Know Every Thing About MRI Systems

How MRI Systems Install and Running

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Taimaz Group

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First Step :

Planning To Install MRI

What we Need and what we do ?

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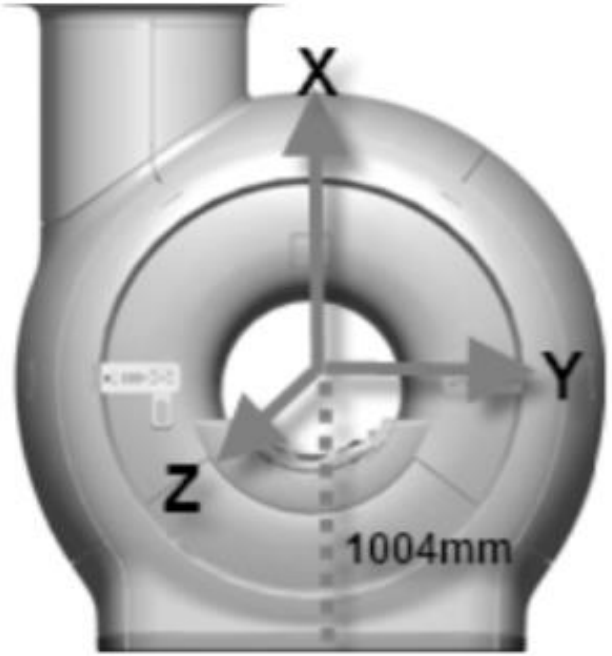
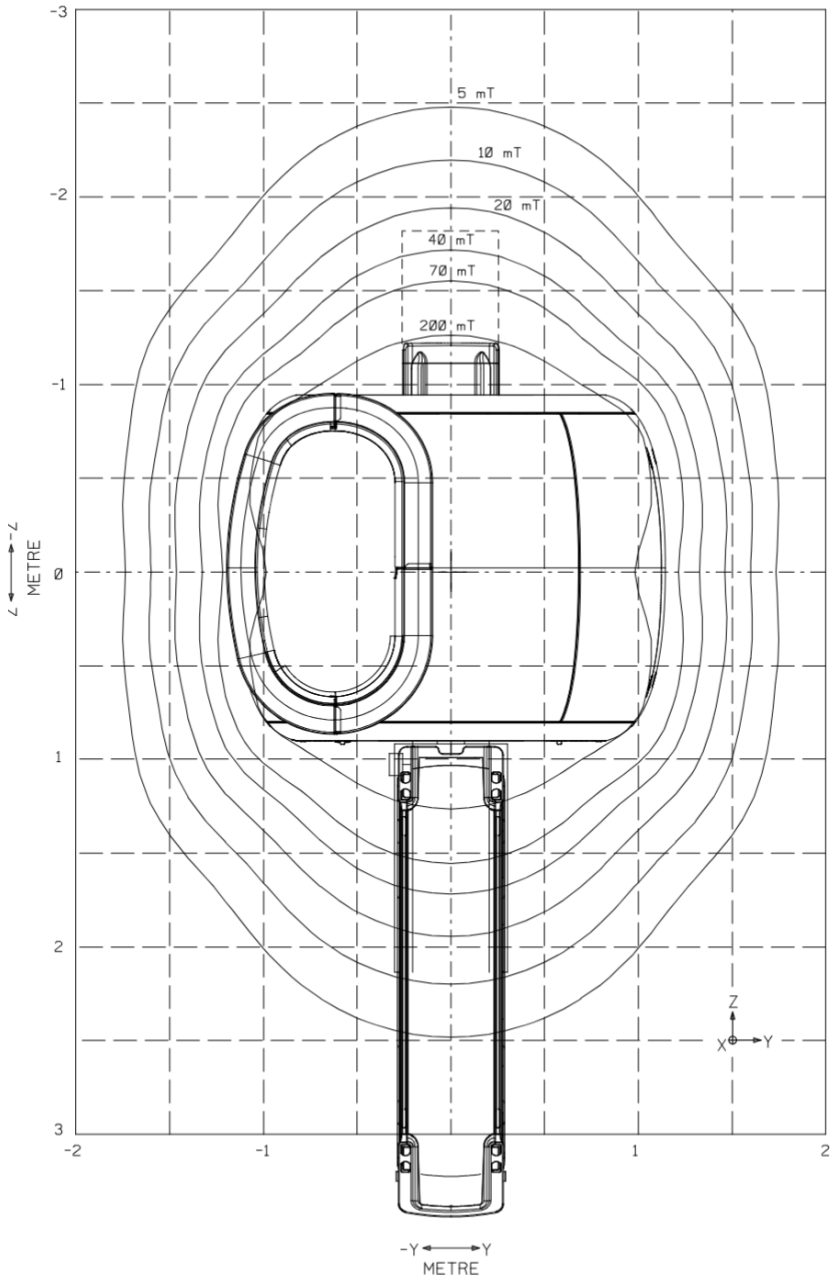
To make on Place ready to install an MRI system:

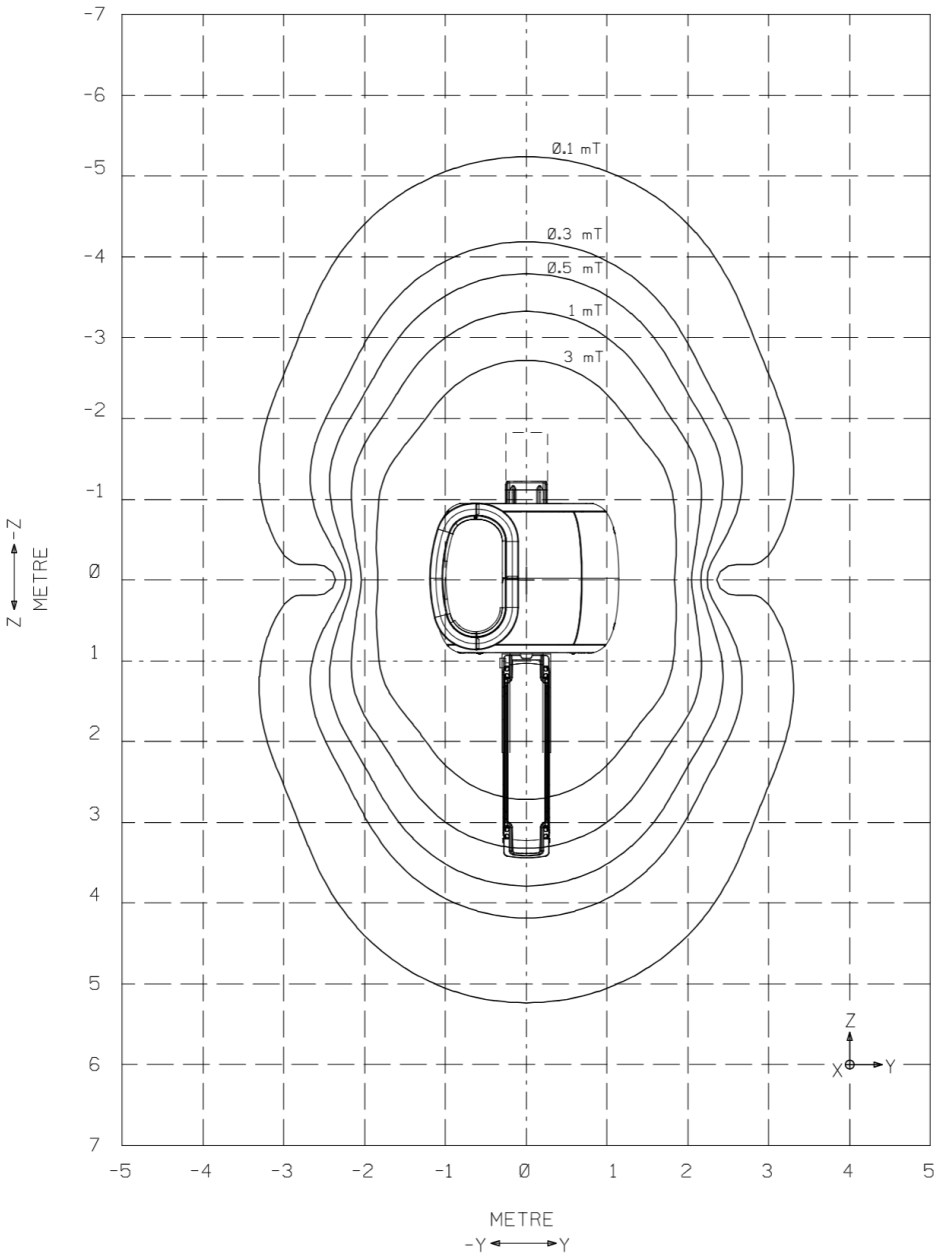
- Architectural Requirements
- Mechanical Requirement
- Electrical Requirements

The axes are identified as:

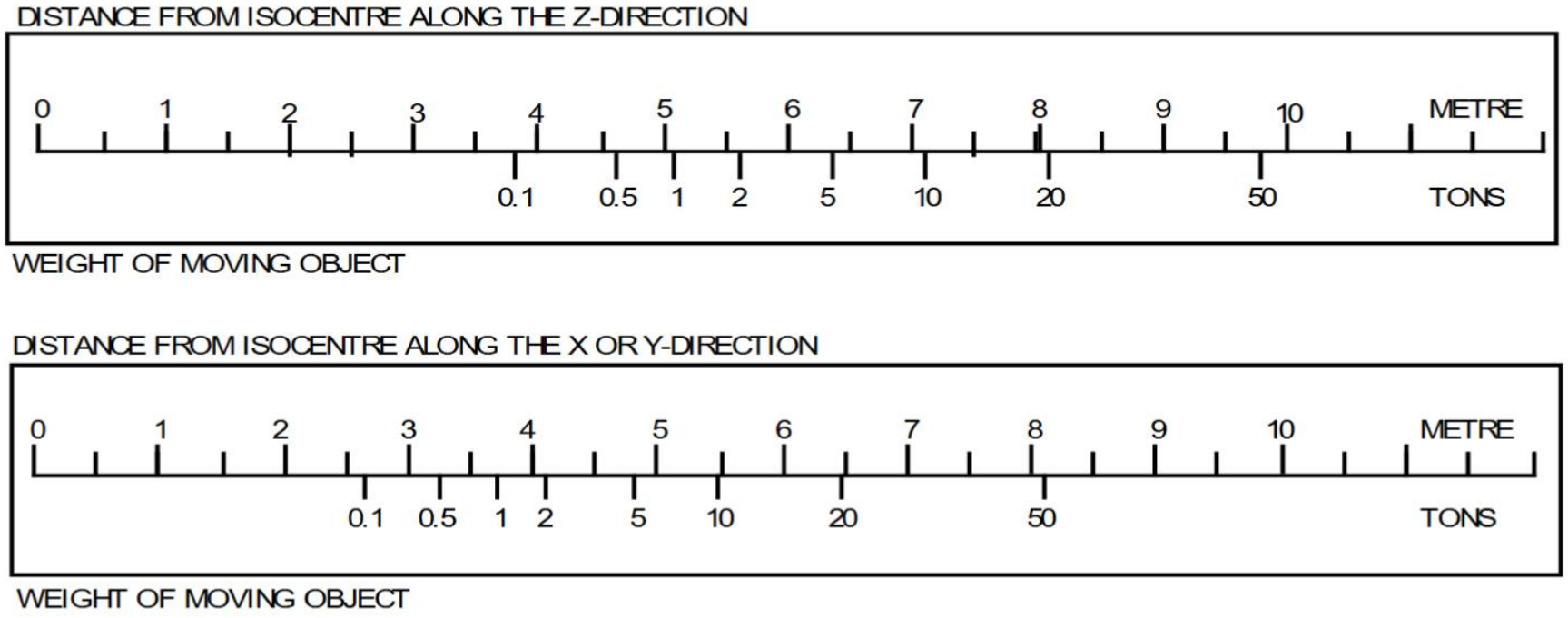
- X = vertical axis (up positive, down negative)
- Z = horizontal front to back axis, length of the patient (front positive, back negative)
- Y = horizontal left to right axis (left negative, right positive)




5 mT
10 mT
20 mT
40 mT
70 mT
200 mT
-3
-2
-1
0
1
2
3
-2
-1
1
2
Z
X
Y
Z
METRE
-Y
Y
METRE


