S.A. ION BEAM APPLICATIONS

Interface Building Document (IBD)	M-Id TBD	
TATA HBTF MUMBAI		

DOCUMENT DISTRIBUTION

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Technical Report

TATA HBTF MUMBAI

Prepared by	Verified by	Validated by
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Keyword :	Interface Building Document - Architecture - Facility Engineering	

NOTICE

The Proton Therapy Equipment Vendor (PTEV) Ion Beam Applications (IBA) reserves the right to review all architectural building plans and all related facility documentation that covers any aspect of the building-equipment interface. This review will be conducted at the time of the building pre-construction review in order to verify that all requirements of this Interface Building Document (IBD) are properly taken into account and, if this is not the case, require any changes to these plans that are necessary to reflect all requirements of this document. However, this review shall not relieve the Design/Building Team (D/BT), the General Contractor and/or the Customer/Buyer from the responsibility for meeting its requirements.

During the Building acceptance, the Facility Interface and Construction Manager will make use of this PTEV requirement document to perform the Facility Readiness Review. It serves also as the requirement document for reviewing the deliverables to be delivered by the customer/buyer to the PTEV for all equipment that affects or influences the Proton Therapy System and that is installed by the customer/buyer.

TATA HBTF MUMBAI

I. INTRODUCTION

00. INTRODUCTION

ACRONYMS

PTEV: Proton Therapy Equipment Vendor
D/BT: Design/Building Team

See other acronyms definitions in the text.

TABLE OF CONTENTS

Refer also for additional technical specifications to Chapter III: Installation, Chapter IV: Cooling & Gases, Chapter V: Electrical set, Chapter VI: Other Technics & Chapter VII: BOD Requirements.

SCOPE OF THE DOCUMENT

This document defines the facility interface requirements necessary to support installation, operation, and maintenance of the Proton Therapy System.

The released version of this document establishes the technical baseline of these requirements to be used by the Design/Build Team (D/BT) for the building design. However, since some interface details are subject to continuing refinement as a result of on-going equipment design and possible customer scope variation, these refinements will be incorporated in periodic updated revisions.

The building design must consider not only equipment to be supplied under the initial configuration, but also upgrades planned for the future.

The initial proton therapy facility configuration addressed in this document includes:

- 3 Gantry Treatment Rooms, Gantry TR1 (GTR1), Gantry TR2 (GTR2), Gantry TR3 (GTR3).

The following is a list of the main subsystems that shall be supplied and installed under the initial configuration:

- Cyclotron (Accelerator);
- Energy Selection System (ESS);
- Beam Transport System (BTS) for GTR1,GTR2, GTR3;
- Gantry for Treatment Room GTR1, GTR2, GTR3;
- Nozzle for Treatment Room GTR1, GTR2, GTR3;
- Patient Positioning System (PPS) for Gantry treatment rooms;
- Therapy Safety System (TSS);
- Therapy Control System (TCS);
- Utilities (Cooling, electrical, pneumatic, etc);
- Water Cooling Room (WCR) Equipment;
- Power Supply Room (PSR) Equipment;
- Main Control Room (MCR) Equipment;
- Treatment Rooms (TR) Equipment;
- Treatment Control Rooms (TCR) Equipment;
- PTEV Server Room Equipment;

REFERENCE DOCUMENTS

IEC 62040-1 : Uninterruptible power systems (UPS) - Part 1: General and safety requirements for UPS

IEC 62040-2: Uninterruptible power systems (UPS) - Part 2: Electromagnetic compatibility (EMC) requirements

IEC 62040-3: Uninterruptible power systems (UPS) - Part 3: Method of specifying the performance and test requirements

IEC 60204-1: Safety of machinery - Electrical equipment of machines - Part 1: General Requirements

ISO 13849-1: Safety of machinery - Safety related parts of control systems.

IEC 61508: IEC 61508-1 - Ed. 1.0: Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 1: General requirements (see www.iec.ch/61508)

IEC 60601-1: "Medical electrical equipment - Part 1: General requirements for basic safety and essential performance"

The International System of Units (or Metric System) has been the internationally recognized standard metric system. This system will be used as a convention. Exception made for plumbing where the BSP System will be used (see Chapter 7.5 - BSP Thread Definition).

“Radiation sources Proteus 235” IBA document MID 35597

GENERIC REQUIREMENTS

The D/BT shall ensure that the usual safety related to industrial or medical building and access are compliant with local regulations (e.g.: electrical hazards signage, noise, floor marks, risks of fall, pits marking or fencing, emergency exits and so on...).

Seismic event shall be analyzed by D/BT to comply with local regulations and local conditions (i.e.: ground investigations,...). The D/BT shall inform the PTEV of any criteria to be checked on the equipment itself which may impact its design.

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REV:	DATE:	MODIFICATION:	DRAFTMAN:	CHECKED BY:	VALIDATED BY:
A	30/04/15	Original issue	LCHEN	QBA	PV

MATERIAL: –
SCALE: –
DIMENSIONS: --
TOLERANCES: –

PROJECT: PROTON THERAPY
S/PROJECT: TATA HBTF MUMBAI

I.
GENERAL INTRODUCTION

TITLE:
Introduction

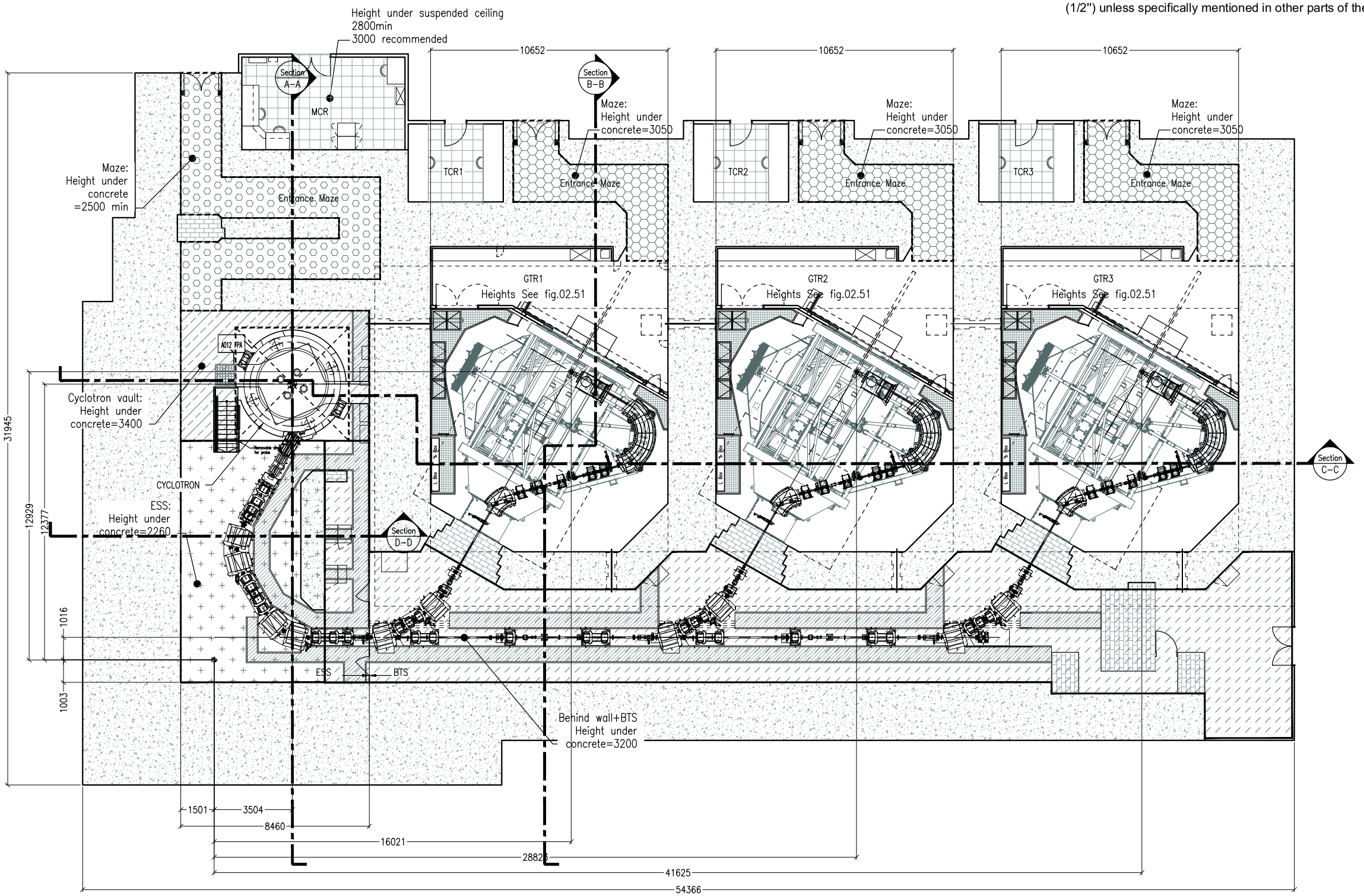
07.42.33.

00.00 A

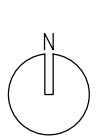
1. The Proton Therapy Equipment (PTE) is installed on three levels: The middle level (treatment level) contains most of the PTE (such as the cyclotron, the ESS/BTS, the Treatment Rooms (TR), the Main Control Room (MCR), PTEV Server Room and Treatment Control Rooms (TCR). See other levels on next figures.

2. As a general orientation reference, this figure shows the treatment level floor plan of the facility with the proton therapy equipment installed. As a convention, we consider the exterior wall along the BTS to be the South wall. Everything in this document (text and figures) is coordinated to this reference.

3. As a building standard, D/BT shall follow normal concrete construction tolerance of +/- 1cm (1/2") unless specifically mentioned in other parts of the text or figures.



TREATMENT LEVEL



0 5 10 METER

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A	30/04/15	Original issue	LCHEN	QBA	PV

MATERIAL: –
SCALE: 1/250 (A3)
DIMENSIONS: mm
TOLERANCES: –

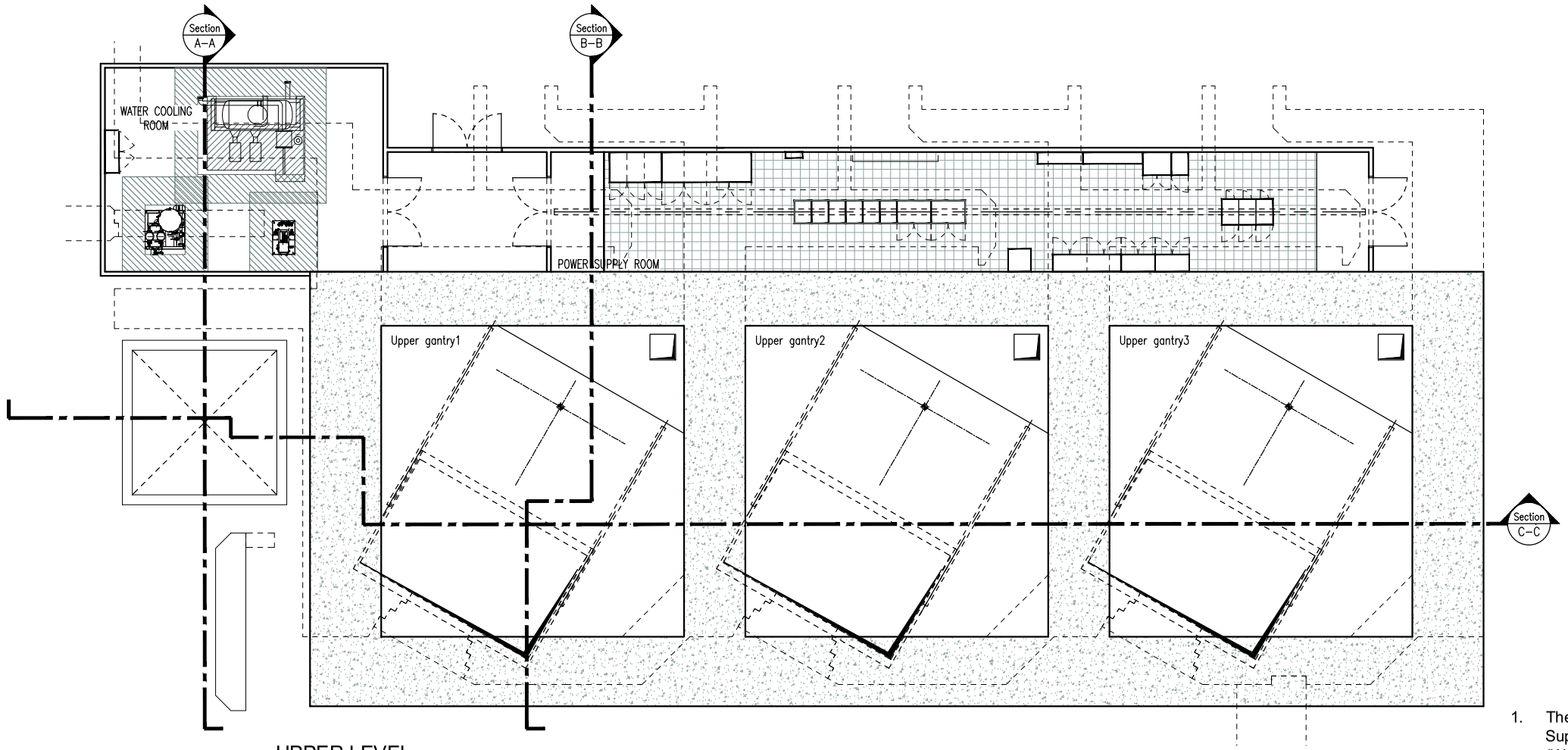
PROJECT: PROTON THERAPY
SUBPROJECT: TATA HBTF MUMBAI

I.
GENERAL
INTRODUCTION

TITLE:
Facility general
Layout
Treatment Level

07.42.33.

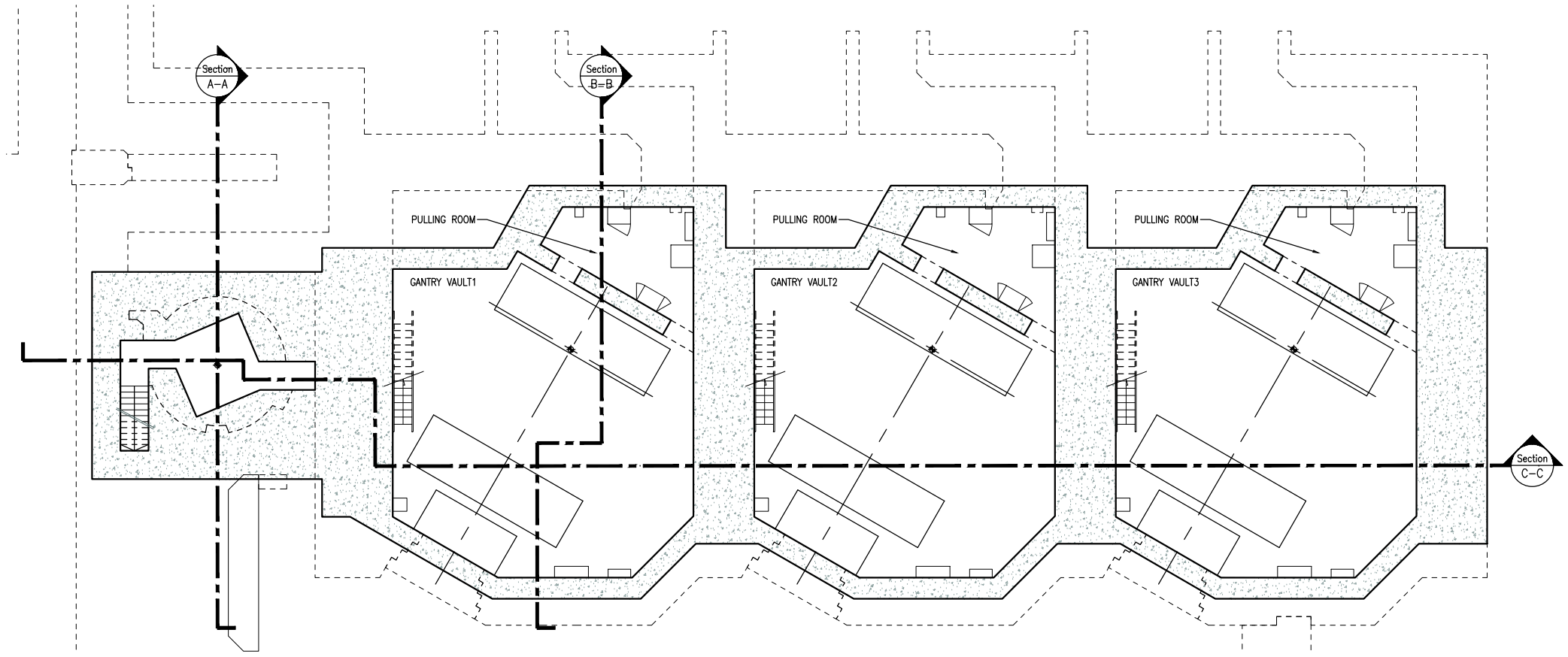
00.31-1 A 1/3



UPPER LEVEL

1. The highest level (or upper level) includes the Power Supply Room (PSR) and the Water Cooling Room (WCR).

2. Finally, The lowest level (or basement) consists of the cyclotron pit and the pits where the gantry structures are supported.



