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TPS STORAGE AND BOOSTER RING CABLE TRAY INSTALLATION STATUS AND CIA DESIGN ARRANGEMENT *

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Abstract

The TPS infrastructure and the whole subsystems for the accelerator are now approach to finish. The cable trays for booster and storage ring in tunnel are almost finished. The 3 layers cable trays for booster ring are for dipole, quadrupole power supply cable and IC/VA signal cable respectively. The designed for limited space for cooling water below the cable tray and the magnet girder above. The storage ring cable tray also designed for different subsystems, and separate the power and signal layer. The power racks for all subsystem are located in control and instrument area (CIA). The magnet and ID power supply are placed in the 1st floor and the IC, VA, MP and FE control racks are placed in the 2nd floor. The separation between the power and signal cable tray are noticed for the whole path inside tunnel and CIA. Now the subsystem is under installation, although it is hard to cabling but it would not be the problem.

INTRODUCTION

Based on the existing land available, the circumference of the TPS storage ring is 518 m. The lattice of the TPS storage ring has a double-bend achromat (DBA) structure to minimize the emittance of the electron beam; it is composed of 24 cells with six long-straight sections of 12 m in length and 18 standard-straight sections of 7m in length that can accommodate several insertion devices to enhance the brightness of the photon beam. The subsystems of the TPS rely the most advanced and reliable techniques, such as superconducting devices, topping-up injection, ultra-high vacuum, advanced beam monitoring and control, precision mechanical system, small-ripple power supplies, a low-noise electrical grounding system, etc [1].

CONTROL AND INTRUSMENT AREA

The control and instrument area (CIA) is located in the inner circle adjacent to TPS tunnel. Because of limited space, the power and control racks are located in different floor. The DC power supplies (PS) of magnets and ID controller are placed on the 1st floor, and the control racks such as front end (FE), vacuum (VA), machine positioning (MP) and instrument control (IC) are placed on the 2nd floor.

Fig.1 showed the arrangement of the CIA. Every CIA delivers independent power supply to the subsystem [2]. Different subsystem has exclusive electrical switchboard in order to reduce the interference between each other. In the 2nd floor, the power supply cable trays are designed from above the racks and the signal cables go out from below. However, the power supply cables are inlet from the above of the power supply racks and outgo to the trenches below the racks in the 1st floor.

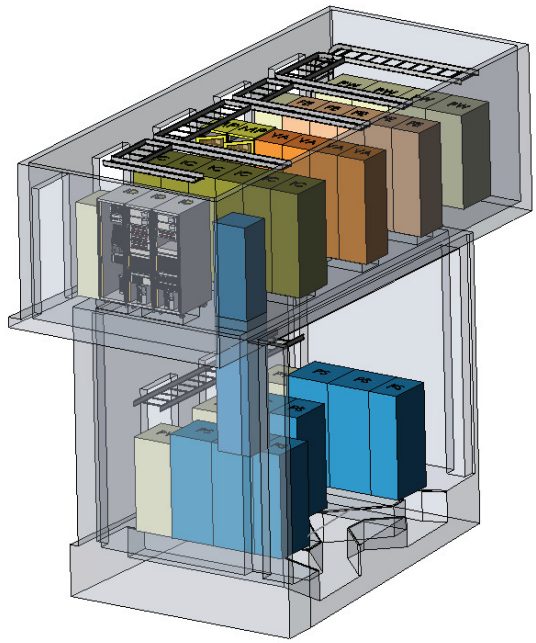

Figure 1: Layout of CIAs.

CIA CABLE TRAY DESIGN

Figure 2 showed the cable trays designed in CIA. The power cable trays shown in gray color which are on the top of the floor. The different subsystems own the exclusive cable tray. The purple, blue, green and yellow ones are VA, MP, IC and FE specialized cable trays respectively. The red cable trays designed for booster used. Different subsystems have different path from power rack to element in tunnel.

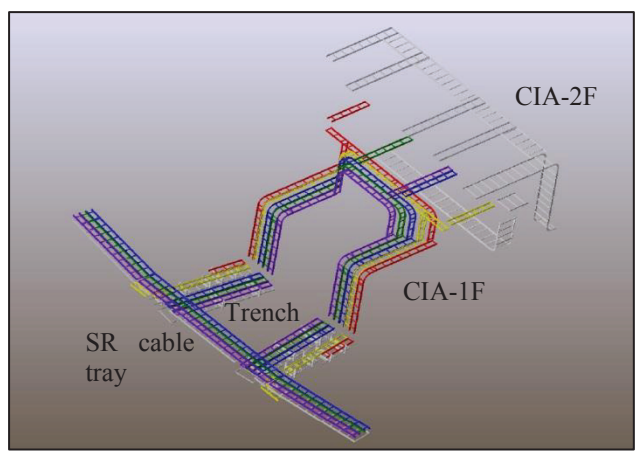

Figure 2: Design for cable tray in CIA.