0.1 mT
0.3 mT
0.5 mT
1 mT
3 mT
-7
-6
-5
-4
-3
-2
-1
0
1
2
3
4
5
6
7
-5
-4
-3
-2
-1
0
1
2
3
4
5
Z
X
Y
-Z
METRE
METRE
-Y
Y

Influences of Moving ferromagnetic Objects



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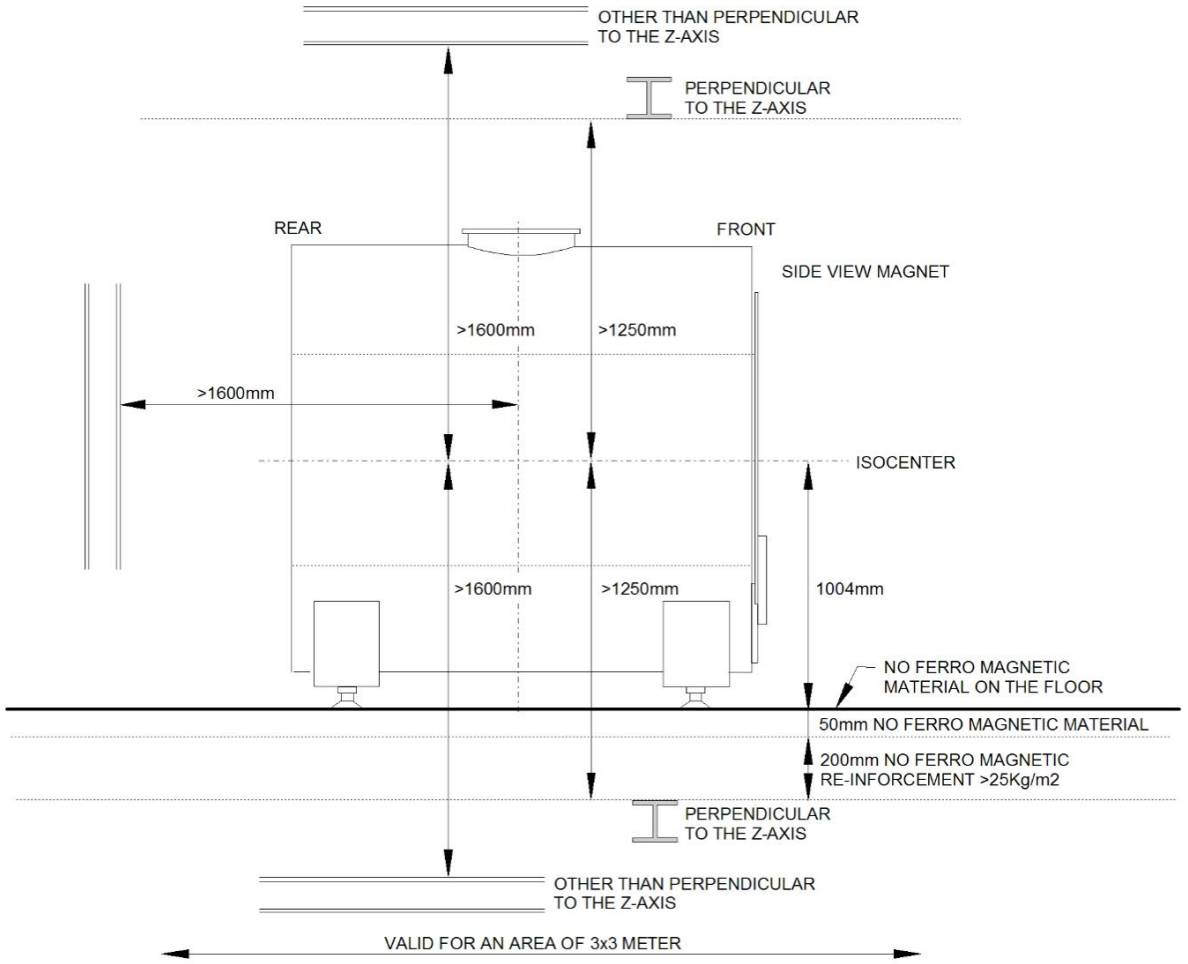
Iron Plan of Building



Some Examples :

Maximum permissible field strengths for magnetically susceptible objects (*)	
Object	**Maximum field strength (mT)**
Optical disk data carrier	60.0
LCD video monitor	3.0
Ultrasound with LCD monitors	2.5
Magnetic data carrier (diskette, tape, disk, credit card)	1.0
Video monitor, monochrome (stationary)	1.0
ECG equipment with LCD display	1.0
Flat detector	0.5
Pacemaker	0.5
X-ray CT scanner manufactured after 2003	0.2
Video monitor, color (CRT)	0.1
Image intensifier	0.1
Ultrasound with color CRT	0.1
X-ray CT scanner with photo multipliers	0.1
ECG equipment with CRT	0.1
PET-scanner	0.1
Gamma camera	0.1
Linear accelerator	0.05 (**)
Electron beam microscope	0.05 (**)

Influences of Current in Power Lines :

Currents in power lines, large transformers or electric motors near the magnet can affect the stability of the field.

The following table shows the minimum distance allowed.

Object with electromagnetic field		Safe distance from magnet ISO-centre in meters
Power line	500 A	5
Transformer	650 kVA	10
Motor / Generator	30 kVA	5

In case of other values, the safe distance can be calculated with the following formula.

$\sqrt{}$(X/old) x distance = new distance

X = new value, old = value from table above, distance = distance from table above.

For example power line 1500 A.

$\sqrt{}$ (1500A/500A) x 5m = $\sqrt{}$3 x 5 = 8.7 m

Electrical requirments

Mains configuration	• STAR, 3 phase + neutral + protective earth (PE) • Delta is allowed for the 480V version	
Voltage and Frequency		
or	220 / 380V +10% / -10%	50 Hz +1Hz / - 1 Hz
or	220 / 380V +10% / -10%	60 Hz +1Hz / - 1 Hz
or	230 / 400V +10% / -10%	50 Hz +1Hz / - 1 Hz
or	230 / 400V +10% / -10%	60 Hz +1Hz / - 1 Hz
or	480V +10% / -10%	60 Hz +1Hz / - 1 Hz
Note: MDU version to be ordered via order questionnaire		
Mains impedance (at nominal voltage)	Omega HP gradients: < 150 mΩ	
	Omega gradients < 200 mΩ	
Distortion Power factor	> 0.9	
Cos phi	> 0.9 (under full load)	
THD_I	< 45 %	
THD (V) indication	<3%	
K-factor	< 10	
Crest Factor	< 3	
Mains interruptions	< 0.5 period, minimum intervals of 5 periods	
Phase Voltage imbalance	< 2%	
Phase (L1,L2,L3) to neutral (WYE)	230V +/-10%	
Neutral to PE voltage indication	< 5 V recommended: < 1 V RMS	
PE wire diameter	Local code(*)	
Protective Earth Sourcing Integrity	Advise value < 1.5 ohm	

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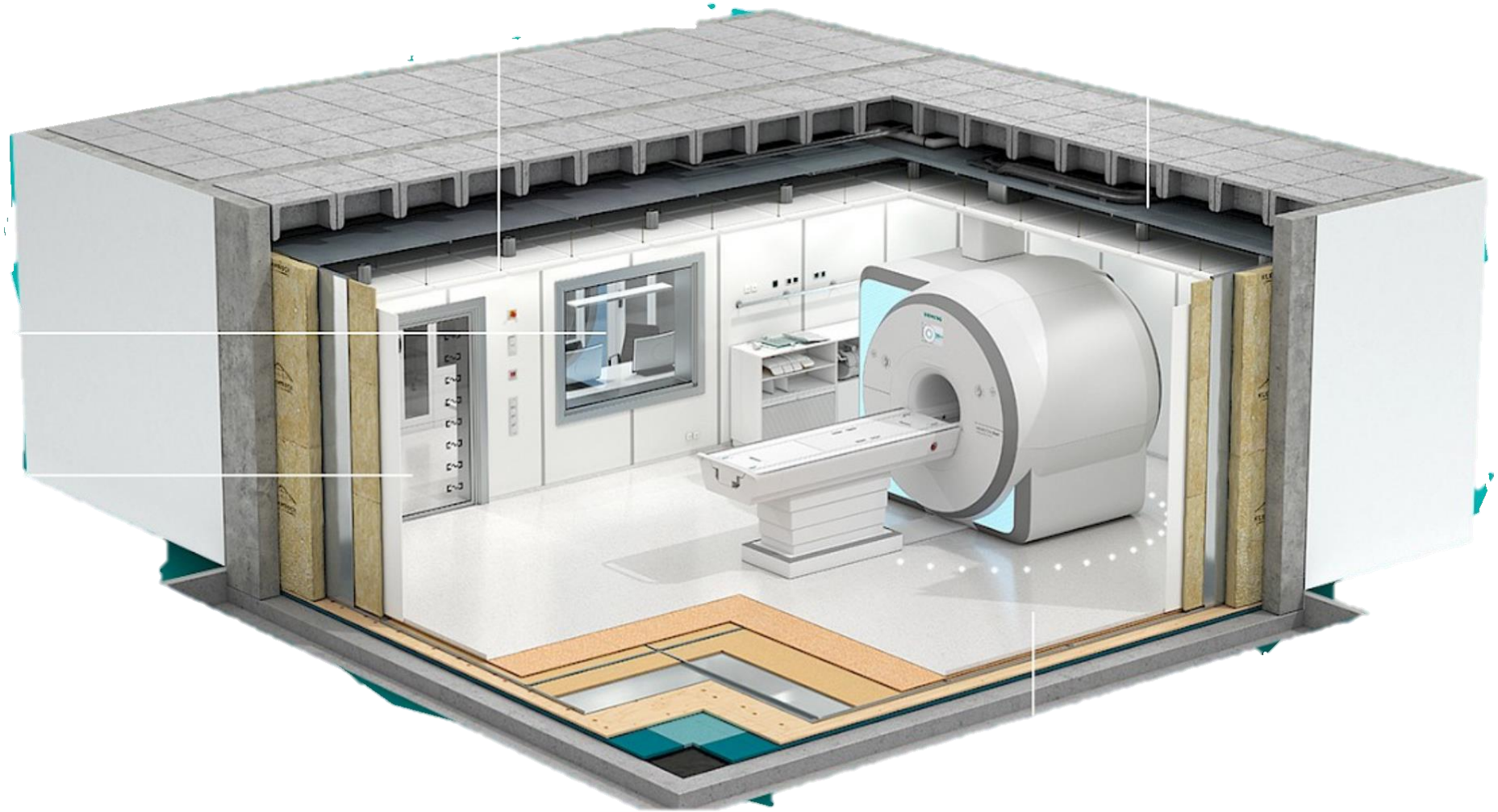
Electrical power rating			
MRI system Gradient system		**Omega Gradients**	**Omega HP Gradients**
Apparent Power	**kVA**	60	80
Rated current	**A/phase**	90	116
Peak current	**A/phase, <5ms**	400 (*)	
Peak current	**A/phase, <1ms**	500 (*)	
Nominal fuse rating (**)	**A rms**	100	125

Air Condition Requirements

Ambient requirements	
Temperature	15 - 24 °C (*)
	The temperature of the conditioned air that enters the room must not be less than 6 degrees below the mean room temperature
Maximum temperature change	5 °C per 10 min
Relative humidity	30% - 70%, no condensation
(*) Requirements specified at the air intake of the cabinets.	

Total heat dissipation to air in kW		
	Omega	**Omega HP**
Dissipation standby	2	
Peak dissipation scanning	4	4.5
(*) Heat dissipation of an optional chiller or other third party equipment, if installed in the technical room is not included.		

