STATUS OF THE UTILITY SYSTEM CONSTRUCTION FOR THE 3 GEV TPS STORAGE RING

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Abstract

The construction of the utility system for the 3.0 GeV Taiwan Photon Source (TPS) was started in the end of 2009. The utility building for the TPS ring has been completed in the end of 2012. Main utility equipment has been installed inside. The whole construction of the utility system is scheduled to be completed in 2013. Total budget of this construction is about four million dollars. This utility system presented in this paper includes the electrical power, cooling water, air conditioning, compressed air, and fire control systems.

INTRODUCTION

Taiwan Light Source (TLS), the first third-generation synchrotron radiation facility in Asia, has been operated for 20 years since the first beam stored in the storage ring. However, TLS has gradually lost its advantage of competition due to its limitation of straight sections and available space for new IDs. To meet increasing demand for more state-of-the-art researches, the TPS project was proposed and designed to achieve targets of low emittance, high brightness, stability and reliability. The utility system of the TPS had been designed [1] and kept constructing [2].

Considering the future efficient operation of both existing TLS and the TPS, the TPS is constructed adjacent to TLS. Some areas of TPS and TLS are even overlapped. The existing Administration (AD) building is isolated in the core area of TPS ring.

The TPS civil construction includes three buildings, i.e., the storage ring building (T building), the Academic Activity Center (D building) and the waste water treatment building (C building). Utility Building III is constructed on the basement of the D building, where most main utility equipments are located.

Main utility equipment of the TLS was installed in two existing utility buildings i.e., Utility Buildings I and II. Utility building III, especially for the TPS, is located near the existing two utility buildings.

There is as Administration and Operation Center connected with the T building and facing the D building, as shown in Figure 1.

There are two utility trenches from the Utility Building I and the Utility Building II respectively connecting to the TLS ring for the piping system and electrical power transmission. Likewise, there is a trench connecting the Utility Building III and T building.

Figure 1: TPS, TLS and three Utility Buildings.

CONSTRUCTION STATUS

All the construction processes of utility system are under strict review and check procedures. All the shop drawings are implemented by 3 D drawings to check all display of all equipment, piping, wind ducts, and cable trays in detail.

Figure 2 shows the external appearance of the TPS ring building. There is a bridge over the T building from the AD Building to outside, as shown in the figure. The water and electrical power transmitted to the AD Building are through two sides of the bridge.

The civil construction of the D and T buildings had been completed in Dec. 2012 and April 2013, respectively.

Figure 2: External appearance of the T building.

The Utility Building III is constructed on the basement of D building. The whole structure of the Utility Building III has been completed. In the first phase, only three chillers are installed inside. The whole utility system in the Utility Building III is scheduled completed on June 2013. There will be eventually six chillers, each with 1400 RT installed in the main machine room. Heaters, three air compressor, two heat pumps and pumps for DIW, cooling water and chilled water will be also installed in the main machine room. There is a corner area for four DIW systems. Figure 3 shows the 3D schematic draw the main machine room.

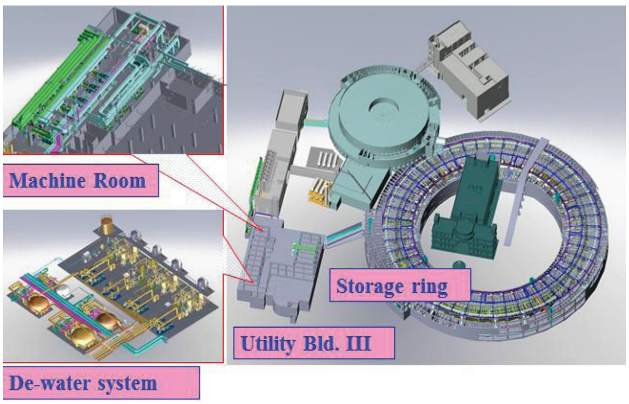

Figure 3: 3D schematic draw of the main machine room.

Figure 4 shows the internal appearance of the T building. The T building may be generally divided into three parts, i.e., utility area (in the core area), the storage ring tunnel and the experimental hall. The utility area is further divided into two zones. Both widths of the inner zone and the outer zone are about 4~5m. Two zones are separated by a corridor with 2.3m in width. There are 24 control instrumentation areas (CIA) symmetrically distributed along the inner zone of the utility area. Each CIA serves for one sections of the storage ring. There are 13, 12 and 12 AHUs serve for the CIA, the storage tunnel and the experimental hall, respectively. There are more 12 outer air AHUs providing outside fresh air for the whole TPS ring. Two local de-ionized water (DIW) systems are located on both sides of CIA to supply DIW into the tunnel through trenches

The shielding walls and ceilings and 24 CIAs have been constructed. One CIA is shown in the right side of Figure 4.

Currently, the installation of wind ducts in the truss and wiring and piping works are in process.

Figure 4: Internal appearance of the T building.

DIW AND AIR CONDITIONING SYSTEMS

In both TLS and TPS, the water system includes DIW, chilled water, cooling tower water and hot water. All water subsystems except cooling tower water are operated in close loops. The DIW system may be further divided into four subsystems, i.e., Cu system for magnets and power devices, Al system for vacuum chambers, RF system for the RF facility, and booster system for booster devices and beam line optical instruments. For better temperature control effect (within ±0.1 ^{o}C), we install buffer tank on each DIW subsystem.

