

PT: Proton Therapy
 BOD: Building Occupancy Date
 PTEV: Proton Therapy Equipment Vendor
 ESS: Energy Selection System
 BTS: Beam Transport System
 TPS/OIS: Treatment Planning System/Oncology Information System
 D/BT: Design/Building Team

61.OVERALL HVAC REQUIREMENTS

- The facility HVAC systems in all the building, including PT rooms and technical areas will be supplied and installed by the D/BT in order to comply with local regulations and shall be operational and stabilized to normal temperature prior to the BOD. All structural walls and slabs must have reached thermal equilibrium. For additional requirements, see Chapter VII: BOD requirements.
- The HVAC requirements for all the rooms where PTEV equipment will be installed are summarized hereafter. It is highly recommended for the HVAC system to be monitored and adapted in each of the following areas.
- The HVAC local regulations related to radiation safety for the Cyclotron/ESS/BTS vaults, the treatment rooms and the research area if any, may require a separated air flows system to prevent from mixing or transporting activated ions in regular HVAC system. Our experience shows that 6 air renewals/hour in these areas are enough to keep radiation below the accepted limit in most of the worldwide regulations.
- In treatment room, the building equipment (HVAC, ...) shall not produce more than 65 db (daily average)

5. CYCLOTRON AND ESS/BTS VAULT

The PTEV requests that HVAC devices be installed in the ESS/BTS areas in a way not to obstruct handling and alignment work.

	Vault - Cyclotron Area	Vault - ESS Area	Vault - BTS Area
Temperature °C (°F)	22 (72)	22 (72)	22 (72)
Temp Stability °C (°F)	± 2.5 (4.5)	± 2.5 (4.5)	± 2.5 (4.5)
Relative Humidity %	35 to 60	35 to 60	35 to 60
Power Dissipation (kW) to air	9	2	2

6. GANTRY AREA & GANTRY TREATMENT ROOMS

The Gantry areas require special HVAC consideration because the Gantry is sensitive to thermal expansion / contraction of its steel structure. It is especially vulnerable to differential expansion / contraction that may occur because of possible temperature gradients due to the stratification in the three levels high Gantry chamber.

To maintain the best environment for the Gantry, a destratification pipe is installed by the D/BT according to the PTEV recommendations. This destratification pipe blows the air at the three different levels of the Gantry.

The air circulation throughout the vault shall be sufficient to guarantee that every part of the Gantry structure stays within the ± 1.5 °C (± 2.5°F) tolerance.

There shall be therefore at least one thermostat at each level of the Gantry chamber. (Lower level, Treatment level and Upper Level).

The two first thermostats shall be installed in the opposite corner of the destratification pipe. For maintenance reasons, the third thermostat can be installed above the treatment area concrete ceiling. PTEV shall approve the three thermostats location prior to installation.

The temperature shall stay within ±1.5 °C (± 2.5 °F) of the nominal Facility temperature at which the equipment is aligned.

The HVAC must either operate continuously through holidays and other idle periods or a soak period must be observed to stabilize the temperature of the structure before gantry rotation is attempted.

Many bearing surfaces in the gantry must be bare steel because the high contact pressures preclude other options. Moreover, since Gantry rotation and breaking is by means of friction drive rollers, the surfaces cannot be coated or lubricated. Therefore corrosion of the bare steel surfaces is a concern. As a result, humidity in the Gantry room shall be minimized to the extent practical

	Gantry Pit	Treatment Area
Temperature °C (°F)	22 (72)	22 (72)
Temp Stability °C (°F)	± 1.5 (2.5)	± 1.5 (2.5)
Relative Humidity %	40 to 60	40 to 60
Equip Power Dissipation (kW)	3	2

7. POWER SUPPLY ROOM

It would be advantageous to directly duct out the hot air from the power supplies.

Temperature °C (°F)	22 (72)
Temp Stability °C (°F)	± 2.5 (4.5)
Relative Humidity %	35 to 60
Equip Power Dissipation (kW)	50

Remark: The estimation of the equipment power dissipation in the Power Supply Room is based on the conservative assumption that 70% of the losses from the power supplies are transferred to the air.

8. WATER COOLING ROOM

Temperature °C (°F)	22 (72)
Temp Stability °C (°F)	± 2.5 (4.5)
Relative Humidity %	40 to 60
Equip Power Dissipation (kW)	5

9. MAIN CONTROL ROOM

Temperature °C (°F)	22 (72)
Temp Stability °C (°F)	± 2.5 (4.5)
Relative Humidity %	40 to 60
Equip Power Dissipation (kW)	2

10. TREATMENT CONTROL ROOM

Temperature °C (°F)	22 (72)
Temp Stability °C (°F)	± 2.5 (4.5)
Relative Humidity %	40 to 60
Equip Power Dissipation (kW)	2.5

11. PTEV SERVER ROOM

This room will be equipped with independent air conditioning unit. If the TPS/OIS servers are part of the scope and integrated to the server room, ensure that the power dissipation is taken into account as indicated in the table. If the TPS/OIS servers are located in another room, the related HVAC will need to evacuate 9 kW due to other doubled devices.


Temperature °C (°F)	22 (72)
Temp. stability °C(°F)	± 2.5 (4.5)
Relative humidity (%)	40 to 60
Equip. Power Dissipation (kW)	9 (10 if TPS/OIS)

12. STORAGE ROOMS

Temperature °C (°F)	22 (72)
Temp. stability °C(°F)	± 2.5 (4.5)
Relative humidity (%)	40 to 60

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DRAFTSMAN:	LCHEM	CHECKED BY:	QBA	VALIDATED BY:	PV

MATERIAL: --
 SCALE: (A3) mm
 DIMENSIONS: mm
 TOLERANCES: --

PROJECT: PROTON THERAPY
 SPROJECT: TATA HBTF MUMBAI

VI.

Other Technics

HVAC
 REQUIREMENTS

TITLE: HVAC

Requirements

07.42.33.

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63. SAFETY SYSTEM

ACRONYMS

TSS: Therapy Safety System
 D/BT: Design/Building Team
 ESS: Energy Selection System
 BTS: Beam Transport System
 PTEV: Proton Therapy Equipment Vendor
 SRCU: Safety Redundant Control Unit
 MCR: Main Control Room
 BTB: Building Terminal Box
 NO/NC: Normally Open / Normally Closed

TABLE OF CONTENTS

- Safety System layout: Upper level 01
- Safety System layout: Basement & Treatment level 02
- Safety System details 03
- XRay sign electrical wiring 04
- Table of Operands 05-1/2/3

SAFETY SYSTEM LEGEND

SS	BEAM STATUS SIGN SEE DETAIL IN FIGURE 63.03
C	DOOR INTERLOCK SWITCH
ES	EMERGENCY STOP WALL MOUNTED 1350mm ABOVE FLOOR TO CENTERLINE
SB	SEARCH BUTTON WALL MOUNTED 1350mm ABOVE FLOOR TO CENTERLINE
JB	JUNCTION BOX
AG	AUDIBLE GONG
WL	WARNING LIGHT
MD	MOTION DETECTOR
ND	NEUTRON DETECTOR CONTACT

Refer also to **Chapter II (ROOMS)** for architectural specifications of the rooms

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MATERIAL: -
 SCALE: (A3)
 DIMENSIONS: mm
 TOLERANCES: -

PROJECT: PROTON THERAPY
 SPROJECT: TATA HBTF MUMBAI

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 Other technics

Therapy safety systems

TITLE:
 Presentation

07.42.33.

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GENERAL REQUIREMENTS

The purpose of the Therapy Safety System (TSS) is to provide a Proton Therapy Safety system that complies with the customer's and PTEV's Safety Requirements as well as the appropriate regulations.

The TSS does not concern the radiation safety design of the building. The Therapy Safety System (TSS) only controls the access to the rooms where treatment is provided and/or beam will be present. This is where access sensors and/or information output are installed.

The TSS performs several safety functions in order to assure a safe use of the equipment. It will be used as a redundant system that operates for risks that could lead to the loss of a safety function due to a single fault condition.

The TSS Design is done by the PTEV.

- The TSS related building interlocks shall be provided by the D/BT and shall comply with all applicable codes and standards.
- The TSS electrical conduits, junction boxes, sensors/actuators, cabling up to the SRCU's cabinets, all components necessary to complete the system shall be provided and installed by the D/BT.
- For each SRCU, PTEV provides an associated Building Terminal Box (BTB). All individual device cables shall be connected to these BTB following the Table of Operands.
- The final component selection by D/BT shall be given to the PTEV for approval, prior to purchase.
- Both ends of each sensor/actuator cable shall be connected: one end to the BTB following the Table of operand, the other end to the sensor/actuator itself. These connections shall be done by the D/BT. Verification of that cabling-internal connections shall be done by the D/BT.
- The final connections to the SRCU's Cabinets shall be done by the PTEV.
- Testing and verification of the entire safety system shall be done by the PTEV.
- The TSS components locations and system interface and requirements are shown on this figure and on *Figure 63.02-Safety System layout* and *Figure 63.05-TSS Table of Operands*.

Before imminent door closure for beam production, an audible alarm will warn that a search procedure of a specific zone of the building is underway. This alarm will be of the type single stroke. However, in areas where patients are present (treatment rooms), this must be a patient friendly sound (like a single gong and not too loud).

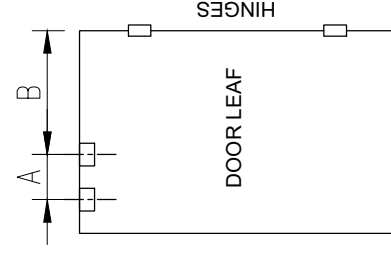
- Search Buttons: momentary action push button to be activated by the last person leaving the room, and located so as to make the person leaving the room check effectively for the absence of any other person in the room. The contact will be closed when the button is pushed.
- Area Emergency Stops:

12.1. Must have highly visible visual identification. Preferably yellow base. Red

SENSORS/ACTUATORS

The following safety devices and interlocks will be provided and installed by the D/BT in all rooms where the proton beam may be present:

- Access door interlocks :
 - All area access door interlocks will be selected to comply with the requirements of the IEC 61508 or the ISO 13849-1 to safeguard up to category 3. When motorized systems are used for opening the doors, they should also be selected according to safety principles of IEC 61508.
 - Two mechanically independent switches on access doors indicating the "door closed" state will be installed. One equipped with an NO contact, the other with a NC contact.
 - Rotable shaft or arm model for hinge-mounting can be used.
 - Always mount the switches and magnets on top of the door as illustrated below or on the edge opposite to the hinges for single doors.
Distance "A" must be as small as possible.
Distance "B" must be as large as possible



- Audible Gong

Before imminent door closure for beam production, an audible alarm will warn that a search procedure of a specific zone of the building is underway. This alarm will be of the type single stroke. However, in areas where patients are present (treatment rooms), this must be a patient friendly sound (like a single gong and not too loud).

24V= Gong actuated

- Search Buttons: momentary action push button to be activated by the last person leaving the room, and located so as to make the person leaving the room check effectively for the absence of any other person in the room. The contact will be closed when the button is pushed.
- Area Emergency Stops:

12.1. Must have highly visible visual identification. Preferably yellow base. Red

mushroom-shaped sensor, twist to release from depressed position.

- A protective guard shall be installed around the button head to prevent unwanted actuation.

- Two contacts: One NC and one NO.

- Must be located in such a way that a worker in the room never has to cover more than ± 6 m ($20'$) to reach one and at least ± 2 m ($6'$) distant from a Search button.

- Warning Lights (Beacons): The visible signal shall be powerful enough to overcome the ambient lighting. The light shall flash repeatedly as long as the voltage is applied at a minimal frequency of 1 Hz. Preferred colors are red and amber.

24V= Warning Light ON

- See also plans on this figure and *Figure 63.02*.