RF Cage



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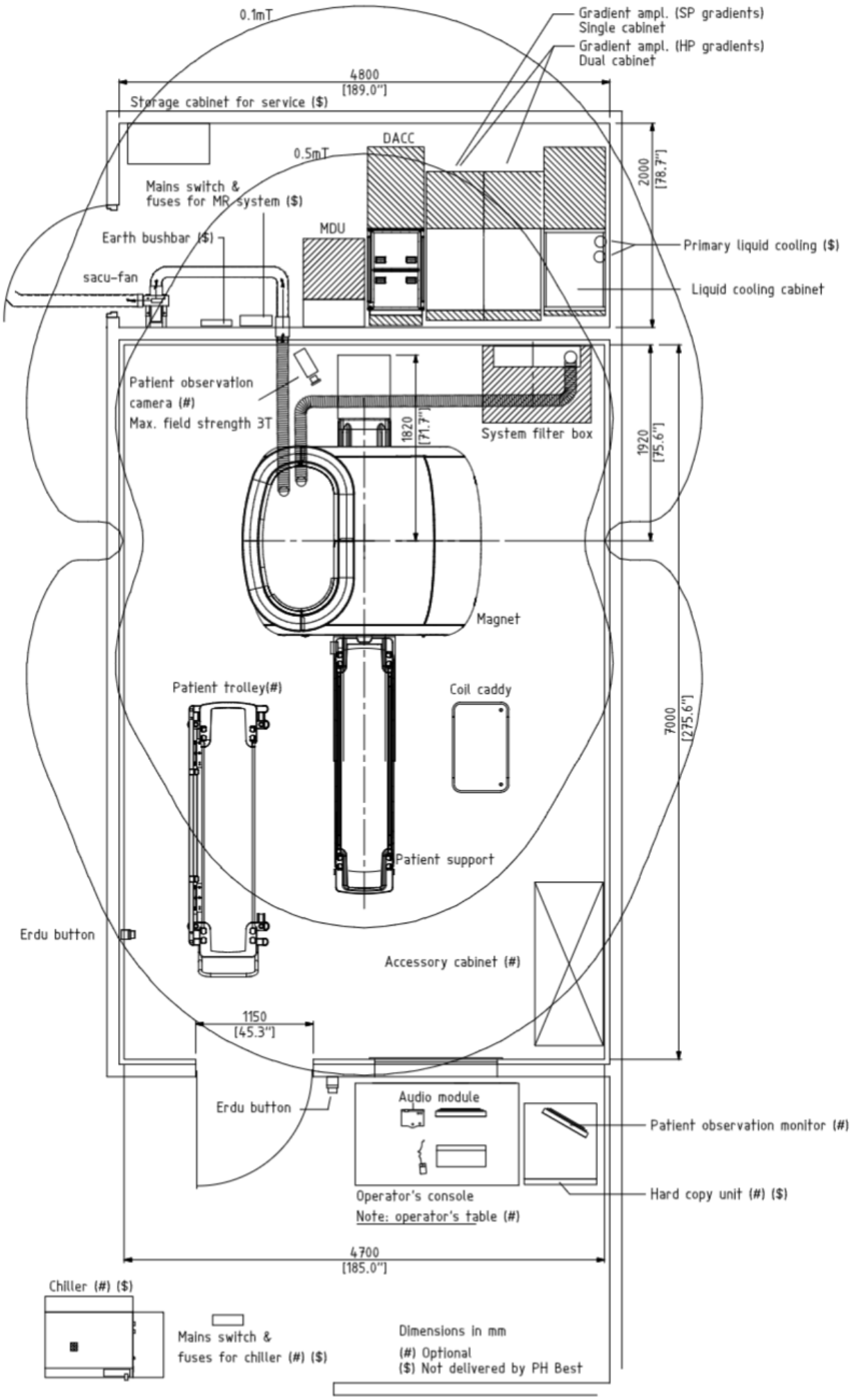
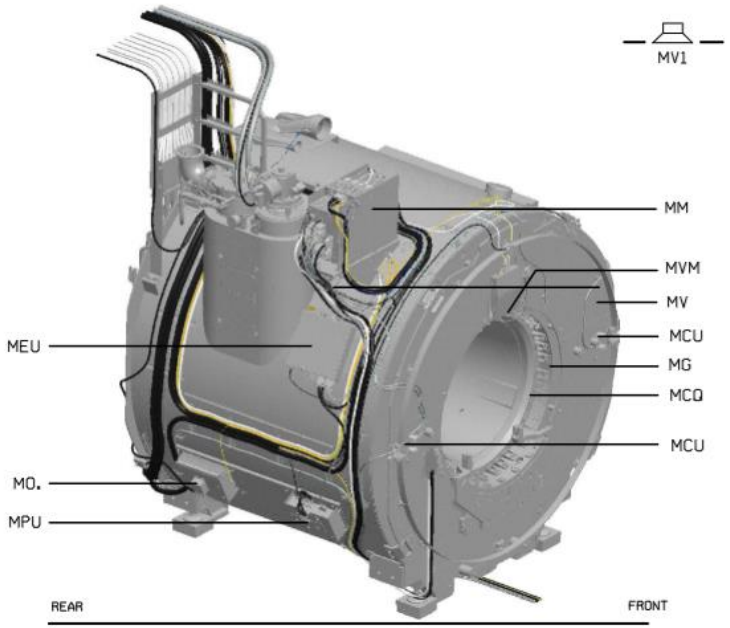
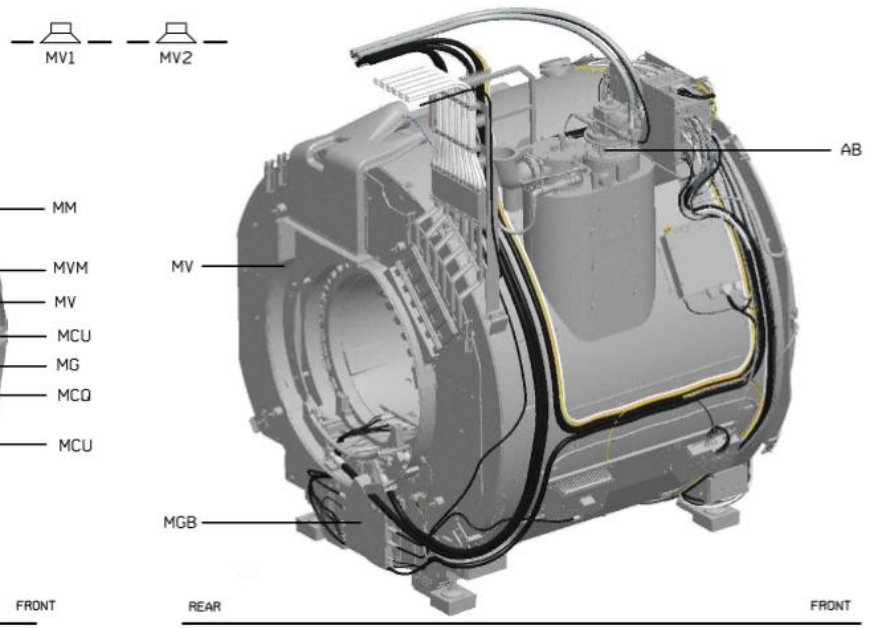
PHILIPS

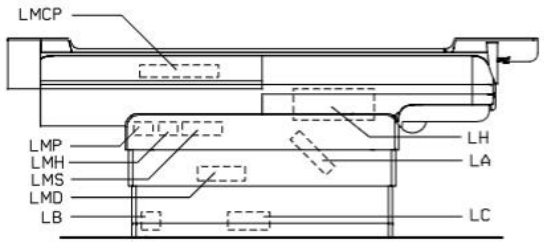

0.1mT
Gradient ampl. (SP gradients)
Single cabinet
Gradient ampl. (HP gradients)
Dual cabinet
4800
[189.0"]
Storage cabinet for service ($)
DACC
0.5mT
2000
[78.7"]
Mains switch &
fuses for MR system ($)
MDU
Earth bushbar ($)
Primary liquid cooling ($)
sacu-fan
Liquid cooling cabinet
Patient observation
camera (#)
Max. field strength 3T
1820
[71.7"]
System filter box
1920
[75.6"]
Magnet
Patient trolley(#)
Coil caddy
7000
[275.6"]
Patient support
Erdu button
Accessory cabinet (#)
1150
[45.3"]
Erdu button
Audio module
Patient observation monitor (#)
Operator's console
Note: operator's table (#)
Hard copy unit (#) ($)
4700
[185.0"]
Chiller (#) ($)
Mains switch &
fuses for chiller (#) ($)
Dimensions in mm
(#) Optional
($) Not delivered by PH Best



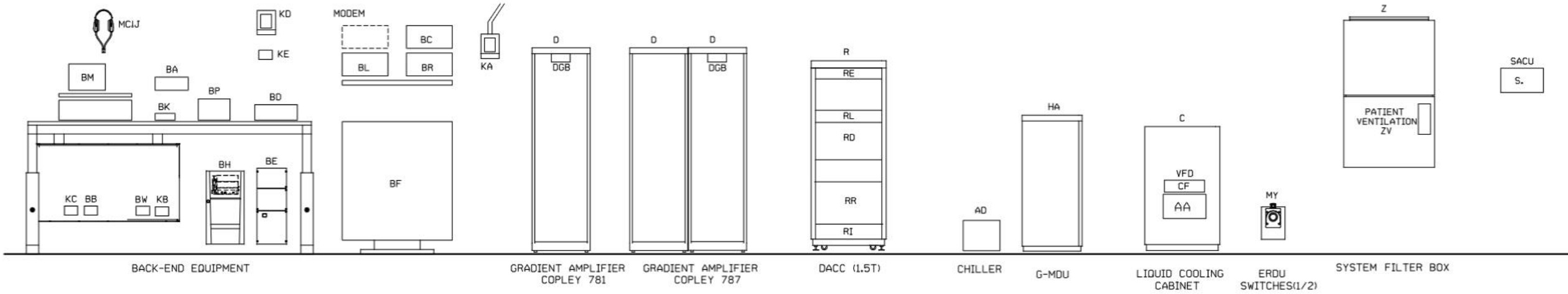
MAGNET : MA.
ENCLOSURES : ME/MK/ML



MAGNET : MA.
ENCLOSURES : ME/MK/ML



PATIENT TABLE : L
ENCLOSURES : LE



BACK-END EQUIPMENT

GRADIENT AMPLIFIER
COPLEY 781

GRADIENT AMPLIFIER
COPLEY 787

DACC (1.5T)

CHILLER

G-MDU

LIQUID COOLING
CABINET

ERDU
SWITCHES(1/2)

SYSTEM FILTER BOX

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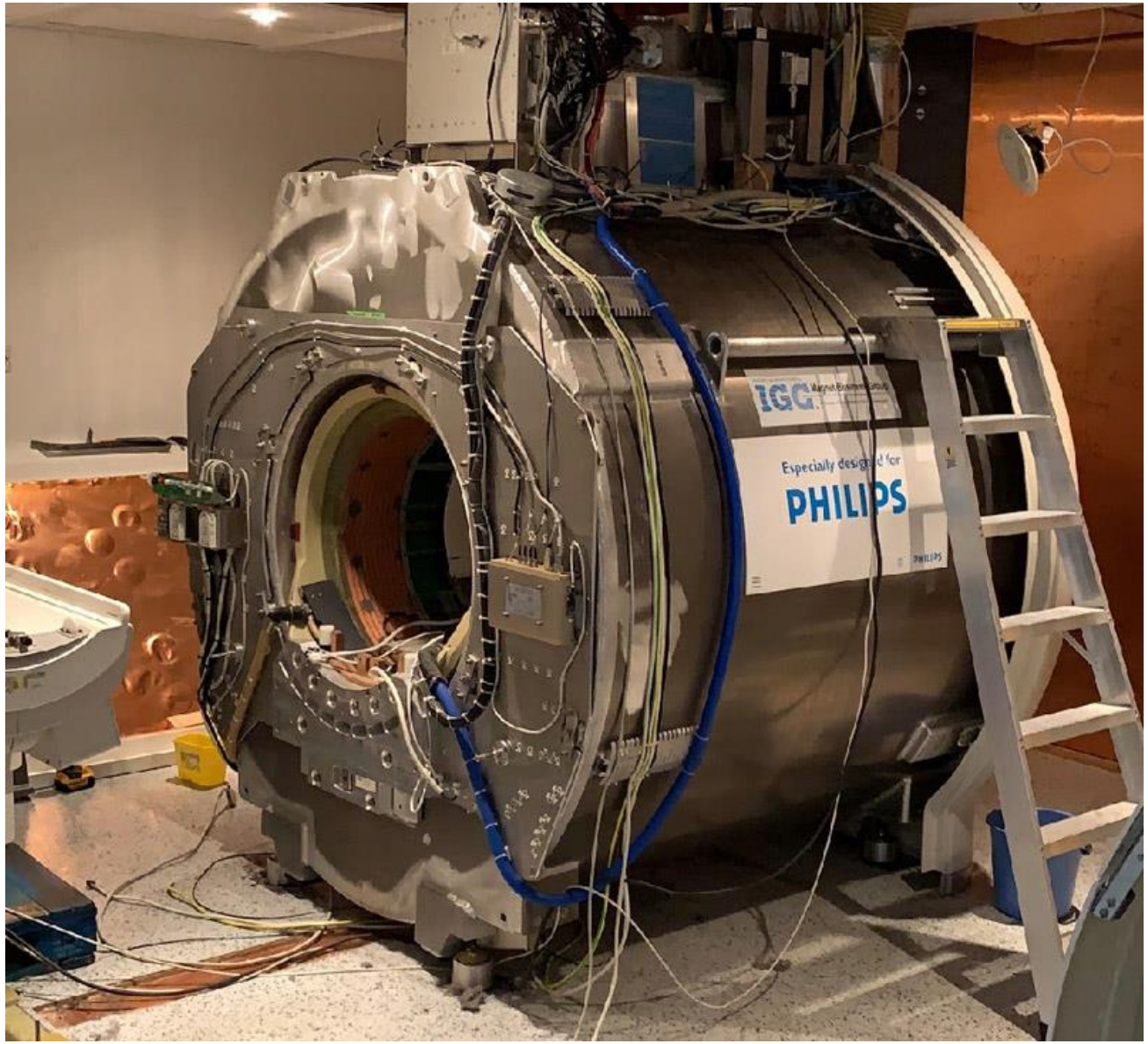
IGG
PHILIPS

