth grounds are called secondary grounds): Secondary grounds must not compromise Ground Isolation of 1,000 ohms or greater.
Materials	1. The choice of RF Shield material including fasteners is the responsibility of the customer's architect and RF vendor. 2. The choice of material must not affect magnet homogeneity (i.e. copper, brass or treated aluminum are non-magnetic and will not affect Magnet homogeneity). **NOTE:** Any steel RF Shield will affect the magnet's homogeneity and must be reviewed by GE Healthcare MR Siting and Shielding Group. 3. The floor under the Magnet in a 10 ft x 10 ft (3.048 m x 3.048 m) area must not be fabricated from magnetic materials, refer to Magnet Room Floors Magnetic Properties requirements in the pre-installation manual appropriate for the magnet system. Contact the GE Healthcare MR Siting and Shielding Group. 4. The Magnet Room floor materials must meet the requirements in Magnet Room Floors. 5. The door or any other moving or non-rigid parts must not be fabricated from magnetic materials. 6. The RF Shield integrity (attenuation) must not be compromised by corrosion for the anticipated duration of usage for MR imaging. The following items are critical: a. Avoid direct contact of materials of different solution potential (e.g. dissimilar metals galvanic corrosion) when selecting fastens to secure the RF screen material to the RF supporting structure. b. Ensure the RF shield seams/joints have overlaps that are properly dressed selecting proper material to avoid galvanic corrosion. c. Introduce sacrificial anodes to prevent corrosion of critical RF shield components. **NOTE:** Typically the RF Shield surrounds the Magnet Room finished walls, ceiling, and floor. Therefore the RF Shield may not be in a temperature and humidify controlled environment. d. RF Screen Room including all openings (i.e. windows, doors, vents, etc.) need acoustic properties to meet local regulations and customer requirements. **NOTE:** RF Screen Room doors with <55 db acoustic attenuation have caused customer acoustics issues.

Parameter (See Note *)	Requirements (See Note *)
Construction	1. The design of the shield support system is the responsibility of the customer's architect and RF vendor. 2. RF Shield construction methods must not compromise RF Shield integrity (attenuation) for the anticipated duration of usage for MR imaging. a. When RF shield seams/joints are sealed with solder: all solder drips, cold solder joints, and cracked solder joints must be cleaned and repaired. b. RF Shield movement can cause micro electrical arcs (static discharge or broadband RF noise) that will cause MR image artifact known as White Pixel. c. Physical fluctuation of the RF Shield material can result in RF leaks due to seam openings, cracks, enlarged holes at fasteners. Physical fluctuation of the RF Shield can be generated by cyclic air pressure changes and door closures/openings. d. All electrical and mechanical connections and fasteners including screws, nails, nuts, bolts, clips clamps, concrete anchors, seismic anchors, etc. must be tightened and secured to supplier specifications so as not to become a potential broadband noise source. e. All fasteners must be solid locking devices such as t-nuts, PEM nuts or welded nuts; no self tapping screws allowed. f. The Magnet Room floor design and construction must meet the requirements in Floors.  **CAUTION** **For safety reasons, magnetic materials must be secured to ensure magnetic components do not become projectiles.** **Methods of securing must not loosen due to repeated use, some options include (but not limited to) redundant restrains straps or anchors/bolts with locking nuts.**
Testing	1. The customer's architect and RF vendor are responsible for conducting testing to verify compliance with the requirements for RF attenuation and ground isolation. 2. The RF shielded room verification test is to be performed in the presence of a GE representative. 3. The FINAL RF Shielded room acceptance test shall be performed in accordance with Chapter 11, RF Shielded Enclosure Test Guideline.
Maintenance	1. The customer is responsible for maintaining the RF Shield service life integrity for the anticipated duration of usage for MR imaging per the RF vendor's recommended maintenance. 2. The customer is responsible to notify the GE Service Representative of any RF shielded Room maintenance issues since there may be system performance impacts.
NOTE:	* The RF Shielded Room design, materials, construction, and installation shall be such to meet the requirements for the anticipated duration of usage for MR imaging.

2 Vents

2.1 HVAC

RF shielded room contractor is to install HVAC waveguides (open pipes or honeycomb-type) which penetrate room and to ensure waveguides are non-magnetic and electrically isolated. HVAC contractor is to determine size and number of vents, consistent with local codes.

Honeycomb-type waveguides must be accessible for annual customer inspection and cleaning / maintenance.

An exhaust fan placed outside the RF shielding with appropriate wave guide filtering is required for quick removal of helium gas in the event large amounts of helium disperse into the Magnet Room. The exhaust fan can be connected to the output relay of the optional oxygen monitor. The fan will then be activated in the event the room oxygen level is less than 18%. Refer to Chapter 5, Room Ventilation for other exhaust fan requirements.

3 Plumbing

All metallic pipes entering the RF Room, excluding cryogenic vent and floor drains, must be located within 30 inches (762 mm) of the RF common ground.

NOTICE

Mounting and support of all metallic pipes must comply with requirements in RF Shielded Room Requirements to minimize the possibilities of electrical discharge which can cause RF broadband noise.

NOTE: When welding in an MR room with system equipment installed, the return path for the welding must be in very close proximity to the welding. The close proximity is needed to make sure the welding currents do not cause damage to the system. Never use the building structure as a return path for welding.

3.1 Water

All pipe waveguides must comply with requirements in RF Shielded Room Requirements to minimize the possibilities of electrical discharge which can cause RF broadband noise. All plumbing must be in accordance with local and national codes.

3.2 Medical Gases

The customer should consider if medical gases are to be piped into the Magnet Room along with suction service for patient life support. Remember, all non-electrical entries into the Magnet Room must use appropriate waveguide. Special precaution must be taken to ensure that ferromagnetic medical gas cylinders are not brought into the Magnet Room.

3.3 Sprinklers

If using sprinklers in the Magnet Room, dry pipe systems have the advantage of reducing ground problems. However, all decisions regarding fire protection systems are the customer's responsibility. If wet-type sprinkler system is used, pipe penetration should be limited to one location.

4 Electrical

4.1 Electrical Lines and Filters

The entry of any electrical lines into the RF Shielded Room must be filtered to ensure compliancy with the RF Shielded Room attenuation requirements. The RF Shielded Room vendor must supply filters for all penetrations of the RF shielding excluding the lines entering through the GE supplied RF penetration panel. All filters (for electrical lines) must be located outside the 200 gauss line.