WIRING

- All wiring must be done according to applicable local codes for safety circuits
- If a sensor/actuator does not operate on 24 V D.C. or require more current than provided by the TSS (2A,24V), an interfacing relay shall be installed by the D/BT.
- The cabling between the building safety devices and the TSS cabinets shall be made using one cable per device (2 core cable), except for the status displays, the door interlock switches and the Emergency Stops where multi-conductor cables may be used. In general, the use of junction boxes shall preferably be avoided unless absolutely necessary.
- The TSS embedded conduits can be used to run cable to more than 1 component, but conduit sizes and cables quantities shall follow local regulations.
- A loose end (≈ 300 cm ($\pm 10'$)) shall be provided on the cables in the MCR and at each location where PTEV must do the connections, so that they can be connected in any of the TSS cabinets. (See MCR layout *Figure 33.07*)

Each two-conductor cable shall be labeled with the Building Item Number specified in TSS Table of Operands. Each multi-conductor cable shall be labeled with the first Building Item

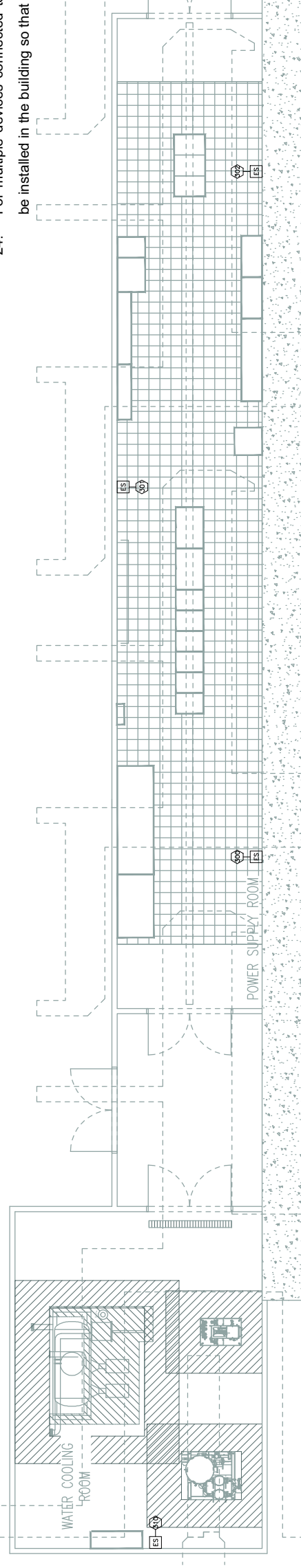
Number of the group and the detail of each cable (wire colors/numbers) shall be provided by the D/BT in a dedicated document.

- The wires size shall be between 0.5 mm² (AWG20) and 1 mm² (AWG18) and shall preferably be kept as low as possible while maintaining the line voltage drop below 10% of the nominal voltage for the specified current.

The safety devices shall be connected to the SRCUs with cables having an outer diameter of approx. 5 mm ($1/4"$). The working voltage will be of 300V. The test voltage will be of 1500V.

All auxiliary power supplies possibly needed (ie: status signs) shall be galvanically isolated (relays or optocouplers) from the TSS 24VDC.

For multiple devices connected to a single terminal block in the TSS, a connection box shall be installed in the building so that only one pair of wires ends up in the TSS.



UPPER LEVEL

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A	30/04/15	Original issue	LCHEN	OBA	PV

MATERIAL: -
SCALE: 1/150 (A3)
DIMENSIONS: mm
TOLERANCES: -

PROJECT: PROTON THERAPY
SPROJECT: TATA HBTF MUMBAI

VI.
Other technics

Therapy safety systems

TITLE:
Safety system layout
Upper Level

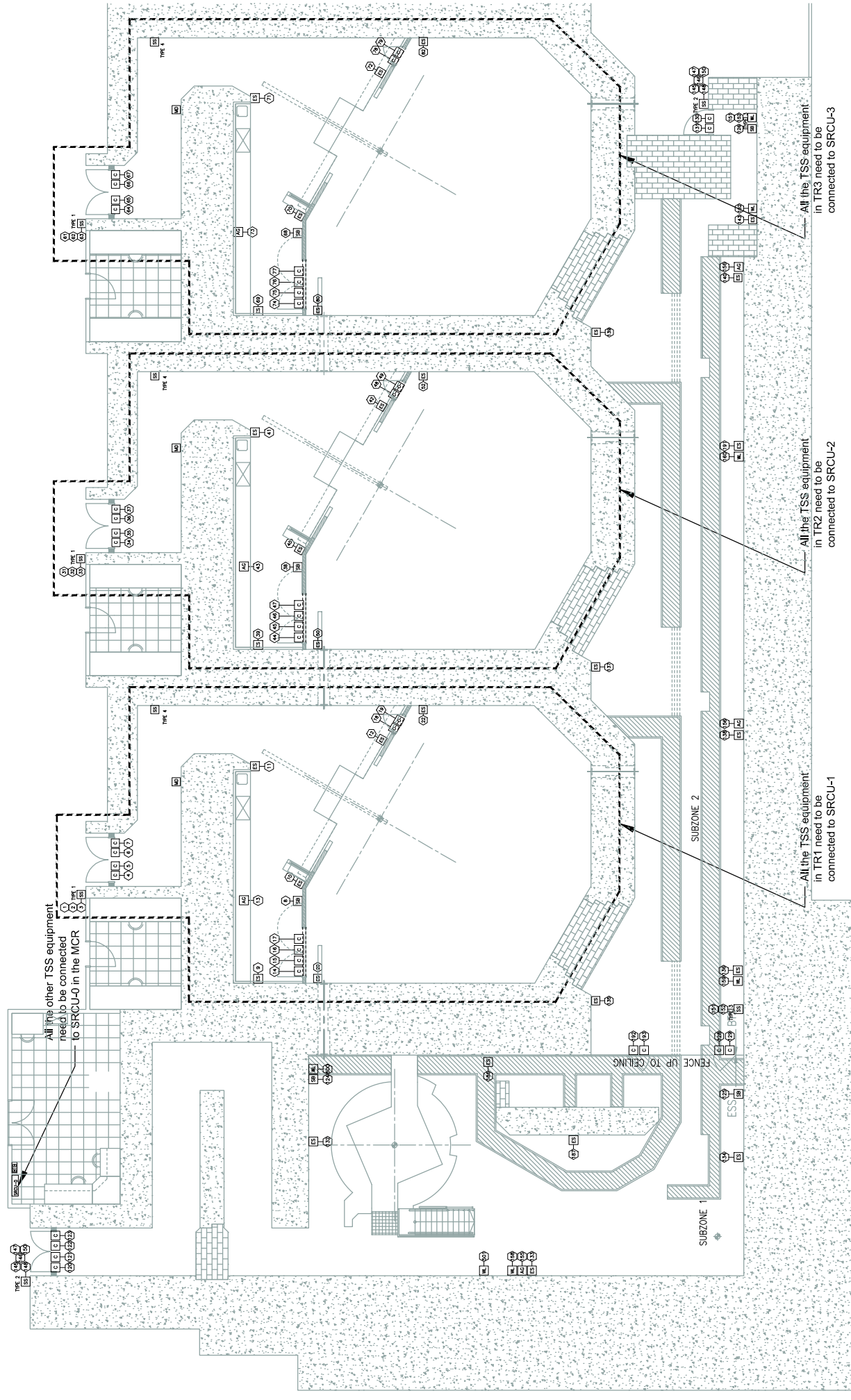
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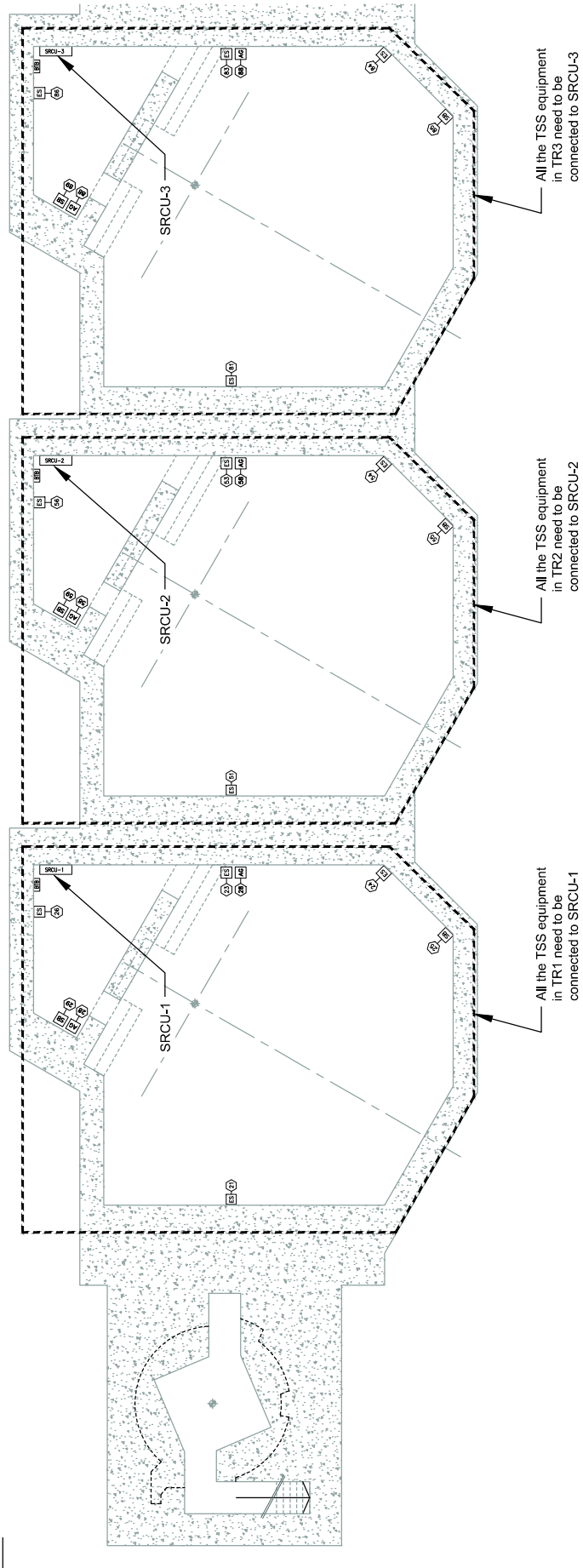
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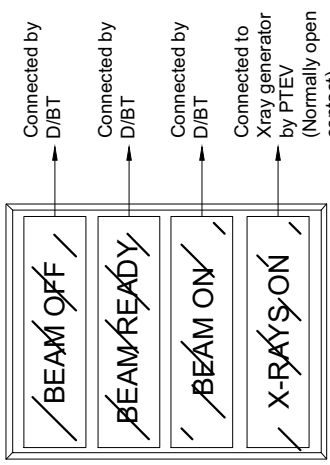
PROJECT: PROTON THERAPY	VI.	Other technics	Therapy safety systems	TITLE: Safety system layout Treatment Level Basement	07.42.33.	63.02 A
SPROJECT: TATA HBTF MUMBAI						



TREATMENT LEVEL



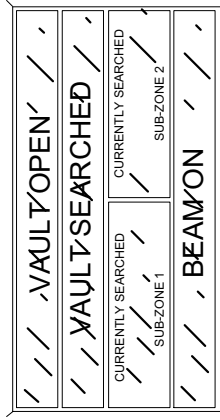
BASEMENT



TREATMENT ROOM AREA STATUS DISPLAY

SIGN TYPE 1

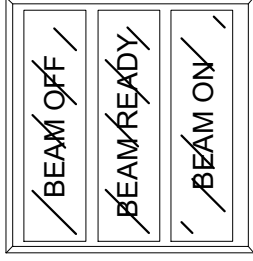
ILLUMINATED SIGN. 300 W X 300 H X 75 D (APPROX.)
 FOUR HORIZONTAL SECTIONS, HINGED FRONT, THREE 15 WATT LAMPS PER SECTION. TRANSLUCENT PANELS
 FIRST SECTION, GREEN PANEL, WHITE LETTERS - "BEAM OFF"
 SECOND SECTION, ORANGE PANEL, BLACK LETTERS - "BEAM READY"
 THIRD SECTION, RED PANEL, WHITE LETTERS - "BEAM ON"
 FOURTH SECTION, YELLOW PANEL, BLACK LETTERS - "X-RAYS ON"
 SUBMIT DETAILS AS A SHOP DRAWING



BEAM TRANSPORT VAULT AREA STATUS DISPLAY

SIGN TYPE 2

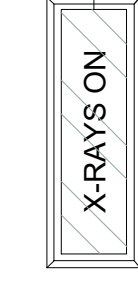
ILLUMINATED SIGN. 400 W X 400 H X 75 (APPROX.)
 FOUR HORIZONTAL SECTIONS, HINGED FRONT, THREE 15 WATT LAMPS PER SECTION. TRANSLUCENT PANELS
 FIRST SECTION, GREEN PANEL, WHITE LETTERS - "VAULT OPEN"
 SECOND SECTION, RED PANEL, WHITE LETTERS - "VAULT SEARCHED"
 THIRD SECTION, RED PANEL, WHITE LETTERS - "SUB-ZONE ..."
 FOURTH SECTION, RED PANEL, WHITE LETTERS - "BEAM ON"
 SUBMIT DETAILS AS A SHOP DRAWING