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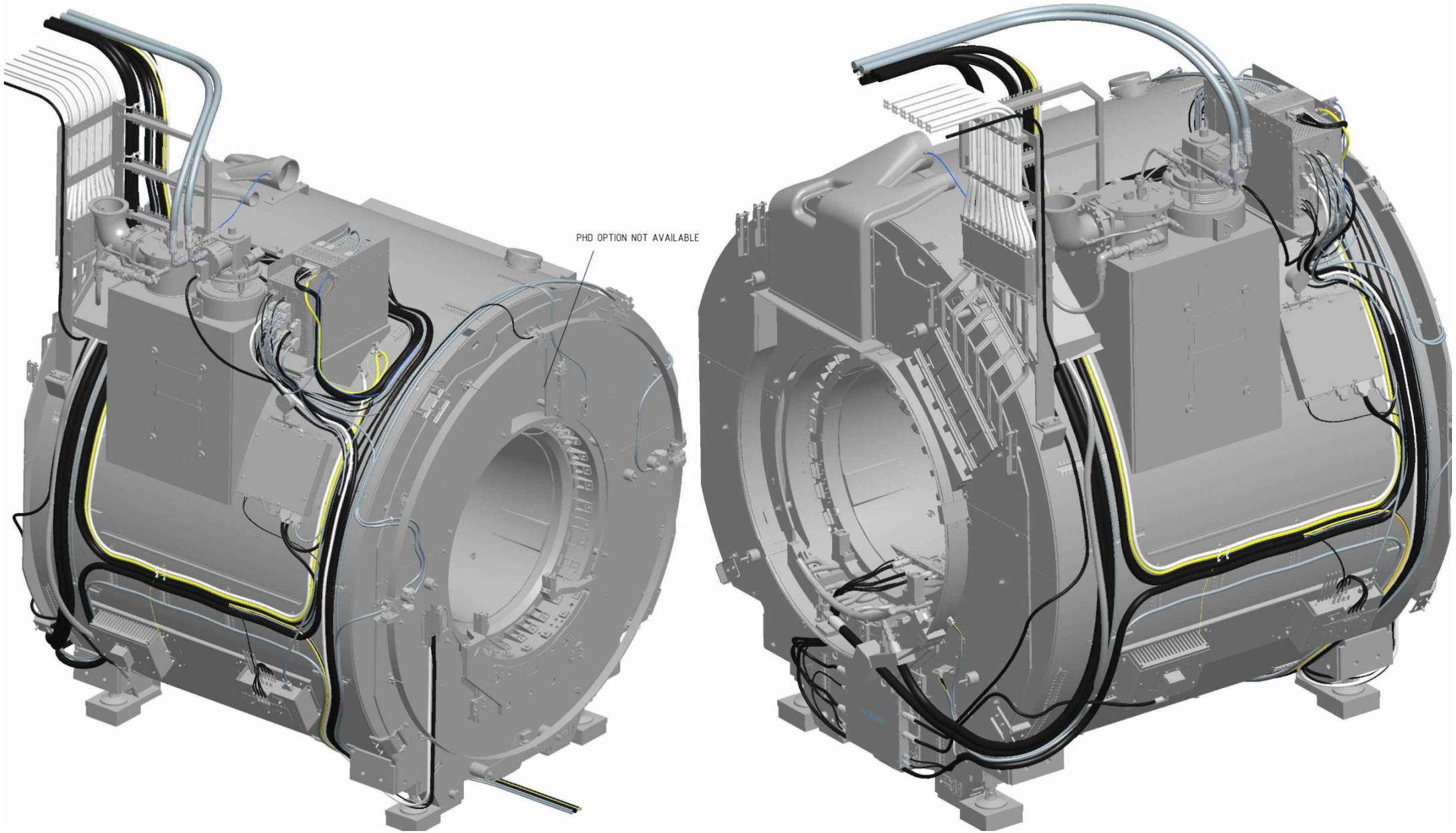
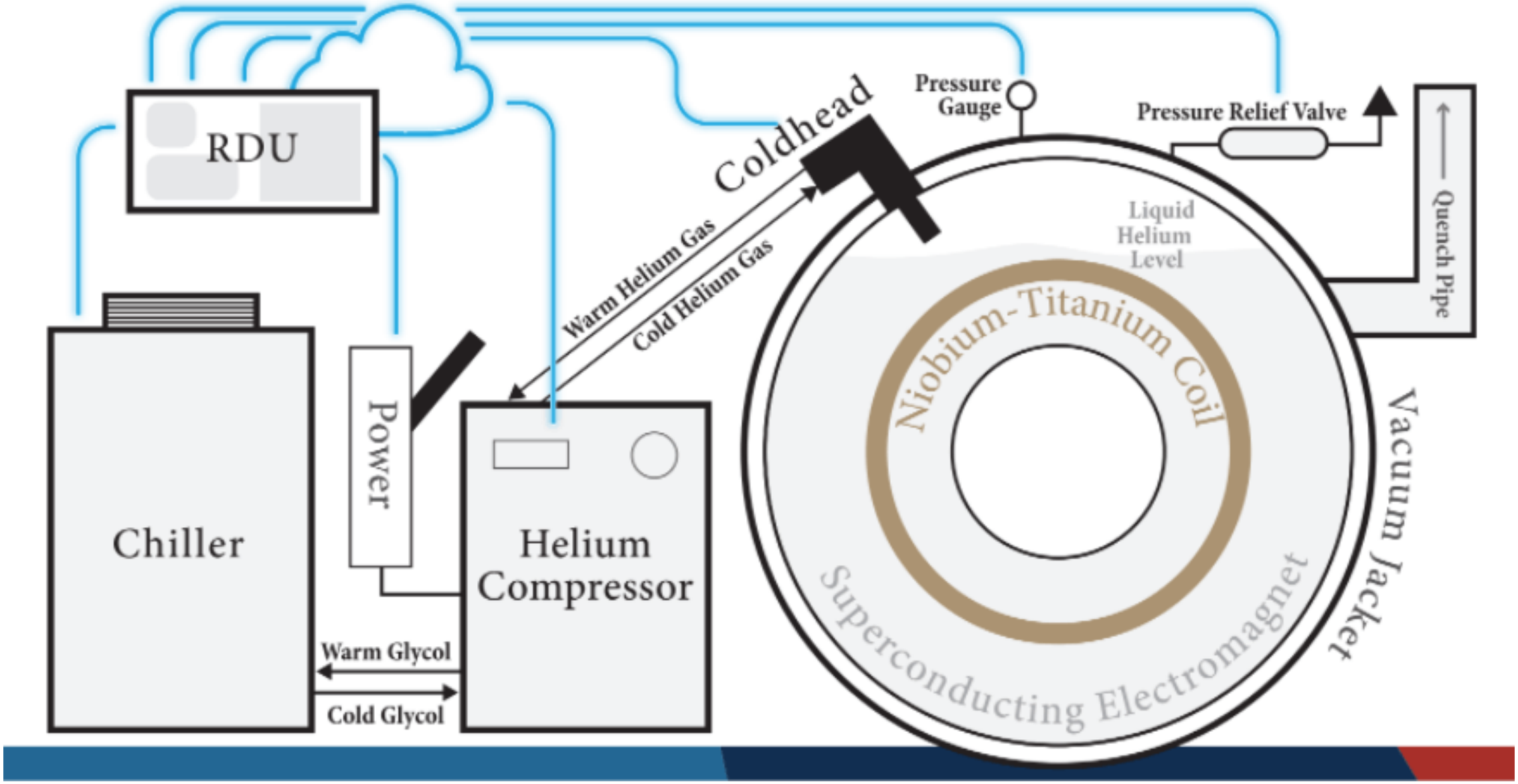

PHD OPTION NOT AVAILABLE


FA-50
Sumitomo


F-70
Sumitomo
CRYOGENICS


RDU
Coldhead
Pressure Gauge
Pressure Relief Valve
Quench Pipe
Liquid Helium Level
Warm Helium Gas
Cold Helium Gas
Niobium-Titanium Coil
Vacuum Jacket
Superconducting Electromagnet
Chiller
Power
Helium Compressor
Warm Glycol
Cold Glycol

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MRI Quench ?

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One liter of liquid helium
expands to approximately 750 liters
of gaseous helium at standard temperature

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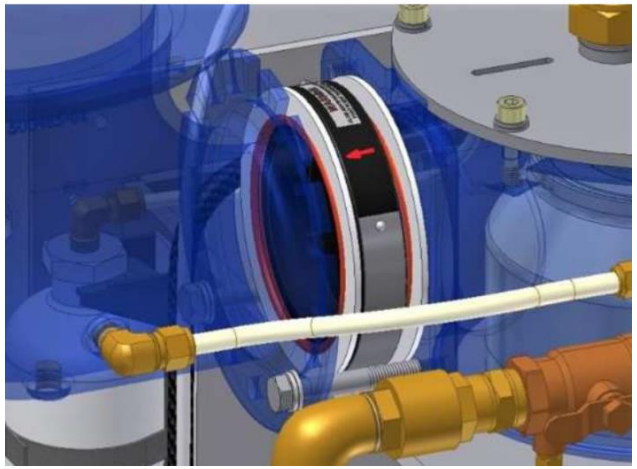
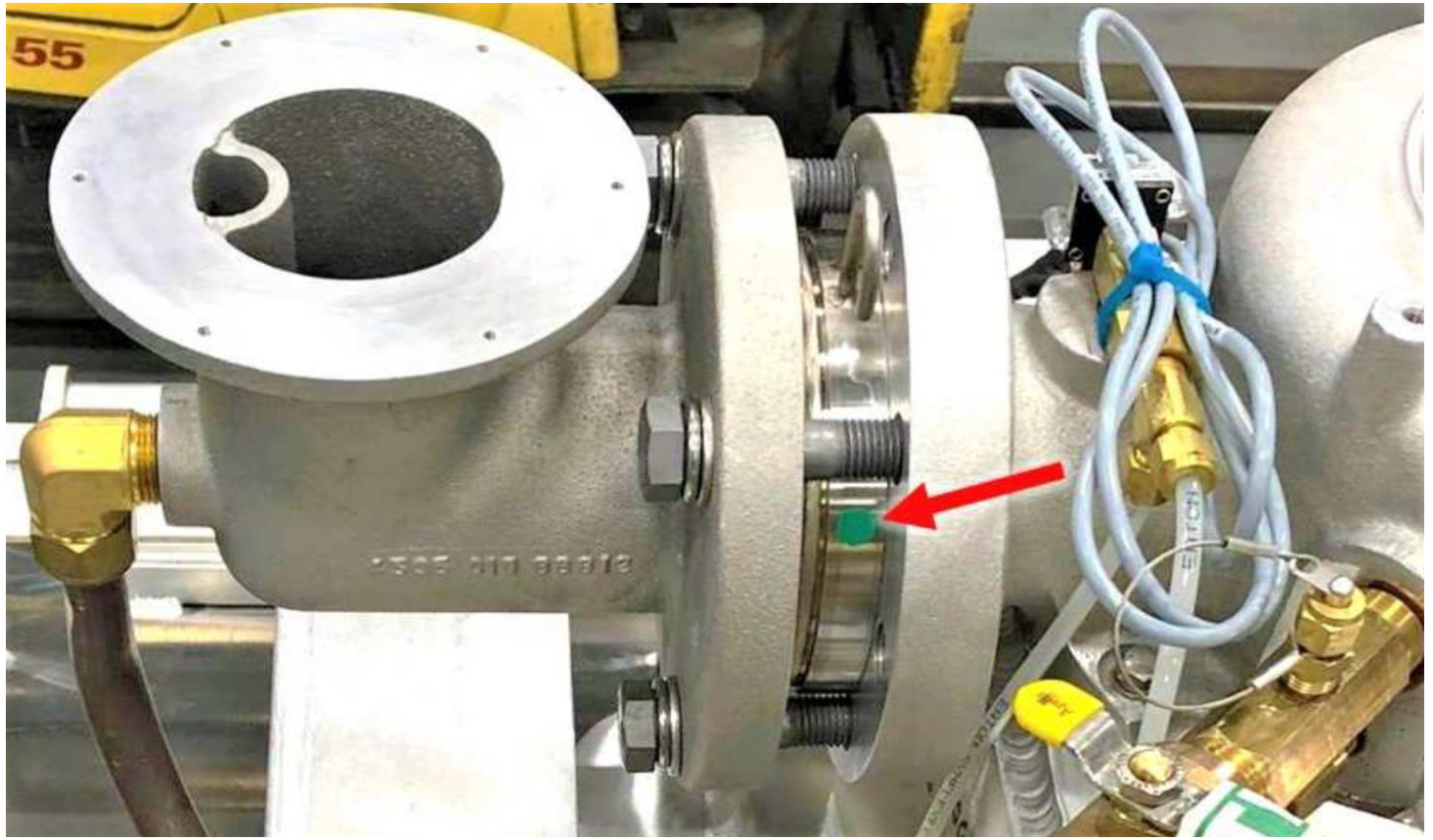
EMERGENCY
RUN DOWN
OPERATION OF THIS SWITCH
WILL DE-ENERGISE
THE MAGNET
WARNING: ENERGISING THE
MAGNET IS A LONG AND
COSTLY PROCESS