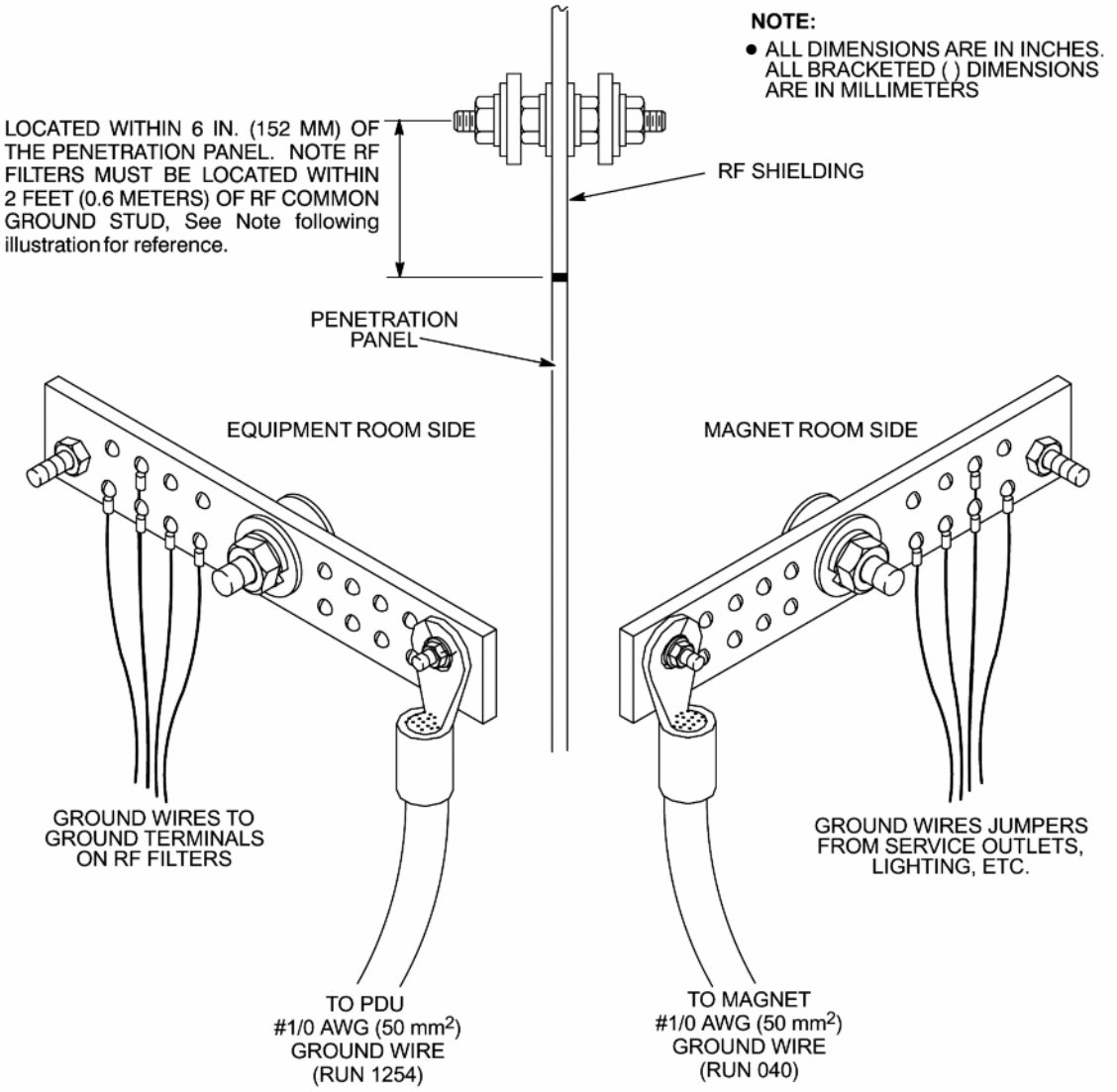
NOTE: All electricals lines and filters must comply with requirements in RF Shielded Room Requirements to minimize the possibility of electrical discharge which can cause RF broadband noise.

RF Shielded Room vendor must review with the electrical contractor the number of incoming power lines to the Magnet Room to determine the number of filters needed for electrical requirements.

Grounding from customer supplied power filters to the RF Shield Common Ground Stud, see Chapter 6, Critical Power Requirements and Chapter 6, Grounding for power and grounding requirements of all incoming power lines to the RF shielded room.

Common ground connection for shielded room must be located within 6 in. (152 mm) of the RF shielded room Penetration Panel with RF filters located within 2 feet (0.6 meters) of the RF Common Ground Stud. RF shielded room vendor to provide this common ground connection on both sides of shielded room by means of a stud extending through the shielded room (see Table 8-2). The RF Common Ground Stud and terminal bars must be accessible for servicing purposes on both sides of shield room. It is recommended that the RF Common Ground Stud be positioned above the Penetration Panel so it is concealed behind the Penetration Panel Covers (see RF Penetration Panel).

Table 8-2: RF Common Ground Penetration Stud



NOTE: RF Common Ground Stud location to be per Chapter 6, Grounding

4.2 Room Lighting

NOTICE

Installation and selection of lighting fixtures must comply with requirements in RF Shielded Room Specifications to minimize the possibility of electrical discharge which can cause RF broadband noise.

Fluorescent lighting is not allowed in the Magnet Room due to the RF noise generated by the fluorescent light tubes. Dimmer switches must not be used; however, a selectable switch may be used to change the light intensity.

For additional Magnet Room lighting information refer to Chapter 5, Lighting, Chapter 6, Grounding, Chapter 6, Emergency Power, Chapter 6, DC Lighting Controller (Facility Option).

5 RF Penetration Panel

The RF Shielded Room Vendor must provide the opening in the RF shielding and appropriate mounting hardware for the GE Penetration Panel.

The entire Penetration Panel must be located outside 200 Gauss.

NOTICE

Penetration Panel electrical and mechanical connections, mounting hardware, and installation must comply with requirements in RF Shielded Room Requirements to minimize the possibilities of electrical discharge can cause RF broadband noise.

NOTICE

The Penetration Panel mounting hardware must not loosen over time to maintain RF attenuation requirement in RF Shielded Room Requirements for the anticipated duration of usage for MR imaging. Some of the design parameter that can contribute to loosen of the Penetration Panel mounting hardware are: wall material compression over time, insufficient fasteners quantity or spacing, over or under tightness of mounting fasteners, insufficient locking mechanism (i.e. Locktight, double/locking nuts), etc.

The RF shielded room acceptance test must be performed after the opening is cut in the RF shielding for the GE Penetration Panel. This acceptance test must be conducted with vendor supplied blank panel and the same mounting hardware to be used with the GE Penetration Panel. It is the facility's responsibility to ensure that the RF Shielded Room Vendor testing meets the attenuation specifications listed in RF Shielded Room Specifications.

The Penetration Panel must be covered on both sides for safety. If GE supplied adjustable covers are not used, customer must furnish covers or enclosures with key or tool required for opening to limit access to the panel. The mounting and clearance dimensions for the Penetration Panel GE covering are shown in Penetration Panel/Covering Mounting Requirements illustration in Table 8-3.

Illustration 8-1 and Illustration 8-2 show two possible methods for mounting the GE MR Penetration Panel. Either method may be used depending on RF shielded room wall thickness. Make sure if the mounting method in Illustration 8-1 is used then the RF wall thickness must be 0.75 in. (19 mm) 0.0625 in. (1.6 mm). Refer to the two preceding Notices. Check with RF Shielded Room Vendor to determine appropriate mounting method.

The Penetration Panel is to be mounted above the finished floor on the Equipment Room side of the RF shielded room. GE supplies only the Penetration Panel as shown in Illustration 8-1 and Illustration 8-2.

NOTE: The following illustrations are examples only and they remain responsible for this RF integrity detail. The connection is dependent upon the thickness and flexibility of the RF shield. The RF vendor is responsible for these details, not GEHC.