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SR AND BR CABLE TRAY DESIGN

The cross section view of storage ring (SR) cable trays are shown in Fig. 3. There are two layers of the cable tray. The upper layer is made for control purpose, which is divided into three parts. The VA, IC and MP individually have the own cable tray, which is 200 mm in width and 60 mm in height with cover on it. The lower layer is made for power use, which are 650 mm in width and 60 mm in height. Because of the cables for dipole and quadrupole magnet are very thick and heavy (35 mm in diameter), the lower layer of cable tray need to be more flexible. The finish height for the 2 layers cable tray is 300 mm in order to easy to step on.

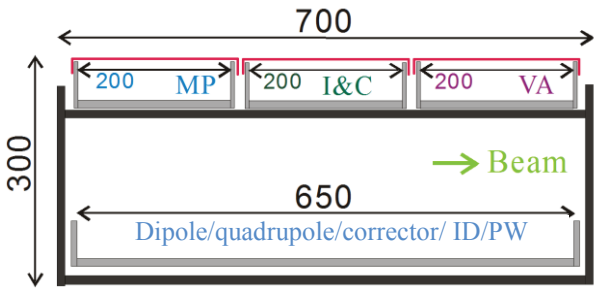

Figure 3: Storage ring cable tray design.

The booster ring (BR) cable tray was shown in Fig. 4. There are three layers of the cable trays, which are fixed on the booster shielding wall. The upper two layers of cable tray are made for booster dipole, quadrupole and sextupole magnet cables. The 3rd layer cable tray is made for control purpose, whish VA, IC and safety share the lower layer of the cable tray. The bottom of the cable tray is 200 mm from the ground level in order to reserve the cooling pipe space for the booster magnets. The gap between the cable tray and the booster wall is 60 mm in order to keep space for cabling and piping. The finish height of cable tray need be less than 560 mm, because of the lowest level of booster girder is fixed in 580 mm height.

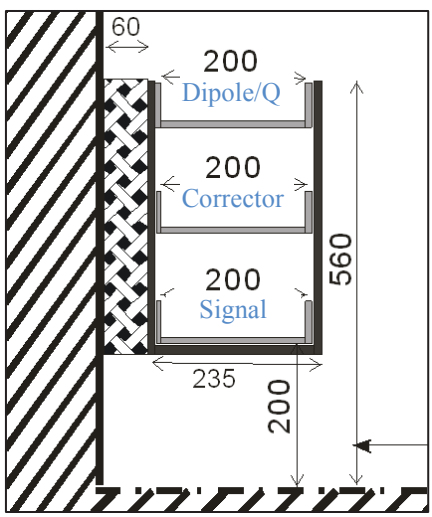

Figure 4: Booster ring cable tray design.

ONE COMPLETE CELL FROM TUNNEL TO CIA

There are 24 cells in TPS, one complete cell is shown in Fig. 5. There are 3 girders and 2 dipoles in one cell. The two layers SR cable tray is next to the girder. The cables are connected to CIA by two cable trenches, which are also divided into power and signal cable trays. The booster cable tray is fixed on the wall and also connected to cable trench. In the 1st floor of CIA, the power cables are put on the trench and connected to the power racks. The cables in the 2nd floor are climbing up to the roof of 1F CIA and cabling in the exclusive cable tray. The cables are connected just below the rack of the subsystem. The deionized filter systems are in the both side of the 1F CIA.

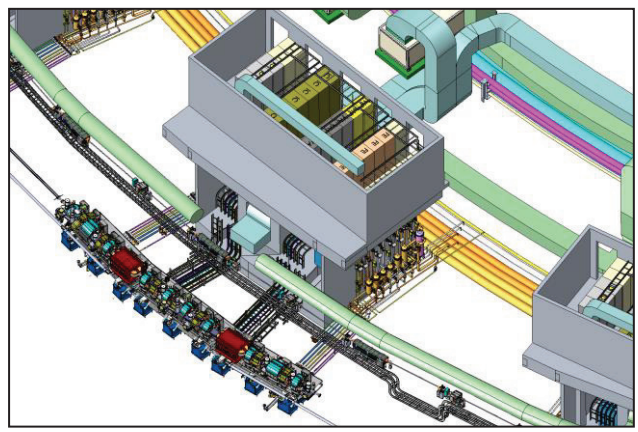

Figure 5: TPS one cell (CIA & SR/BR).