SIEMENS
STOP
STOP

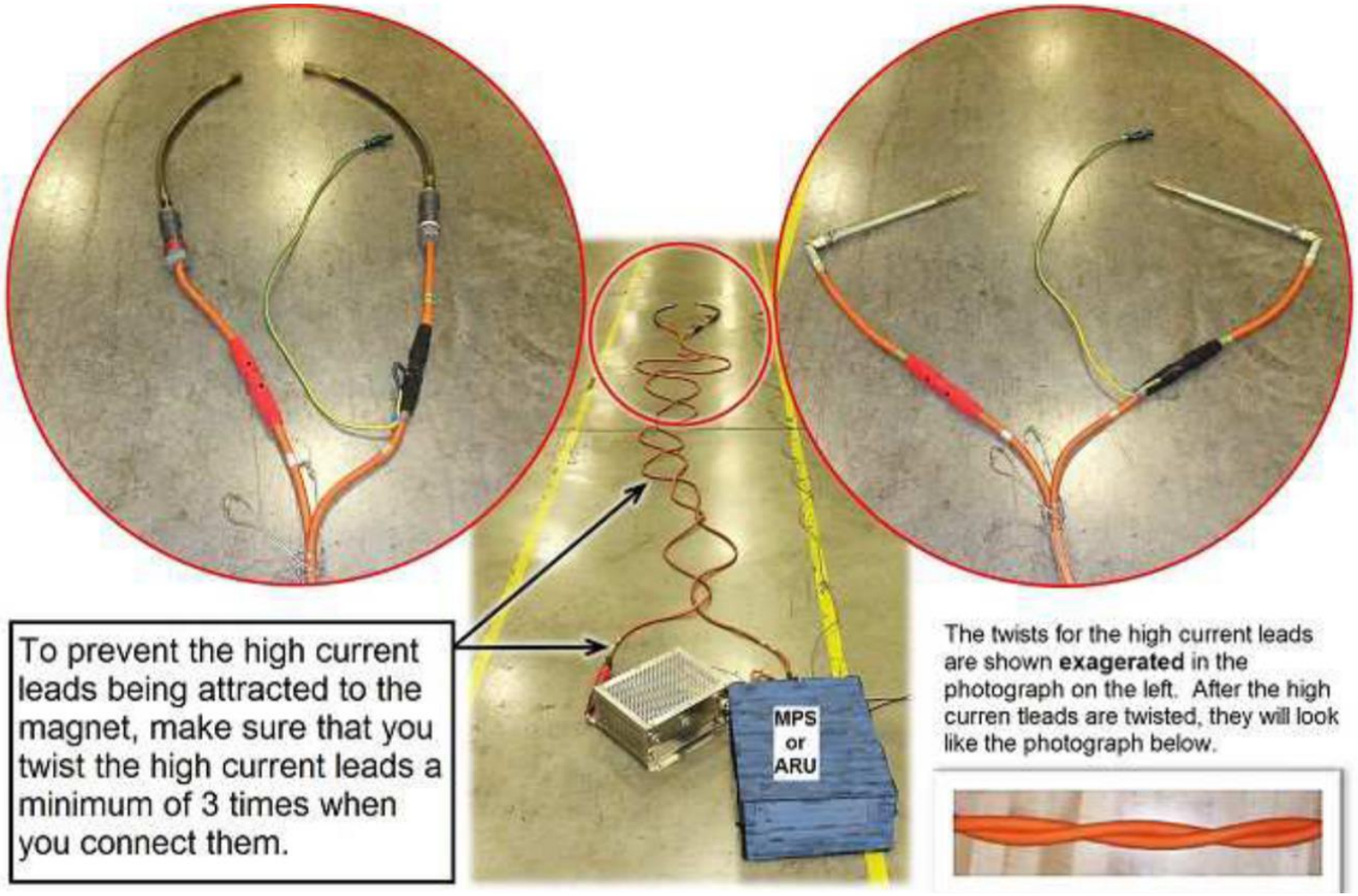

HEATER
TEST
CHARGER
POWER
BATTERY
TEST
TEST
HEATER LED
TEST
A
B
HEATER
TEST
BATTERY
CAUTION!
HEATER
ACTUATED
GE Healthcare

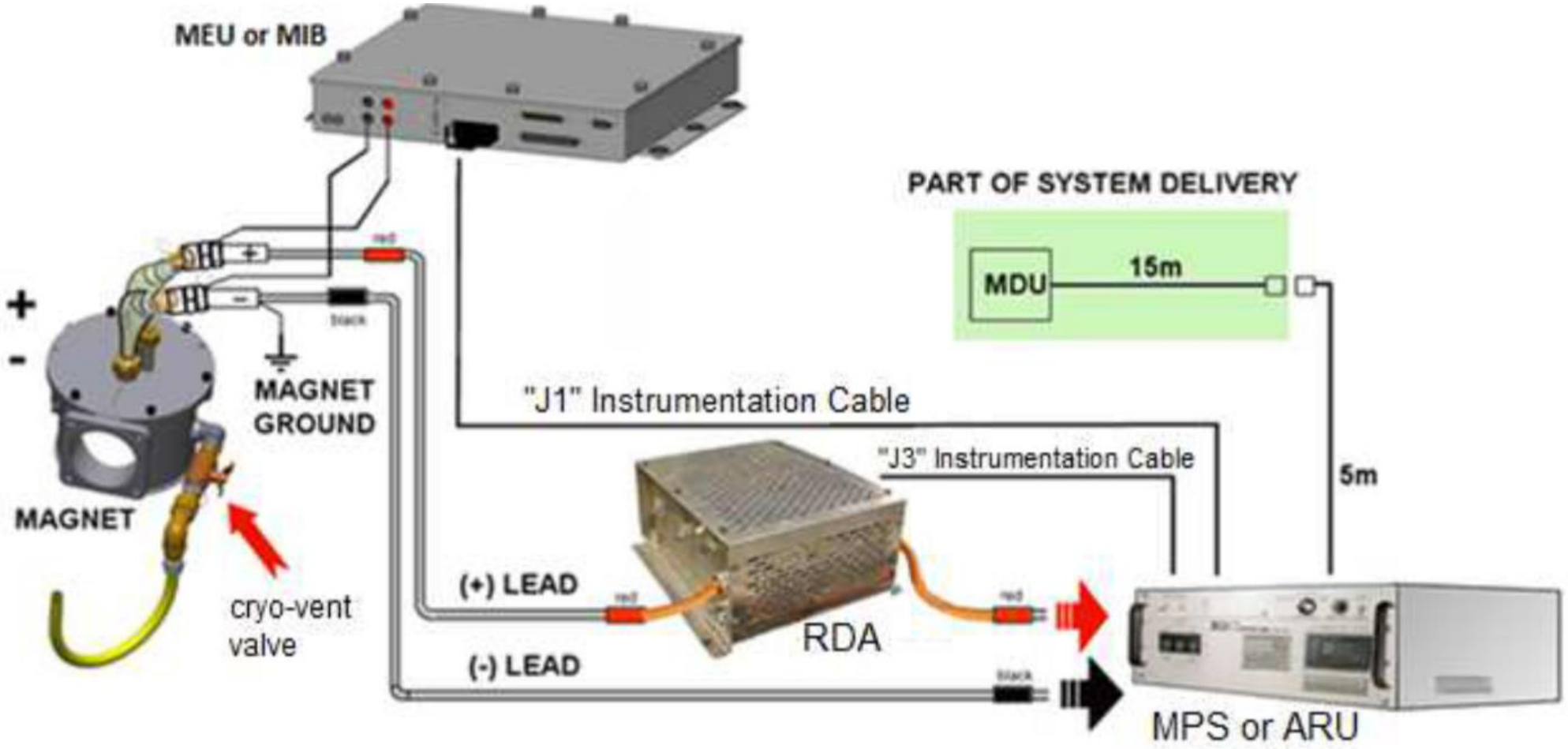
Burst Disk





Ramp Up The system




MEU or MIB
PART OF SYSTEM DELIVERY
MDU
15m
+
-
MAGNET GROUND
"J1" Instrumentation Cable
"J3" Instrumentation Cable
5m
MAGNET
(+) LEAD
cryo-vent valve
RDA
(-) LEAD
MPS or ARU

Shimming ??!