Illustration 8-1: Penetration Panel Cut Out For 0.75 Inch (19 MM) Thick RF Wall

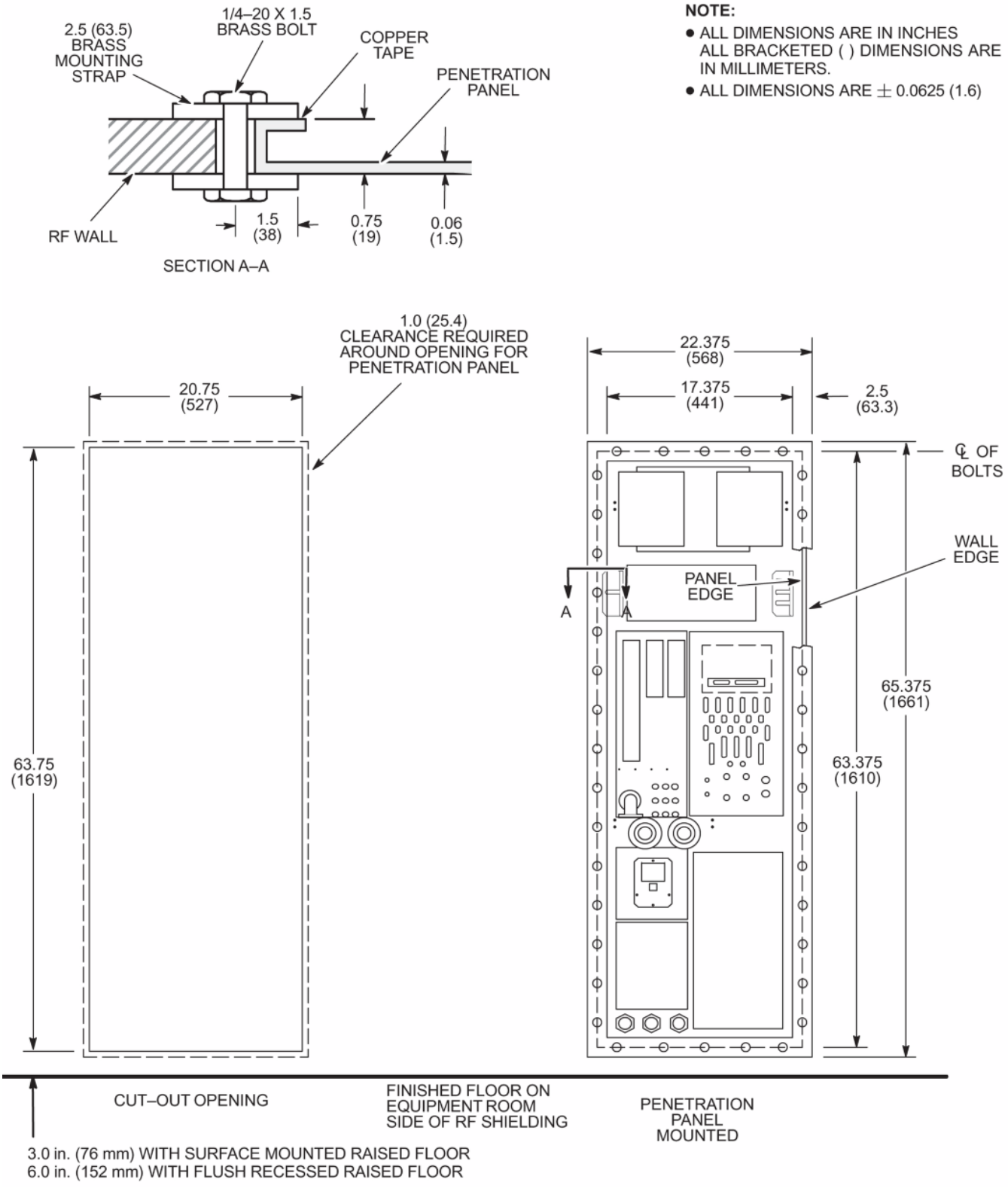


Illustration 8-2: Penetration Panel Cut Out For RF Wall Thickness Varying From Small To Large

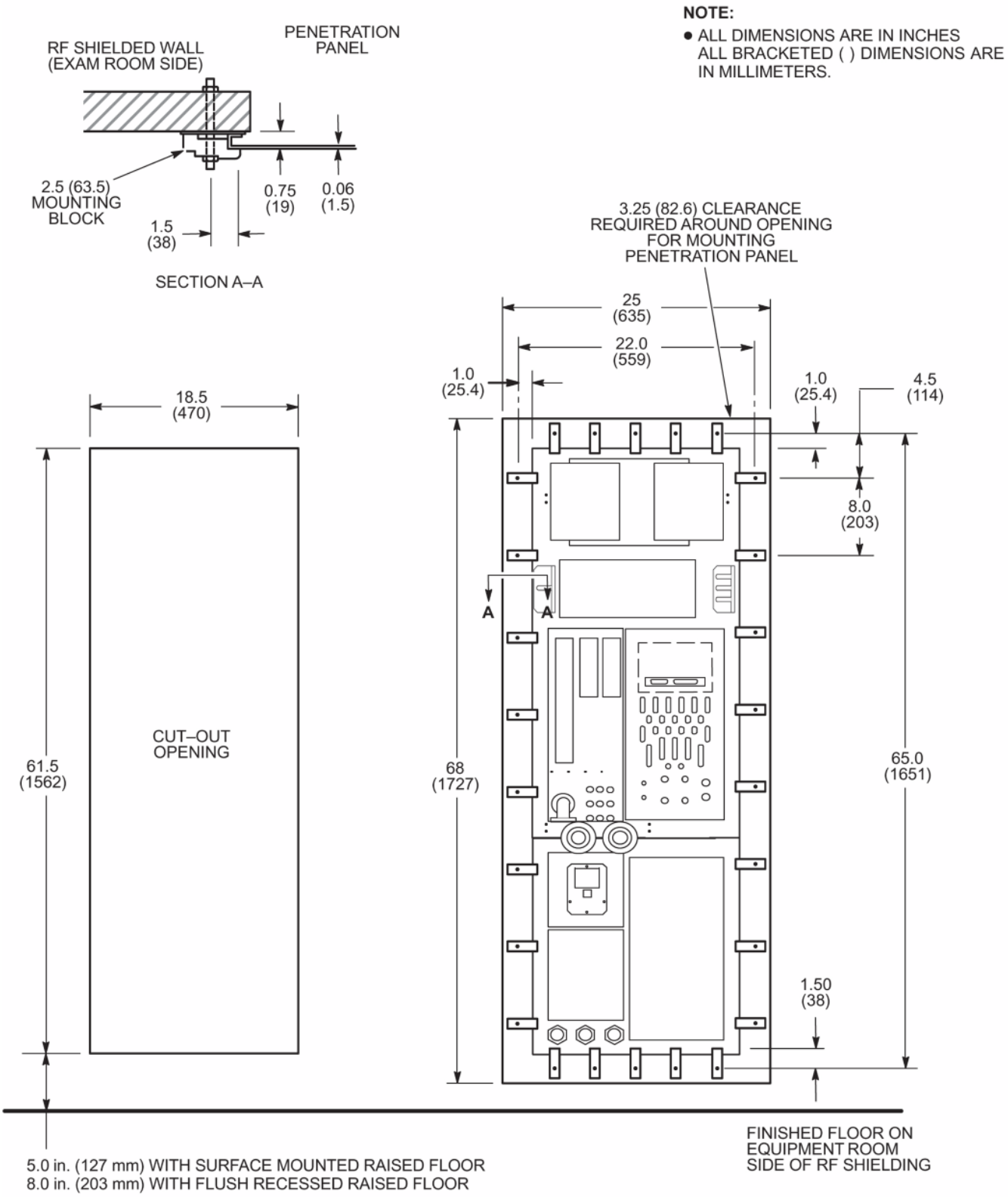
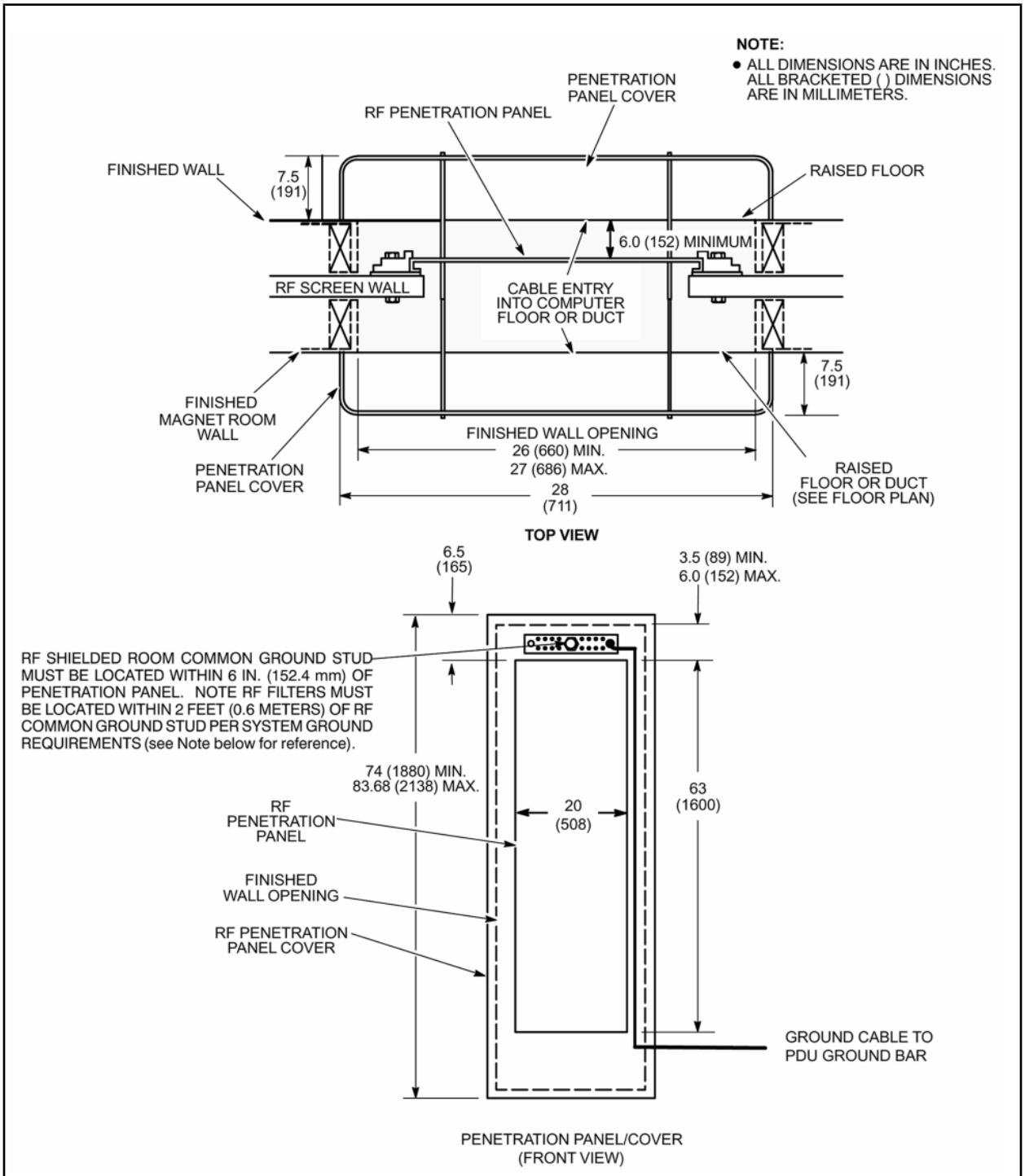