TREATMENT ROOM AREA STATUS DISPLAY

SIGN TYPE 5

ILLUMINATED SIGN. 300 W X 225 H X 75 D (APPROX.)
 FOUR HORIZONTAL SECTIONS, HINGED FRONT, THREE 15 WATT LAMPS PER SECTION. TRANSLUCENT PANELS
 FIRST SECTION, GREEN PANEL, WHITE LETTERS - "BEAM OFF"
 SECOND SECTION, ORANGE PANEL, BLACK LETTERS - "BEAM READY"
 THIRD SECTION, RED PANEL, WHITE LETTERS - "BEAM ON"
 SUBMIT DETAILS AS A SHOP DRAWING



TREATMENT ROOM AREA STATUS DISPLAY

DISPLAY SIGN TYPE 4

ILLUMINATED SIGN. 300 mm W X 125 mm H X 75 mm D (APPROX.)
 ONE HORIZONTAL SECTION, HINGED FRONT, THREE 15 WATT LAMPS PER SECTION. TRANSLUCENT PANELS
 YELLOW PANEL, BLACK LETTERS - "X-RAYS ON"
 SUBMIT DETAILS AS A SHOP DRAWING



DOOR SIGN DETAIL

SIGN TYPE 3

ILLUMINATED SIGN. 300 W X 250 H X 75 D (APPROX.)
 TWO HORIZONTAL SECTIONS, HINGED FRONT, THREE 15 WATT LAMPS PER SECTION. TRANSLUCENT PANELS

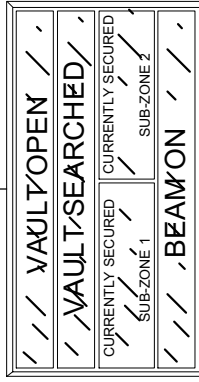
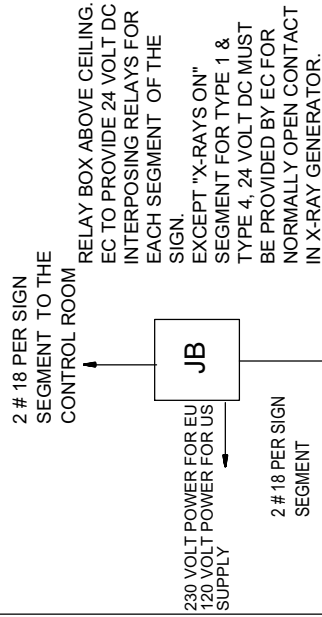
FIRST SECTION, RED PANEL, WHITE LETTERS - "ROOM SEARCHED"
 SECOND SECTION, GREEN PANEL, WHITE LETTERS - "NOT SEARCHED"

SUBMIT DETAILS AS A SHOP DRAWING

NOTE:

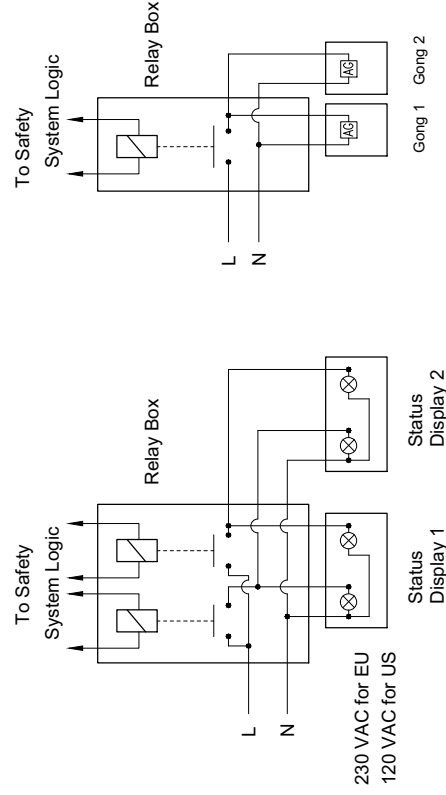
ALL WIRING SHALL BE RUN FROM DEVICE VIA RACEWAY AND CABLE TRAY OR ABOVE CEILING TO RECESSED CONDUITS TO DESTINATION AS SCHEDULED. PROVIDE 10"0" SLACK CABLE AT TERMINATION POINT.

DESIGN AND DIMENSIONS ARE FOR PROPOSAL ONLY. FINAL DESIGN AND DIMENSIONS CAN BE MODIFIED BY D/IBT, CUSTOMER OR TO FOLLOW LOCAL REGULATIONS.



STATUS DISPLAY SIGN WIRING SCHEMATIC

WIRING OF MULTIPLE STATUS DISPLAYS OR GONGS



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MATERIAL: -
 SCALE: (A3)
 DIMENSIONS: mm
 TOLERANCES: -

PROJECT: PROTON THERAPY
 SPROJECT: TATA HBTF MUMBAI

Other technics

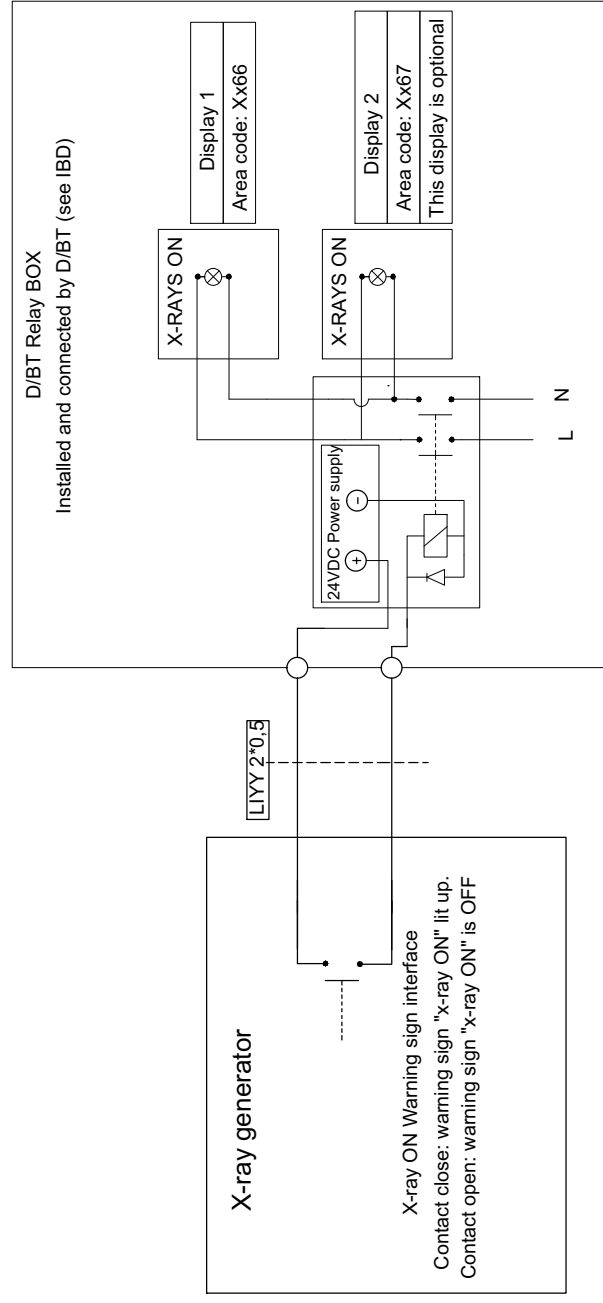
Therapy safety systems

TITLE: Safety system details

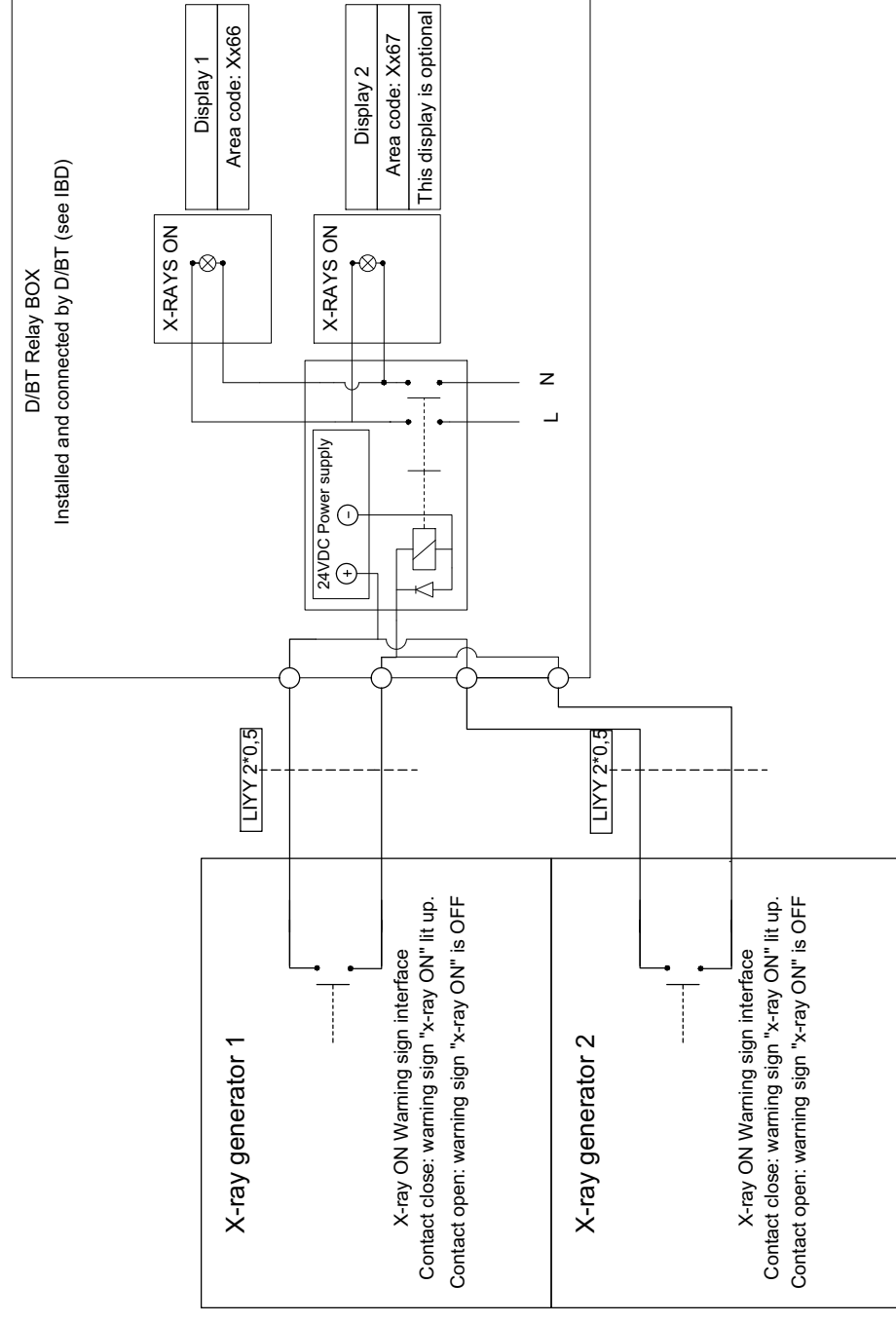
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For 1 X-Ray generator in the room




For 2 XRay generators in the room



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SCALE: (A3)
DIMENSIONS: mm
TOLERANCES: -

PROJECT: PROTON THERAPY
SPROJECT: TATA HBTF MUMBAI

VI.
Other technics

Therapy safety systems

TITLE:
Xray sign electrical wiring

07.42.33.