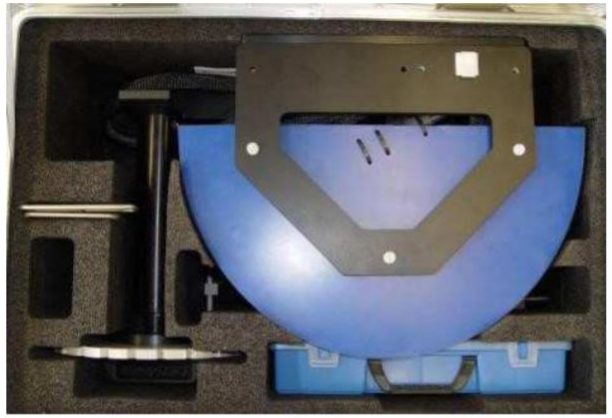


Figure 539: Probe array in case

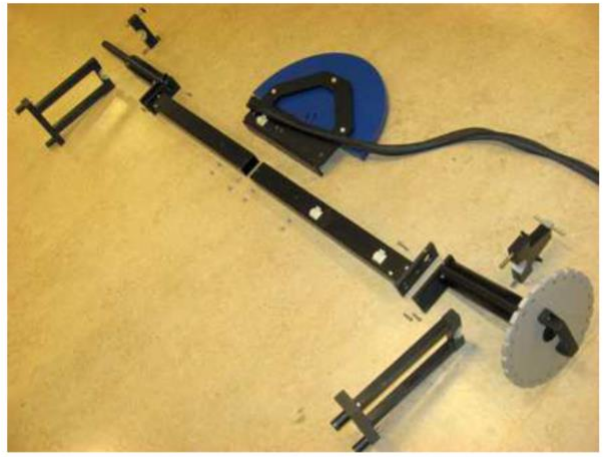


Figure 540: 'Exploded View' of shim gantry

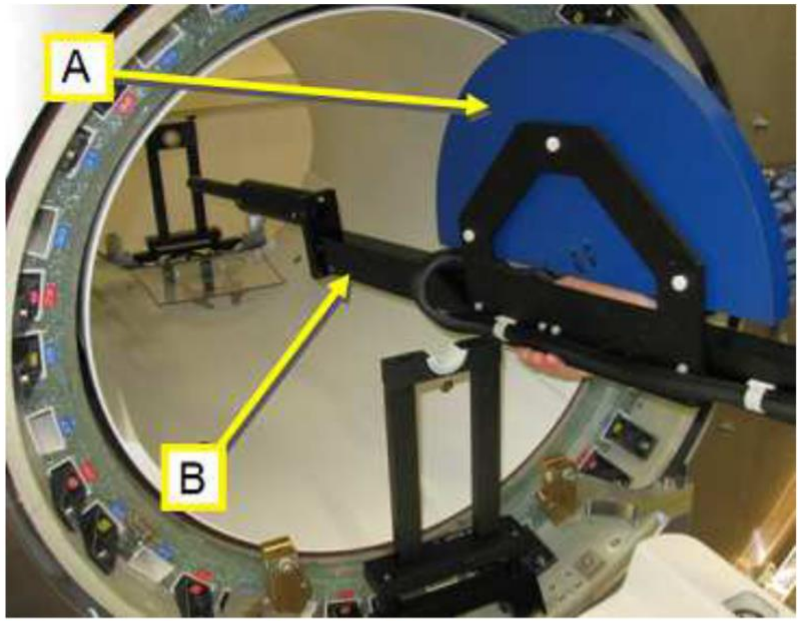


Figure 545: Inserting the shim gantry

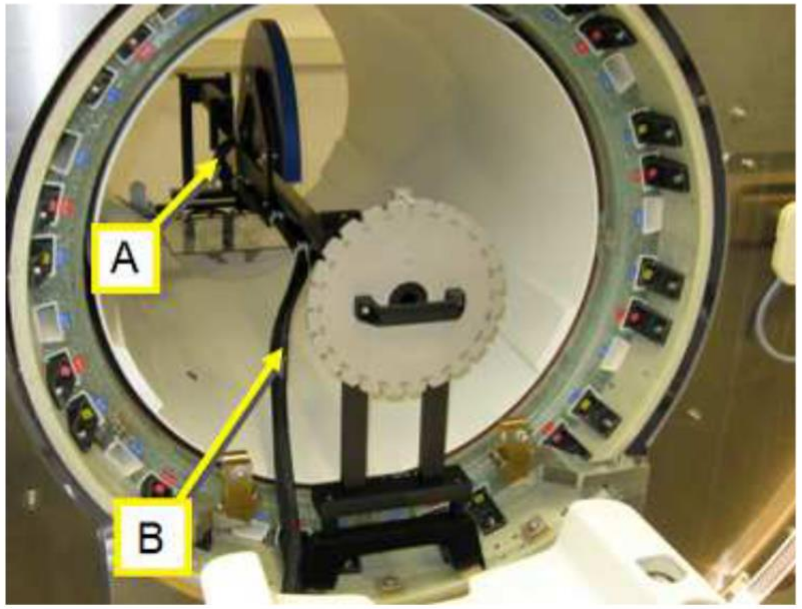


Figure 546: Complete assembly

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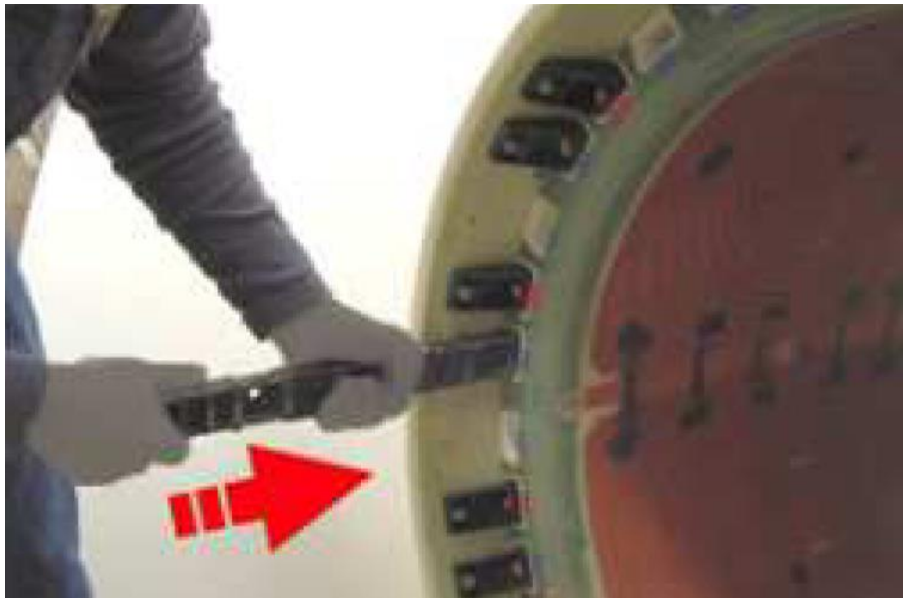

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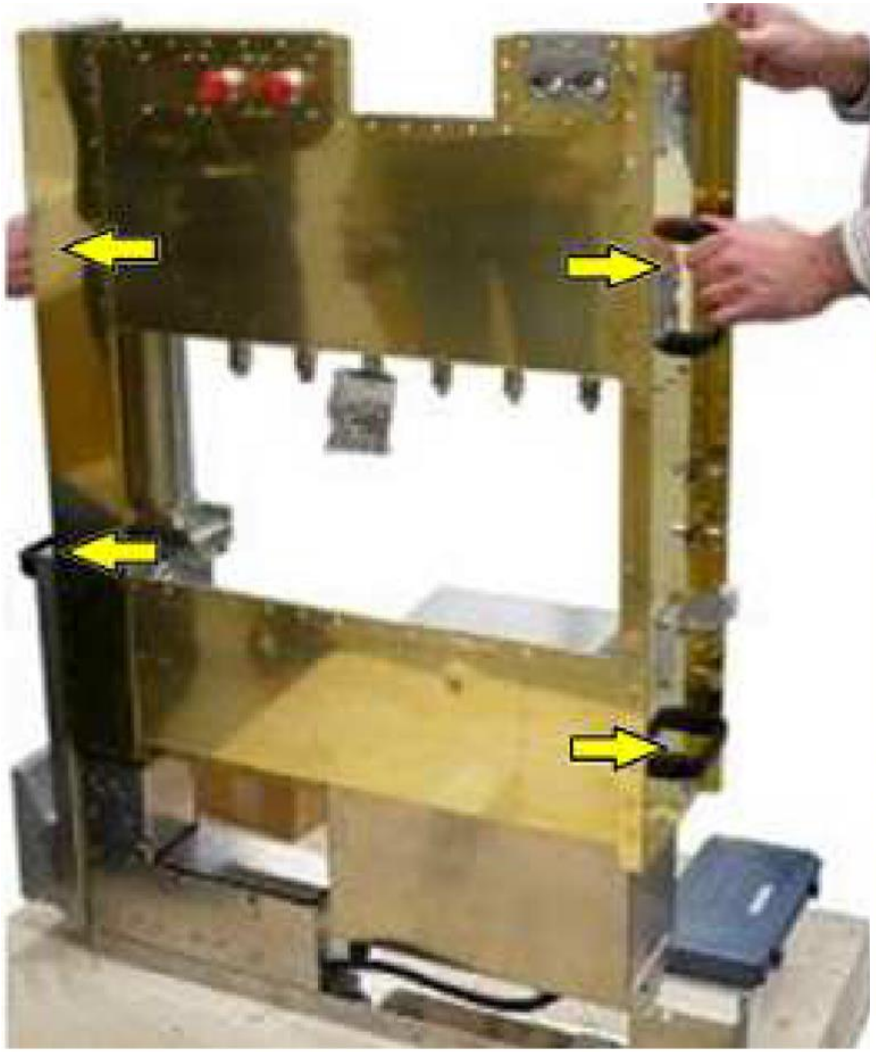
System Filter Box



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Gradient Coil

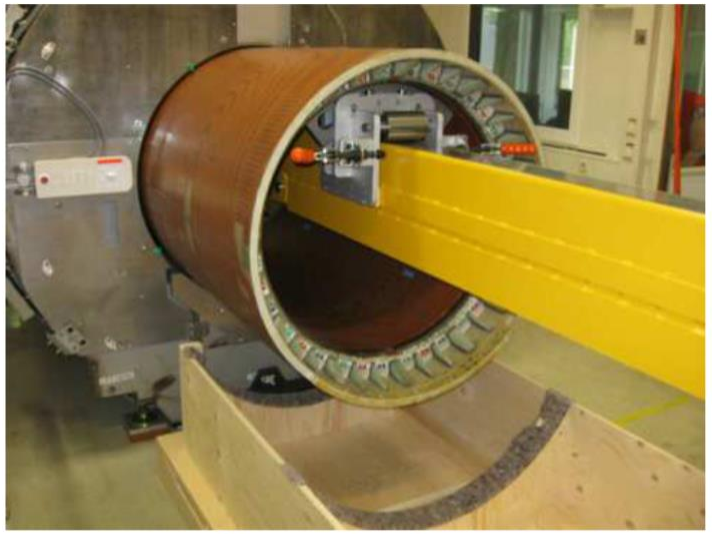

Figure 35: Gradient coil on beam

Figure 36: Gradient coil in crate bottom

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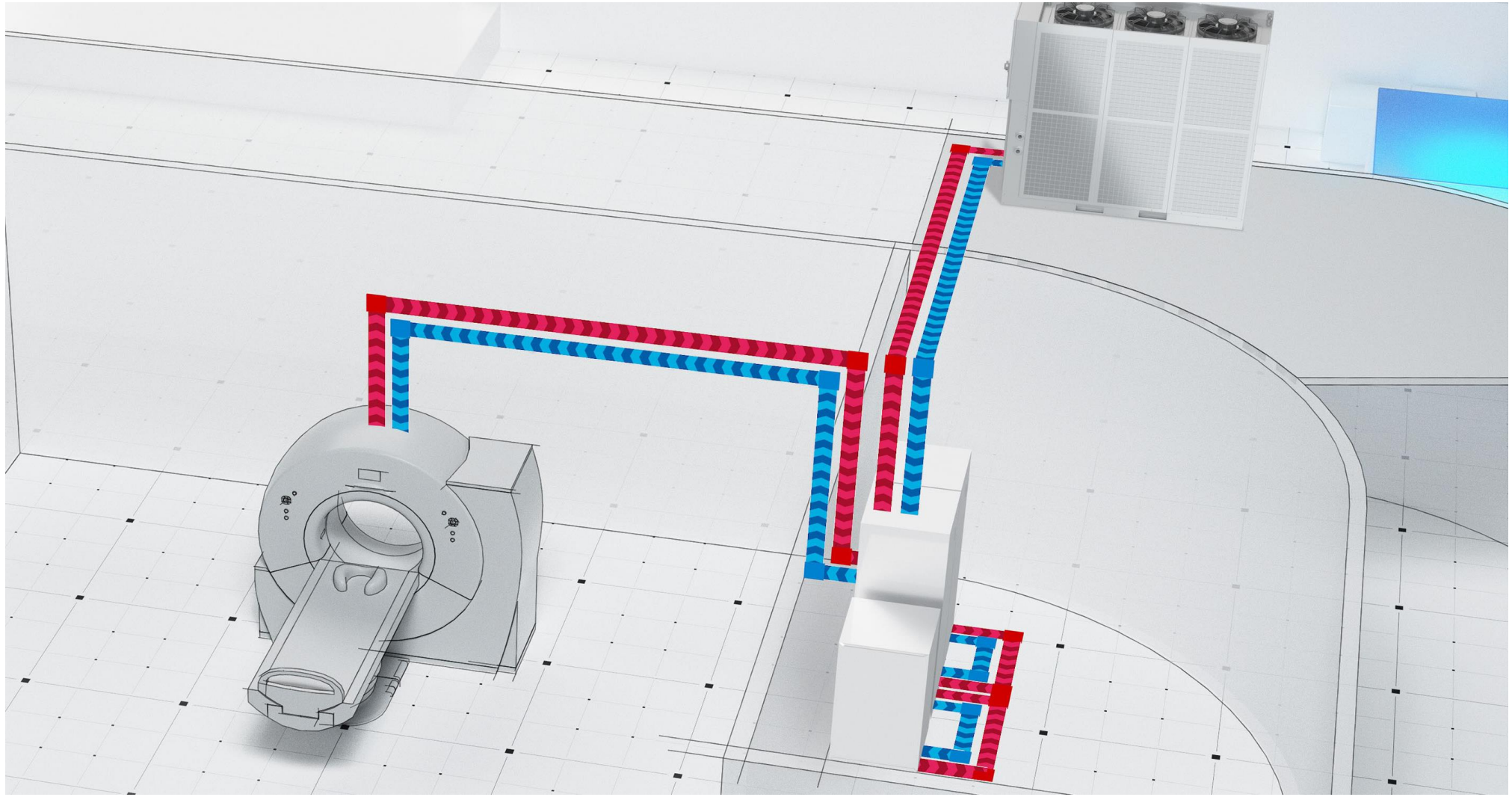
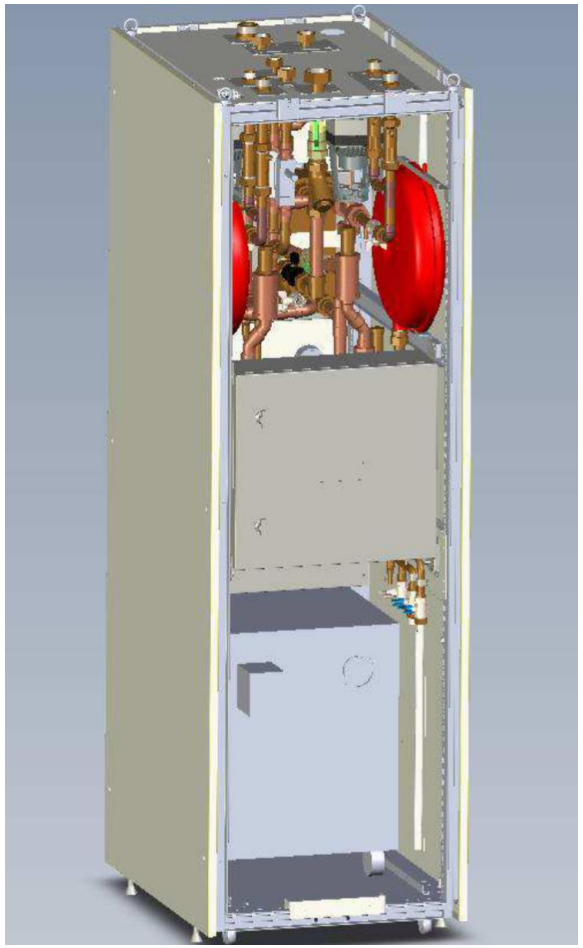
SIEMENS
MAGNETOM Skyra