Table 8-3: Penetration Panel/Covering Mounting Requirements



NOTE:	RF Commonn Ground Stud location to be per System Ground subsection in Chapter 6, Grounding

6 Physical Considerations

6.1 Introduction

The RF shielded room can be either a free standing shielded structure or a shielded room within an existing room. All styles of RF Shielded Rooms must be electrically isolated from earth ground complying with requirements in RF Shielded Room Requirements.

NOTE: All physical considerations must comply with requirements in RF Shielded Room Requirements to minimize the possibilities of electrical discharge that can cause RF broadband noise.

6.2 Doors and Other Openings

Shielded room doors are a major source of RFI leaks and must comply with requirements in RF Shielded Room Requirements.

The door requires a minimum finished opening of 43 in. (1092 mm) to allow for helium dewars and patient tables to pass through the opening. However, a 48 in. (1219 mm) wide door is recommended for easy maneuvering of the Patient Table. Maximum door sill height is 1 in. (25 mm) with a 10 degree maximum threshold inclination.

6.3 Walls

It is recommended that walls be covered to protect RF material and to add to the aesthetics of the room. Fire retarding material must be used per building codes. Consult RF shield room vendor for RF shielding service requirements prior to covering RF walls. Removable wall covering may be needed if periodic RF shield servicing is required to maintain RF integrity.

NOTE: Walls materials and installation including all electrical and mechanical connections, mounting hardware, and installation must comply with the requirements in RF Shielded Room Requirements to minimize the possibilities of electrical discharge can cause RF broadband noise.

The recommended patient viewing window dimensions are 48 in. wide by 42 in. high (1219 mm x 1067 mm). The location of the window is dependent on the position of Operator Workspace position.

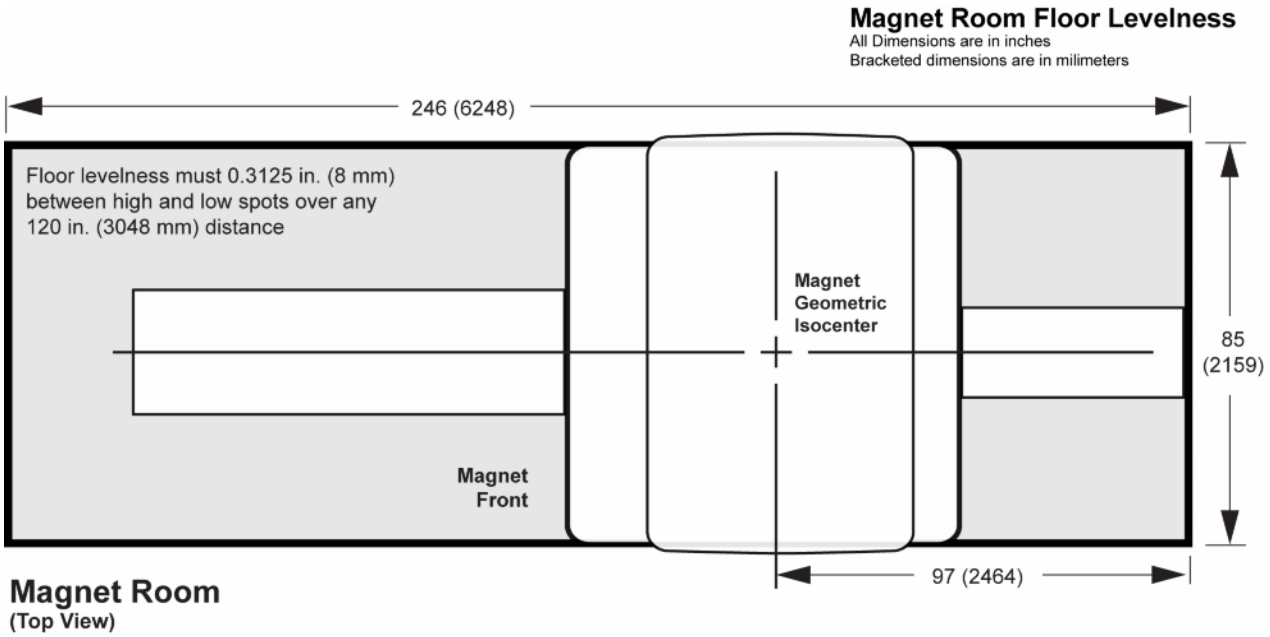
NOTE: The operator at the Operator Workspace must be able to view the patient during a scan.

6.4 Magnet Room Floor Requirements

NOTE: The following information applies to areas of the site impacted by the MR System upgrade.

1. The floor/flooring (i.e. structural, sub-floor and finished flooring) must meet local and national codes.
2. The floor under the Magnet in a 10 ft x 10 ft (3.048 m x 3.048 m) area must not be fabricated from magnetic materials per Magnet Room Floors Magnetic Properties in Construction Materials.
3. Floor/flooring must support the weight of equipment during system installation and throughout the operation and Service life.
4. Magnet, Enclosure, and Patient Table areas (shown below) must be level to 0.3125 in. (8 mm) between high and low spots over any 120 in. (3048 mm) distance
5. For non-VibroAcoustic Damping Option sites: RF Shield Vendor to provide Aluminum, Brass or Stainless Steel plates to support the Magnet feet (non-compressible material to maintain the depth and level requirements stated in preceding requirements).
6. Metal access floor tiles are not allowed anywhere in the Magnet Room.
7. Rear Pedestal floor support:
   a. The floor under the Rear Pedestal must support 550 lbs (250 kg) distributed across the 4 leveling feet (1.2 meter).
   b. The Rear Pedestal leveling feet must be positioned on one solid floor member, no joints or seams are allowed.
8. Electrically conductive materials utilized must comply with requirements in RF Shielded Room Requirements to minimize the possibilities of electrical discharge which can cause RF broadband noise.
9. The finished floor needs to be water resistant and protect the RF/Magnetic Shield and subfloor from possible water damage.
10. MR System Interconnection cables are FT4 or equivalent rated; not plenum rated.
11. The flooring grounding device and fastener/securing equipment are supplied by the customer or customer contractor and must be installed as the manufacturer defines.

Illustration 8-3: Magnet Room Floor Levelness Area



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Chapter 9 Shipping and Delivery

1 MR System Shipping and Receiving

NOTICE

All shipping dimensions and weights are approximate and may vary based on ship-to location, required rigging, or other requirements. Some shipping or access routes may have requirements in addition to those listed in this section. Contact the GE Healthcare Project Manager of Installation (PMI) to verify magnet shipping, rigging, and access.