63.04 A

	Brand reference examples (the given refs may not be complete or totally accurate)	Internet links
Note 1	Emergency Stops Omron A22E	www.omron.com
Note 2	Door interlock XALK178E yellow station - 1 red mushroom head pushbutton Ø40 turn to release 1NO+1NC Mechanical safety switches PSENmech	www.schneiderelectric.com https://www.pilz.com/en-BE/eshop/0001400034704480GL/PSENmech
Note 3	Audible Gong (for TR) Schmersal AZ16-02 -or- TV.S 335 Edwards signaling 339-G1	http://www.usa.schmersal.net/cat?lang=en&product=31s733471r8ezh4uhdl58917660499 http://www.edwards-signals.com/?pid=317
Note 4	Audible Gong (for pit & technic areas) Federal Signal A4/600/24VDC Edwards signaling 333-4G1 -or- 156G-3G1	www.federal-signal-indust.com www.edwards-signals.com
Note 5	Warning Light Edwards signaling 48FINA-G1-20WH Federal Signal FB2PST	www.edwards-signals.com www.federal-signal-indust.com
	Harmony XVE	http://www.downloads.schneider-electric.com/sites/oreo/us/document-detail.page?p_docId=16641717&p_Conf=#http://www.schneider-electric.us
	Werma reference 827 300 78 (orange blinking light), with support 975 826 05	http://www.werma.com/gfx/file/report/2014_15_Catalogue_en_Cover_Web.pdf
Note 6	Search Button Schneider-electric: XALD102	http://www.schneider-electric.com/products/be/fr/1000-coiffrets-cablage-interfaces/1020-stations-de-contrôle/660-harmony-xald-xalk/?p_url=http://www.ops-ecat.schneider-electric.com/ecatalogue/browse.do%3fconf=basKet%26el_typ=product%26cat_id=BU_AUT_660 L3



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MATERIAL: -
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DIMENSIONS: mm
TOLERANCES: -

PROJECT: PROTON THERAPY
SPROJECT: TATA HBTF MUMBAI

VI.
Other technics

Therapy safety systems

TITLE:
Table of operands :
Notes

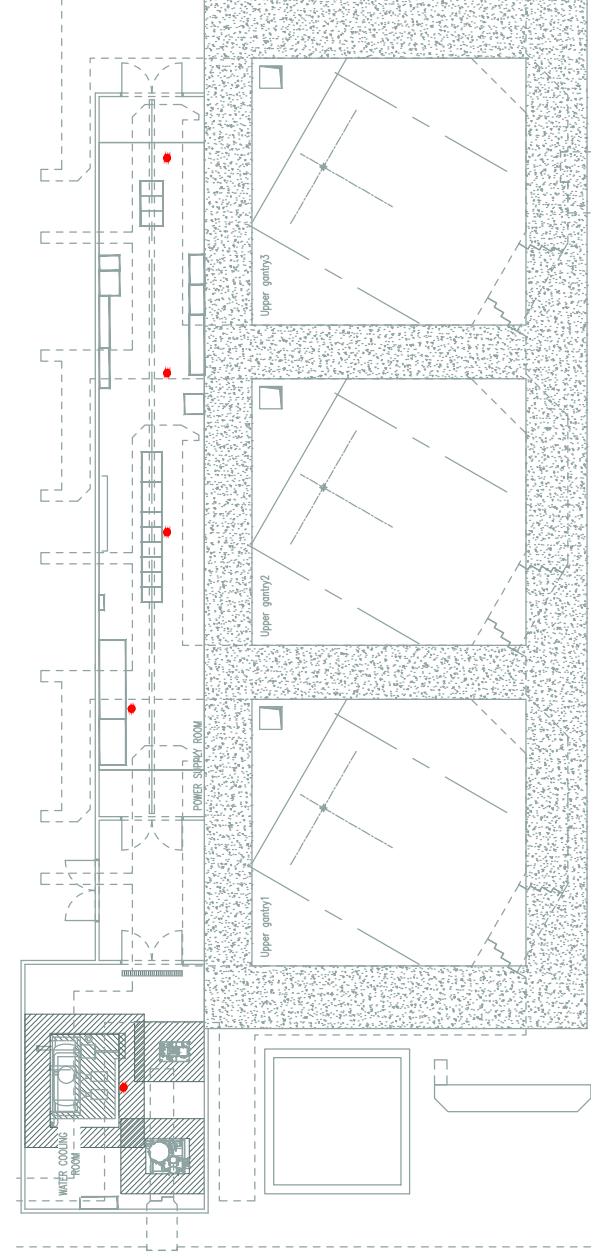
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D/BT: Design/Building team
 PTEV: Proton therapy equipment vendor
 TPS: Treatment planning system
 OIS: Oncology information system
 PSR: Power supply room
 MCR: Main control room

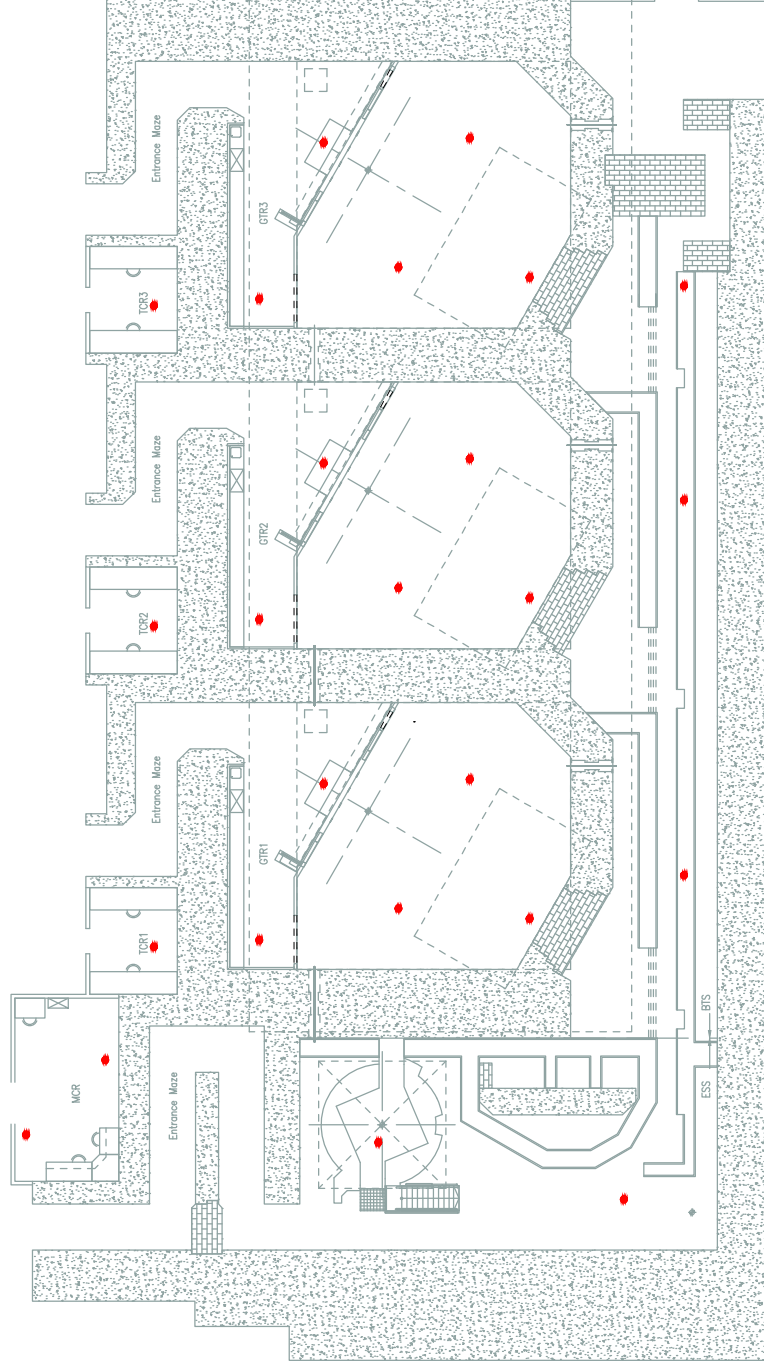
65. FIRE / SMOKE DETECTION & AUTOMATIC EXTINCTION

- D/BT shall ensure that in PTEV both technical & treatment rooms:
 - All fire/smoke detection and automatic extinction.
 - The exit paths and procedures.
 - Fire resistant doors that can be opened from inside of the room, walls, emergency lighting and other related equipments shall be compliant with local regulations.
- The system for fire /smoke detection and automatic extinction is the responsibility of the D/BT.
 At least one fire / smoke detector should be installed at the following places:
 - TPS/OIS Server Room
 - At any place where a large concentration of electrical cables is hidden in a confined place, under the access floor
 - In the PTEV storage rooms
 - At any other place defined by the D/BT study or as required by local codes.
 - See also locations on plans on this figure
- We suggest that the electronic and display units related to the building fire detection be installed in a 19' type racks in the Main Control Room.
- The detailed format of the signal exchange will have to be agreed upon by the D/BT and PTEV at the time of the equipment selection.
- While the use of water is generally not recommended to extinguish electrical fires, the equipment supplied by the PTEV should not suffer irreversible damages from being sprayed with clean water, provided that electrical power is shut off simultaneously or before, and that the equipment is immediately and thoroughly dried before resuming operation.
 Within these restrictions a wet sprinkler system is acceptable.

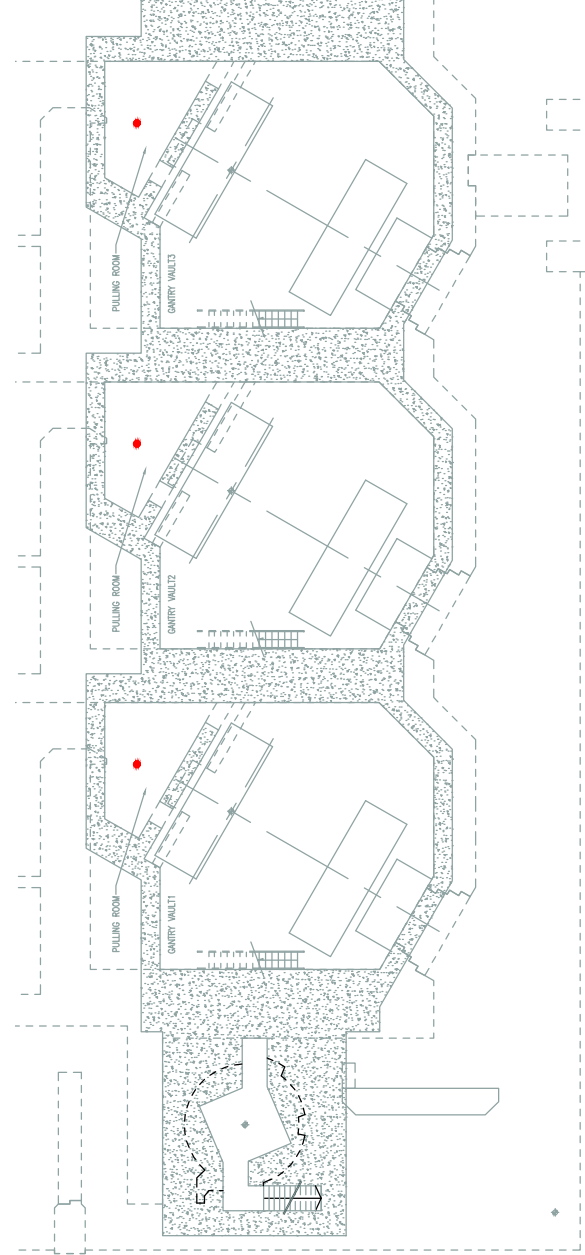
In the PSR, the MCR, PTEV Server Room and the TPS/OIS Server Room a gas system (Inergen or pre-action equivalent) installation is recommended to minimize risks of accidental water flooding, above and below the raised floor.



UPPER LEVEL



TREATMENT LEVEL



BASEMENT

REV:	A	DATE:	30/04/15	MODIFICATION:	Original Issue
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MATERIAL: —
 SCALE: 1/250 (A3)
 DIMENSIONS: mm
 TOLERANCES: —

PROJECT: PROTON THERAPY
 SPROJECT: TATA HBT MUMBAI

VI.
 Other Technics

Fire Protection

TITLE:
 Fire Protection

07.42.33.

