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

J.C. Chang[a, *], Z.D. Tsai[a], Y.C. Lin[a], Iris Liu[a], C.Y. Liu[a], Y.C. Chung[a], J. R. Chen[a,b] and C.K. Kuan[a]
[a] National Synchrotron Radiation Research Center (NSRRC), Hsinchu 30076, Taiwan
[b] Department of Biomedical Engineering and Environmental Sciences, National Tsing-Hua University, Hsinchu 300, Taiwan

Abstract

The construction of the utility system for the 3.0 GeV Taiwan Photon Source (TPS) has been contracted out in the end of 2009. The whole construction of the utility system is scheduled to be completed in the end of 2012. Total budget of this construction is about four million dollars. The utility system includes the electrical power, cooling water, air conditioning, compressed air and fire control systems. The TPS construction site is located adjacent to TLS. Some areas of TPS and TLS are overlapped. Under tight schedule, limit budget and geographic constrains, it is a challenge to complete the utility system construction of TPS on time, on budget, and to specification. This paper presents some issues and status of the utility system construction for the TPS storage ring.

INTRODUCTION

To meet the goals of low emittance, high brightness, stability and reliability of the TPS, a precision and stable utility system is designed and constructed currently. We designed sufficient electrical power and cooling capacities to approach the goals. The full electrical power capacity is designed 12.5 MW. The total cooling capacity of chillers is 8,400 RT.

The TPS civil construction includes three buildings, i.e., the storage ring building (T building), the academic activity building (D building) and 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.

Utility system is one of the most critical subsystems effects on beam quality and upgrading utility system had been studied in NSRRC since 1998 [1]. The utility system of the TPS had been designed [2] and currently is under construction. This paper presents some construction challenges and the its resolutions, also the latest construction status of three main utility subsystems, i.e., electrical power and grounding system, the cooling water system and the air-conditioning (A/C) system.

LAYOUT OF THE UTILITY SYSTEM

Considering the site limit and 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 first challenge of TPS construction is to keep the TLS and AD building in normal operation. Thus, a temporary piping system for the AD building from the Utility Building II had been built underground last year.

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 designed near the existing two utility buildings. The main chilled water piping systems among three utility buildings will be connected for an efficient operation purpose. 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 TPS. The schematic drawing of the TPS, TLS and three Utility Buildings is shown in Figure 1.

Figure 2 shows the status of the TPS ring construction.

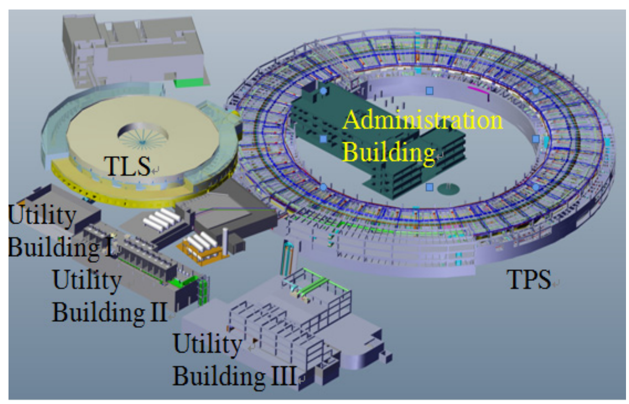

Figure 1: TPS, TLS and three Utility Buildings.

Figure 2: Status of the TPS ring construction.

* E-Mail: jcchang@nsrrc.org.tw

The TPS storage ring building may be generally divided as three parts, i.e., utility area (in the core area), the storage ring tunnel and the experimental hall. The utility area is more divided as two zones. The width of both the inner zone and the outer zone is 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 24 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. There are four and eight AC electrical power substations distributed on the experimental hall and the outer zone of the utility area, respectively. Figure 3 shows the layout of AHUs of the TPS storage ring building.

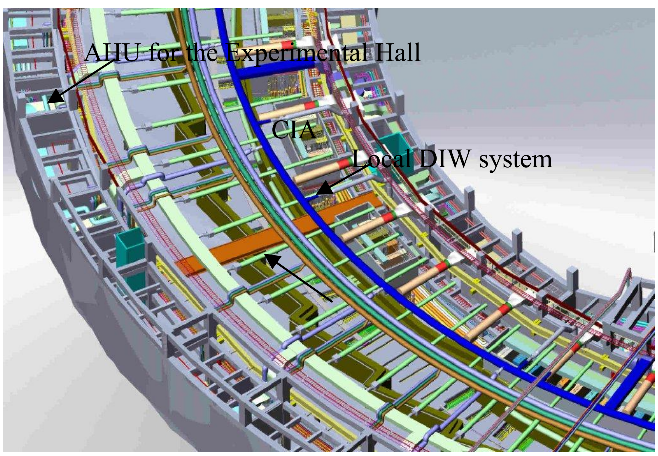

Figure 3: Layout of the TPS storage ring.

UTILITY BUILDING

The Utility Building III is constructed on the basement of D building. There will be eventually six chillers, each with 1400 RT installed in the main machine room. Four DIW systems, heaters, three air compressor, two heat pumps and pumps for de-ionized water (DIW), cooling water and chilled water will be also installed in the main machine room. Figure 4 shows the 3D schematic draw the main machine room.

DIW System

In both the TLS and the TPS, the water system includes de-ionized water (DIW), chilled water, cooling tower water and hot water. All water subsystems are operated in close loops. The DIW system may be more divided into four subsystems, i.e., Cu DIW for magnets and power devices, Al DIW for vacuum chambers, RF DIW for the RF facility, and booster DIW for booster devices and beam line optical instruments. The specifications of cooling water subsystems are listed in Table 1.