1. The customer must provide an area for unloading system components

   NOTE: Contact the GE Healthcare Project Manager of Installation (PMI) for a list of experienced rigging companies.

2. At delivery, the customer is responsible for ensuring:
   a. All floors along the route will support the weight of the magnet (GE Healthcare recommends a structural analysis)
   b. Doors or other openings are sufficiently wide to allow passage
   c. Sufficient room is provided for any required dollies or rigging

Table 9-1: Signa HDxt System Upgrades Shipping Data

MR Component	Approximate WxDxH		Approximate Weight		Method Of Shipment
	in.	mm	lbs	kg	
Rear Pedestal Assembly with Rear Split Bridge Assembly, Low Profile Carriage Cover	34 x 58 x 48	864 x 1473 x 1219	310	132	box on pallet
Enclosure Top	48 x 36 x 36	1219 x 914 x 914	30	14	box
Enclosure Skirts	40 x 24 x 24	1016 x 610 x 610	30	14	box
Water-Cooled Cryocooler Compressor	29 x 42 x 33	737 x 1067 x 838	320 dry weight	154 dry weight	crate
Air-Cooled Cryocooler Compressor	24 x 30 x 40	610 x 762 x 1016	370	168	Box on Pallet
Air-Cooled Cryocooler Compressor Transformer	41 x 49 x 21.5	1041 x 1245 x 546	285	129	(height includes 4 in. runners for forklift access)
Patient Blower Box	24 x 30 x 24	610 x 762 x 610	30	14	box
HFD/PDU Cabinet without Fan Module installed	24 x 37 x 75	610 x 940 x 1905	1810	823	on cabinet casters, wrapped with plastic
Fan Module for HFD/PDU Cabinet	28 x 38 15	711 x 965 x 381	160	73	on pallet
RFS Cabinet	24 x 36 x 77	610 x 914 x 1956	785	356	on cabinet casters, wrapped with plastic

MR Component	Approximate WxDxH		Approximate Weight		Method Of Shipment
	in.	mm	lbs	kg	
SPT Phantom Set	34 x 32.5 x 60	864 x 826 x 1524	350	159	on cart casters with box cover
Operator Workspace Cabinet	24 x 35 x 31	600 x 900 x 780	243	110	wood pallet with cardboard cover
Operator Workspace Host Display	27 x 33 x 27	686 x 838 x 686	125	57	skid
Operator Workspace equipment	32 x 32 x 23	813 x 813 x 584	100	45	box
Operator Workspace Table	45 x 54 x 37	1143 x 1372 x 940	180	82	box
VibroAcoustic Damping Option *	36 x 65 x 12	914 x 1651 x 305	575	261	box on pallet
32 Channel Cabinet *	24 x 36 x 77	610 x 914 x 1956	471	214	on cabinet casters, wrapped with plastic
Chilled Air Blower for IPCM Option *	24 x 42 x 45	610 x 1060 x 1140	375	170	special crate
Notes * Optional Equipment					

Chapter 10 Site Planning Reminders

1 General Pre-Installation Reminders

The following Reminders define absolute minimum site planning issues that must be completed prior to equipment delivery, installation and calibration. Tables below are organized to identify site planning design requirements, safety requirements, then a list of tasks that must be completed prior to delivery of the magnet or electronics into the MR site. The final group defines tasks that must be completed prior to ramping the magnet to field.

The customer's site planner/architect is expected to use this guide when performing final site completion inspections. The items in the following tables assist subsequent inspections. This does not relieve the customer's site planner/architect from meeting any other requirement in this manual.

All work must be in compliance with national and local codes.

Table 10-1: Design/Engineering Requirements Review & Final Inspection

Step	Requirement
1	The customer's site planner/architect must review customer supplied site planning construction drawings to ensure the plans are in compliance with the requirements defines in the Pre-Installation Manual and the MR Typical Drawings
2	Site construction plans identify means to contain the magnetic field and that the site design complies with the external magnetic field requirements. Refer to: Chapter 3, Magnetic Field Proximity Limits
3	Magnet Room floor level, locations (relative to magnetic shield, cryogenic vent), service area, and VibroAcoustic Damping Kit, etc. meet site planning requirements. Refer to: Chapter 8, Magnet Room Floors
4	The site main power details meet the power quality requirements. Refer to: • Chapter 6, System Power Introduction • Chapter 6, Critical Power Requirements
5	Magnet Room lighting design, material and construction techniques comply with RF Shielded Room Requirements, specifically broadband noise requirements. Refer to: Chapter 8, RF Shield Room Requirements
6	Magnet and equipment room design will meet requirements should multiple MR scanners share common rooms, areas. Refer to: • Chapter 3, Two Magnet Site Layout • Chapter 3, Equipment Room Shared By Multiple MR Systems

WARNING

GASEOUS HELIUM IS AN INVISIBLE, ODORLESS GAS THAT CAN CAUSE ASPHYXIATION WHEN OXYGEN IS DEPLETED. HELIUM GAS, WHICH IS LIGHTER THEN AIR, WILL RISE TO THE CEILING.
THE MAGNET WILL EXHAUST HELIUM GAS DURING MAGNET DELIVERY & INSTALLATION.

THE FOLLOWING SAFETY ITEMS MUST BE STRICTLY ADHERED TO PRIOR TO MOVING THE MAGNET FROM THE TRUCK INTO THE ROOM.

Table 10-2: Site Safety Readiness

Step	Requirement
1	Magnet room ventilation must be installed and fully tested to ensure required air ventilation is available when equipment delivers. Exhaust fans, fan controllers must be installed and functioning. Refer to: Chapter 5, Room Ventilation

Table 10-3: Actions to Be Completed Prior To Magnet Delivery (to site) and Move Into Magnet Room

Step	Requirement
1	Room Ventilation completely installed and functioning. Refer to Safety Site Readiness, item 1 above.
2	The MDP has been installed (by certified electrician) and the MDP is fully operational with power available for 24 hour/day, 7 day/week to cool the Shield/Cryo Cool Compressor cabinet. Power must also support the Magnet Monitor and the Coldhead Compressor Chiller – if customer provided. Refer to: Chapter 6, System Power Introduction
3	The magnet delivery route is clear and ready for the magnet installation. Refer to: Chapter 3, Minimum Delivery Route Sizes and Capacity

Table 10-4: Actions to Be Completed Prior To System Delivery (to site) and Installation

Step	Requirement
1	All areas in the MR Magnet Room, Equipment Room and the Control Room are dust-free. Final room construction, after magnet delivery, needs to protect the equipment from dust. Refer to: Chapter 5, Pollution
2	Environmental systems and controls are fully functioning to provide the required site environment for all MR System equipment. Refer to: • Chapter 5, Temperature and Humidity Specification • Chapter 5, Air Cooling • Chapter 5, Water Cooling Requirements
3	MR System Interconnects routing has been installed. Refer to: Chapter 3, MR System Interconnections Routing
5	The PDU power is ready for connection to the Main Disconnect Panel MDP). Refer to: • Chapter 6, Main Disconnect Panel (MDP) Requirements • Chapter 6, System Power Distribution Unit

WARNING

GASEOUS HELIUM IS AN INVISIBLE, ODORLESS GAS THAT CAN CAUSE ASPHYXIATION WHEN OXYGEN IS DEPLETED. HELIUM GAS, WHICH IS LIGHTER THEN AIR, WILL RISE TO THE CEILING.
THE MAGNET WILL EXHAUST HELIUM GAS DURING MAGNET DELIVERY & INSTALLATION.

THE FOLLOWING SAFETY ITEMS MUST BE STRICTLY ADHERED TO PRIOR TO MOVING THE MAGNET FROM THE TRUCK INTO THE ROOM.

Table 10-5: Actions to Be Completed Before Magnet Ramp-up

Step	Requirement
1	The Magnet Room RF Shield has been fully installed, including magnet dock anchor and tested to meet the RF attenuation and room isolation requirements. Refer to: Chapter 8, RF Shielded Room Specifications
2	The Magnet Room construction has been completed and all ferrous metal objects have been removed from the room.
3	Power has been connected from the Main Disconnect Panel to the Power Distribution Unit. Refer to: • Chapter 6, Main Disconnect Panel (MDP) Requirements • Chapter 6, System Power Distribution Unit
4	The Penetration Panel has been installed. Refer to: Chapter 8, RF Penetration Panel

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Chapter 11 Appendicies

1 Glossary

BB

Abbreviation for Broadband

Cryogen

A substance for producing low temperatures. Liquid helium is the cryogen used to cool the magnet to approximately 4 Kelvin (-269°C or -452°F).