65.01 A

67 NETWORK

ACRONYMS

D/BT: Design/Building Team
 TPS: Treatment Planning System
 OIS: Oncology Information System
 PTEV: Proton Therapy Equipment Vendor
 PT: Proton Therapy
 SC: Switching Cabinet

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Refer also to Chapter II (ROOMS) for architectural specifications of the rooms
 + UPS layout : figure 52.32
 + Server Room layout : figure 35.01

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 SPROJECT: TATA HBTF MUMBAI

VI.
 Other technics

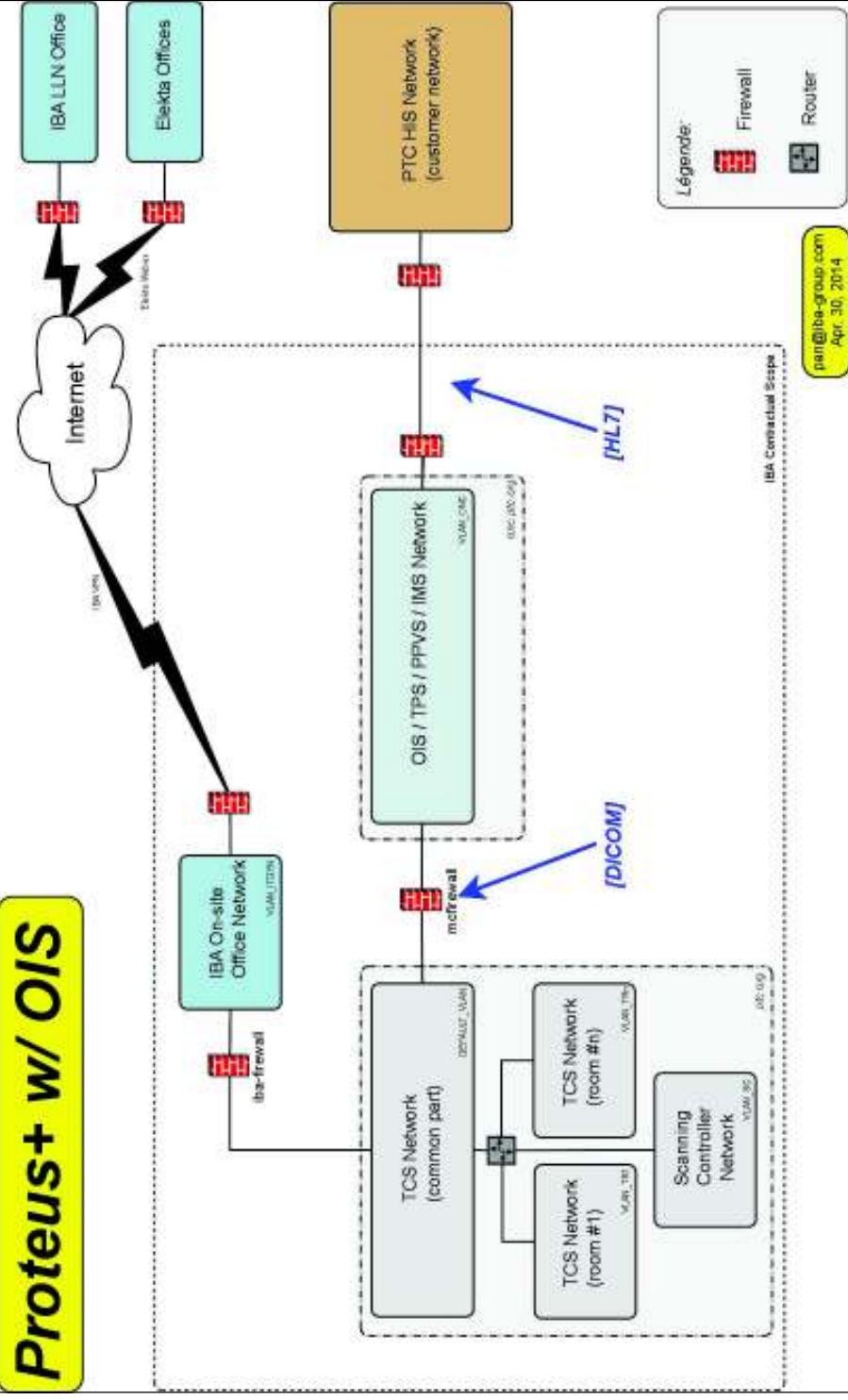
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TITLE:
 Presentation

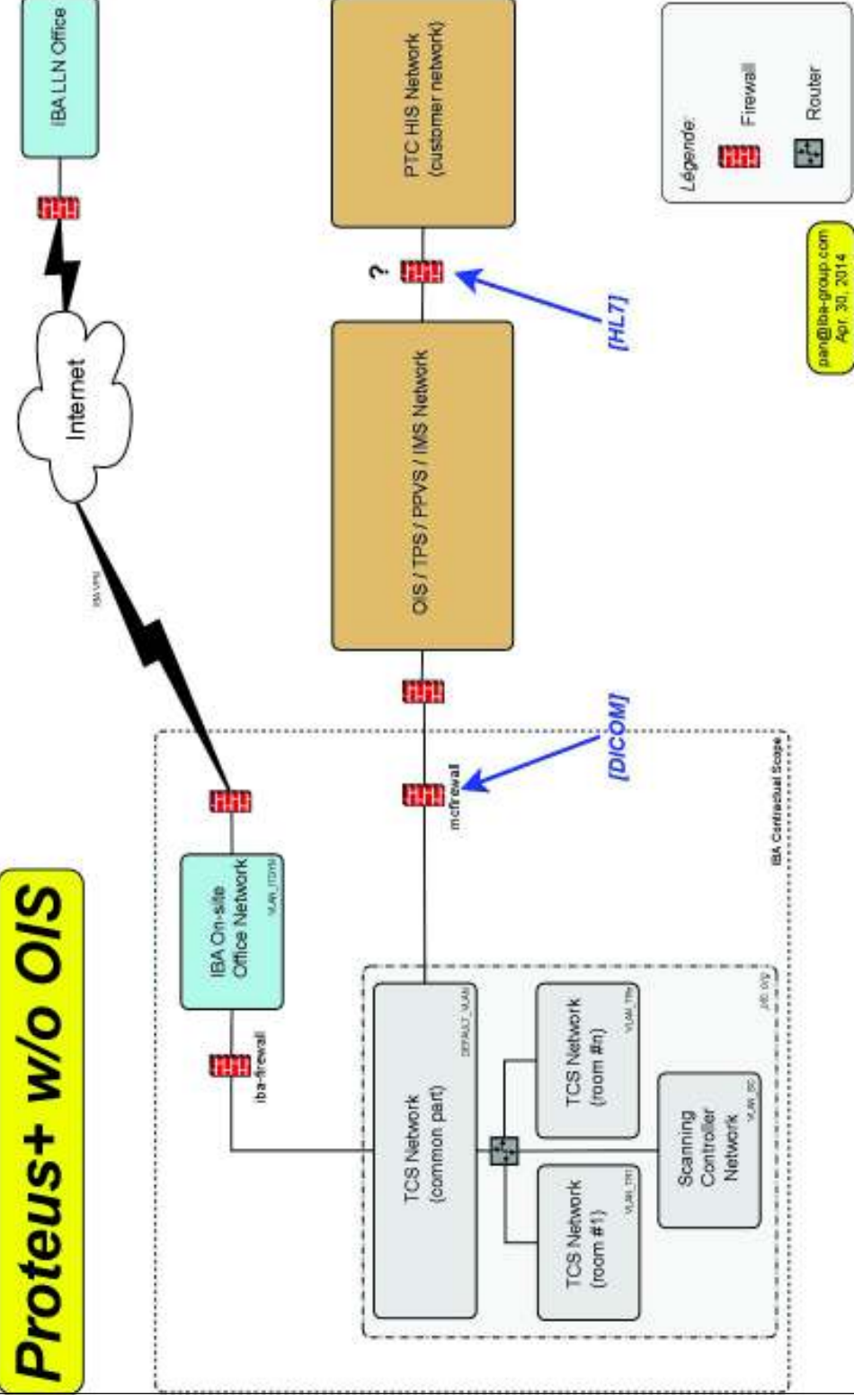
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Proteus+ w/ OIS



Proteus+ w/o OIS



OVERALL NETWORK TOPOLOGY

Both diagrams on this page give a high-level view of the intended network topology of the PTEV Proteus+ product as deployed in the Proton Therapy Centre, and illustrate its connectivity with the hospital network on the customer side, and the PTEV corporate network on the other side.

Depending on the contract signed with the customer, the scope of the PTEV's sphere of responsibility can vary. It will always include the TCS network (the core PTEV product), but may or may not include the ONC network (the one that hosts the OIS, TPS, PPVS and IMS subsystems). The top diagram illustrates a situation where PTEV takes full responsibility for the ONC network, the bottom one a situation where PTEV's responsibility is limited to its core product.

Please note that in both cases, the diagram is to be read as a network block diagram. It represents physical or virtual networks, IP ranges and DNS or AD domain coverage. No information about geographical location is conveyed in these diagrams. What is more, the administrative responsibilities over the management of these network, as described below, do not contradict the fact that installation of the network cabling infrastructure is the duty of the DB/T.

1. TCS network

This network hosts the TCS, or core PTEV Proton Therapy product. It is shown in the bottom left corner of both diagrams, as a set of grey rectangles.

This network is further subdivided in multiple VLANs (= virtual networks), one for the "common components" (i.e. equipments that are global to the PT centre like servers and MCR control workstations), one per treatment room, and one dedicated to the PBS scanning controller.

The TCS network is always isolated from the rest of the world by two firewalls:

- one ("mcfirewall") that links it with the ONC network and is primarily used to allow bi-directional DICOM communications (prescription data from OIS to TCS and treatment result from TCS to OIS)
- the other ("PTEV-firewall") that links it with the on-site PTEV office network and through it to the Internet and the VPN to PTEV corporate headquarters. This connection will be used primarily for:
 - * downloading software fixes from the various platform and application vendors
 - * sending monitoring data and alerts to PTEV
 - * allowing PTEV engineers to remotely connect to the equipment to perform remote support and maintenance

* when PTEV takes responsibility for the ONC network, this link will also be used by Elekta engineers to perform remote support and maintenance of the OIS infrastructure

2. ONC network

This network hosts the OIS, TPS, PPVS and IMS subsystems. Depending on the customer contract, it can be managed by the customer or by PTEV. It is shown on the diagram as a light-blue rectangle in the latter case, as a light-brown one in the former. Depending on the needs, this network can also be further subdivided into multiple VLANs.

When managed by PTEV, the ONC network is isolated from the rest of the world by two firewalls:

- "mcfirewall", already defined above
- "oncfirewall", that links the ONC network with the customer's hospital network and allows a bi-directional flow of information with the HIS system, typically using the HL7 protocol.

When the ONC network is managed by the customer, it may be the case that the ONC and HIS networks are merged in a single entity (hence the question mark above the right-most firewall in the bottom diagram).

3. HIS network

The HIS network hosts the customer's HIS system and all other typical business applications (email, office suites, file servers, etc.). It is shown on both diagrams as a light-brown rectangle on the right side. This network is always under the customer's responsibility.

4. On-site PTEV office network

This network covers the few offices on-site where the PTEV staff will work for the duration of the maintenance contract. It is shown on both diagrams as a blue rectangle at the top. It is administered by PTEV IT Dept. and is not part of the PTEV PT product proper.

This network is connected full-time to the PTEV corporate headquarters network through a firewall and a VPN link over Internet.

Through this network, PTEV headquarters-based engineers can get access to the site TCS network for diagnostic, support and maintenance purposes, if and when the "PTEV-firewall" allows them to do so.