09

Cooling Overview



Cooling System



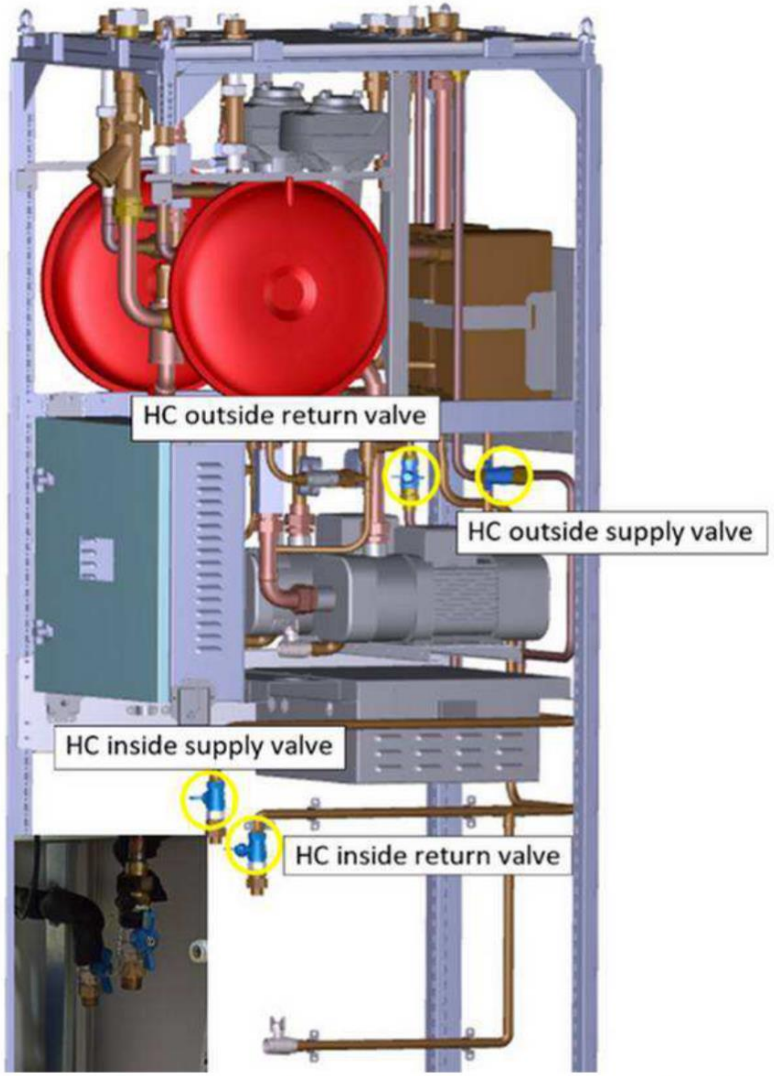


Figure 186: LCC2B valve positions for inside installed HC

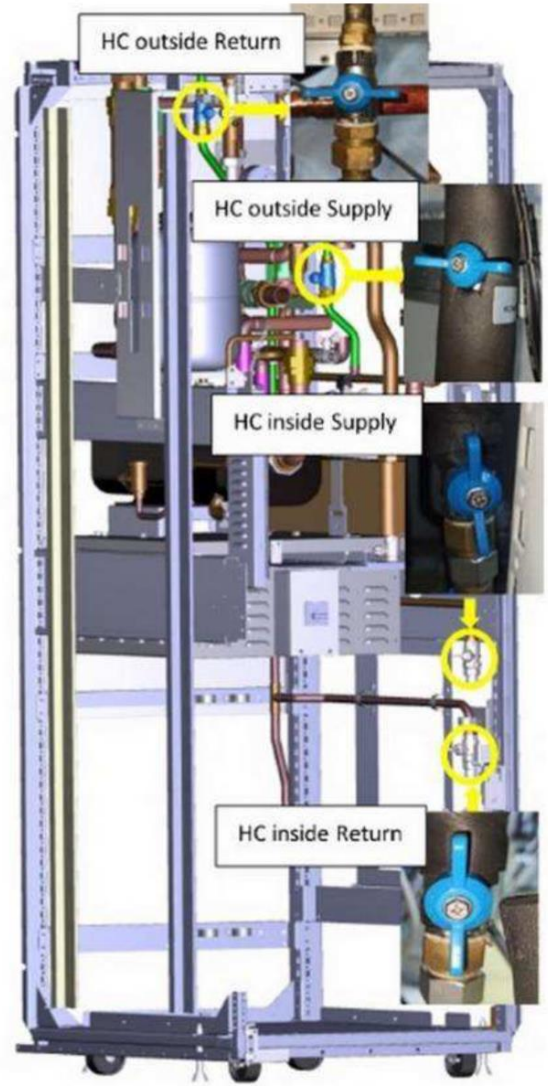
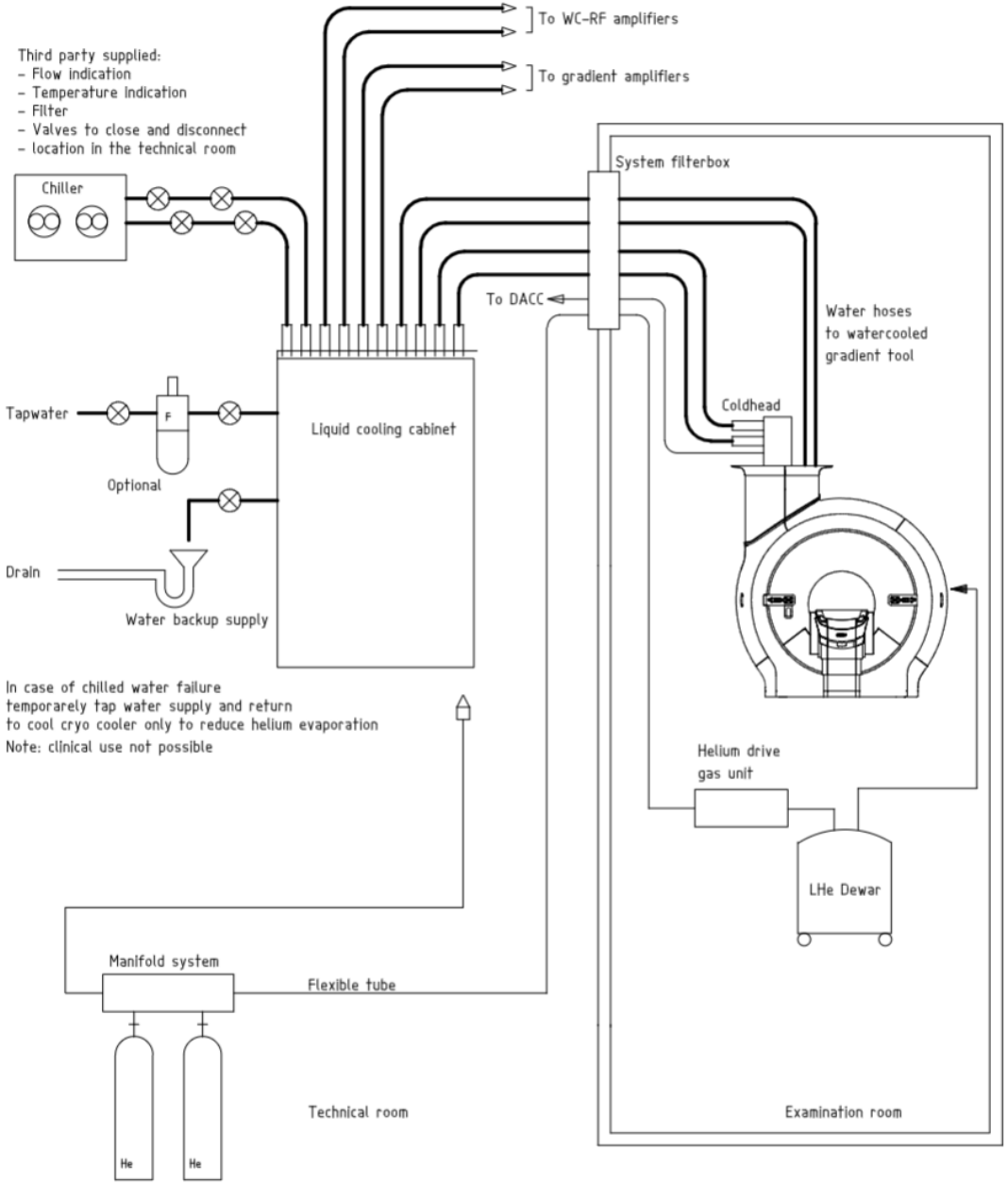
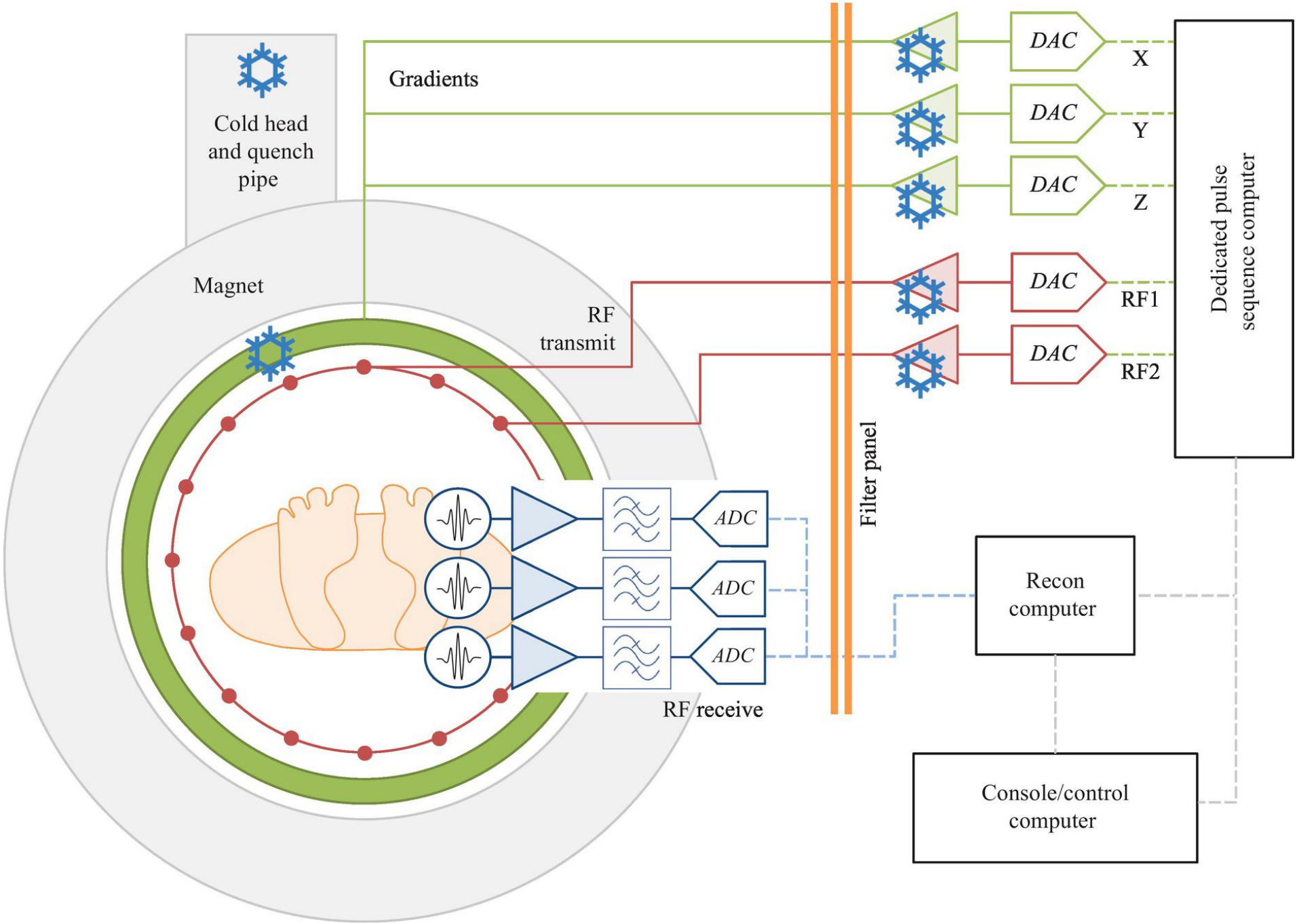
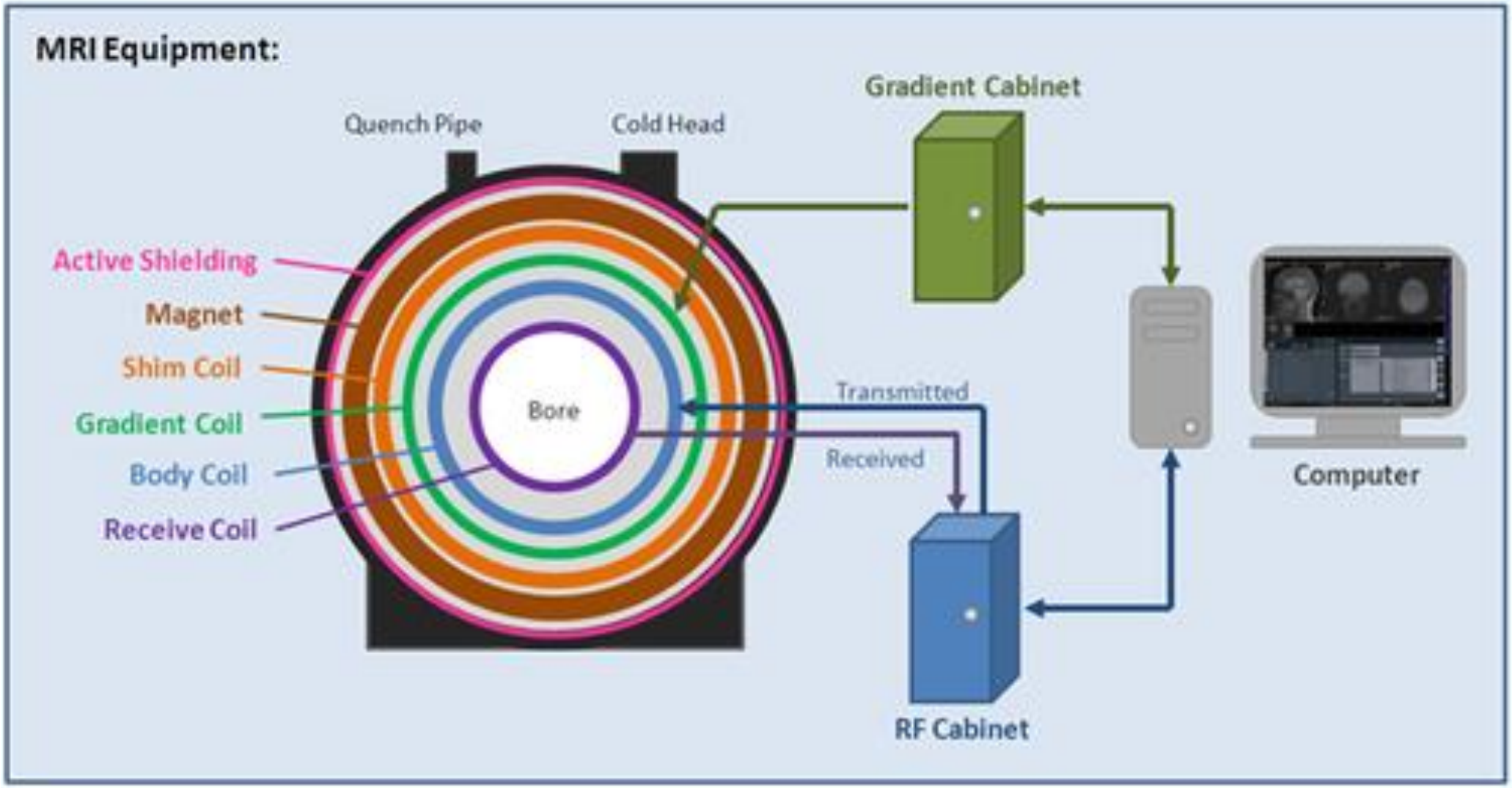