INSTALLATION STATUS

The TPS installation now is almost completed. The status of storage ring is shown in Fig. 6. The two layers SR cable trays are next to SR girder. There are adapter in the inner side, thus a switchboard is located in the upstream of the cable tray. The cables include power and signal are pull in the inner side of girder in order to remain aisle clearance. Although the cabling, especially the power cables, is complex and difficult, the cables are still line in order. Different cables will not cross to each other. The SR cable trays are strong enough to support people, which already passed the test. The cover on the upper layer of cable tray could remove during cabling.

Figure 6: TPS SR installation status.

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The status of booster ring is shown in Fig. 7. The three layers BR cable trays are fixed on the booster wall. The booster dipole, quadrupole and sextupole magnet cables are put on the upper two layers. The cooling water pipe was located below booster cable tray. The cooling pipe and cables are cross the 60 mm gap between BR cable tray and booster wall. Because TPS is concentric booster, every component in the booster should design in limited width for enough space in footpath.

Figure 7: TPS BR installation status.

The cable tray design in the maze door is shown in Fig. 8. The only way for staff transport elements into TPS tunnel is cross the maze door. The three layers of booster cable trays need to bend underground and rise to the booster wall again. The manufacture is not easy because of symmetric shape and limited space.

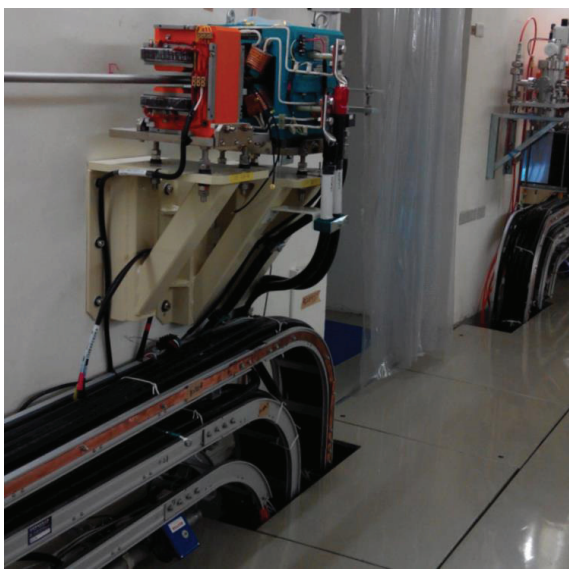

Figure 8: BR cable tray in maze section.

The installation of SR/BR cable tray is finished, the final part of cable tray is LINAC to booster (LTB) and booster to storage ring (BTS) section. Although the lengths of these sections are only about 10 m, the design still need to satisfied subsystems requirement. According to the quantity and size of PS cables, one layer 200 mm in width times 100 mm in height cable tray is sufficient to both LTB and BTS section. The signal cable tray design in the lower layer is similar to booster cable tray. The cooling DI water piping is below the cable tray shown in Fig. 9. The total height of two layer cable tray is 560 mm and the gap between cable tray and side face of girder is 150 mm.

Figure 9: TPS LTB cable tray.

CONCLUSIONS

The TPS infrastructure and the whole subsystems for the accelerator are now approach to finish. The cable trays for booster and storage ring in tunnel are finished. The 3 layers cable trays for booster ring are for dipole, quadrupole power supply cable and IC/VA signal cable respectively. The designed for limited space for cooling water below the cable tray and the magnet girder above. The storage ring cable tray also designed for different subsystems, and separate the power and signal layer. The power racks for all subsystem are located in CIA. The magnet and ID power supply are placed in the 1st floor and the IC, VA, MP and FE control racks are placed in the 2nd floor. The separation between the power and signal cable tray are noticed for the whole path inside tunnel and CIA. Now the subsystem is under installation, although it is difficult to cabling but the whole subsystem would be systematic.

ACKNOWLEDGMENT

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[2] J.C. Chang et al., “Status of the Utility System Construction for the 3 GeV TPS Storage Ring”, 4th International Particle Accelerator Conference (IPAC 2013), Shanghai, China.