BASEMENT

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REV:	DATE:	MODIFICATION:	DRAFTMAN:	CHECKED BY:	VALIDATED BY:
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MATERIAL: –
SCALE: 1/200 (A3)
DIMENSIONS: mm
TOLERANCES: –

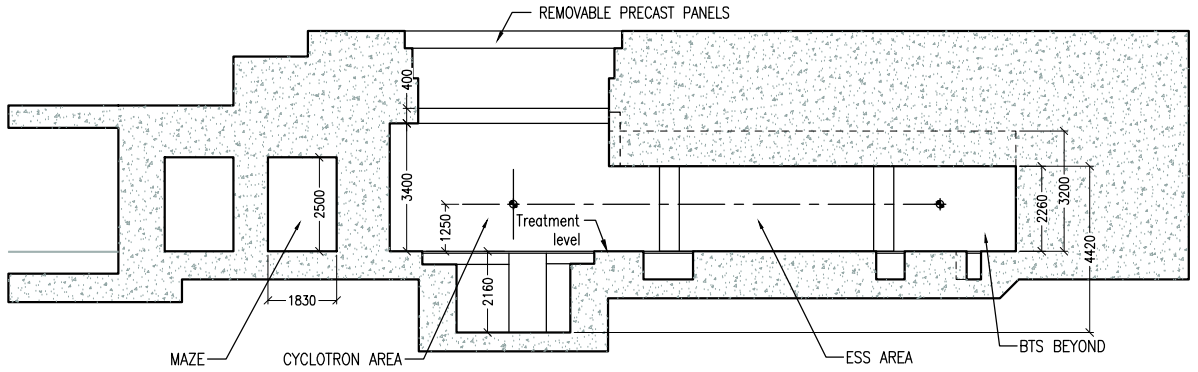
PROJECT: PROTON THERAPY
SPROJECT: TATA HBTF MUMBAI

I.
GENERAL INTRODUCTION

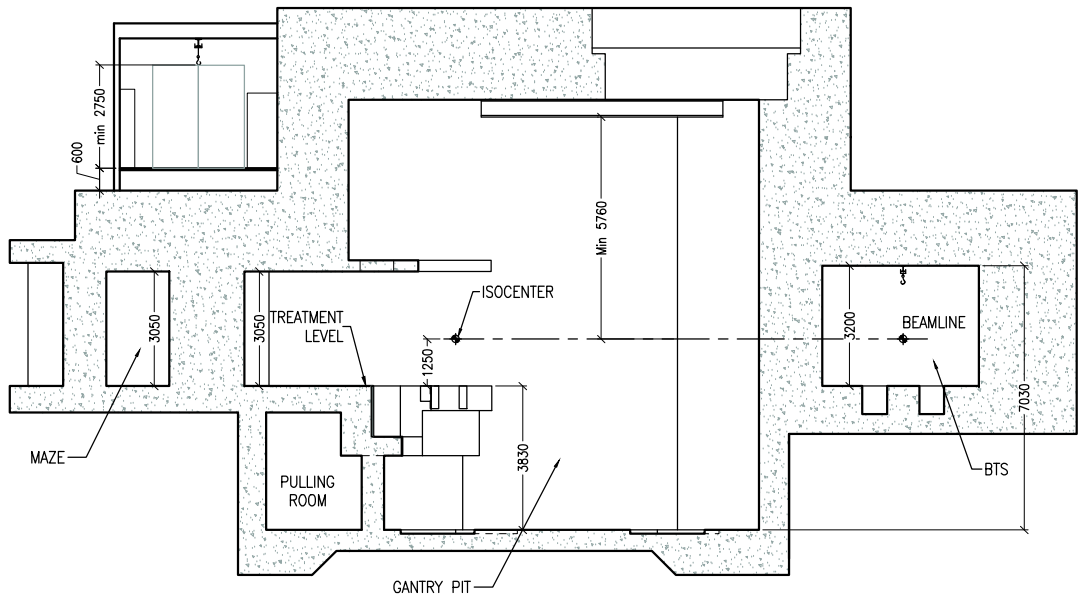
TITLE:
Facility General Layout
Upper Level
& Basement

07.42.33.

00.31-2 A 2/3



SECTION A-A



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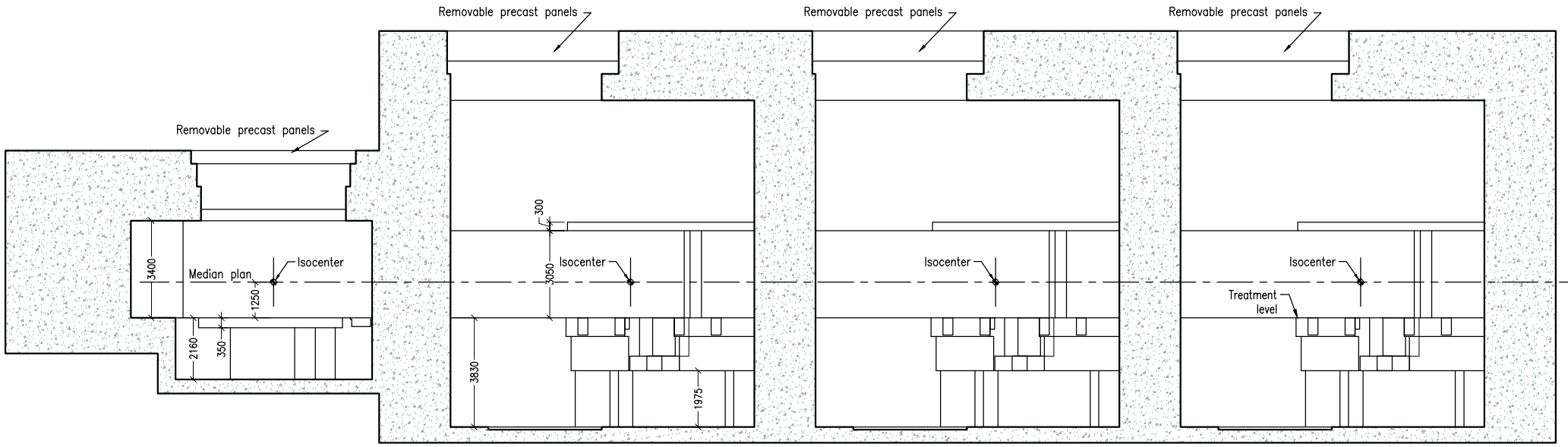

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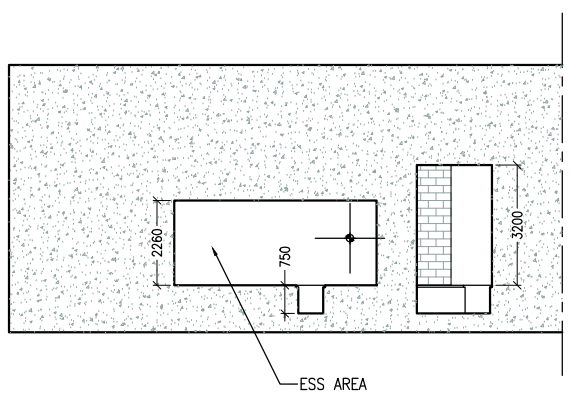

SECTION D-D

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A	30/04/15	Original issue	LCHEN	QBA	PV

MATERIAL: –
SCALE: 1/200 (A3)
DIMENSIONS: mm
TOLERANCES: –

PROJECT: PROTON THERAPY

SPROJECT: TATA HBTF MUMBAI

I.
GENERAL INTRODUCTION

TITLE:

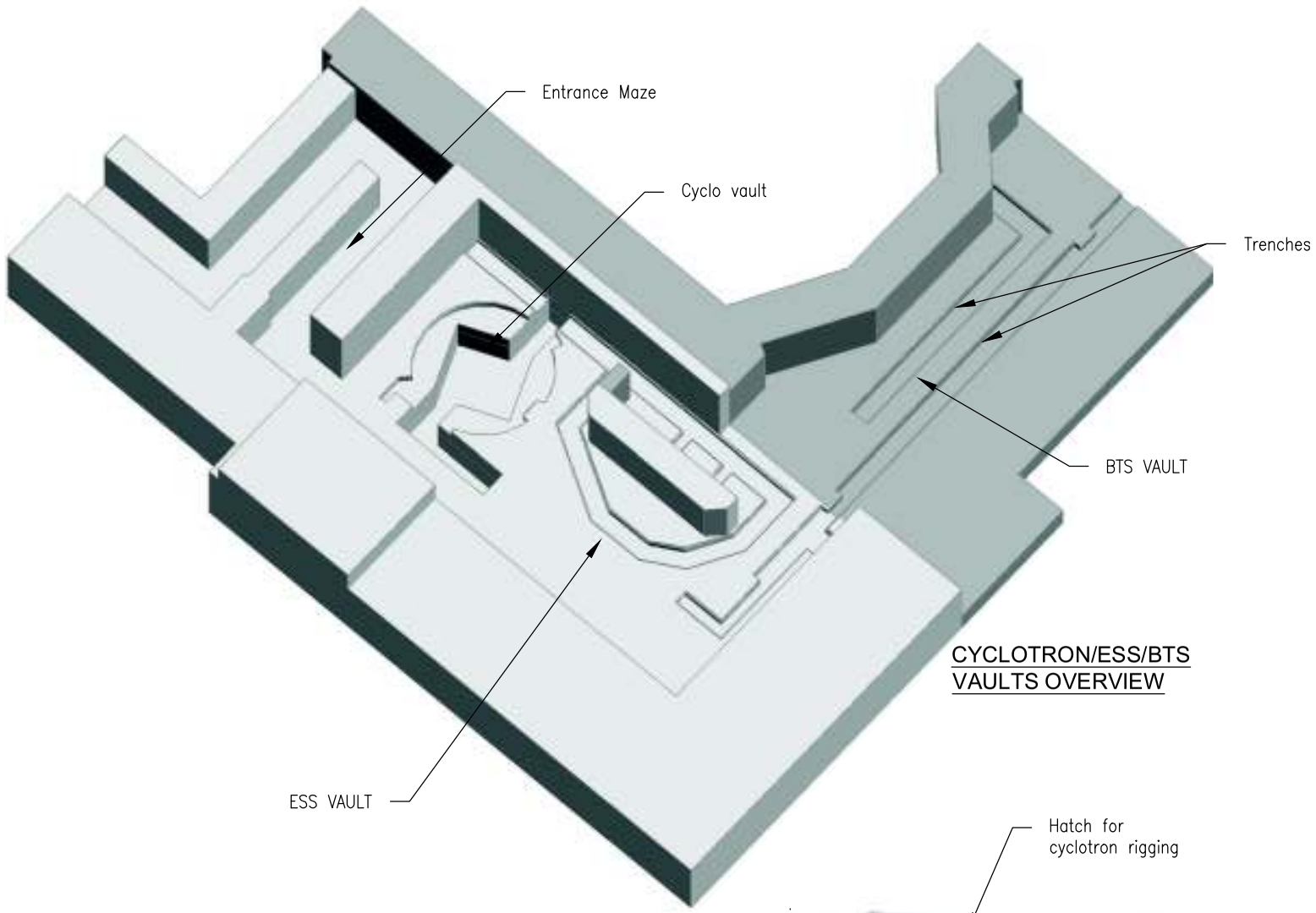
Facility General Layout Sections

07.42.33.

