DESIGN AND DISTRIBUTION OF HLS IN SSRF

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Abstract

The place change of the key inserts, different kinds of magnets, for instance, in an accelerator caused by the uneven earth subside will affect the accelerator commission. All accelerator laboratories have taken the influences more and more seriously. The Shanghai Synchrotron Radiation Facility （SSRF）having been developed is located at Pudong, Shanhai, where geological condition is complicated. It is necessary to establish a monitoring system to monitor the uneven subside of foundation and key parts of the accelerator. The hydrostatic Leveling System (HLS) is used to real time monitor the vertical displacement of the foundation and the supports of the key inserts in accelerator. This paper discuses the design of HLS and distribution around the accelerator in SSRF.

INSTRUCTION

The Shanghai Synchrotron Radiation Facility (SSRF) is a low emittance third-generation light source, which is composed of a 20m-long LINAC(100Mev), 180m-circumference Booster (100Mev---3.5Gev), 432m-circumference Storage Ring(3.5Gev), the low-energy, high-energy beam transport lines and the beam lines and stations.

It is located at Pudong, Shanghai, where is at the confluence of more then two rivers and the geological condition is complicated. It is necessary to establish a monitoring system to monitor the uneven subsides of foundation and key parts of the accelerator. FIG.1 shows SSRF's location at Pudong.

Fig.1 Location of SSRF at Pudong, Shanghai

In order to meet the alignment requirement of SSRF, which is to maintain the key magnetic elements at ±100 μm in relative position, the HLS sensor's specifications should be as follows: Resolution 1 μm, Uncertainty 5 μm, Vertical measuring rang 10 mm.

CCD HLS PROTOTYPES

This type of HLS sensor is developed based on the one that was developed for the BEPCII, which I introduced at IWAA2004, CERN, Geneva, from October 4th to 7th, 2004. HLS has the same general principle of communicating vessels, but there are different kinds of methods to measure and record the changes of a liquid surface. In the Hydrostatic Levelling System developed for the SSRF, the charge couple devices (CCD) are also used to measure and record the upper surface of a liquid.

The vessel sensor developed for BEPCII was the kind of full-filled one, but the one for SSRF is a half-filled one. The basic principle is the same. Fig.2 shows the cross section of the HLS vessel. The float moves up and down with the height of the surface of liquid. And the mark bar moves up and down too along with the float connected through connecting stick. A bundle of parallel light shines on the bar and it will produce a shadow band on the acceptance widows of CCD.

Because the geological condition of the SSRF site is more unstable than the BEPCII site, the HLS must have larger measuring range. Meanwhile, in order to get shorter time for HLS to stabilizing, the system uses circuit through stainless steel pipe with inner diameter 40 mm.

Fig.3 shows the photo of the vessel sensor, which was manufactured in the cooperating company, the Beijing Gekon Instrumentation Company.

DISTRIBUTION OF HLS

In SSRF, although the level of the storage ring slab is at the same level as that of the booster and linac, they are on different foundations. It is important to monitor the relative altitude change between the level of SR slab and that of booster and linac.

In order to keep HLS work continually and reliably, and to keep the measurement continuance, and make it convenient to assemble and demount the vessel sensors, ball valves are assembled at every prospective measuring point. There are more than 200 prospective measuring points around the SSRF machine, but the vessel sensors will not be assembled at every of them. By using the valves, it is possible to change the sensors places to monitor different points at different parts of the machine during different periods, and during these changing courses it is not necessary to switch off the HLS, and it will not influence other sensors' working.

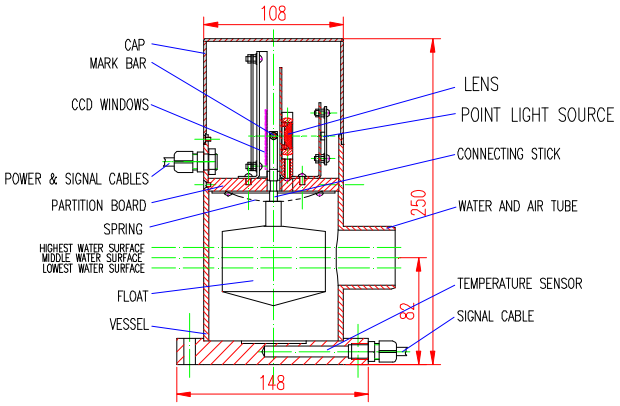


Fig.2 Cross section of the HLS vessel

Fig.3 Photo of the vessel sensor

Topology of HLS in booster and linac

Sensors of HLS in booster and linac mainly monitor the vertical place changes of the points on the ground. There are two measuring points in the linac tunnel near the wall along which the water pipe is arranged. Meanwhile there are four measuring points around and near the booster girds and the water pipe is erected beside or under the girds. Fig. 4 shows the layout f HLS in booster and linac.