Table 1: Specifications of Water Subsystems of the TPS

	Temperature	Pressure	Capacity
Cu DIW	25 ± 0.1 °C	7.5 ± 0.1 kg	1600 GPM
Al DIW	25 ± 0.1 °C	7.5 ± 0.1 kg	380 GPM
RF DIW	25 ± 0.01 °C	7.5 ± 0.1 kg	1200 GPM
Booster DIW	25 ± 0.1 °C	7.5 ± 0.1 kg	700 GPM
Cooling Tower	32 ± 0.5 °C	3.0 ± 0.2 kg	9000 RT
Chilled Water	7.0 ± 0.2 °C	3.5 ± 0.2 kg	8400 RT
Hot Water	50 ± 0.3 °C	2.5 ± 0.2 kg	1600 kW

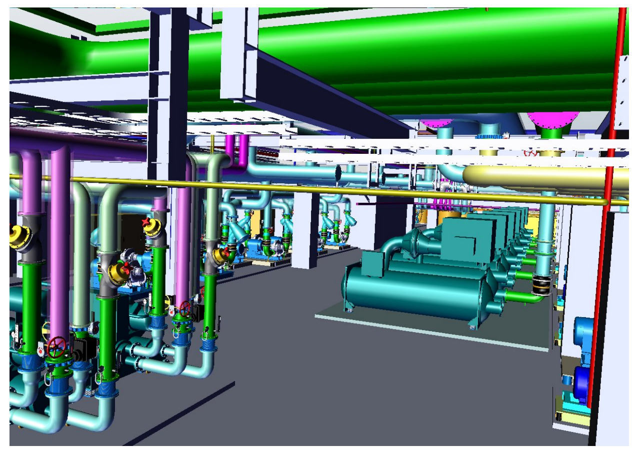

Figure 4: 3D schematic draw of the main machine room.

The whole structure of the Utility Building III has been completed. Some main utility equipment has been installed. Considering there will be few cooling load imposing on the TPS before commissioning, only three chillers are installed in the first phase. These three chillers have been installed in the main machine room, as shown in Figure 5. The whole utility system in the Utility Building III is scheduled completed in the end of 2011.

Figure 5: Three chillers installed in the Utility Building III.

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 9789 kW, which is listed in Table 2. The power demand of the main utility equipment installed in the Utility Building III is estimated about 4143 kW. The total power capacity of the TPS is estimated about 12.5 MW. We will contract with Taiwan Power Company for 1MW power capacity in the first phase.

Table 2: Total Power Demand for the TPS Storage Ring.

	power demand (kW)
magnet power-supply system	3540
RF system	3196
other precision devices	2553
Public-utility facilities	500
total	9789

Electrical power system of TPS will be classified according to the power loads. Basically, most power feeders are classified as the technical load or the conventional load. Some subsystems of the storage ring will be equipped with specific power feeder, such as the RF system, power supply system, vacuum system and processing load. Main electrical power equipment, including transformers, one generator, and high and low voltage power panels have been installed in the power substation in the Utility Building III.

STORAGE RING

According to the study of utility effects on the beam stability, thermal effect is the most critical mechanical factor affecting the beam stability [1]. Thus, the design of the cooling water system of the TPS is important.

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. Figure 6 shows the 3D schematic draw of local DIW system.

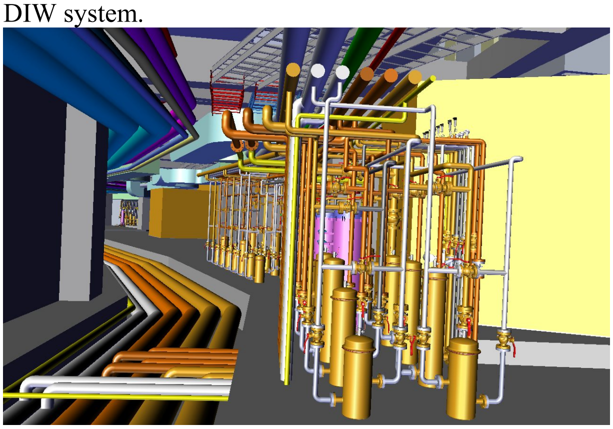

Figure 6: 3D schematic draw of a local DIW system.

A/C system is another critical system related to the thermal effect. As mentioned, the TPS storage ring building is designed as three areas, i.e., utility area, the storage ring tunnel and the experimental hall. The specifications of A/C system of these three areas are listed in Table 3.

Table 3: Specifications of the A/C System of TPS.

Location	Total flow rate(m^3/s)	Total cooling capacity(kW)	AHU No.
Exp. hall	135	1811	24
Ring tunnel	56	760	12
CIA	79	1062	13

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.

According to our latest schedule, the construction of the D building as well as the trench between the Utility Building III and T building will be completed in the end of this year. A permanent piping system from existing Instrumentation Development building to AD building will also be constructed this year. The whole civil construction of the TPS is scheduled completed in 2012. The utility construction of the TPS will be completed in the beginning of 2013. Because the civil and utility construction engineering is strongly related, the integration of the whole TPS construction is very important. For better efficiency, intensive chasing progress and application of powerful drawing and management software are necessary to control the construction and budget schedules

CONCLUSION

The utility system layout of the TPS was designed and illustrated in 3D drawing. The electrical power demand and the cooling capacity of the DIW and A/C systems were estimated. The construction of buildings D and T will be completed in the ends of 2011 and 2012, respectively.

ACKNOWLEDGEMENT

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