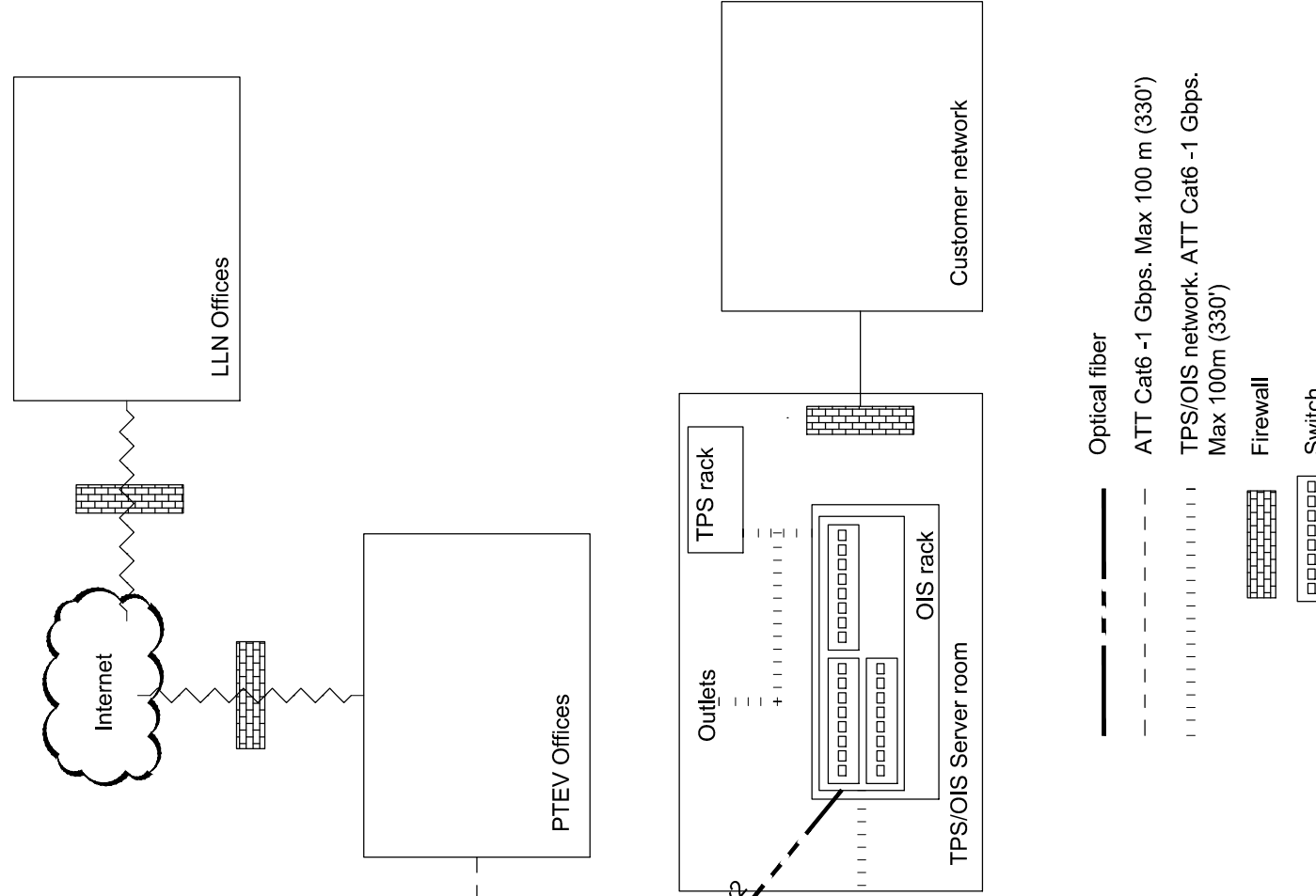
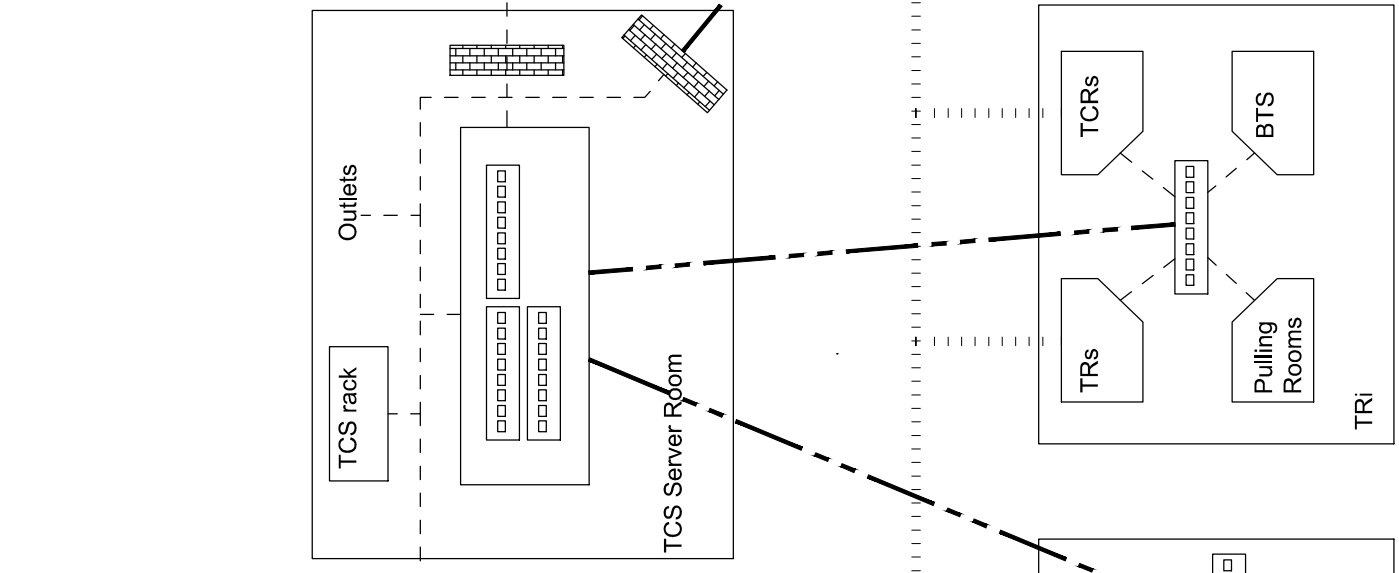
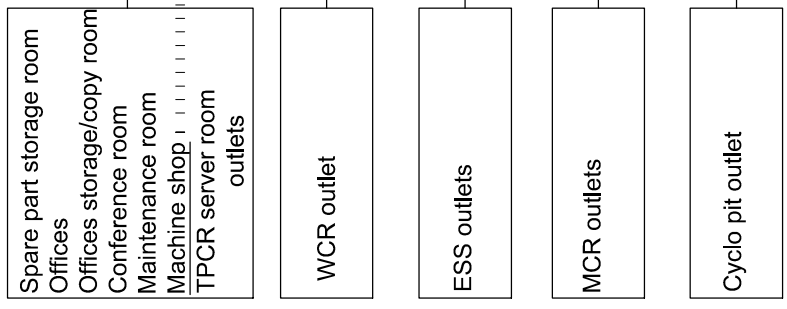
5. firewalls

The point of contact between PTEV's and the customer's sphere of responsibilities is always embodied by a firewall, whether between the TCS and ONC networks, or between the ONC and HIS networks. At that point, it is always permissible to install two firewalls back-to-back, the "left" one (on the diagram) administered by PTEV, the "right" one by the customer. This increases the delimitation of responsibilities and gives assurances to both parties that no unilateral change can take effect.

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Other Technics	VI.
Network Requirements	
TITLE:	Overall Network Topology
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VI.
 Other Technics

Network
 Requirements

TITLE:
 Physical Network
 Topology

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Refer to figure 67.04-1/2

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PROJECT: PROTON THERAPY
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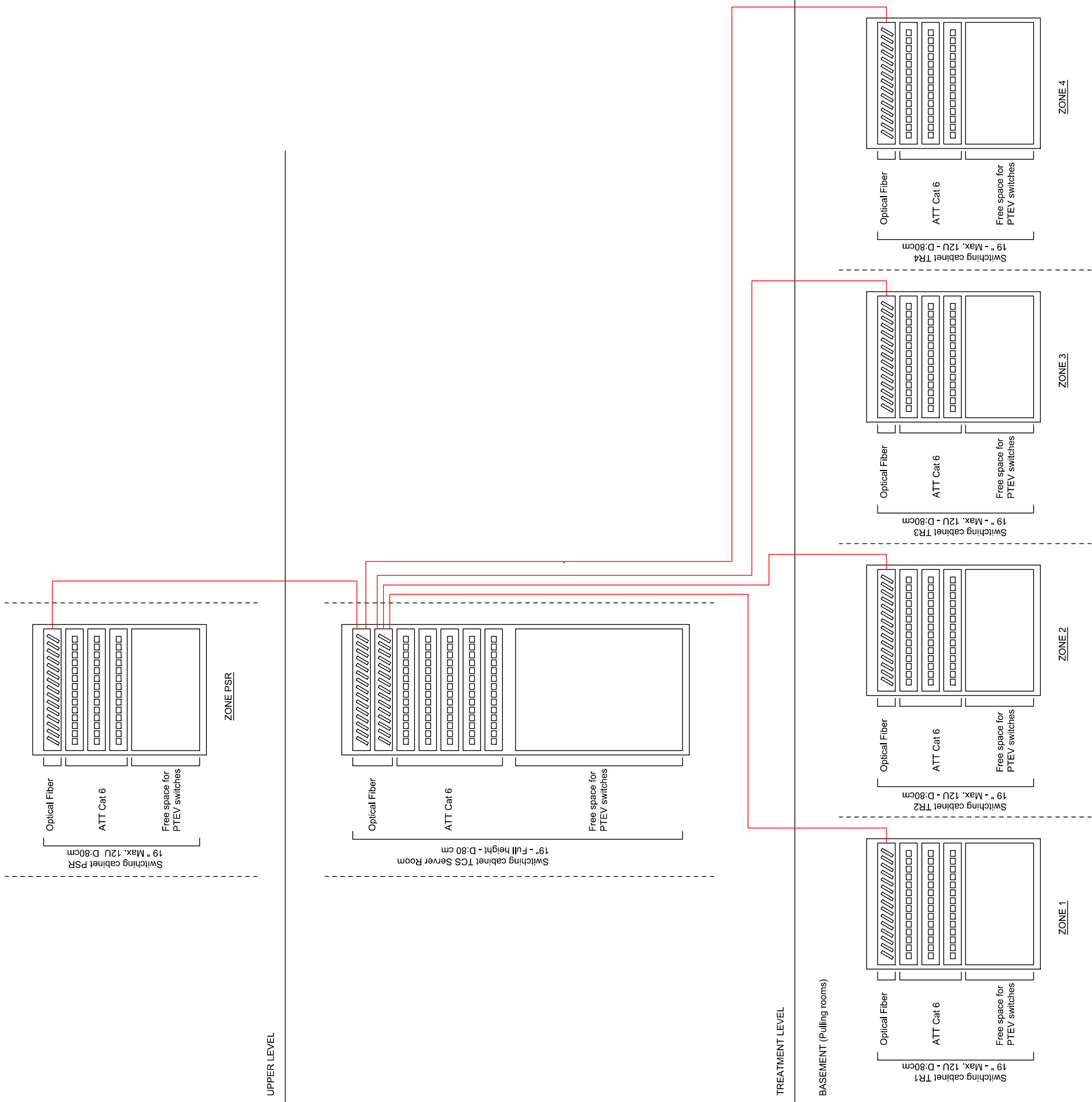
Other Technics

Network Requirements

TITLE:
 Optical fiber connections

07.42.33.

67.03 A



Theoretical drawing of switching cabinets

Fiber Optic cable: OM3 Multi-mode 50µm optical fiber, min 4 strands, terminated with LC or SC connectors. With a bandwidth of 10 Gbps.

COMPUTER NETWORK REQUIREMENTS

1. The PTEV Server Room (and TPS/OIS server room if any) and PTEV offices shall be linked to specific locations through an independent network of high-speed data transmission lines.

The D/BT will therefore pre-install the network including the cable race way, cabling wall junction boxes with data plug outlets and the plugs according to Figure 67.04-1 & 67.04-2 (Network requirements).

The general characteristics of the network are:

- 1.1 ATT category 6 cables and plugs (1 Gbps/s) or better.
- 1.2 Maximum 100 meters (330') between sources. To avoid length exceeding 100 m (330'), D/BT shall connect the cables to the nearest switching cabinet. If the distance between the sources and the nearest cabinet exceeds 100 m (330'), D/BT will provide an additional switching cabinet and link it with FO to TCS server room switching cabinet.
- 1.3 D/BT will label all network data outlets
- 1.4 A patch panel 19" with all the plugs terminations shall be installed by the D/BT in the Pulling Room of the Gantry. These cabinets will have a "glass door" and spare space of maximum 12 U for additional PT equipment. In the server room The cabinet will have a spare space of minimum 12 U. A full height cabinet is recommended. All the lines will be concentrated in these cabinets and installed in adequate "patch panel". See Figure 67.04-1/2 (Network requirements).
- 1.5 D/BT shall furnish and install Fiber Optic Lines between each Treatment Room switching cabinet and the server room switching cabinet. Fiber Optic cable specifications: OM3 Multi-mode 50µm optical fiber, min 4 strands, terminated with LC or SC connectors. With a bandwidth of 10 Gbps. If TPS/OIS server room, D/BT shall provide 8x2 optical fibers between TPS/OIS server room and TCS server room.

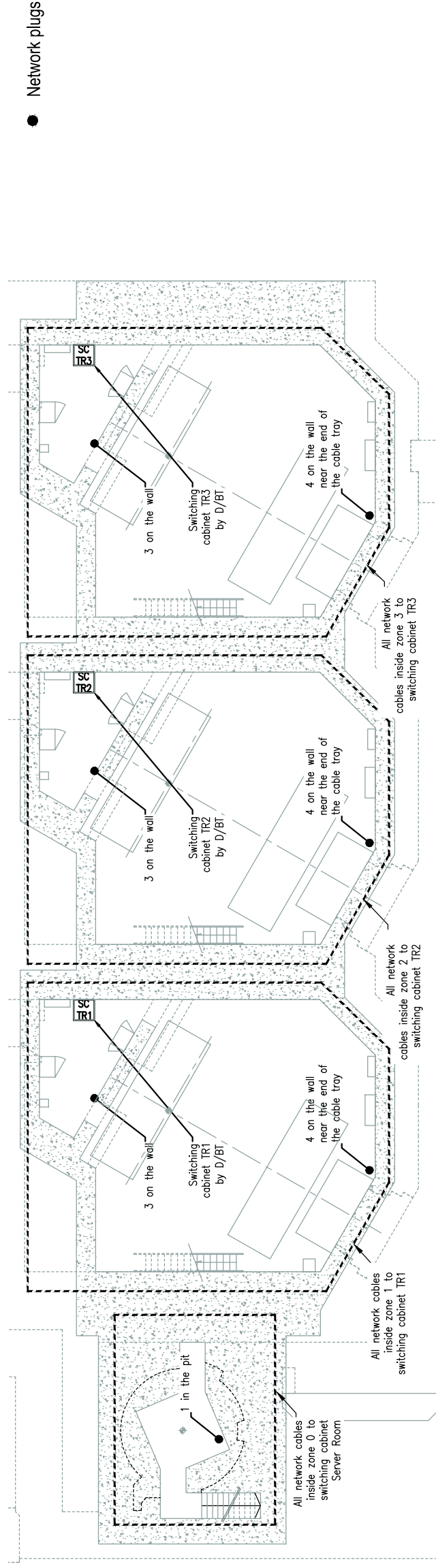
1.6 Prior to the start of the PT installation, D/BT will provide a certificate issued by an independent company attesting compliance of :

- the network with the category 6 standards (or better).
- the optical fiber with an equivalent relevant standard.