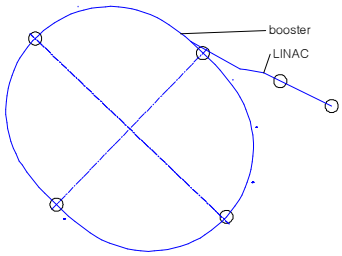


Fig.4 Layout of HLS in booster and LINAC

Fig.5 shows the layout of the HLS in Linac.

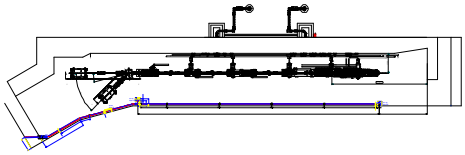


Fig.5 layout of HLS in LINAC

The vessel sensors are put on upholds (Fig.6) which are specially designed to keep all vessel sensors in the system at the same level including those in the storage ring. The upholds are fixed on ground at one end and the upper end will be put sensors.

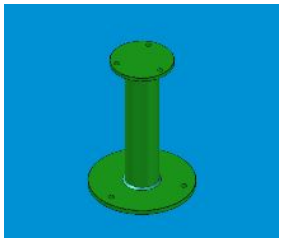


Fig.6 the Picture of the uphold of vessel sensors

The water pipe beside the girds is fixed on the side of girds using a special fixture which can slightly adjust the pipe height. The fixture is showed at Fig.7.

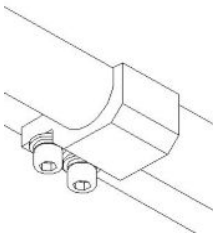


Fig.7 Fixture on gird side

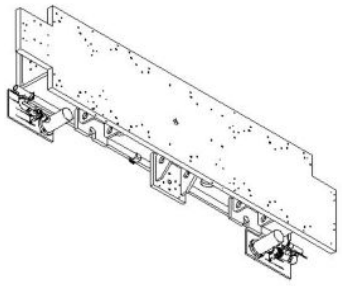
In order to keep different parts of water pipes stable and at the same level when the pipe passes an open area between girds, they must be fixed on the bolsters which can adjust the pipe height too. Fig.8 shows the picture of pipe and bolster

Fig.8 picture of pipe and bolsters

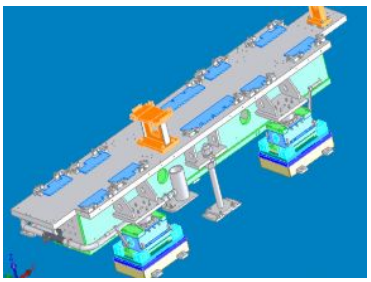
Layout of HLS in SR

As the first step of HLS project vessel sensors are not assembled on every gird around the storage ring. Twenty typical girds are chosen to be monitored by HLS. But considering the connectivity of the water pipe and the amplification of the system in the future, the water pipe and location of vessel sensors are preset on almost all the girds in the SR.

There are five kinds of archetypal girds in the SR. The layouts of the pipe and the location of vessel sensors on these girds are different, but the basic structures are the same. The water pipe is assembled on the upper edgeways of the sub-steel-plate of the gird. The distance between the centre of the pipe and ground is 374 mm. Because the place on the gird in the direction of outside of the SR is relatively loose and the inner place is more crowded, the pipe is arranged along the outside of the gird, and two sensor points are arranged on the outside and one is arranged on the inner side of the gird. Fig.9 shows the arrangement of pipe and sensor point on a gird.



（a）on the outside



（b）on the inner side

Fig.9 arrangement of pipe and sensor points on a gird

For the convenience of mounting and operating of the system, a ball valve is emplaced ahead of every vessel sensor along the pipe. When closing a valve ahead of one sensor, it will not influence the work of the HLS. So it is convenient to replace or repair one or some sensors and it is not necessary to stop the work of all the HLS.

The sensor and valve on the outside of gird are showed at Fig.10.