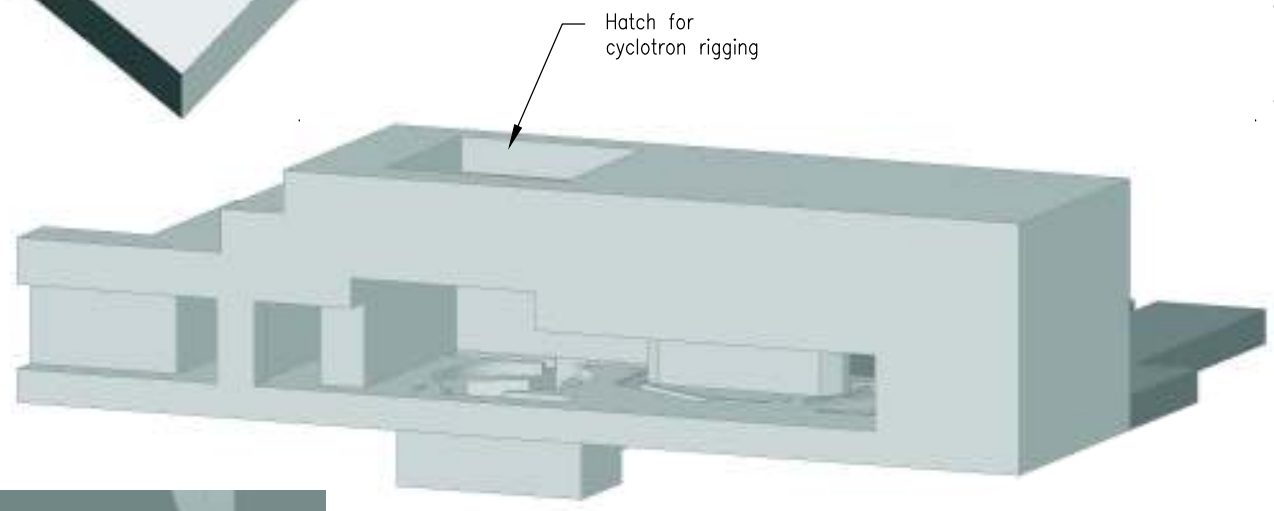
00.31-3 A 3/3

II. ROOMS

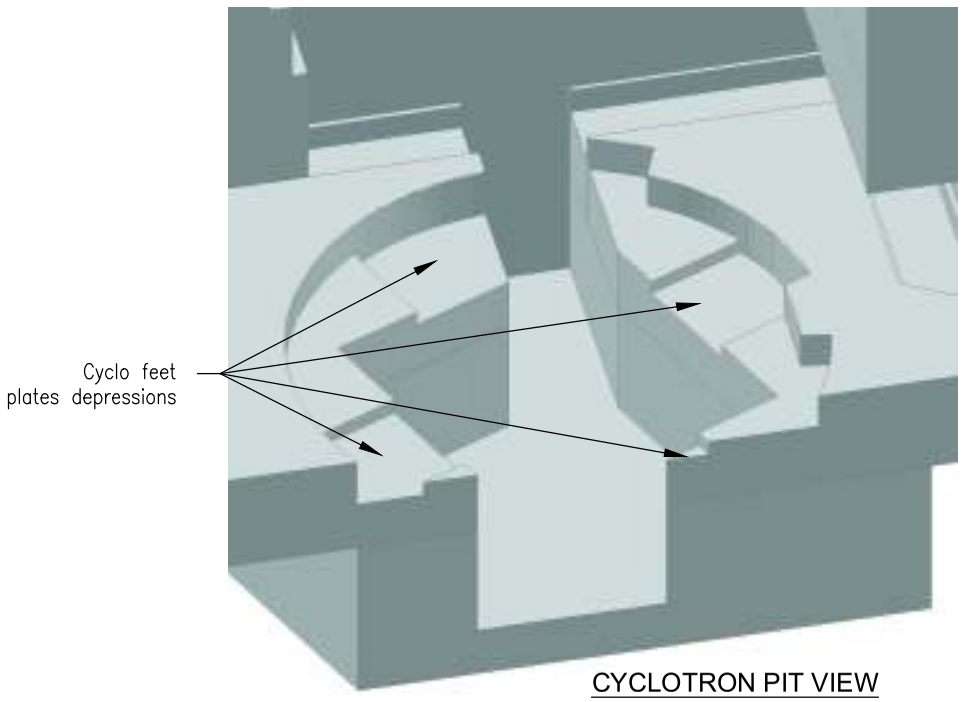
S.A. ION BEAM APPLICATIONS



CYCLOTRON/ESS/BTS
VAULTS OVERVIEW



CYCLOTRON/ESS VAULTS
CROSS SECTION VIEW



CYCLOTRON PIT VIEW

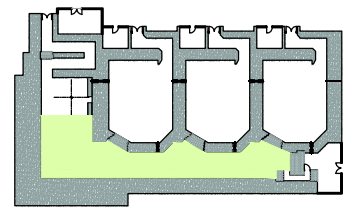
01. CYCLOTRON, ESS & BTS VAULTS

ACRONYMS

ESS:	Energy Selection System
BTS:	Beam Transport System
D/BT:	Design Building team
PTEV:	Proton Therapy Equipment Vendor
PTE:	Proton Therapy Equipment
TR:	Treatment Room
PPS:	Patient Positioner System

TABLE OF CONTENTS:

Refer also for additional technical specifications to Chapter III: Installation, Chapter IV: Cooling & Gases, Chapter V: Electrical set, Chapter VI: Other Technics & Chapter VII: BOD Requirements.



S.A. ION BEAM APPLICATIONS

DATE:	MODIFICATION:	VALIDATED BY:
30/04/15	Original issue	PV
REV:	DRAFTMAN:	CHECKED BY:
A	LCHEN	QBA

MATERIAL: –
SCALE: –
DIMENSIONS: mm
TOLERANCES: –

PROJECT: PROTON THERAPY
SPROJECT: TATA HBTF MUMBAI

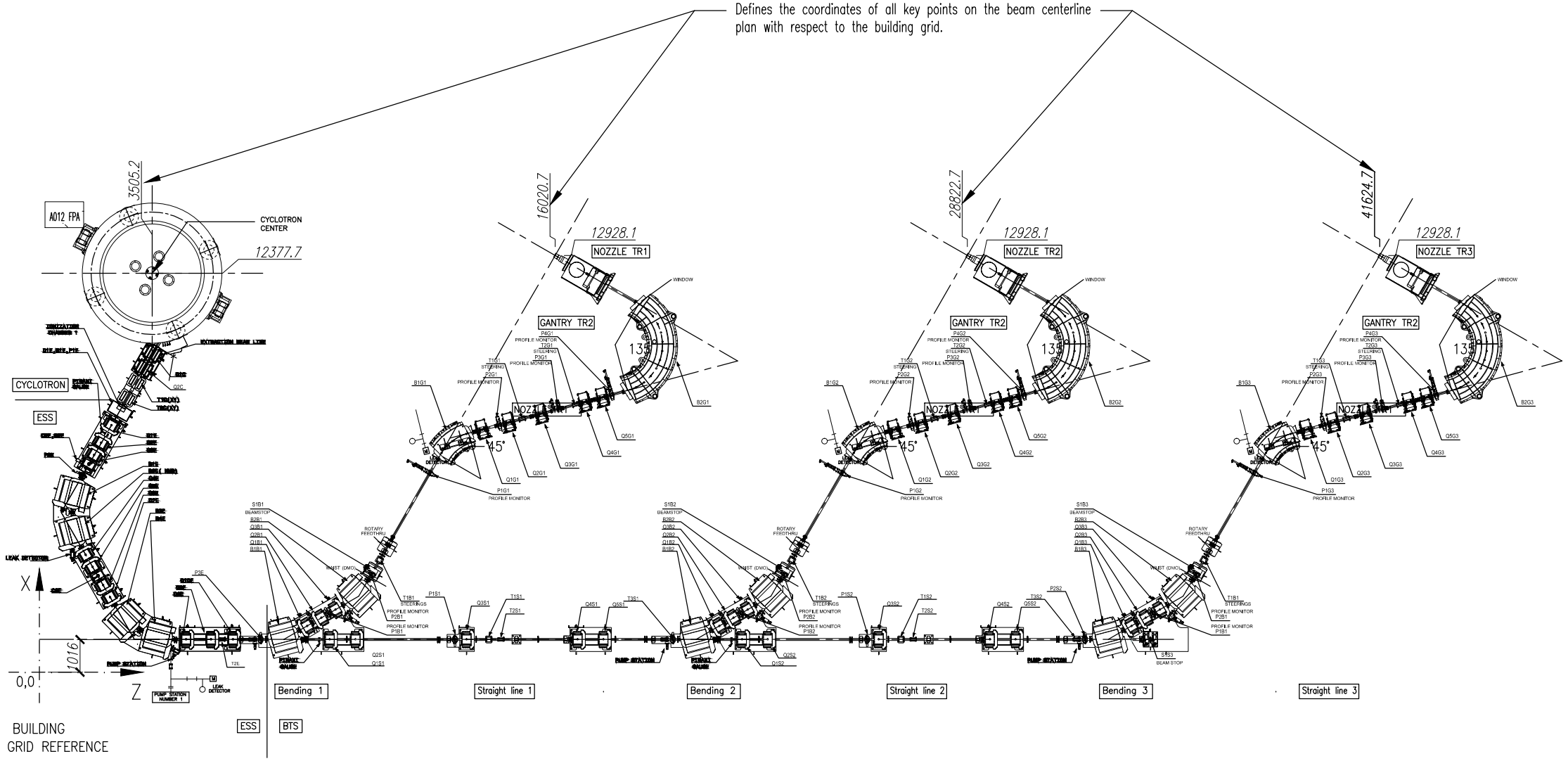
II.
ROOMS

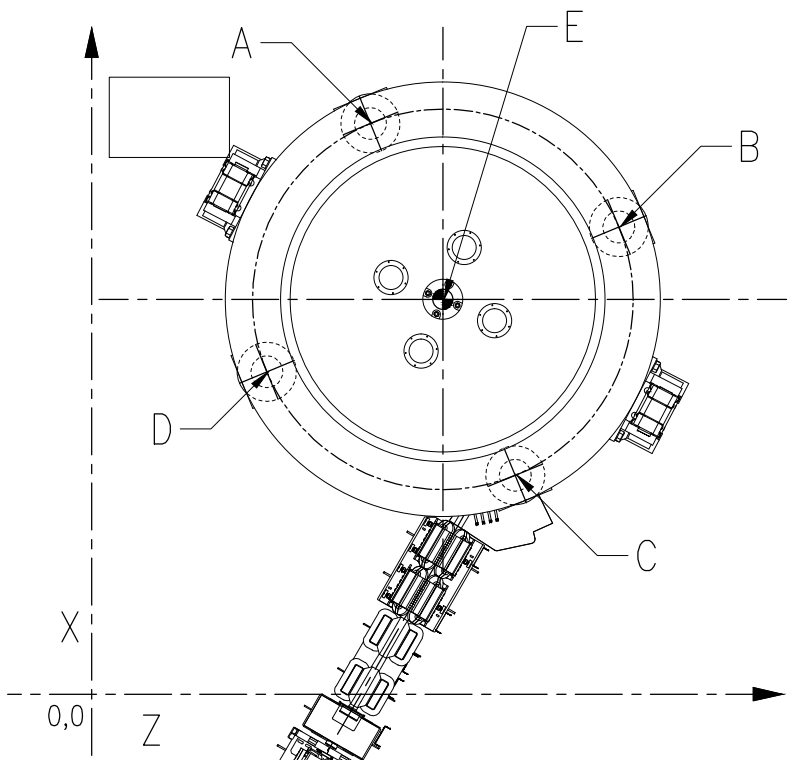
Cyclotron/ ESS
/ BTS Vaults

TITLE:
Presentation

07.42.33.

01.00 A





Cyclo feet Coordinates							
	A	B	C	D	E	Axis BL	Units
Z	2782	5262	4228	1748	3505	–	mm
X	14135	13101	10621	11655	12378	1016	mm

CYCLOTRON/ESS/BTS COMPONENTS

1. The cyclotron generates the proton beam. After conditioning of the proton beam in the ESS, the beam is further transported through the BTS up to the treatment areas. In the TR's, after the BTS, the beam is then transported by an additional beamline depending on the type of TR and is delivered through a “nozzle” to a patient supported on a patient positioner (PPS) at specific points called isocenters.

2. Isocenters locations as shown on this figure are theoretical and will be slightly rounded to allow repeatability of the relative locations of each isocenter in respect to its TR. D/BT will take these resulting building isocenters as reference for execution drawings.

3. The accelerator can be considered as a large iron cylinder standing on four feet. Its total weight is 227.000 kg (500,000 lbs.)

4. The major components of the ESS and BTS are shown here. For nomenclature refer also to Table1 on next figure. Repetitive beam line components are quadrupole magnets (“Q”) and 30° dipole magnets (“B”). Many smaller items, which do not have a critical impact on the building interface, are not shown. Indicative values for weights and dimensions are given in next figure, Table 2: Cyclotron Main Components, and Table 3: ESS/BTS Main Components.

5. The beam centerline is 125 cm (49.21") above the treatment floor level.

6. The magnets will be aligned by PTEV to the beam axis typically to ± 0,5 mm (±1/64") tolerance.

To be revised after beamline finalization

S.A. ION BEAM APPLICATIONS

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A	30/04/15	Original issue	LCHEN	QBA	PV

MATERIAL: –
SCALE: –
DIMENSIONS: mm
TOLERANCES: –

PROJECT: PROTON THERAPY
SPROJECT: TATA HBTF MUMBAI

II.
ROOMS

Cyclotron / ESS / BTS Vaults

TITLE:
Beam Transport Components & Isocenters

07.42.33.

01.11-1 A 1/2

TABLE 1 : BEAMLINE COMPONENTS NUMBERING

Quadrupoles: [Q]
Steerings: [T]
Dipoles: [B]
Beam Profile Monitors: [P]
Beam Stop: [S]
Colimators: [C]
Degradors: [D]

Cyclotron: [C]

Quadrupoles	Steerings
Q1C	T1C
Q2C	T2C

ESS: [E]

Quadrupoles	Dipoles	Steerings	Beam Profiles monitors	Beam Stop	Colimators	Degrador
Q1E	B1E	T2E	P1E	S1E	C1E	D1E
Q2E	B2E		P2E	S2E	C2E	
Q3E	B3E		P3E		C3E	
Q4E	B4E					
Q5E						
Q6E						
Q7E						
Q8E						
Q9E						
Q10E						

Bending and Straight line 1,2,3: [B1, B2, B3, S1, S2, S3]

Quadrupoles	Dipoles	Steerings	Beam Profiles monitors	Beam Stop
Q1B1/Q1B2/Q1B3	B1B1/B1B2/B1B3	T1B1/T1B2/T1B3	P1B1/P1B2/P1B3	S1B1/S1B2/S1B3
Q2B1/Q2B2/Q2B3	B2B1/B2B2/B2B3	T1S1/T1S2	P2B1/P2B2/P2B3	S1S3
Q3B1/Q3B2/Q3B3		T2S1/T2S2	P1S1/P1S2	
Q1S1/Q1S2		T3S1/T3S2	P2S1/P2S2	
Q2S1/Q2S2				
Q3S1/Q3S2				
Q4S1/Q4S2				
Q5S1/Q5S2				

Gantry TR1, TR2, TR3 : [G1, G2, G3]

Quadrupoles	Dipoles	Steerings	Beam Profiles monitors
Q1G1/G1G2/G1G3	B1G1/B1G2/B1G3	T1G1/T2G2/T2G3	P1G1/P1G2/P1G3
Q2G1/G2G2/G2G3	B2G1/B2G2/B2G3	T2G1/T2G2/T2G3	P2G1/P2G2/P2G3
Q3G1/G3G2/G3G3			P3G1/P3G2/P3G3
Q4G1/G4G2/G4G3			P4G1/P4G2/P4G3
Q5G1/G5G2/G5G3			

Table 2: Cyclotron Main Components

ITEM	Qty	WEIGHT (kg / lbs)	HEIGHT (cm/in)	WIDTH (cm/in)	DEPTH (cm/in)	INSTALL ROUTE	REPLACE ROUTE
Cyclotron magnet							
Lower Return including lower Main Coil and Pole	1	115000/ 254000	160 / 63	dia 434 / 170		R1	R1
Upper Return including upper Main Coil and Pole	1	117000 / 257000	105 / 41	dia 434 / 170		R1	R1
Yoke Lifting Actuator	2	4500 / 10000	190,5/ 75	51 / 20	36 / 14	R1	R6A
Hydraulic Pump	1	600 / 13250	112 / 44	102 / 40	102 / 40	R6A	R6B
Cyclotron vacuum							
Vac. Chamber (upper)	1	272 / 600	36 / 14	dia 254 / 100		R1	R1
Vac. Chamber (lower)	1	408 / 900	51 / 20	dia 254 / 100		R1	R1