- The D/BT will provide an Internet access line that shall be connected to the D/BT cabinet in the Server Room and TPS/OIS server room. The general characteristics of the line are:

- Minimum 5 Mbps in download
- Minimum 5 Mbps in upload.
- D/BT will provide a static IP address (at least /29 subnet of public IP).

Network plugs in other PTEV areas		
Spare parts storage room (2)	1 in each	On the wall
Temporary office before BOD (10 pl)	10	On the wall
Temporary office before BOD (3 pl)	3	On the wall
Permanent offices from BOD (12 pl)	12	On the wall
2 Permanent offices from BOD (3 pl)	3 in each	On the wall
Offices storage & copy room	3	On the wall
Conference room	2	Under raised floor
Maintenance room	3	On the wall
If TPS/OIS server room by PTEV, at the desk	2	On the wall
If TPS/OIS server room by PTEV, at the rack	4	Under raised floor
Network plugs in other areas		
TPCR server room	10	On the wall



BASEMENT

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SPROJECT: TATA HBTF MUMBAI	
Other Technics	Network Requirements
TITLE: Network Requirements: Basement	
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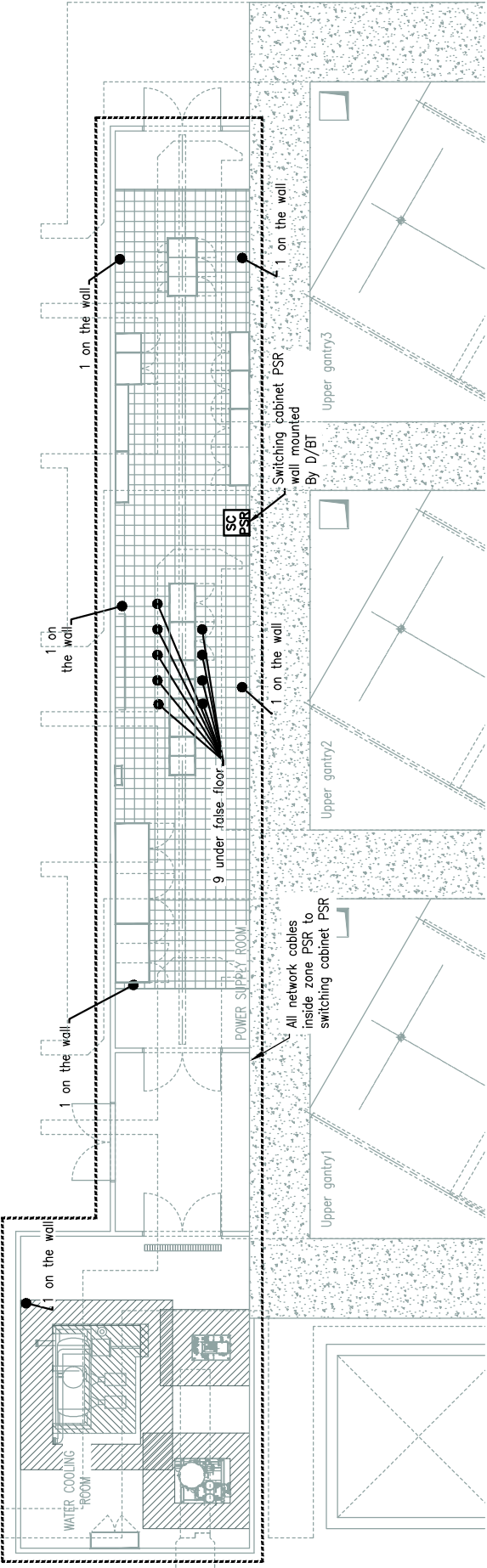
VI.
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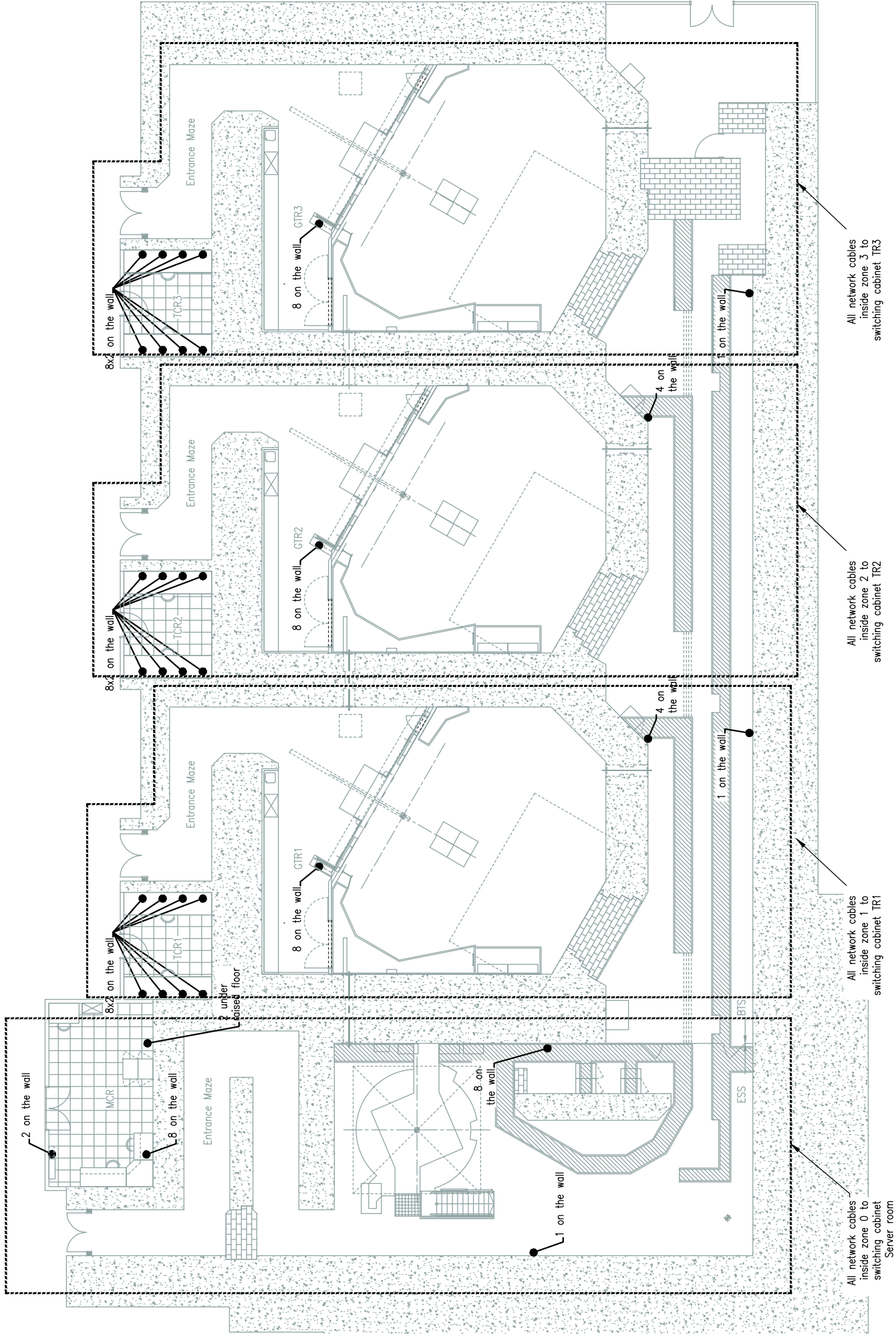
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 Network
 Requirements :
 Upper Level &
 Treatment Level

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UPPER LEVEL



TREATMENT LEVEL

D/BT:
BOD:
MCR:
PTEV:
TCR:
CCTV:
PTE:
RPD:
TR:
ESS:
BTS:
PSR:
WCR:
TPS/OIS:

Design/Building Team
Building Occupancy Date
Main Control Room
Proton Therapy Equipment Vendor
Treatment Control Room
Closed Circuit TV
Proton therapy Equipment
Remote Positioning & Delivery
Treatment Room
Energy Selection System
Beam Transport System
Power Supply Room
Water Cooling Room
Treatment Planning System / Oncology Information System

68.

COMMUNICATION EQUIPMENT

- The system for communication and surveillance is the responsibility of the D/BT and shall be in accordance with the Customer needs.
- Cell phone coverage should be foreseen from BOD.
As cell phone service is not available in all spaces, the PTEV requires a multi-user multi-channels communication system as described below linking all equipment areas during installation and start-up.
- The preferred solution is a system of 2 way radio with repeaters in shielding spaces. The following areas will be accessible: see Table: Communication Requirements .
- The system shall be interfaced to the main control room.
- This entire system shall be furnished and installed by the D/BT.
- Additionally, all PTEV office spaces shall be equipped with connections for network and telephone access. These spaces include the PTEV Office, SM Office, Main Control Room, Primary Storage Area, Conference Room, and Kitchen Corner/Lounge.

SURVEILLANCE EQUIPMENT

- A Closed Circuit TV system (CCTV) shall be supplied and installed by the D/BT. The CCTV cameras shall be located accordingly with PETV. It will at the minimum cover the following areas: see Table: communication requirements
- CCTV cameras of the TR will be connected to monitors located in corresponding TCR's.
- All other CCTV cameras will be connected to a monitor-switching unit located in the MCR. For personnel safety, the CCTV system will be in operation prior to start of beam tests on PTE.
- All CCTV shall be equipped with "pan, tilt & zoom" capabilities remotely controlled from TCR's and the MCR.
- The microphones shall be used to communicate with the different areas from the TCR.
Option: For a Treatment Room with Remote Positioning and Delivery(RPD), the building shall provide a video monitoring system including:
 - a set of video cameras installed in TR, that will allow monitoring motion of equipments near the patient. These cameras will provide sufficient visibility on the zones at risk covering as many treatment configurations as possible.
 - at least two monitors installed in TCR near the Motion Control Access Point.

Note: For a gantry room, it is recommended to install one camera on the gantry backwall, aimed towards the nozzle edge, along a viewing direction parallel to the gantry rotation axis, and offering view on the nozzle edge and isocenter, in order to monitor possible collisions with nozzle or beam modifying accessories during gantry rotation, snout translation, drawer insertion / retraction and PPS motion.

Table : Communication Requirements indicates the location for Intercoms, Telephones and CCTV cameras.

Table: Communication Requirements

	A system of 2 ways radio	Telephone	Video
Cyclotron Area	Yes (near cyclotron)	Suggested	Yes (with view of degrader face)
ESS Area	Yes	Optional	Yes
BTS Area	Yes	Optional	Yes
Gantry Platforms	Yes	Optional	Optional
Gantry Pulling Room	Yes	Optional	Optional
Gantry Pit	Yes	Optional	Optional
Treatment Area	Yes	Yes	Yes
TCR / RA Control	Yes	Yes	Monitoring Station
MCR	Yes	Yes	Monitoring Station
PSR	Yes	Yes	Yes
WCR	Yes	Yes	Yes
Storage Rooms	Yes	Yes	No
Maintenance Room	Yes	Yes	No
TPS/OIS server room	Yes	Yes	No
PTEV Server Room	Yes	Yes	No
A system of 2 ways radios with repeaters is preferred.			

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VI.
Other Technics

Communication and surveillance

TITLE:
Communication and surveillance equipment

07.42.33.

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VII. BOD REQUIREMENTS

90.BOD REQUIREMENTS

ACRONYMS

- BOD: Building Occupancy Date
- ESS: Energy Selection System
- D/BT: Design Building team
- PTEV: Proton Therapy Equipment Vendor
- BTS: Beam Transport System
- PTE: Proton Therapy Equipment
- PSR: Power Supply Room
- WCR: Water Cooling Room
- UPS: Uninterruptible Power Supply
- TPS/OIS: Treatment planning System/Oncology Information System
- CCTV: Closed Circuit TV

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- Milestones 90.02-1/2

Refer also to **Chapter II (ROOMS)** for architectural specifications of the rooms

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Vii. BOD requirements

Building completion & milestones

TITLE: Presentation

07.42.33.

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1. BUILDING COMPLETION REQUIREMENTS

The building shall be completed, and all services available, as specified in this document and shall have been accepted by the PTEV prior to the arrival of both the installation team and the equipment necessary for the installation of the system.