Cryostat

An apparatus maintaining a very low constant temperature. The cryostat consists of one concentric, cylindrical container housed in an outer vacuum tight vessel. The magnet and shim coils are mounted in the inner container. The container is filled with liquid helium. The shields surrounding the inner container are kept cold by a refrigeration device.

Dewar

A container with an evacuated space between two highly reflective walls used to keep low temperature substances at near-constant temperatures. Liquid helium is usually stored and shipped in dewars.

Exclusion Zone

Area where the magnetic flux density is greater than five gauss. Personnel with cardiac pacemakers, neurostimulators and other biostimulation devices must NOT enter this zone. Signs are posted outside the five gauss line alerting personnel of this requirement. Since the magnetic field is three-dimensional, signs are also posted on floors above and below the Magnet Room in which the five gauss line exists.

Ferrous Material

Any substance containing iron which is strongly attracted by a magnetic field.

Gauss (G)

A unit of magnetic flux density. The earth's magnetic field strength is approximately one half gauss to one gauss depending on location. The internationally accepted unit is the tesla (1 Tesla = 10,000G and 1 milli Tesla = 10G).

Gradient

The amount and direction of the rate of change in space of the magnetic field strength. In the magnetic resonance system, gradient amplifiers and coils are used to vary the magnetic field strength in the x, y, and z planes.

Homogeneity

Uniformity. The homogeneity of the static magnetic field is an important quality of the magnet.

Isocenter

Center of the imaging volume ideally located at the magnet center.

Isogauss Line

An imaginary line or a line on a field plot connecting identical magnetic field strength points.

Magnetic Field (B)

A condition in a region of space established by the presence of a magnet and characterized by the presence of a detectable magnetic force at every point in the region. A magnetic field exists in the space around a magnet (or current carrying conductor) and can produce a magnetizing force on a body within it.

Magnetic Resonance (MR)

The absorption or emission of electromagnetic energy by nuclei in a static magnetic field, after excitation by a suitable radio frequency field.

Magnetic Sheilding

Using material (e.g. steel) to redistribute a magnetic field , usually to reduce fringe fields.

NB

Abbreviation for Narrow Band

Quench

Condition when a superconducting magnet becomes resistive thus rapidly boiling off liquid helium. The magnetic field reduces rapidly after a quench.

Radio Frequency (RF)

Frequency intermediate between audio frequency and infrared frequencies. Used in magnetic resonance systems to excite nuclei to resonance. Typical frequency range for magnetic resonance systems is 5-130 Mhz.

Radio Frequency Shielding

Using material (e.g. copper, aluminium, or steel) to reduce interference from external radio frequencies. A radio frequency shielded room usually encloses the entire magnet room.

Resonance

A large amplitude vibration caused by a relative small periodic stimulus of the same or nearly the same period as the natural vibration period of the system. In magnetic resonance imaging, the

radio frequency pulses are the periodic stimuli which are at the same vibration period as the hydrogen nuclei being imaged.

Security Zone

Area within the Magnet Room where the magnet is located. Signs are posted outside the Magnet Room warning personnel of the high magnetic field existing in the Magnet Room and the possibility of ferrous objects becoming dangerous projectiles within this zone.

Shield Cooler Coldhead

An external refrigeration device which maintains the shields inside the cryostat at a constant temperature.

Shim Coils

Shim coils are used to provide auxiliary magnetic fields in order to compensate for inhomogeneities in the main magnetic field due to imperfections in the manufacturing of the magnet or affects of steel in the surrounding environment.

Shimming

Correction of inhomogeneity of the main magnetic field due to imperfections in the magnet or to the presence of external ferromagnetic objects.

Superconducting Magnet

A magnet whose magnetic field originates from current flowing through a superconductor. Such a magnet is enclosed in a cryostat.

Superconductor

A substance whose electrical resistance essentially disappears at temperatures near zero Kelvin. A commonly used superconductor in magnetic resonance imaging system magnets is niobium-titanium embedded in a copper matrix.

Tesla

The internationally accepted unit of magnetic flux density. One tesla is equal to 10,000 gauss. One milli Tesla is equal to 10 gauss.

2 RF Shielded Enclosure Test Guidelines

2.1 Introduction

This document describes the procedure and methodology of performing an RF shielding effectiveness verification testing on enclosures that will house GE Healthcare Magnetic Resonance Imaging (MRI) equipment. MRI equipment is sensitive to RF energy from sources outside of the shielded enclosure. To ensure proper operation of the MRI equipment, the shielded enclosure must attenuate local RF signals to levels that do not cause interference.

NOTE: RF Shielding Performance is based on plane-wave measurements. *H* and *F* field tests are not required, but are allowed as needed for diagnostic purposes.

2.1.1 Purpose of Test Plan

The purpose of this test plan is to describe a series of RF shielding effectiveness tests to demonstrate compliance of an MRI shielded enclosure to the requirements of GE Healthcare.

The test procedure described in this guideline is a modification of MIL-STD-285 and IEEE Std 299-1991. This procedure provides a thorough evaluation of the shield integrity at the upper end of the frequency range of interest showing any RF leakage that may cause imaging problems. These testing guidelines ensure that the electromagnetic environment inside of the enclosure will meet the requirements of GE Healthcare.

2.1.2 Not used

2.2 Applicable Documents

MIL-STD-285	MILITARY STANDARD ATTENUATION MEASUREMENTS FOR ENCLOSURES, ELECTRO-MAGNETIC SHIELDING, FOR ELECTRONIC TEST PURPOSES, METHOD OF; 25 June 1956
IEEE Std 299-1991	IEEE STANDARD FOR MEASURING THE EFFECTIVENESS OF ELECTROMAGNETIC SHIELDING ENCLOSURES; 2 July 1991

2.3 Test Sample Set-Up

The shielded enclosure under testing will be set up in a normal configuration that consists of:

- Magnet installed including all floor mounting bolts
- RF shielded door(s)
- Waveguide penetrations, HVAC, vents, medical gas lines, etc.
- AC power supplied through low-pass filters
- Patient view window, skylights, windows, hatches, etc.
- Blank penetration panel installed, dimensionally equivalent to the GE panel and the same mounting hardware to be used with the GE penetration panel.

For safety reasons, the enclosure will be electrically grounded during the shielding effectiveness test. Any variances from the normal configuration will be noted in the certification report.

2.4 Shielding Effectiveness

This test procedure determines the worst case shielding effectiveness based on the lowest test point reading obtained. The lowest reading obtained will be the reading of the room.

2.5 Measurement Procedure

To simulate the effects of external RF sources, the transmitting antenna will be located outside the enclosure on a plane parallel to the face of the enclosure wall at a distance of 6 ft. (1.8 m) unless physically constrained to a lesser separation. The areas of least effectiveness are located by searching the inside of the enclosure with the antenna connected to the spectrum analyzer.

2.5.1 Test Position

The transmitting antenna will be positioned in front of all critical areas (doors, windows, filters, penetration areas, etc.) at a minimum of every 20 ft. (6.1 m) of the wall. The receiving antenna is scanned over all panel section joints (where accessible) at the floor, wall, and ceiling for a minimum of 10 ft. (3.05 m) in all directions from the location of transmitting antenna. The receiving antenna will be at a minimum of 1 ft. (0.3 m) from the shield. For areas that are inaccessible for direct location of the transmitting antenna, the inside of that area will still be scanned using the receiving antenna with the transmitting antenna positioned in front of the adjacent wall or test position.

2.5.2 Frequency Range

The standard frequency for shielding measurements will be 100 mHz ±10 mHz (150 mHz ±10 mHz for 3T). This allows the frequency to be adjusted slightly to avoid interference from local active transmitters and/or RF noise from other sources. Test frequency utilized will be noted in the certification report.