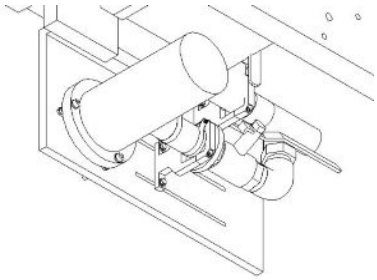


Fig.10 sensor and valve on outside

Because of the crowded place on inner side of the girds, the valves and sensors cannot be arranged nearly, and the valves are emplaced at an end of the girds along the beam direction. Fig.11 shows the sensor on inner side and Fig.12 shows the valve at the end of the gird.

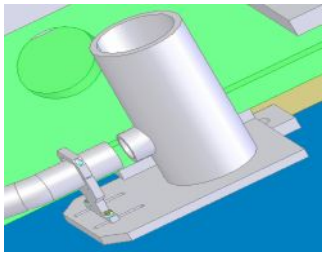


Fig.11 the sensor on inner side

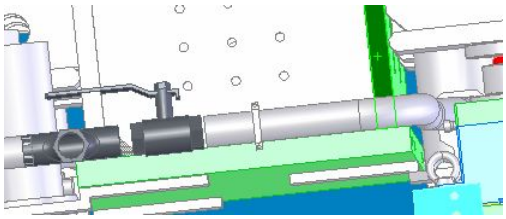


Fig.12 place of valve for the sensor on inner side

The water pipe passing the linear part of SR is arranged along the zigzag wall around the machine. The pipe is bended and welded on-the-spot according to the structure of the wall and gird in SR.

Design of filling and draining system

The filling and draining system is arranged at outside of the shield wall of SR in order not to influence the operation of SR during the HLS filing or draining. The layout is showed at Fig.13.

Before filling the water into the HLS, pour the specially treated water into the main water box. Then open the filling valve of main box to fill water into the filling water box. Close the filling valve of main water box and raise the platform to keep the inner water surface higher than the centre of the pipe at the other side of the wall. Open the filling valve and the water is filled into the pipe of HLS. Adjust the height can control the filling speed and volume.

During draining the water from the system, close the filling valve and open the draining valve, switch on the draining pump then water is drained from all the system.

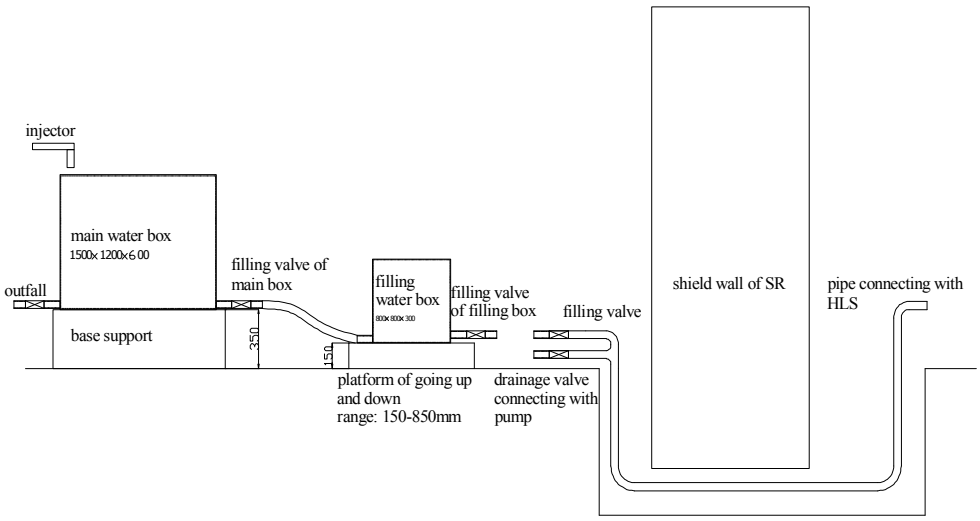


Fig.13 layout of filling and draining system

CONCLUSIONS

The design plan of the HLS for SSRF has passed the assess of the experts who are invited by SSRF and has been sanctioned. All the water pipes have been mounted along the linac, the booster and the SR. The filling and draining system has been constructing.

The manufacture of the vessel sensors has been finished. In November the sample sensor passed the test and calibration. As the schedule the vessel sensors will be emplaced on every monitoring point on-site in April, 2008. And the first survey data will be obtained in June, 2008. All the work progresses well now and we hope we could get an approving result.

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