D/BT shall provide an "As-built" document showing the measured values of all dimensions requested in the IBD.

D/BT must provide complete certified testing and operational reports for all building HVAC, electrical and chilled water system equipments to verify what the systems can provide and their capabilities and reliability. D/BT must provide load report for each steel beam installed in the facility.

The PTEV will start the PTEV alignment activities followed by the installation work when these conditions comply to the PTEV's requirements and inspection.
All building work shall be completed except mentioned areas/building parts that requires rigging/insertion of the PTE to be finalized (i.e. somelight walls, block walls, suspended ceiling...).

D/BT shall ensure that the Site is properly kept clean when PTEV starts installation phase (1 month before BOD) and evacuate at its own cost and responsibility all garbage resulting from building works.

1.1 DUST CONTROL

In all rooms where PTEV install equipment, all exposed concrete shall be sealed and all exposed concrete walls and ceiling shall be painted with epoxy or polyurethane to prevent dusting and allow easy cleanup. All concrete floors, grouting trenches shall receive an industrial epoxy coating. The paint type shall be submitted to PTEV for approval prior purchasing.

All painting, sanding or any other dust producing activity shall be completed to the greatest extent possible. If not possible, these activities shall be kept to strict minimum.

All equipment areas shall be cleaned and vacuumed.

D/BT will cut the concrete blocks outside the Cyclotron/ESS/BTS areas (a cleaning is necessary afterwards in the cutting places).

A cleaning will be necessary if the concrete blocks installation by the PTEV sub-contractors generates dust.

All doors and openings of the building will be closed or sealed to prevent dust intrusion in the PTE areas.

1.2 INFRASTRUCTURE & SERVICES

All site facilities and services shall be accessible as necessary to support the health and safety as well as the effective operations of PTEV and subcontractor personnel during the installation and testing period. This includes power, water, and communications in the equipment areas as well as office space, tool storage, and toilets.
The service elevator shall be operational.

A single master key for most PTEV rooms should be available at BOD. A final key system will be discussed and agreed for after BOD period.

Maintenance of the building site, periodic (at least once a week) cleaning services during all the technical ramp-up, security, and fire watch, including storage/staging areas around the outside of the building, is the D/BT's responsibility.

1.3 INSERTION OF THE EQUIPMENT

All doors, corridors, etc. leading to rooms where PTE will be installed shall be cleared so as to allow transportation from Equipment unloading areas to the assembly or final place of Equipment installation.

All egress routes identified in Chapter III (Installation), including the building loading dock, type area shall be ready for use and free of obstructions.

The building access and surrounding exterior access areas including roads to and from the site and place for unloading and staging of PTE shall remain free of obstruction and completely accessible to the PTEV.
It must be possible allowing for the unloading of trucks and installation equipment i.e. portable cranes.



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VII.
BOD requirements

Building completion & milestones

TITLE: Building completion requirements

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MAIN TYPICAL PTEV RELATED BUILDING MILESTONES
BEFORE BUILDING OCCUPANCY DATE

1. ML-3 (Milestone-3)

The following items must be ready before the start of Site PreSurvey by PTEV (>50 working days before Building Occupancy Date (BOD))

- 1.1. Access for surveyors to all interior PTE Areas (Cyclo, BTS and Treatment room areas)
- 1.2. All of the Mass shielding Concrete (wall, ceiling, floor incl. trenches) in PTE vault and treatment rooms areas must be poured, fully cured, props removed. The walls and ceilings shall be totally finished with epoxy paint and the trenches shall be totally finished with epoxy coating.
- 1.3. All required embeds must be in place (but not grouted).
- 1.4. All PTE Areas must have temporary lighting
- 1.5. All PTE Areas must have temporary power (230V/120V) for use of low power equipments (theodolites, laptops...)
- 1.6. All PTE Areas secured with barriers and pit covers, for worker safety (e.g. gantry pits, BTS trenches, ...)
- 1.7. Temporary storage for building survey tools. (Maintenance room or specific container with lockable access)

2. ML-2 (Milestone-2)

The following items must be ready before the start of Site Survey by PTEV (30 working days before Building Occupancy Date (BOD)). Same as ML-3, plus:

- 2.1. All of the Mass shielding Concrete (wall, ceiling, floor incl. trenches) in PTE vault and treatment rooms areas must be sealed.
- 2.2. All required embeds in place and aligned according to pre-survey conclusions
- 2.3. Adequate Fire Protection. The use of portable fire extinguishers can be used if allowed by the local Fire Code and Fire Marshal.
- 2.4. HVAC in the Cyclotron, ESS, BTS and treatment rooms operational.
- 2.5. All BTS Utility Trench metal grating in place

3. ML-1 (Milestone-1)

The following items must be ready prior to the start of PSR & WCR PTEV components installation (15 working days before BOD). Same as ML-2, plus:

- 3.1. D/BT shall ensure that the Site is properly kept clean and evacuate at its own cost and responsibility all garbage resulting from building works
- 3.2. Clear unobstructed road access on the site
- 3.3. 24 hour Site Security including exterior PTEV PTE Staging and installation areas

3.4. PSR Room

- 3.4.1. Exterior and interior access doors in place.
- 3.4.2. All ramp access in place.
- 3.4.3. Concrete floor slabs sealed with industrial epoxy coating
- 3.4.4. Walls and ceilings sealed and painted
- 3.4.5. All HVAC Ducting completed.
- 3.4.6. Fan Coil Units in-place on structural support stand and chilled water piping hooked-up, tested and operational.
- 3.4.7. D/BT supplied structural support frames for PTEV power supply and electronic cabinets in place and anchored.
- 3.4.8. All embedded electrical cabling conduits labeled from end to end and with pull-strings installed.
- 3.4.9. 480V and 400V electrical power "hook-up" locations with cabling completed.
- 3.4.10. D/BT supplied UPS power supply and battery cabinet in place and operational.
- 3.4.11. Chilled water supply and return lines piped and valved-off at wall.
- 3.4.12. Floor Drain System tested and operational.
- 3.4.13. Compressed air system valved-off at wall.
- 3.4.14. Structural Steel D/BT furnished overhead monorail beam in-place, load tested and documented (if applicable)
- 3.4.15. Cable Trays installation in the PSR (immediately after electrical cabinets rigging by PTEV)
- 3.4.16. Access Floor completion in PSR

3.5. WCR Room

- 3.5.1. Exterior and interior access doors in place.
- 3.5.2. All ramp access in place.
- 3.5.3. Concrete floor slabs sealed and industrial epoxy finished.
- 3.5.4. Walls and ceilings sealed and epoxy painted
- 3.5.5. All HVAC Ducting completed and operational.
- 3.5.6. All Chilled Water Supply and Return piping in place from the Building Chiller Pumps to the PTEV Treated Water Equipment Room including all valves, filters and strainers completed and pressure tested as per the PTEV - IBD.
- 3.5.7. Potable Water supply lines for filling the PTEV Treated Water Equipment completed, tested and operational.
- 3.5.8. Floor Drain System tested and operational.

3.6. MCR and PTEV Server Room (and TPS/OIS server room if any)

- 3.6.1. All cable tray and access floor systems completed in the MCR and PTEV Server room



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PROJECT: PROTON THERAPY
 SPROJECT: TATA HBTF MUMBAI

VII.

BOD requirements

Building completion & milestones

TITLE: Milestones

07.42.33.

4. ML-0: BOD

The following items must be ready prior to the start of cyclotron, BTS and room installation (BOD) Unless otherwise stated or agreed with PTEV, all IBD requirements shall be fulfilled at the time of the BOD.

- 4.1. All egress routes inside the building clear and free of any obstruction
- 4.2. Crane Pads clear, unobstructed & accessible.
- 4.3. All PTE Areas must have permanent electrical power and lighting
- 4.4. Building full power available on request at each PTEV hook-up.
- 4.5. D/BT chilled water system operational, full capacity of cooling water available in PTEV Water Conditioning Room
- 4.6. All floor drain systems for the Cyclotron, ESS and Gantry Pits fully operable and tested to the main sump pump pit.
- 4.7. The sump pumps and ejection system located in main sump pit operational and tested.
- 4.8. All Precast Concrete Roof and hatch Panels shall be field measured, fabricated and labeled awaiting their installation following the coordinated PTEV PTE Installation Schedule and Construction Schedule.
- 4.9. Temporary Roof Hatch in place over the Cyclotron roof opening.
- 4.10. Staircase to the cyclotron pit and metallic platform over the staircase in place
- 4.11. Temporary electrical power for cyclotron, rigging available (400V, 3 phases, 20A, in cyclo vault)
- 4.12. Temporary removable Gantry Hatch covers in place at each Gantry roof hatch opening, able to sustain daily IN/OUT operation
- 4.13. All Structural Steel D/BT furnished overhead monorail beams and lifting Eye's in-place, load tested and documented.
- 4.14. TSS conduit, cabling and components (where possible) completed with labelled cabling from the devices to the Main Control Room and GTR Pulling Room awaiting termination by PTEV.
- 4.15. All Treated Chilled Water Supply and Return Piping from the PTEV Treated Water Room to the BTS including all valves, filters and strainers completed and pressure tested.
- 4.16. All D/BT treated water piping, valves, strainers, filters, caps and tees installed in the BTS Utility Trenches, to the treatment rooms
- 4.17. Facility and PTE Electrical Grounding System tested, and documented.
- 4.18. All cable tray systems completed in the BTS Utility Trenches, Treatment rooms and corridors above the suspended ceiling line.
- 4.19. All HVAC systems shall be completed, tested to meet PTEV requirements, documented.
- 4.20. The air compressors and all related piping, valves and connections installed, tested, documented and operational.
- 4.21. All communication systems in place and operational (see General Notes)
- 4.22. All of the other related PTEV Areas for the support of the PTE Installation Team Members and their equipment including the Main Control Room, Treatment Control Rooms, PTEV Computer Room, PTEV Office Areas and PTEV Storage Rooms must:
 - 4.22.1. All floors, wall and ceiling finished completed.
 - 4.22.2. Have permanent operable lighting.
 - 4.22.3. Have permanent electrical power.
 - 4.22.4. Have permanent operable computer network hook-up available.
 - 4.22.5. Have permanent access to Internet through DSL connection

- 4.22.6. Have permanent operable telephone with international connections ability.
- 4.22.7. Walls, ceilings and lockable doors installed, painted and operable
- 4.22.8. Adequate Fire Protection. See note above regarding the use of Fire extinguishers
- 4.22.9. HVAC systems fully operational.
- 4.22.10. All D/BT supplied casework and countertops in place.
- 4.23. Secured staging areas for the PTE prepared and ready for use.
- 4.24. Office, toilet for PTEV PTE Installation Team are available (see General Notes)
- 4.25. Service Elevator functional

5. ML+1: The following items must be ready at a later stage

Basically all remaining steps not yet done at the stage of the BOD.

This includes but is not limited too:

- 5.1. Base Plates & Magnets Stands grouting
- 5.2. Closing/Waterproofing all hatches
- 5.3. Installation of fences in BTS vault
- 5.4. Building of removable walls in PTE areas
- 5.5. Closing of sighting holes
- 5.6. Room finishing (including partition walls & X-Ray Shielding) in treatment rooms
- 5.7. Installation of Radiation Monitoring System (if applicable)
- 5.8. All CCTV systems (if applicable)
- 5.9. Gantry surrounding catwalk & stairs installation
- 5.10. HVAC systems fully operational and balanced.

6. GENERAL NOTES:

- 6.1. Fire Protection systems, Communication Systems and HVAC Systems shall meet the full requirements as described in the PTEV - IBD Text, Tables and Drawing Figures at the time of BOD unless it is agreed that these services and conditions not yet completed will be completed with-in a reasonable time frame that will not interrupt with or hinder the PTEV PTE Installation Process and schedule.
- 6.2. Office area shall meet the full requirements as described in the PTEV - IBD at the time of BOD unless it is agreed that these services and conditions not yet completed will be completed with-in a reasonable time frame that will not interrupt with or hinder the PTEV PTE Installation Process and schedule. In this case, temporary offices such as trailers shall be put at PTEV disposal in the meantime.



REV:	A	DATE:	30/04/15	MODIFICATION:	Original Issue
DRAFTSMAN:	LCHEN	CHECKED BY:	OBA	VALIDATED BY:	PV

MATERIAL:	-
SCALE:	(A3)
DIMENSIONS:	mm
TOLERANCES:	-

PROJECT: PROTON THERAPY
 SPROJECT: TATA HBTf MUMBAI

VII. BOD requirements

Building completion & milestones

TITLE: Milestones

07.42.33.