Table 3: ESS/BTS Main Components

MAGNETS							
ITEM **Magnets**	QTY	WEIGHT (kg / lbs)	HEIGHT (cm/ in.)	WIDTH (cm / in.)	DEPTH (cm/ in.)	INSTALL ROUTE	REPLACE ROUTE
Quad (Q)		431 / 950	48 / 19	58 / 23	36 / 14	R1	R6
Dipole 35° (B)		2653,5 / 5850 /	81 / 32	114,3 / 45	63,5 / 25	R1	R6
Degrader	1	590 / 1300	94 / 37	66 / 26	41 / 16	R1	R6
PEDESTAL ESS							
ITEM **Magnets**	QTY	WEIGHT (kg / lbs)	HEIGHT (cm/ in.)	WIDTH (cm / in.)	DEPTH (cm/ in.)	INSTALL ROUTE	REPLACE ROUTE
Q1C+ Q2C	1	331 / 730	76/30	102 / 40	79 / 31	R1	R6
Degrader	1	100 / 220	36 / 14	86 / 34	38 / 15	R1	R6
Q1E + Q2E + Q3E	1	499 / 1100	76/30	193 / 76	89 / 35	R1	R6
B1E + B2E / B3E + B4E	2	794 / 1750	76/30	231 / 91	132 / 52	R1	R6
Q4E +Q5E + Q6E + Q7E	1	499 / 1100	76/30	201 / 79	86 / 34	R1	R6
Q8E + Q9E + Q10E	1	476 / 1050	76/30	190,5 / 75	86 / 34	R1	R6
PEDESTAL BTS							
ITEM **Magnets**	QTY	WEIGHT (kg / lbs)	HEIGHT (cm/ in.)	WIDTH (cm / in.)	DEPTH (cm/ in.)	INSTALL ROUTE	REPLACE ROUTE
B1B1/B2B1	2	295 / 650	76/30	124,5 / 49	102/40	R1	R6
Q1B1 + Q2B1 + Q3B1	1	499 / 1100	89 / 35	193 / 76	89/35	R1	R6
Q1S1 + Q2S1 + Q3S1 + Q4S1 + Q5S1 + Q6S1 + Q7S1	1	tbc	tbc	tbc	tbc	R1	R6
B1B2/B2B2	2	295 / 650	102/40	124,5 / 49	102/40	R1	R6
Q1B2 + Q2B2 + Q3B2	1	499 / 1100	89 / 35	193 / 76	89/35	R1	R6

1. Routes are paths into the building that shall be designed to allow transportation of the equipment for installation and/or maintenance. Please refer to dedicated Chapter III (Installation) of this IBD for further details

To be revised after beamline finalization

S.A. ION BEAM APPLICATIONS

REV:	DATE:	MODIFICATION:	DRAFTMAN:	CHECKED BY:	VALIDATED BY:
A	30/04/15	Original issue	LCHEN	QBA	PV

MATERIAL: –
SCALE: –
DIMENSIONS: mm
TOLERANCES: –

PROJECT: PROTON THERAPY
SPROJECT: TATA HBTF MUMBAI

II.
ROOMS

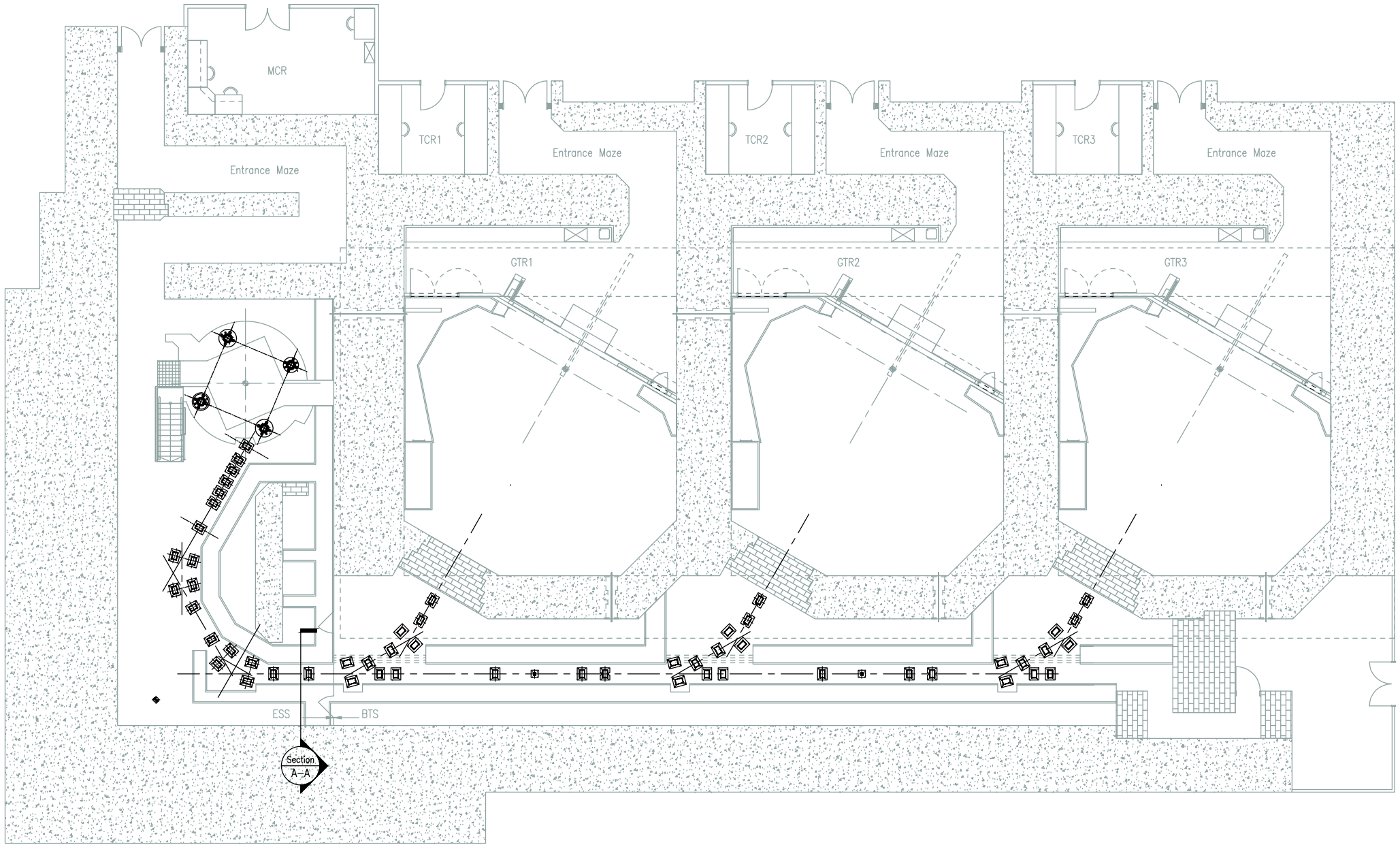
Cyclotron / ESS / BTS Vaults

TITLE:
Beam Transport Components Tables

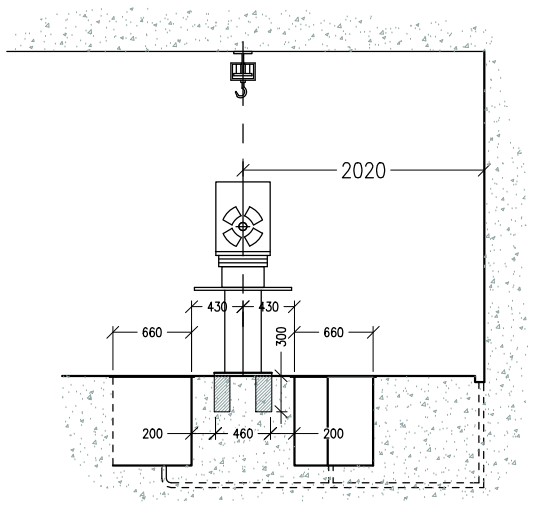
07.42.33.

01.11-2 A 2/2

1. The major items of the ESS equipment will be installed by PTEV as subassemblies mounted on floor stands or magnet tables. This drawing shows indications of the table feet locations. Some closely spaced groups of quadrupole magnets or dipole magnets will be installed as a single subassembly that is mounted on these tables. The sizes and weights of these subassemblies are also given in Table 3: ESS/BTS Main Components on figure 01.11-2.



TREATMENT LEVEL



SECTION A-A

2. For the proper installation of the magnet tables, D/BT shall make sure to avoid concrete rebar installation in the floor locations right under table feet, as shown on the section.

To be revised after beamline finalization

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SCALE: 1/200 (A3)
DIMENSIONS: mm
TOLERANCES: –

PROJECT: PROTON THERAPY
SPROJECT: TATA HBTF MUMBAI

II.
ROOMS

Cyclotron / ESS / BTS Vaults

TITLE:
Magnets supports

07.42.33.

01.12 A

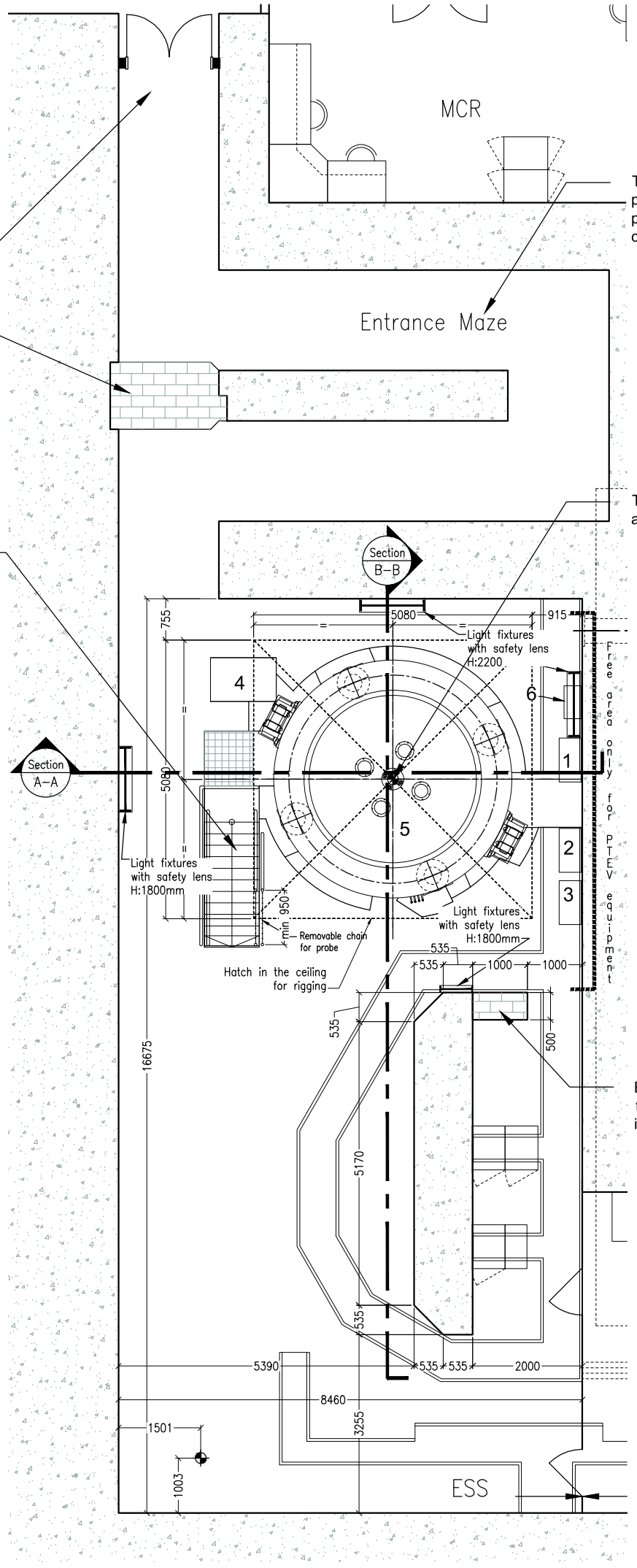
The cyclotron area access door interlocks will be selected in view to comply with the requirements of the IEC 61508 or the EN-954-1 to safeguard up to category 3.
When motorized systems are used for opening the doors, they should also be selected according to safety principles of IEC 61508.It will always be possible to open the doors of the cyclotron vault from the inside. Door hardware shall meet the industrial standards for safety design and function.

A part of the maze shall be constructed with removable concrete blocks, in order to give a direct access to the vault. These blocks will be installed with a physical restraint by the D/BT after all the main parts of the Cyclotron/ESS/BTS have been entered in the vault.
Exceptionally or upon PTEV request, it could be necessary to quickly remove the blocks for egress of equipment.
Thus, the block size will be chosen to make handling easy.

By D/BT: A concrete staircase with railings shall be installed for access to the pit. After cyclotron installation, a platform and railing shall be installed over the pit and its entrance in order to enable personnel to stand in front of the 100 kW amplifier cabinet.
A site measurement of the Cyclotron probe position shall be done by the D/BT before the railings manufacturing.

All light fixtures are mounted horizontal to the wall

NB	Denomination
1	Water Manifold for Cyclotron
2	Water Manifold for Cyclotron
3	Water Manifold for Cyclotron
4	Ampli 100KW
5	Cyclotron
6	Compressed Air Manifold

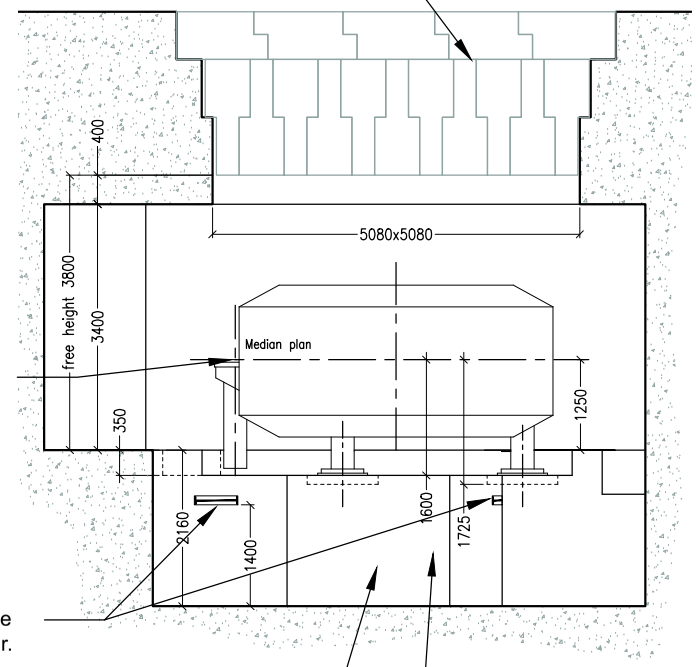


The access to the Cyclotron area will be provided by a maze. It will be designed to prevent radiation leakage outside of the cyclotron area.

A Roof hatch, is necessary for the installation of the cyclotron. This hatch shall be closed and sealed by D/BT as soon as the cyclotron and other equipment have been rigged into the Equipment vault. Prior to the cyclotron installation, it is recommended that the D/BT install and remove the hatch removable panels to insure a proper fit. For heavy maintenance or major component replacement, the opening of the hatch must remain possible for the all life of the system.
In order to prevent from radiation leaks, D/BT shall submit the precast beam design to PTEV for approval before starting their production.

The cyclotron will be centered at point E (See Fig.01.11).

The cyclotron is divided into two parts (upper and lower yoke) along the median plane, enabling to lift the upper yoke in order to have access to the median plane inside the cyclotron. When opened, the total height of the cyclotron is 380 cm (12'-5 3/4") from the treatment floor level.



Lighting fixture will be foreseen in the cyclotron pit with safety lens cover.

SECTION A-A

Block wall from floor to ceiling to build after installation

A pit underneath the cyclotron is required to allow access to lower equipment parts and to receive cyclotron feet interfaces.
A floor drain is required in the cyclotron pit. Specifications of the floor drains, see also Chapter IV.Cooling and Gases.
D/BT will provide moisture detection system in the pit, after the installation of the PTE. The type of moisture detection system shall be submitted to PTEV for approval prior purchasing.

Cable trays will be installed on the walls around the pit as well as in the trench linking the pit to the east cyclotron vault wall. The cable trays will be placed directly on the wall (not perpendicularly with supports) in order to maximize the space in the pit. The tray are installed by D/BT and their localization is described in Fig.52.45 (Locations of CT & duct ends: Basement).

CYCLO VAULT & ESS VAULT

TABLE 1

The treatment level floor plan provided by the D/BT shall locate the beam line and facility walls such that the minimum clearances tabulated in Table 1: Minimum Clearances are provided. The space required around the beam equipment is defined with respect to the centerline of the beam line.