2.5.3 Free Field Calibration

The incident field (free field) is measured by the following procedure:

Position the transmitting antenna parallel to the exterior wall of the enclosure at a distance of 6 ft. (1.8 m) using horizontal polarization, unless physically constrained to a lesser separation, in which case a separate reference will be established and documented at the new test distance. The receiving antenna will be placed between the transmitting antenna and 1 ft. (0.3 m) from the exterior wall of the enclosure. The receiving antenna will be moved vertically and horizontally to achieve maximum signal strength. The receiving antenna will be placed no closer than 2 in. (51 mm) from the exterior wall of the enclosure and in line with the transmitting antenna. The maximum received voltage at the test frequency will be recorded.

2.6 Enclosure Power Reference Isolation

NOTICE

This section does not apply to upgrades.

To prevent personal hazard, it is necessary for the enclosure to be properly grounded.

To minimize common mode currents, the ungrounded enclosure should be isolated from the ground with a minimum of 1000 ohms of DC resistance. The isolation measurement is performed by the following procedure:

- All power to the enclosure is removed. For safety reasons, an AC voltage measurement will be made to verify that no power is connected.
- With electrical power and intentional ground disconnected, connect the test instrument between the shielded enclosure and AC power ground.
- Take a reading and record the value.

NOTE: This test must be made using either an isolated, current limited, high-voltage (>150 VDC) DC source and DMM to read drop across the limiting resistor or a Megger instrument capable of reading values less than 1000 ohms. Conventional resistance meters employing test sources of 9 VDC or less will not be used.

2.7 Test Equipment

Test equipment will be selected to provide measuring capabilities as described in these testing guidelines. The signal source, amplifier, antennas, and receiver or spectrum analyzer will be such that the difference between the induced reference voltage and the receiver sensitivity is at least 6 dB greater than the required attenuation specification.

The signal source and power amplifier will output a CW signal for a nominal test frequency of 100 mHz (150 mHz for 3T). The receiver or spectrum analyzer and preamplifier (if required) will provide adequate sensitivity to permit attenuation measurements to be made at the specified limits. Dipole antennas and other miscellaneous equipment required to transmit and receive the proper RF fields will be used.

The absolute performance calibration of the equipment requiring calibration will be performed on an as-needed basis in accordance with MIL-STD-45662. The calibration period will not exceed one year. The test equipment tolerances of at least ±2% frequency and ±2 dB amplitude will be met. Equipment certifications will be traceable to the National Institute of Standards and Technology (NIST). All equipment will be verified for proper operation between and after each series of tests by repeating the reference readings at the specified frequency(s).

2.8 Data Recording and Verification

Measurements will be performed by qualified responsible EMC test personnel. The test must be performed in the presence of a GE Healthcare representative unless other arrangements were made by GE Healthcare. All data collected during the course of the tests will be recorded on standardized data sheets. The data sheets will include the test location, frequency, reference level, measured enclosure level, and attenuation level.

2.9 Test Report

A final certification report will be provided after the test is performed. This report will include all recorded data necessary for the evaluation of the shielded enclosure test results and will list any changes pertinent to the test set-up or shielding effectiveness. The certification report will also include the test procedures and a list of the actual equipment used during the test. Along with the

data sheet, there will be a presentable drawing showing the shape of the enclosure, all test point locations, doors, filters, windows, and existing building walls.

3 Acoustic Background and Design Guidelines

The acoustic information is provided for site planning and architectural design activities to address acoustics to meet local regulations and customer requirements. For more information about recommended safety procedures regarding patient exposure to MR generated acoustic levels, see the MR Safety Guide included with the system Users Manual.

3.1 Acoustic Background

A typical MR suite has two types of acoustic noise issues. The first is the acoustics within the rooms in which the patients and technicians are impacted by the noise of the MR system as the gradients are pulsed. The second is noise transmitted to other spaces via airborne and structureborne paths.

3.1.1 Airborne

The airborne transmission path entails the excitation of air within the magnet room; the resonator module consisting of the magnet, RF coil, and gradient coil generates acoustic noise similar to an intense loud speaker. The airborne noise passes through walls via any openings, i.e. small holes, cracks, HVAC ducts, and waveguides, into surrounding spaces within and possibly beyond the confinements of the building. Acoustic energy can transmit across distances of significant length.

Examples of airborne acoustics issues may include the following (not limited to only these) :

- MR Operator exposure at Operator Workstation (i.e. Operator viewing in-line with the patient inside the magnet may require a higher acoustic attenuation window)
- Image reading rooms adjacent to Magnet Room, may be separated by hallways
- Secretarial, offices, meeting rooms, patient rooms (ICU, exam, primary care, etc.)
- Adjacent residential areas/spaces
- In-house library facilities

3.1.2 Structureborne

The structureborne transmission path is the result of mechanical excitation of the floor/building structure causing the building to vibrate. The vibration of the surfaces at surrounding spaces then radiates as acoustic noise. Acoustic energy can transmit across distances of significant length.

NOTE: Less than 5% of installed base sites have experienced structureborne acoustic issues.

Examples of structureborne acoustics issues may include the following (not limited to only these):

- Areas directly above or below the Magnet Room, may not always be an issue
- Image reading rooms adjacent to Magnet Room, may be separated by hallways
- Secretarial, offices, meeting rooms, patient rooms (ICU, exam, primary care, etc.)
- Adjacent residential areas/spaces
- In-house library facilities

3.2 Acoustic Design Guidelines

3.2.1 Magnet Room

Noise generated by the MR system is inherent to the operation of the system. The sound quality (human perception) within the Magnet Room can be modified by including sound absorbing materials to make the room sound more subdued and less harsh. The measured sound levels via a sound level meter will not change. However, the measured sound levels can be reduced only when the sound level generated by the MR System is reduced.

Sound quality improvements can be achieved by the following:

- Use ceiling tiles with fiberglass panels having a 2 inch (51mm) thickness set into the standard T-bar grid system.
- Adding fiberglass panels to the side walls covering approximately 20% of the side wall surface area. The panels should focus on covering the top half of the side walls. Panels could take many different and decorative shapes to improve the sterile look of the rooms. Typically panels might be on the order of 4ft x 6ft (1.2m x 1.8m) with a thickness of 4 inches (102mm) or equivalent. Panels shape could vary to produce mosaic effects to meet the customer preference. Any decorative materials used to cover the wall panels must be porous so that sound waves can pass through with ease. In principle, a person should be able to breath through the material with ease. Fire retardant cloth should be used. The NRC (Noise Reduction Coefficient) of the panels should be 0.95 or better when mounted against a hard surface such as drywall or concrete.

3.2.2 Inter-Spacial Areas

Acoustic Noise Control to mitigate noise from being transmitted to other spaces often amounts to paying attention to small details while working with ordinary construction materials. The key objectives are to eliminate all cracks and gaps in the wall construction while making sure that the doors, walls, floor, and ceiling have adequate transmission loss via mass or special double wall construction along with good fitting massive doors.

The entire Magnet must be surrounded by walls with substantial mass and/or double wall construction so that noise is contained in the room and not allowed to pass through into nearby spaces. Wall junctions must be sealed with acoustical sealant so that noise waves to do not escape from the room. In principle, if the room were filled with smoke and under a positive pressure, no smoke would leak from the room.

3.2.2.1 Wall Construction

Wall Construction will entail ordinary building materials in a careful configuration.

- The preferred wall would have an ASTM STC 50 construction which entails the use of standard wall construction of steel studs (typically 3-5/8 inch (92 mm)) with 2 layers of Type X drywall (typically 5/8 (16 mm)) on each side totaling 4 layers and fiberglass batt in the stud cavity. All drywall must be overlapped by 6 inches (152 mm) or more. Beads of (USG) Acoustical Caulking (non-hardening) would be used around the entire perimeter of the drywall. Any form of wall penetration should be avoided. Any necessary wall penetrations must be sealed using

combination of Acoustical Caulking (non-hardening) and fiberglass batt material. See examples of wall construction shown inIllustration 11-1 and Illustration 11-2.