Figure 187: LCC4 valve positions for inside installed HC


To WC-RF amplifiers
To gradient amplifiers
Third party supplied:
- Flow indication
- Temperature indication
- Filter
- Valves to close and disconnect
- location in the technical room
Chiller
System filterbox
To DACC
Water hoses
to watercooled
gradient tool
Coldhead
Tapwater
F
Optional
Liquid cooling cabinet
Drain
Water backup supply
In case of chilled water failure
temporarely tap water supply and return
to cool cryo cooler only to reduce helium evaporation
Note: clinical use not possible
Helium drive
gas unit
LHe Dewar
Manifold system
Flexible tube
He
He
Technical room
Examination room


Cold head and quench pipe
Gradients
Magnet
RF transmit
DAC
X
DAC
Y
DAC
Z
DAC
RF1
DAC
RF2
Dedicated pulse sequence computer
Filter panel
ADC
ADC
ADC
RF receive
Recon computer
Console/control computer


MRI Equipment:
Gradient Cabinet
Quench Pipe
Cold Head
Active Shielding
Magnet
Shim Coil
Gradient Coil
Body Coil
Receive Coil
Bore
Transmitted
Received
Computer
RF Cabinet

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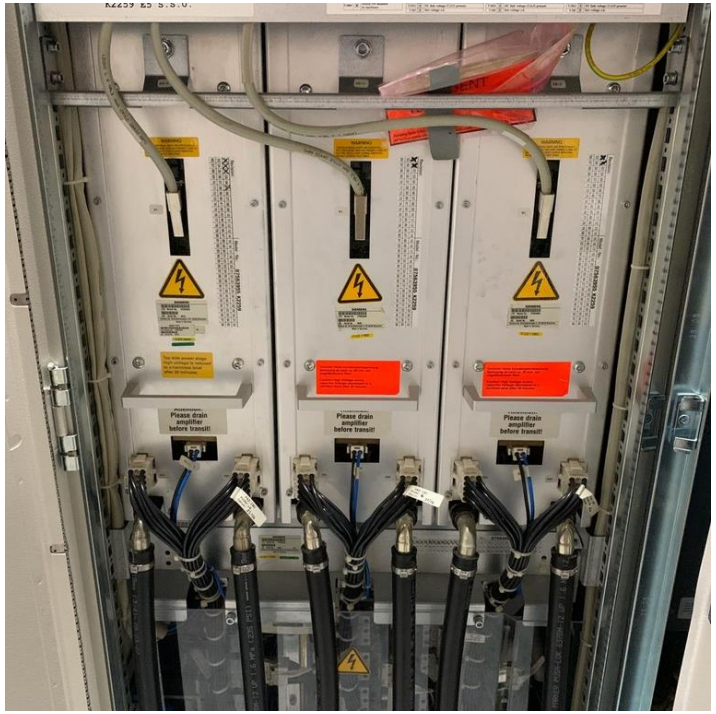
Gradient Amplifier



RF Amplifier

GE Signa MRI An8103 RF Amplifier

RF ampli-fier	 **Figure 424: WDH 1.x**	 **Figure 425: S35**	 **Figure 426: AN8137**	 **Figure 427: WDH 2.0**
Flow Setting	16 – 20 liter / min	9 - 11 liter / min	16 - 20 liter / min	16 – 20 liter / min

RF Coils

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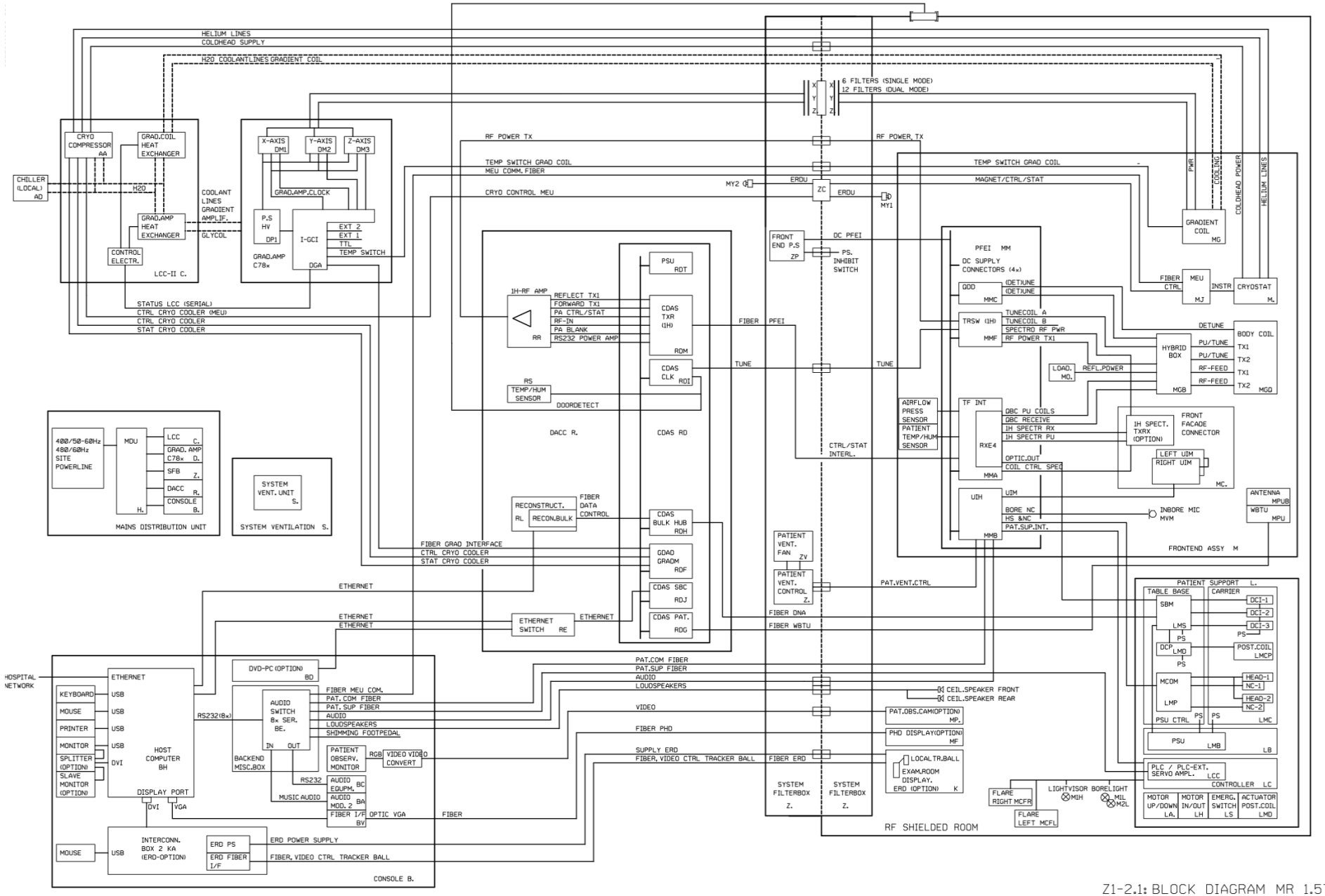

Z1-2.1: BLOCK DIAGRAM MR 1.5T

CSIP Level 1

Let Us Give All People, The Best Solutions!

Thank you…