Table 1: Minimum Clearances around Beamline equipment

Walk space around north & east sides of the cyclotron and RF Cabinet	80 cm/32 inches
Walk space @ squeeze point between ESS beam line & ESS shield wall (South corner)	60 cm/24 inches
From the East wall to the beam centerline (ESS Area)	280cm/110 inches
From the North wall to the beam centerline (BTS Area)	200 cm/79 inches
From floor to ceiling obstructions in the Cyclotron Area	380 cm/149.75 inches
From floor to ceiling obstructions in the ESS shield Area	223 cm/88 inches
From the floor to ceiling obstructions in the BTS Area	254cm/100 inches*
Nominal distance from treatment level floor to beam centreline	125 cm/49.2 inches
Maximum envelope around beam centerline	61 cm/24 inches
Maximum from floor to top of ESS and BTS magnets	163 cm/64 inches

* 24 inch (60 cm) monorail above beam line is acceptable.

S.A. ION BEAM APPLICATIONS

VALIDATED BY:	PV
CHECKED BY:	QBA
DRAFTMAN:	LCHEN
MODIFICATION:	Original issue
DATE:	30/04/15
REV:	A

MATERIAL: –
SCALE: 1/100(A3)
DIMENSIONS: mm
TOLERANCES: –

PROJECT: PROTON THERAPY
S/PROJECT: TATA HBTF MUMBAI

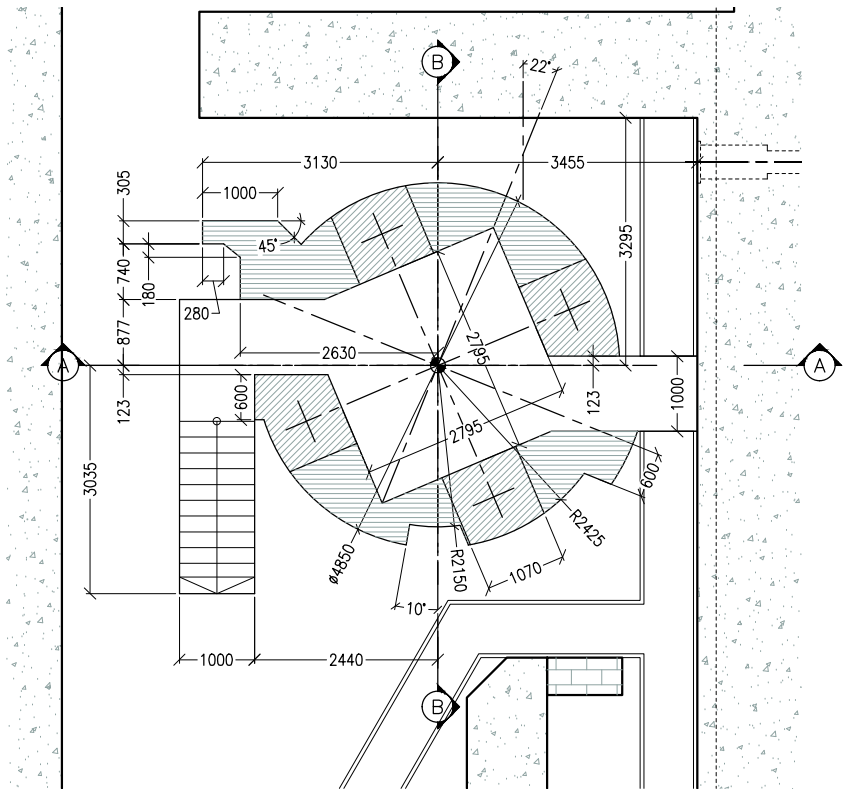
II.
ROOMS

Cyclotron / ESS / BTS Vaults

TITLE:
Cyclo Vault Layout

07.42.33.

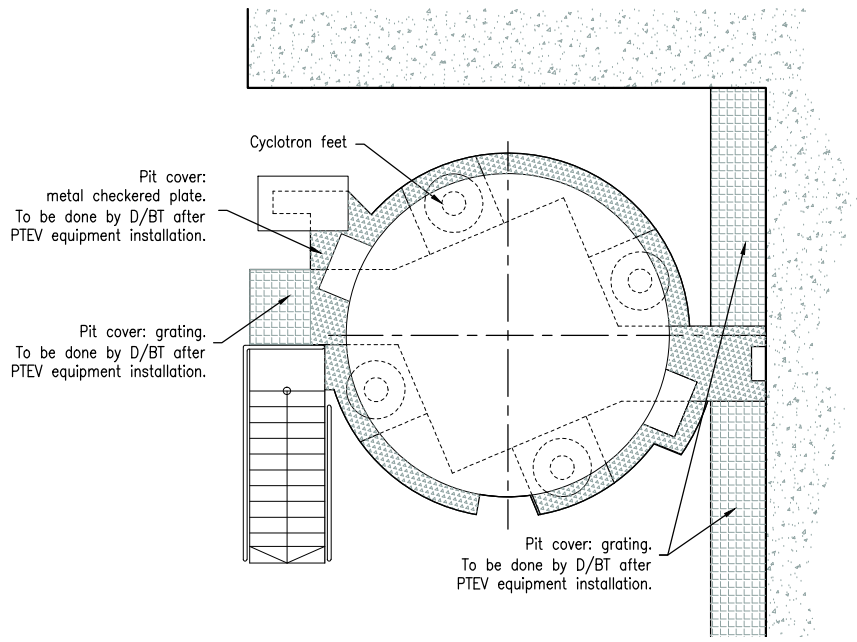
01.31-1 A 1/2



PIT DIMENSIONS

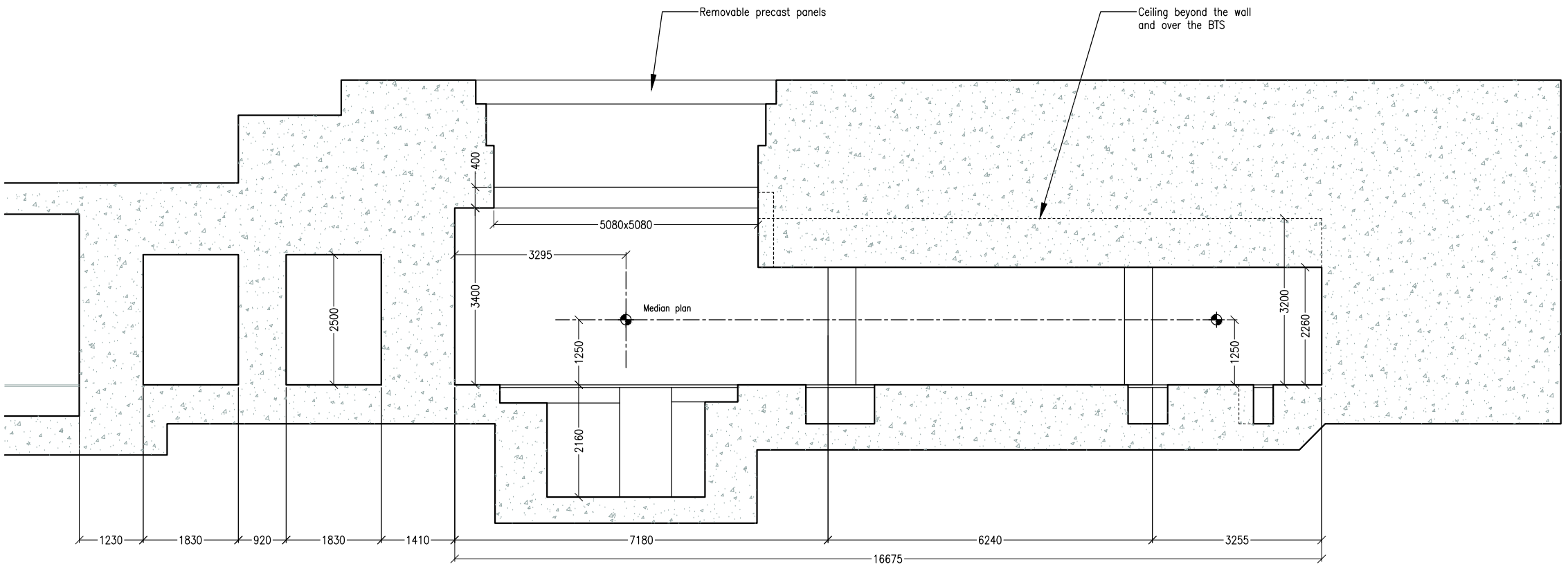
1600mm under Isocenter axis

1725mm under Isocenter axis



GRATINGS

1. The D/BT shall provide an industrial type epoxy floor finish and all walls, trenches and ceilings shall receive a high grade epoxy paint finish. The epoxy paint type shall be submitted to PTEV for approval prior purchase
2. DBT shall provide 230V (110V - 120V US) convenience wall outlets every 10m (30')
3. For cyclotron feet plates details see figure 01.51.



SECTION B-B

S.A. ION BEAM APPLICATIONS

REV:	DATE:	MODIFICATION:	DRAFTMAN:	CHECKED BY:	VALIDATED BY:
A	30/04/15	Original issue	LCHEN	QBA	PV

MATERIAL: –
SCALE: 1/100 (A3)
DIMENSIONS: mm
TOLERANCES: –

PROJECT: PROTON THERAPY

SPROJECT: TATA HBTF MUMBAI

II.
ROOMS

Cyclotron / ESS / BTS Vaults

TITLE:

Cyclotron Vault Layout:
Pit, gratings and section

07.42.33.

N

01.31-2 A 2/2

1. The concrete floor shall meet the following requirements throughout the beam line areas:

1.1 The Proton Beam Transport Line components are aligned with-in “microns” for precision accuracy on a continuous plane from the point of extraction from the Cyclotron to any individual and all iso-center treatment locations with-in the Facility. The Beam Magnet components are tuned to maintain the path of the beam through one component after another. To maintain this “Precision Accuracy” needed to treat patients on a continual basis, the maximum allowed floor “Differential Settlement” along the entire Beam Transport System shall not exceed ± 3 mm (⅛") during the first two years of operation (Differential settlement being intended as the relative deviation compared to the initial floor plane). The 3 mm (⅛") shall be in one direction only.

1.2 The floor load bearing capability in the beam line areas shall be at least 5500 kg/m² (1,100 lbs./ft²) considering 10% margin in order to withstand the weight of the equipment plus handling tool (pallet jack) during and after the installation.

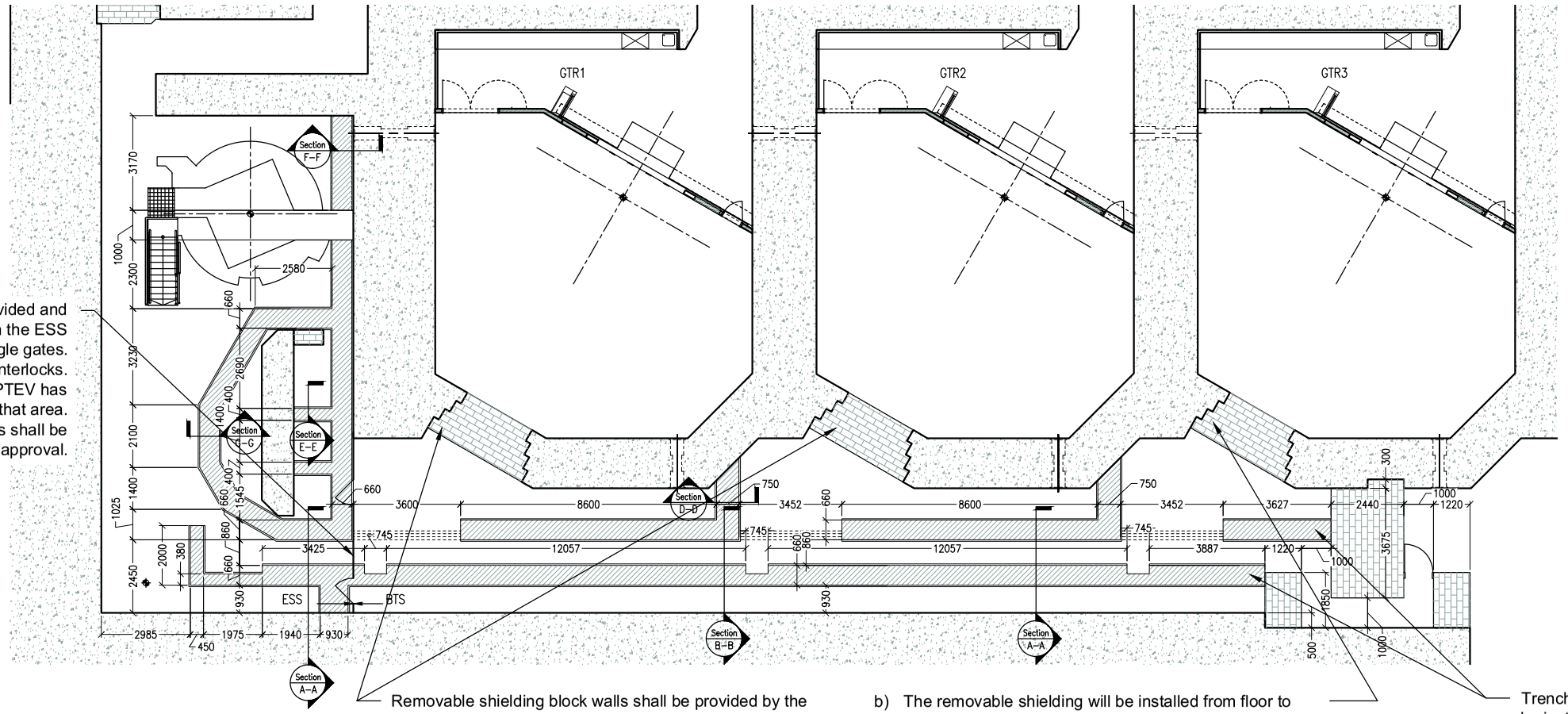
1.3 The floor shall be smooth and flat, without noticeable irregularities in any local region. No water puddles are acceptable.

1.4 The floor under all beam line stands shall be within ±10 mm (±1/2 ") of a level datum plane.

1.5 The floor shall be made in one layer of concrete only. There shall be an industrial type epoxy floor finish applied to the concrete slab and trenchees by the D/BT prior to the installation of the PTEV. All walls and ceilings shall receive a high grade epoxy paint finish. The epoxy paint type shall be submitted to PETV for approval prior purchasing.

1.6 D/BT will provide moisture detection system on the floor under the PTE, after the installation of the PTE. The type of moisture detection system shall be submitted to PTEV for approval prior purchasing.

2. D/BT shall supply 230V (110V - 120VUS) convenience wall outlets every 10m (30') all along the ESS/BTS vaults



A metal grid fence shall be provided and installed bythe D/BT between the ESS and the BTS, with two single gates. This fence will be fitted with interlocks. Installation shall occur after PTEV has completed its Installation in that area. The fabrication drawings shall be submitted to PTEV for approval.

TREATMENT LEVEL

Removable shielding block walls shall be provided by the D/BT, located in the BTS area, in front of the Gantries (and Research Area or FSTR beam entrance if any).
This shielding reduces the amount of radiation going through the beam pipe opening.
This shall consist of physically restrained solid concrete blocks that can be manually removed when access to PTEV equipment is required.

a) The removable shielding will be stacked solid concrete blocks set in a “weave” pattern to form a continuous labyrinth effect so that there shall be no direct or clear line of beam possible through this shielding wall.

b) The removable shielding will be installed from floor to ceiling filling in the entire Gantries entry beam opening in the total thickness as shown on the D/BT drawings.
Also the installation will meet the requirements of the D/BT shielding consultant

c) The removable shielding will not be erected until all of the Proton Therapy Equipment and all related components are completely installed, finally aligned and in their final permanent location and as directed by PTEV.
The removable shielding will be restrained by a light weight retaining system to avoid damage to the equipment in case of seismic activities.