Water treatment is another important issue in the cooling water system. The recycle system, RO system and deoxygenating system are main schemes to control DIW quality. The water resistance will be kept larger than 10 MΩ. The pH value, and the concentrations of oxygen will be controlled within 7 ± 0.5 and 10ppb, respectively, Figure 5 shows the process of DIW treatment.

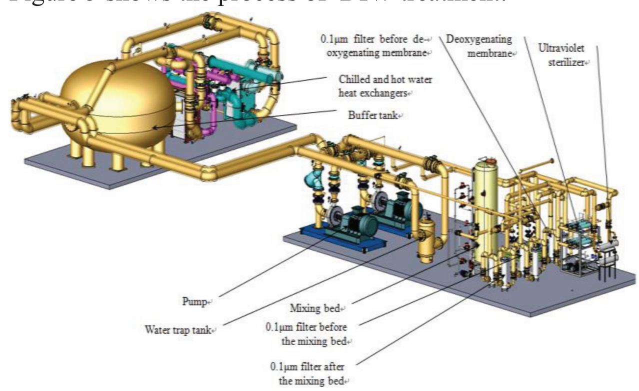

Figure 5: Process of DIW treatment.

In the T building, there are 48 DIW manifolds located on both sides of 24 CIAs. The main pipes of chilled water, hot water, and DIW are installed on the 2m trench under the 2.3m corridor, as shown in the Figure 6. DIW is transmitted from the local manifold to the ring through trench.

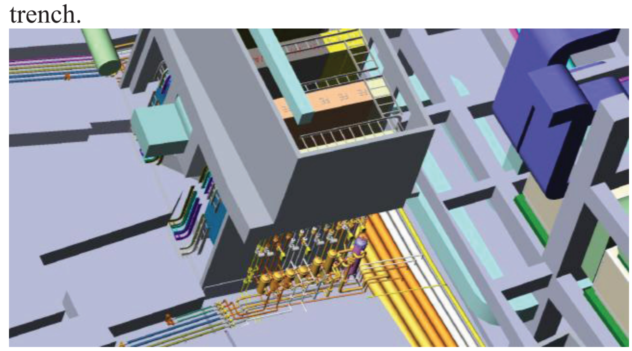

Figure 6: 3D schematic draw of a local DIW system.

Air conditioning system is another critical system related to the thermal effect. The wind ducts of the experimental hall are installed on the truss, as shown in Figure 4. In the first phase, all the AHUs for the ring tunnel and CIA will be installed. However, because no beam line will be constructed in the first phase, there will be only 12 AHUs installed for the experimental hall.

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ELECTRICAL POWER SYSTEM

The power load in the TPS storage ring can be basically divided into the magnet power supply system, the RF system, the HVAC and cooling water system, and other device. According to power demand of each subsystem, the total TPS power demand of the storage ring is estimated about 9,789 kW. The total power capacity of the TPS is estimated about 12.5 MW. In the first phase, we had contracted with Taiwan Power Company for 1MW power capacity on Dec. 2012.

Main electrical power equipment, including transformers, one generator with 1MW capacity, and high and low voltage power panels have been installed in the power substation in the Utility Building III. The second generator will be installed on Sep. 2013.

There are four and eight AC electrical power substations distributed on the experimental hall and the outer zone of the utility area, respectively. All the power substations have been completed on the first quarter of 2013. Currently, wiring works of the T building is on process, as shown in Figure 7.

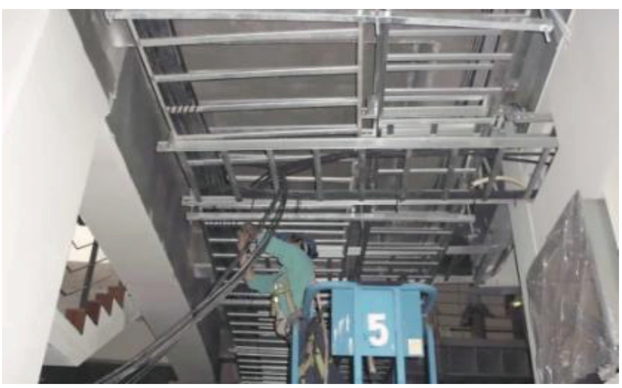

Figure 7: Wiring in the T building.

A low impedance grounding system of 0.2 Ω was designed. The grounding grid consists of 64 electrodes. Those electrodes are copper tubes with 30m in length. All electrodes are connected by bare copper wires. Three electrodes are specially buried under the ground of the RF area. The whole grounding grids have been accomplished. The final impedance of the ground system was tested as 0.14Ω, much better than the designed value.

MOCK-UP ZONE

We set one "mock-up zone" in the T building, which includes one section in the storing ring tunnel, two CIA, and DIW manifold. Figure 8 shows the mock-up zone in the tunnel. The girders and cable trays have been installed. The wind ducts and the power panel have been installed on the inner wall. The holes on the inner wall shown in Figure 8 are drilled for the installation of girders of booster magnets.

The DIW piping from the manifold to the ring through trenches in the mock zone has also been completed, as shown in Figure 9.

Figure 8: Mock-up zone in the tunnel.

Figure 9: DIW piping in the mock-up zone.

CONCLUSION

The utility system layout of the TPS was designed and constructed according to 3D drawing. The construction of buildings D and T have been completed in Dec. 2012 and April 2013, respectively. In the first phase, we had contracted with Taiwan Power Company for 1MW power capacity on Dec. 2012. A mock-up zone in the T building has been assigned as the standard of following construction and installation.

ACKNOWLEDGEMENT

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REFERENCE

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