- The top of the wall must join the ceiling/floor above so that no cracks or gaps occur. If metal pan is used on the ceiling/floor (above), then flute seals would be used to seal the gaps between the drywall and the pan. Alternately drywall can be cut out to fit into the flutes. Acoustical caulking (non-hardening) will be used to seal the remaining cracks and gaps.

Illustration 11-1: Example Of Wall Construction For Airborne Noise Control - Option 1

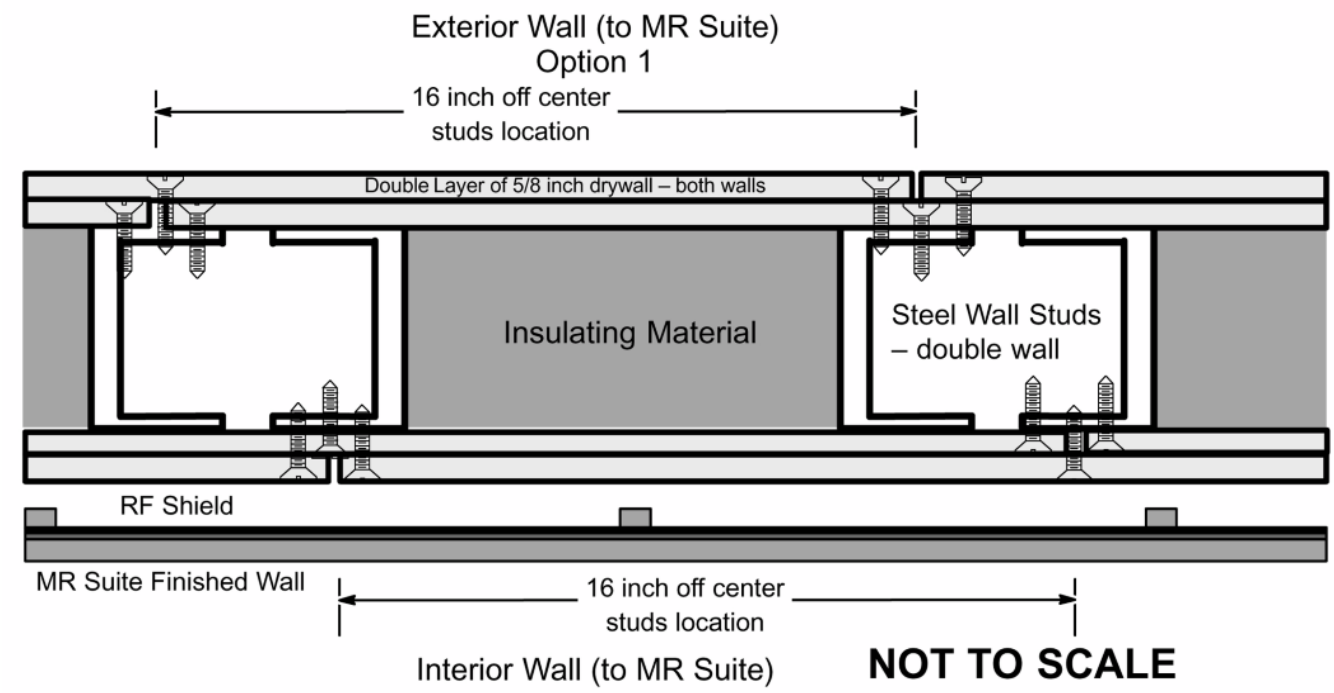
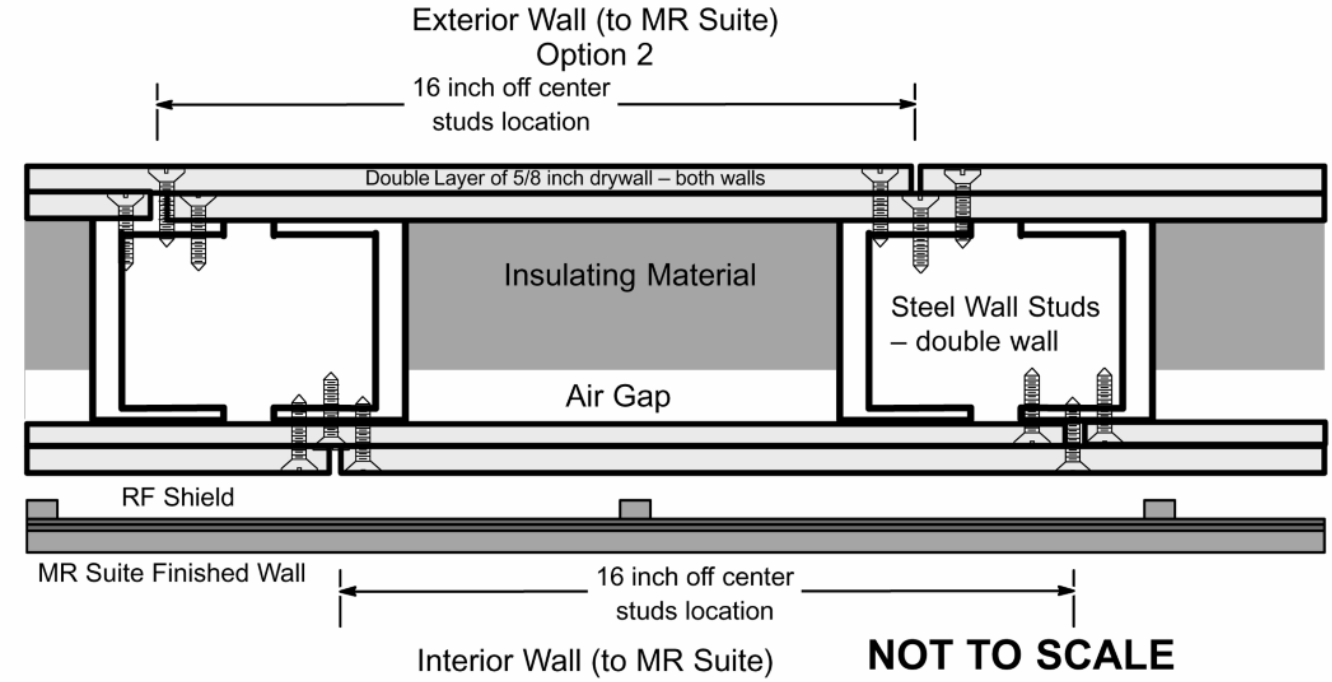


Illustration 11-2: Example Of Wall Construction For Airborne Noise Control - Option 2



3.2.2.2 High Bay RF Room

A high bay RF Room is a self contained RF Room which has open air space between the RF Room ceiling and the building floor above. The air space is an acoustic transmission path. Acoustic energy must be reduced to minimize this transmission of energy through this path.

In cases where the Magnet is to be installed in a high bay, it may be most effective to enclose the RF Room with its own drywall and steel stud room. The key difference being a ceiling assembly that mimics the sidewall construction to contain noise.

- Normal high STC stud walls from above would be used to support a ceiling assembly constructed of structural C channel with two layers of drywall on each side (total of 4 layers) with fiberglass batt in the cavity.
- Penetrations should be avoided via the use of surface mounted lights. HVAC and ducts passing through the ceiling, party wall or side walls would require acoustic noise attenuation in the form of inline silencers. Gaps and cracks would be sealed between the ceiling, party wall or vertical side walls and the cryogen vent plumbing. In essence the Magnet would be enclosed in a drywall "doghouse".

3.2.2.3 Miscellaneous Plumbing, RF Windows and RF Doors

Other construction details are equally important to mitigate noise transmission to meet the intended goal.

- Pipes (gas or water) and electrical conduit or Magnet Room signal cables must be sealed where they penetrate the walls or ceiling. A heavy mastic material such as Duxseal™ is appropriate.

- RF windows should be purchased as window/frame units with an STC rating obtained from laboratory testing per ASTM standards. STC 50 to 60 windows are needed. The installation must include proper sealing to avoid sound leaks.
- RF doors should be selected to provide an STC 50 to 60 to quell the noise. Contact RF Shield Room supplier for selection of RF doors that meet the local acoustic codes and site acoustic requirements. RF door seals must be selected to prevent small gaps around the door perimeter and at the door threshold. RF door seals would either require periodic replacement or a door seal that would last the life of the Magnet Room.

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