Trenches on each side of the ESS/BTS beam line shall be installed to bring either water or electrical service to the beam line.

a) The water service shall be located in the trench separated from the trench carrying electrical cables to minimize danger in case of a water leak.

b) Taking the beam direction as a reference, the right trench will be dedicated for water service and the left one for electrical service.

S.A. ION BEAM APPLICATIONS

VALIDATED BY:	PV
CHECKED BY:	QBA
DRAFTMAN:	LCHEN
MODIFICATION:	Original issue
DATE:	30/04/15
REV:	A

MATERIAL: –
SCALE: 1/200 (A3)
DIMENSIONS: mm
TOLERANCES: –

PROJECT: PROTON THERAPY
S/PROJECT: TATA HBTF MUMBAI

II.
ROOMS

Cyclotron / ESS / BTS Vaults

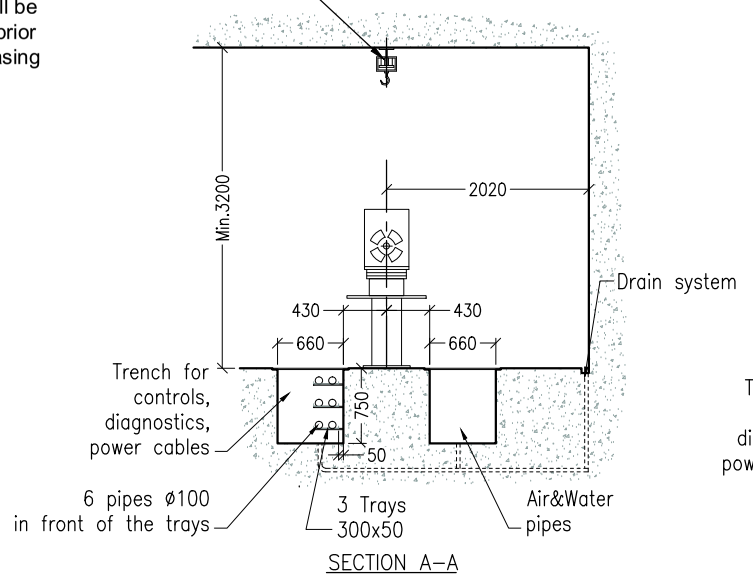
TITLE:
ESS & BTS Vaults

07.42.33.

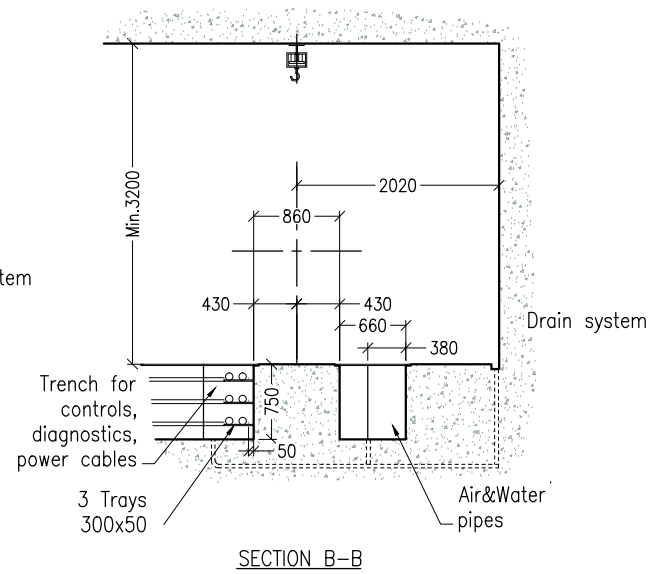
N

01.32-1 A 1/2

A 3175 kg (7000 lbs) capacity monorail and chain hoist shall be furnished and installed by the D/BT, prior to placing any equipment in the beam line, on the ceiling above the BTS beam line. The bottom of the hook will not be lower than 190 cm (±6'-4") above the floor level. The D/BT will provide a load test report for this equipment. Hoist with specifications and drawings shall be submitted to PTEV for approval prior purchasing

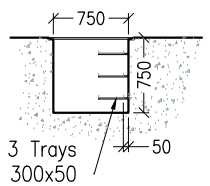


SECTION A–A



SECTION B–B

SECTION D–D



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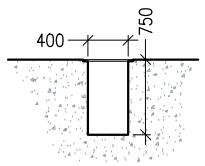

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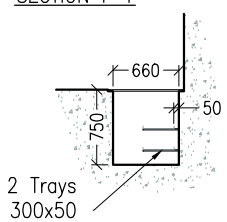

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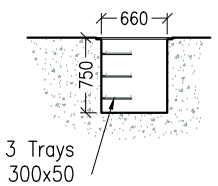


S.A. ION BEAM APPLICATIONS

REV:	DATE:	MODIFICATION:	DRAFTMAN:	CHECKED BY:	VALIDATED BY:
A	30/04/15	Original issue	LCHEN	QBA	PV

MATERIAL: –
SCALE: 1/75 (A3)
DIMENSIONS: mm
TOLERANCES: –

PROJECT: PROTON THERAPY

SPROJECT: TATA HBTF MUMBAI

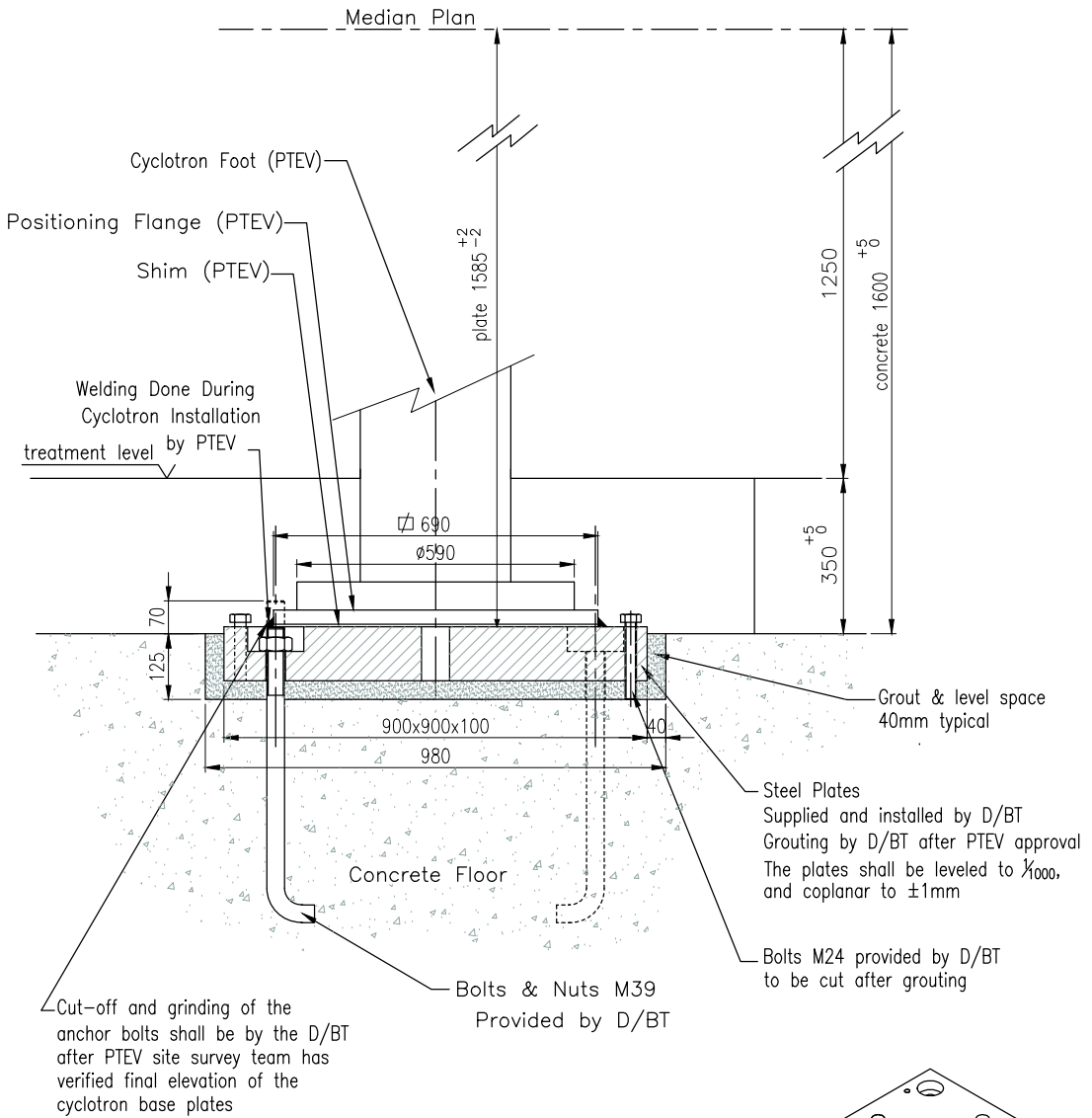
II.
ROOMS

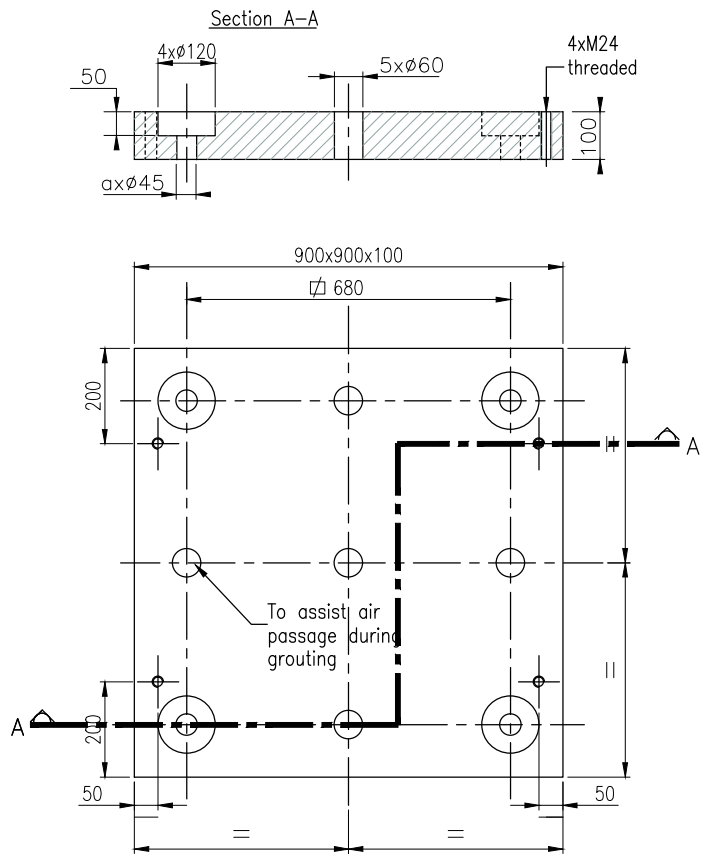
Cyclotron / ESS / BTS Vaults

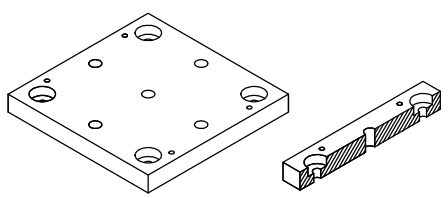
TITLE:
ESS & BTS Vaults: Sections

07.42.33.

01.32-2 A 2/2







1. Four steel plates are required to be attached to the floor in order to support the four cyclotron feet. These plates shall be supplied and installed by the D/BT during the construction, and attached by cast in place anchor bolts. During rigging and alignment, the total weight of the cyclotron may be supported for a short time on only two of the four feet. Therefore each plate must be able to carry half the cyclotron weight (i.e. 110 metric tons – 121 US tons).

2. In addition, in case of earthquake, these plates shall be subject to additional vertical and horizontal stresses. The transmission of forces from these plates to the building frame must therefore be carefully studied by the D/BT.

   Please note the permissible tolerances in vertical position of these plates with respect to the concrete floor slab as indicated here below.

3. The D/BT shall furnish level, align and grout the four plates . The coordinates of the center of these plates are defined in Fig. 01.11-1 (points A, B, C, D).
   The orientation of the plates with respect to the building is defined in Fig. 01.31-2.

4. Grouting shall be performed by D/BT after acceptance of plates' positions and levels by PTEV. D/BT will use high strength, non-shrink, non-metallic grout (5000 PSI or 35 MPa in 3 days).

S.A. ION BEAM APPLICATIONS

REV:	DATE:	MODIFICATION:	DRAFTMAN:	CHECKED BY:	VALIDATED BY:
A	30/04/15	Original issue	LCHEN	QBA	PV

MATERIAL: –
SCALE: –
DIMENSIONS: mm
TOLERANCES: –

PROJECT: PROTON THERAPY

SPROJECT: TATA HBTF MUMBAI

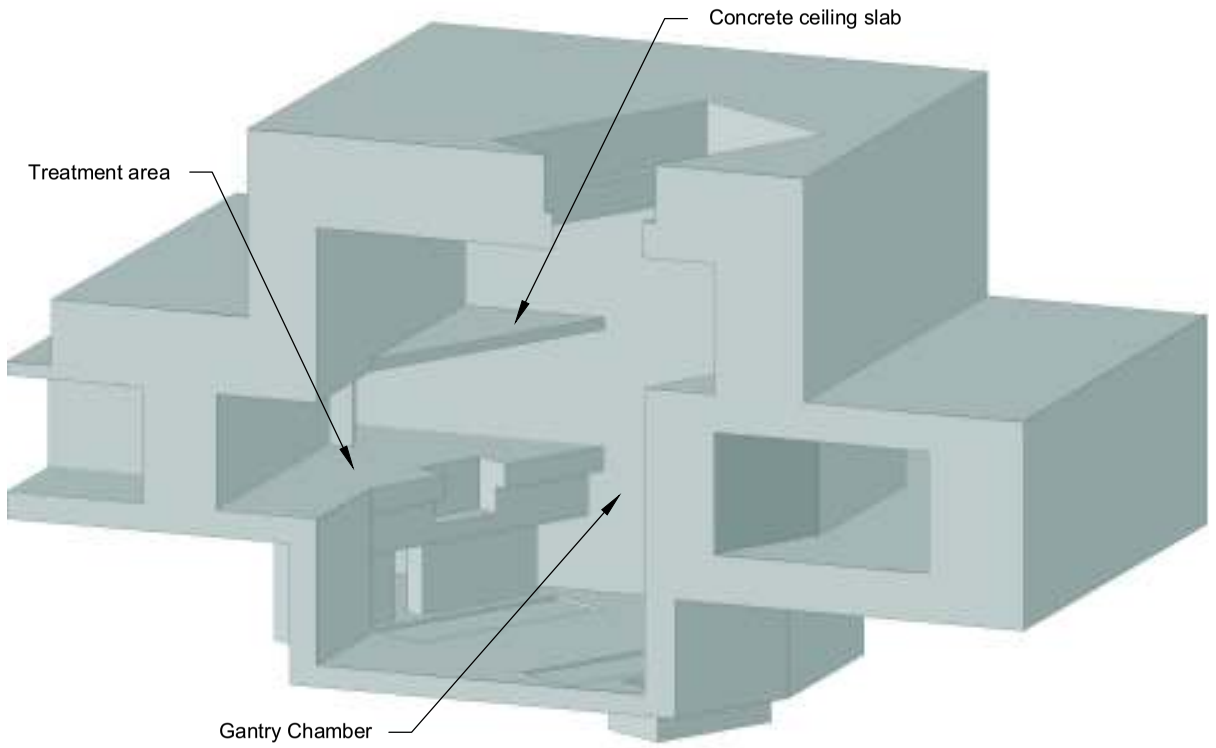
II.
ROOMS

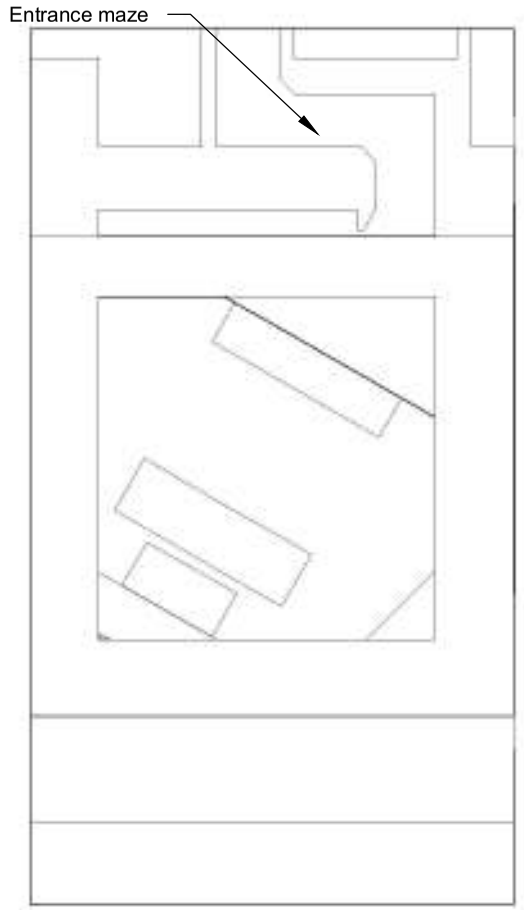
Cyclotron / ESS / BTS Vaults

TITLE:
Cyclotron feet plates

07.42.33.

01.51 A





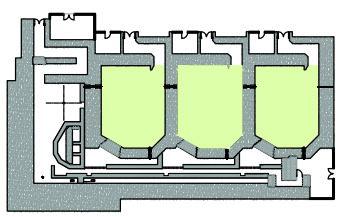
02. GANTRY TREATMENT ROOM

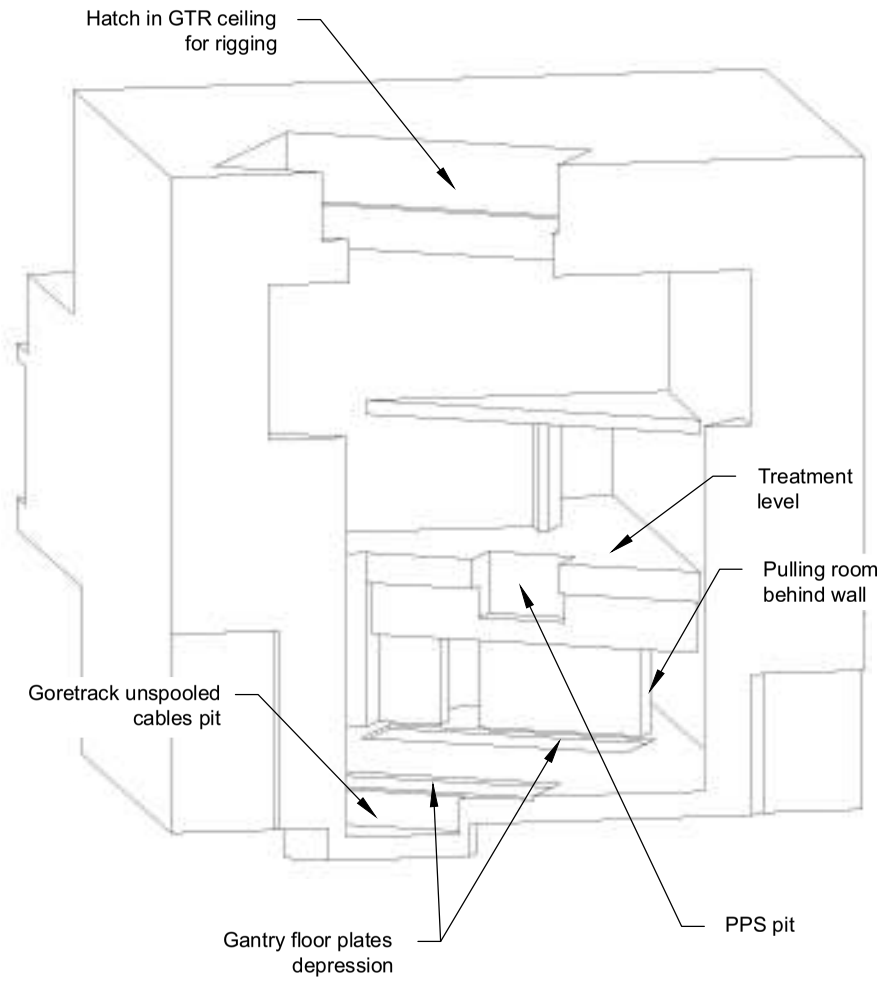
ACRONYMS

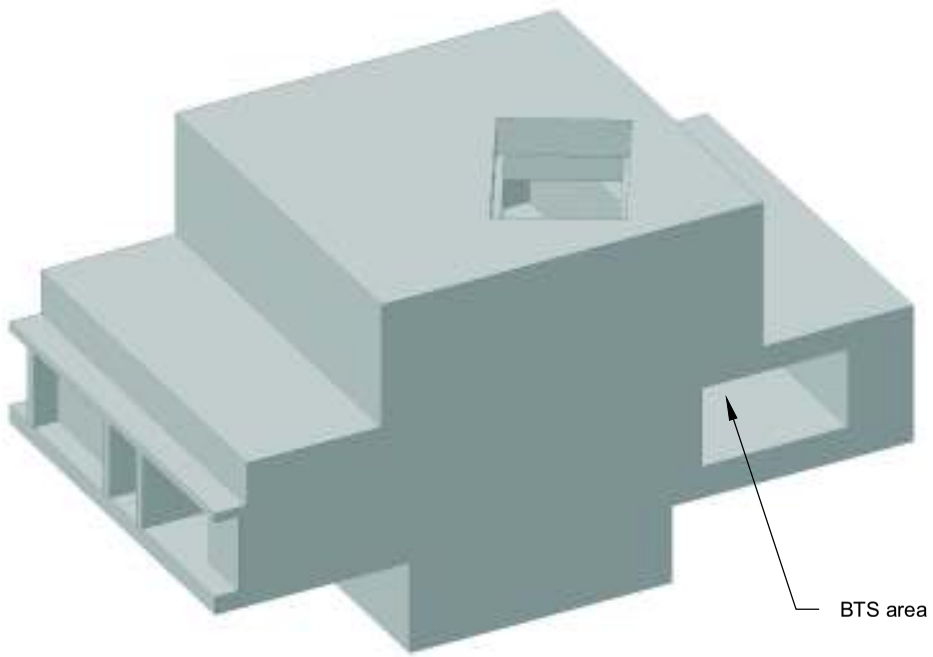
GTR:	Gantry Treatment Room
PTE:	Proton Therapy Equipment
PPS:	Patient Positioner System
TR:	Treatment Room
TCR:	Treatment Control Room
BTS:	Beam Transport System
D/BT:	Design & Building Team
PTEV:	Proton Therapy Equipment Vendor
CT:	Cable Tray
GRF:	Gantry Rolling Floor

TABLE OF CONTENTS:

Refer also for additional technical specifications to Chapter III: Installation, Chapter IV: Cooling & Gases, Chapter V: Electrical set, Chapter VI: Other Technics & Chapter VII: BOD Requirements.







S.A. ION BEAM APPLICATIONS

REV:	DATE:	MODIFICATION:	DRAFTMAN:	CHECKED BY:	VALIDATED BY:
A	30/04/15	Original issue	LCHEN	QBA	PV

MATERIAL: –
SCALE: –
DIMENSIONS: mm
TOLERANCES: –

PROJECT: PROTON THERAPY
S/PROJECT: TATA HBTF MUMBAI

II.
ROOMS

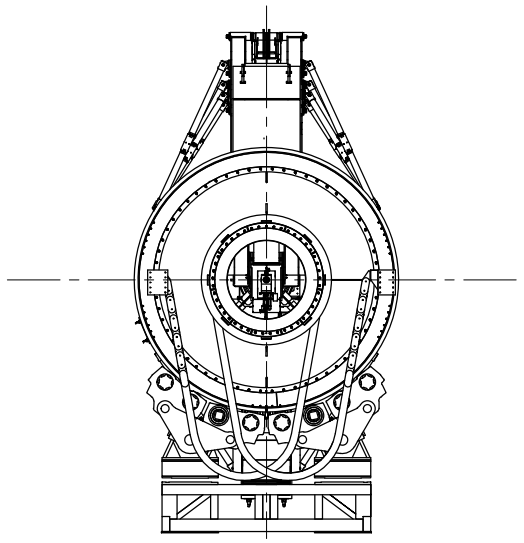
Gantry Treatment Room

TITLE:
General Gantry Treatment Room

07.42.33.

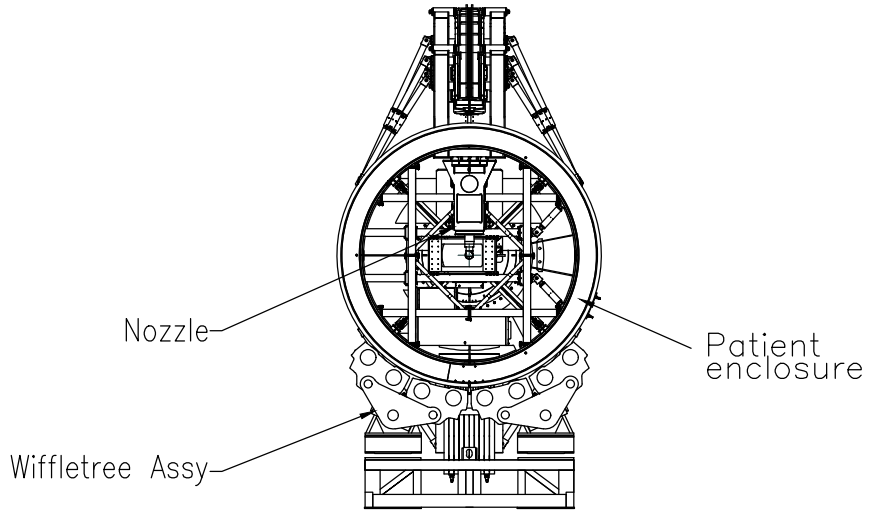
02.00 A

VIEW FOLLOWING A

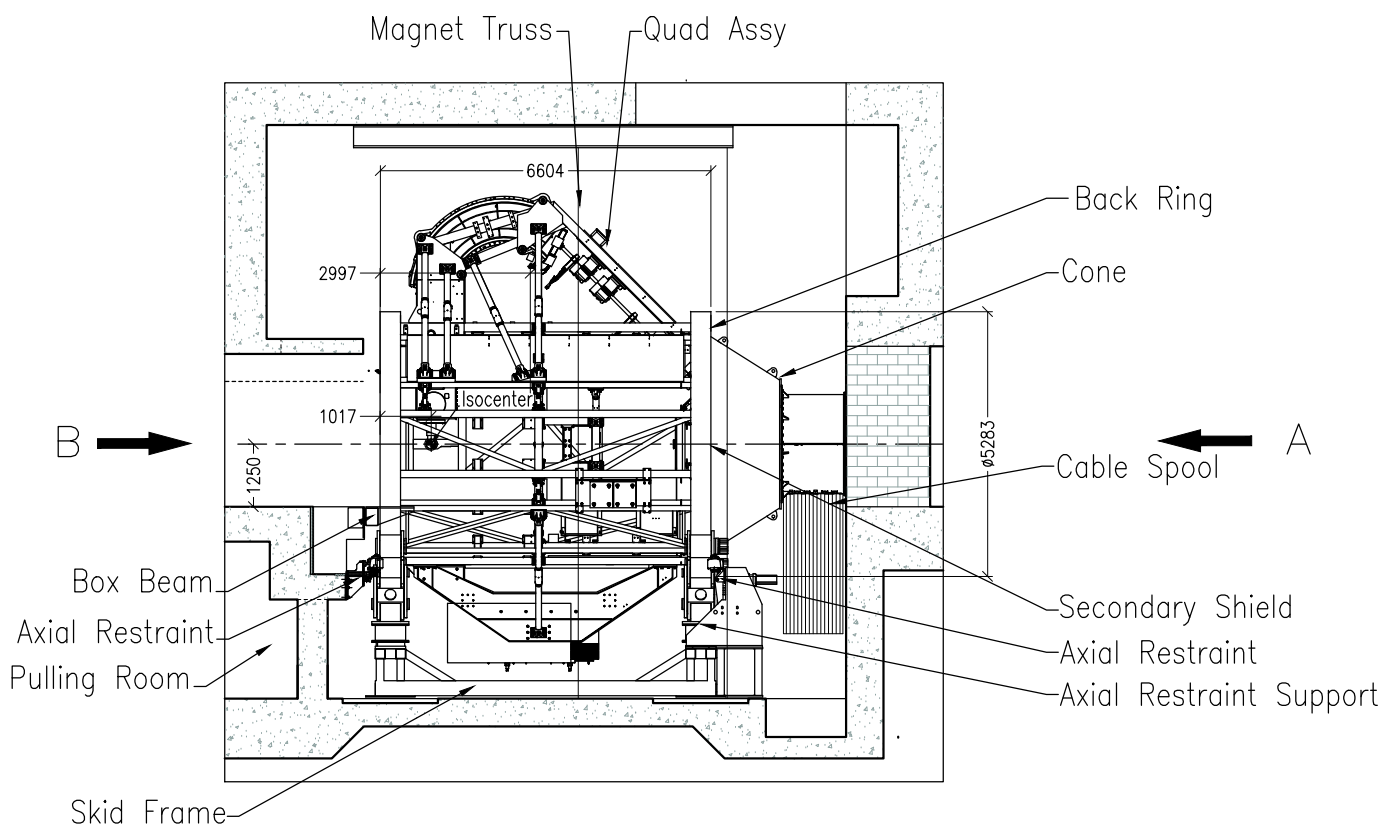


CABLE SPOOL END OF GANTRY

VIEW FOLLOWING B



NOZZLE END OF GANTRY



GANTRY & PATIENT POSITIONER SIDE VIEW

1. The function of the rotating Gantry is to allow the proton beam and the nozzle to be rotated over 360° around the patient positioner couch. The point of intersection between the beam from the nozzle and the Gantry axis of rotation is referred as the isocenter.
2. The Gantry has precision bearing rings, same diameter front and rear that ride on support rollers. A whiffletree arrangement equalizes loads on the support rollers. The support roller assemblies are pre-aligned on a permanent skid resting on the floor.
3. Cable spool system connects wires and hoses to the rotating structure. Looking from the cable spool end, when the gantry is at the counter clockwise rotation limit, the cable coming from the left hand side (West side) are completely wound onto the spool while the cable and hoses coming from the right side (East side) are completely unwound. When the Gantry is at the clockwise rotation limit the opposite happens. The total rotation range, including over travel allowance, is 380°.

TABLE 1: Gantry Structure Main Components & Nozzle by room

ITEM	QTY	WEIGHT (kg / lbs)	HEIGHT (cm / in.)	WIDTH (cm / in.)	DEPTH (cm / in.)	INSTALL ROUTE	REPLACE ROUTE
Front Ring	1	9979 / 22000	528 / 208 dia		51 / 20	R2	R2
Back Ring	1	10070 / 22200	528 / 208dia		51 / 20	R2	R2
Cone	1	2041 / 4500	483 / 190dia		152 / 60	R2	R2
Skid Frame	1	7484 / 16500	152 / 60	432 / 170	724 / 285	R2	R2
Space Frame Module [1]	4	3629 / 8000	292 / 115	597 / 235	597 / 235	R2	R2
Magnet Truss	1	5670 / 12500	165 / 65	254 / 100	597 / 235	R2	R2
Counterweight truss	1	3493 / 7700	165 / 65	254 / 100	597 / 235	R2	R2
Gantry Quad Assy	1	1721,5 / 6000	165 / 65	305 /120	635 / 250	R2	R2
Whiffletree Assy	2	6804 / 15000	91 / 36	254 / 100	508 / 200	R2	R2
Counterweight [2]	1	19504,5 / 43000	127 / 50	102 / 40	254 / 100	R2	R2
135° Dipole	1	9979 / 22000	58 / 23	165 / 65	330 / 130	R2	R2
45° Dipole	1	4536 / 10000	89 / 35	63,5 / 25	152 / 60	R2	R2
Axial Restraint Support	1	1361 / 3000	168 / 66	41 / 16	178 / 70	R2	R2
Cable Spool	1	907 / 2000	269 / 106 dia		129,5 / 51	R2	R2
Primary Shield	1	4536 / 10000	170 / 67dia		69 / 27	R2	R2
Secondary Shield	1	1721,5 / 6000	109 / 43 dia		81 / 32	R2	R2

About the routes refer also to Fig. 50.01 (Routes Definition)

S.A. ION BEAM APPLICATIONS

REV:	DATE:	MODIFICATION:	DRAFTMAN:	CHECKED BY:	VALIDATED BY:
A	30/04/15	Original issue	LCHEN	QBA	PV

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

PROJECT: PROTON THERAPY
SPROJECT: TATA HBTF MUMBAI

II.
ROOMS

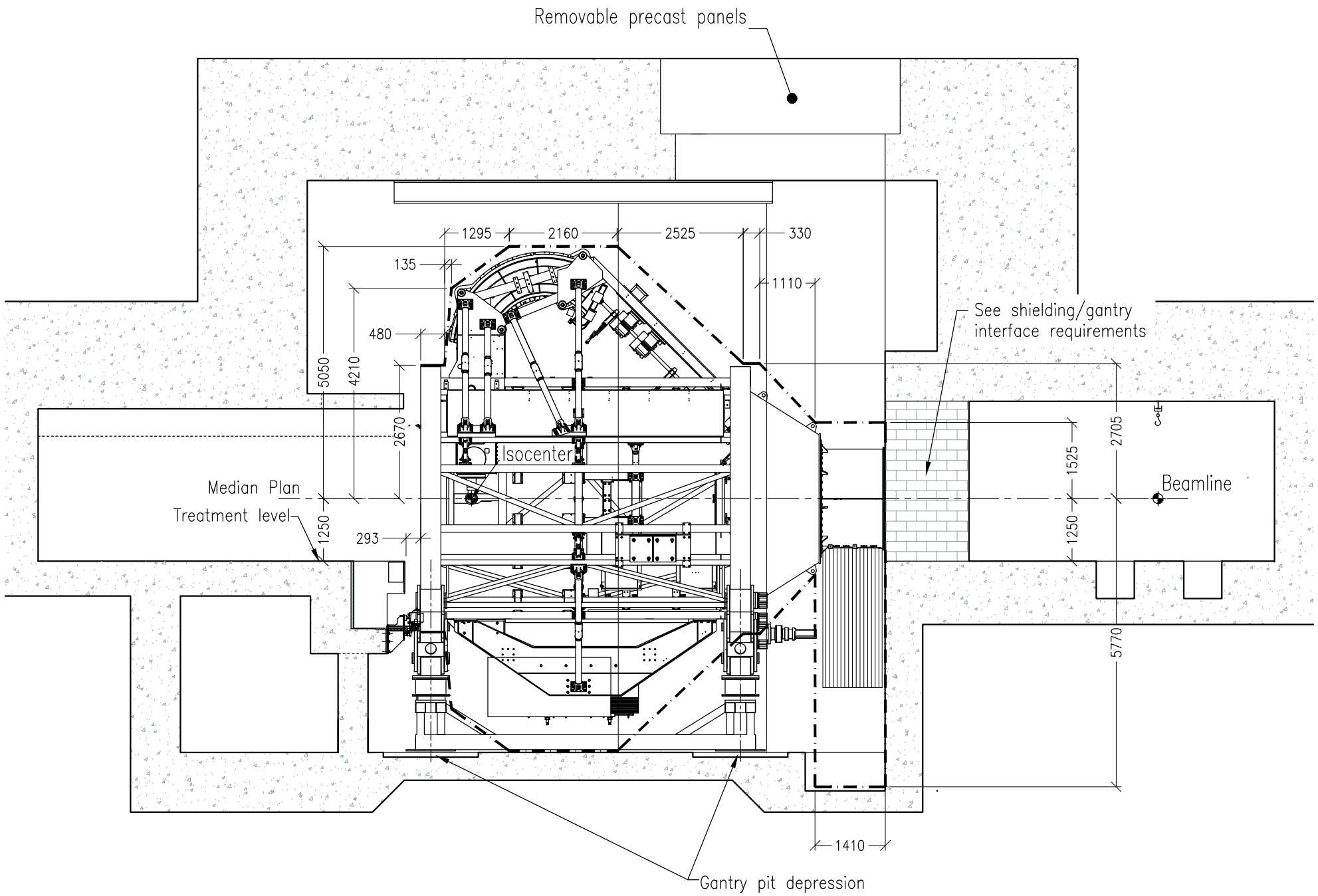
Gantry Treatment Room

TITLE:
Gantry Side, Front & Rear Views

07.42.33.

02.11 A

1. Minimum building clearance for rotating mechanism of the gantry structure. Additional clearance at some rotation angles required for assembly.



S.A. ION BEAM APPLICATIONS

REV:	DATE:	MODIFICATION:	DRAFTMAN:	CHECKED BY:	VALIDATED BY:
A	30/04/15	Original issue	LCHEN	QBA	PV

MATERIAL: –
SCALE: 1/100 (A3)
DIMENSIONS: mm
TOLERANCES: –

PROJECT: PROTON THERAPY

SPROJECT: TATA HBTF MUMBAI

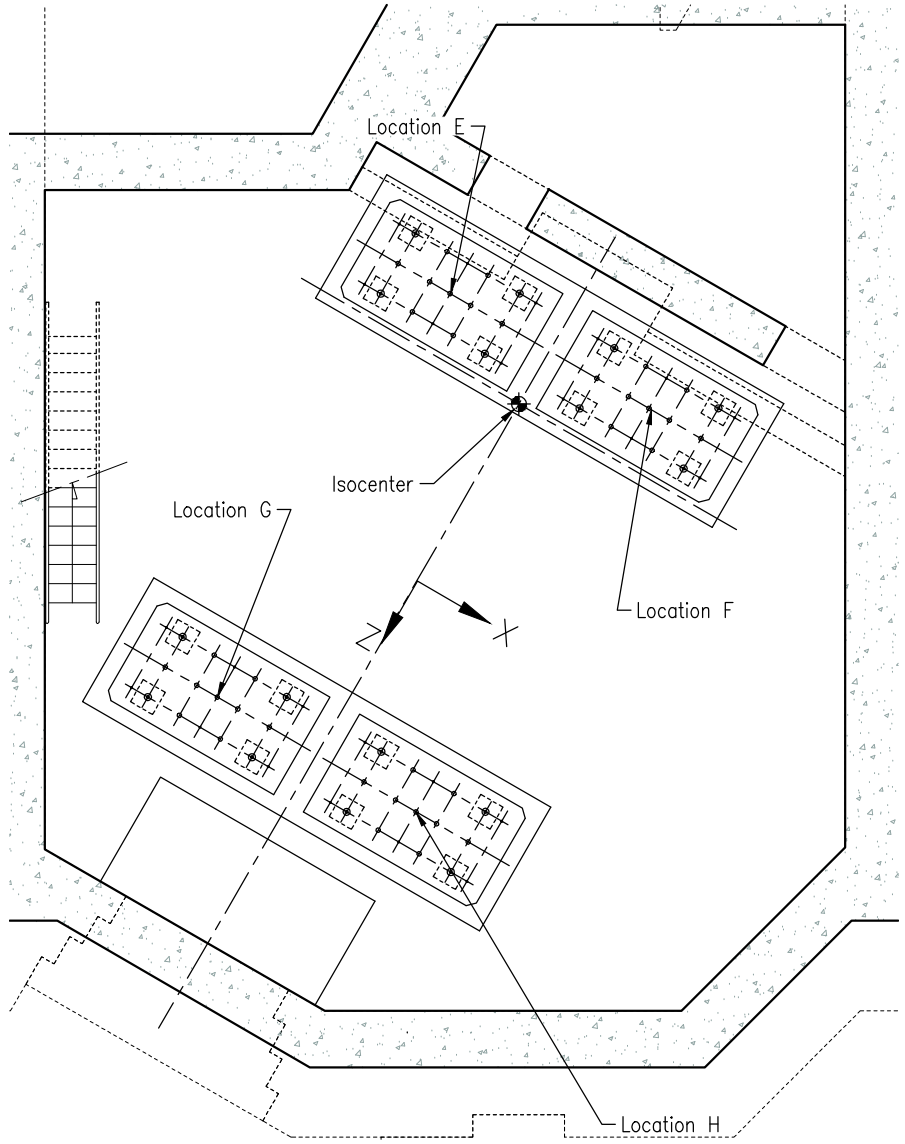
II.
ROOMS

Gantry Treatment Room

TITLE:
Gantry Clearances

07.42.33.

02.12 A



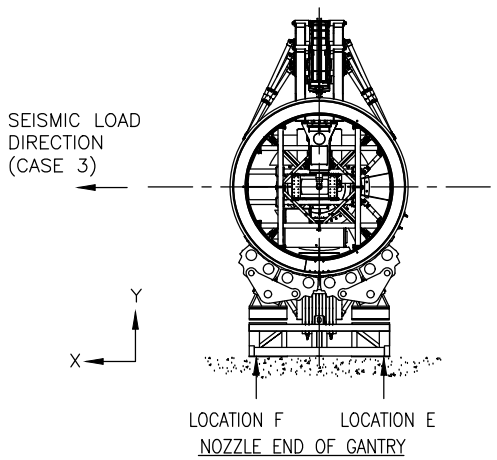
BASEMENT

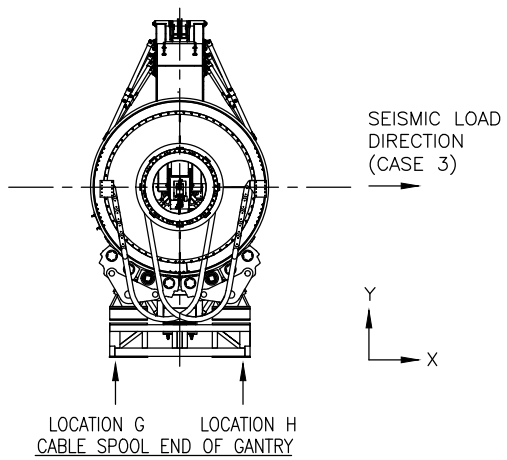
1. The calculated loads on the building during installation, normal operation and in a seismic event (with 0.4g acceleration in all directions) are given in Table 1: Gantry Loads. To help to understand the loads in this table, the drawings illustrates the temporary loads exhibited when the Gantry is assembled and rolled to its final position. The load locations in the Gantry final position are shown as well. This figure also provides the direction of the seismic acceleration for each of the three cases contained in Table 1: Gantry Loads.

2. Case 1 and 2 deal with lateral seismic accelerations along the gantry axis in opposing directions. case 3 involves a lateral acceleration perpendicular to the rotation axis. Note that in these case, the loads provided are the sum of the dead load and the seismic load. While the table provides the loads as point loads, in reality these loads will be spread out over some area by the gantry support structure in its final position and by rollers while being moved. Furthermore, it is planed to place steel plates on the concrete floor during the rigging to distribute the loads on each roller over a larger area.

3. Seismic event shall be analysed by D/BT in regard of local regulations and local conditions (i.e.: ground investigations,...). PTEV Seismic calculation may need to be revised based on local seismic regulations and conditions to be provided by D/BT

FACILITY LOAD LOCATIONS FOR
GANTRY FINAL OPERATING POSITION





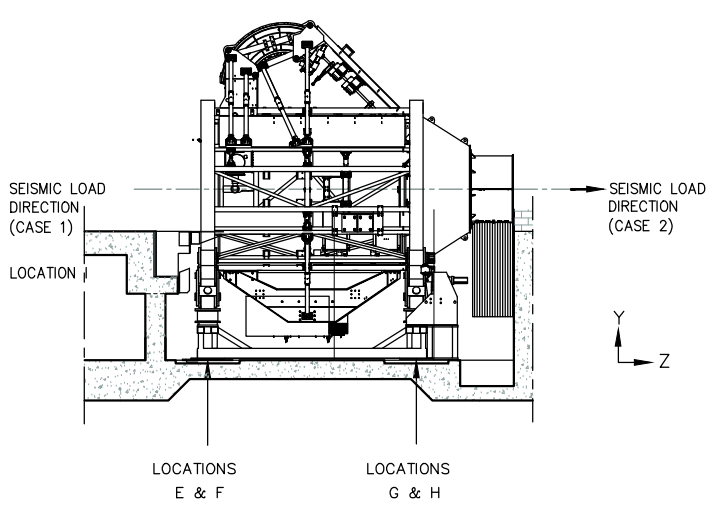


TABLE 1: Gantry Loads

				Seismic (case 1)			Seismic (case 2)			Seismic (case 3)		
Loads	Static Load			+ Static Load			+ Static Load			+ Static Load		
Location	Kips/metric tons			Kips/metric tons			Kips/metric tons			Kips/metric tons		
	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
Initial Installation												
A	0	-50/-22.67	0									
B	0	-50/-22.67	0									
C	0	-50/-22.67	0									
D	0	-50/-22.67	0									
Final Position												
E	0	-57/-25.85	0	0	-74/-33.56	-5/-2.7	0	-24/-10.88	30/13.60	23/10.43	-9/-4.08	0
F	0	-57/-25.85	0	0	-74/-33.56	-5/-2.7	0	-24/-10.88	30/13.60	23/10.43	-105/-47.62	0
G	0	-57/-25.85	0	0	-73/-33.11	-5/-2.7	0	-123/-55.79	30/13.60	36/16.32	-9/-4.08	0
H	0	-57/-25.85	0	0	-73/-33.11	-5/-2.7	0	-123/-55.79	30/13.60	36/16.32	-171/77.56	0
I	0	0	4/-1.81	0	0	-79/-35.83	0	0	-4/-1.81	0	0	-4/-1.81

S.A. ION BEAM APPLICATIONS

REV:	DATE:	MODIFICATION:	DRAFTMAN:	CHECKED BY:	VALIDATED BY:
A	30/04/15	Original issue	LCHEN	QBA	PV

MATERIAL: –
SCALE: 1/100 (A3)
DIMENSIONS: mm
TOLERANCES: –

PROJECT: PROTON THERAPY
S/PROJECT: TATA HBTF MUMBAI

II.
ROOMS

Gantry Treatment Room

TITLE:
Gantry Loads

07.42.33.

N

02.13 A