Modification of the HLS Electronics Layout for Measuring Vertical Movement of the Accelerator Building at KOMAC

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1. Introduction

100-MeV proton linac at KOMAC (KOrea Multi-purpose Accelerator Complex) has operated since 2013 and provides the accelerated proton beam to various users from the research institutes, universities, and industries. Precise alignment of the proton accelerator is required for high efficiency and stable delivery of the proton beam. In order to measure the real-time alignment state of the proton accelerator, HLS (Hydrostatic leveling system) of the ultrasonic type was selected and installed at KOMAC. [1].

The HLS consists of an ultrasonic transducer, an electronic and a vessel. An ultrasonic transducer (H10KB3T, 7MHz) made by GE Sensing & Inspection Technologies is placed at the bottom of the vessel. It transmits the pulse into water and be in a role of receiving ultrasonic antenna. An electronic is placed the separate box linked with the vessel through limited length of cables (about 2 m) shown in the Fig. 1. A vessel has the tube outlet, reference part, temperatures sensor. The reference part has two reference surfaces to calibrate the measurements and special nest for a 1.5 inch reflector to provide alignment survey. The working range of water level is +/- 2.5 mm relative to the middle of the water communication pipe. The resolution of the ULSE (Ultrasonic Level Sensor) is 0.2 um and the accuracy is 5 um in measurement range of 5 mm [2].

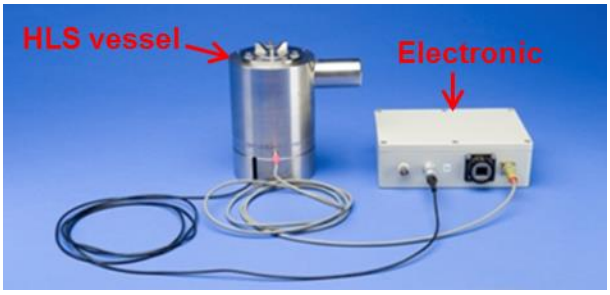

Fig.1. Hydrostatic Leveling System

During the initial operation, the effect of the tidal force in the HLS pattern was confirmed, and it was found that it was influenced by the ambient temperature as well. It was also confirmed that the operation of accelerator affected the performance of the HLS electronic [3].

In this paper, modification of HLS electronics layout is described and its operation results are presented.

2. Preliminary Operation of Hydrostatic Leveling System

A total of 10 HLSs with electronic are distributed throughout accelerator tunnel as shown in the Fig. 2. All HLSs were connected by one pipe-line (Stainless steel, 65A) with two water tanks located on the entrances of 20MeV beam-line hall and 100MeV beam-line hall.

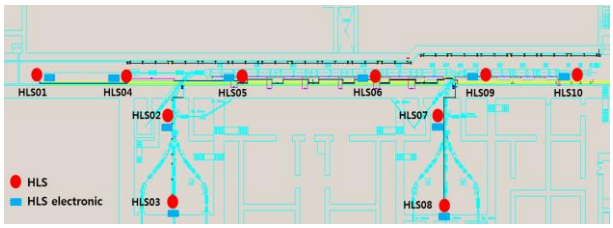

Fig.2. Layout of HLS

The Fig.3 shows data from four HLS for 3 weeks. The effect of tidal force with 12-hours period can be confirmed in (a) of Fig.3. And it can be seen that accelerator operation cycle differs from the pattern at the weekend. This is because the temperature of accelerator tunnel depends on whether the accelerator is driven or not. In (b) of Fig.3, an abnormal signal occurred after the initial period of the accelerator operation as shown in the red circle. In the initial section, the effect of the tidal force can be seen, but it is gradually out of the measurement range. HLS4 is installed in the beam dump section of the accelerator, and it is assumed that the abnormal signal is the influence of radiation while operating the accelerator [3].

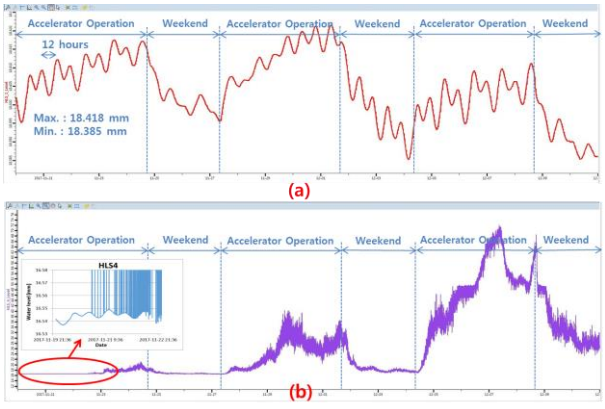

Fig.3. Variation in water level of two HLSs for 3 weeks: (a) HLS1 located in end of accelerator tunnel, (b) HLS4 located in 100 MeV beam-dump with abnormal signal.

3. Modification of the HLS's Electronic layout

The cable of the transducer is known to be of limited length. Nevertheless, due to the influence of radiation, the electronic needs to be spaced outside tunnel. For this, the 2 m cable with the transducer of H10KB2T will be used to insert the 30 m extension cable and so is temperature sensor. The extended cable was confirmed in test-stand. Fig.4 shows the 30 m extension cable in the test-stand and it was operating normally.

Fig.4. Test of Extended cable

Except the electronic of HLS1, the electronics of 9 HLSs are installed separated from HLS vessel using extended cable as shown in the Fig. 5.

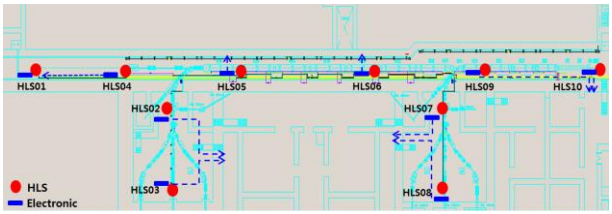

Fig.5. Modified layout of HLS

4. Operation Results

Fig.6 shows the tendency of water level of HLS1 during 7 days. Before modification of HLS electronic layout, HLS5 was affected by radiation and HLS1 was not affected by radiation. After that, the abnormal signal of HLS did not appear. The effect of tidal force with 12-hours period can be confirmed in (a), (b) of Fig.6. Also, the variation of the water level according to the temperature of tunnel the temperature of the tunnel can be seen.

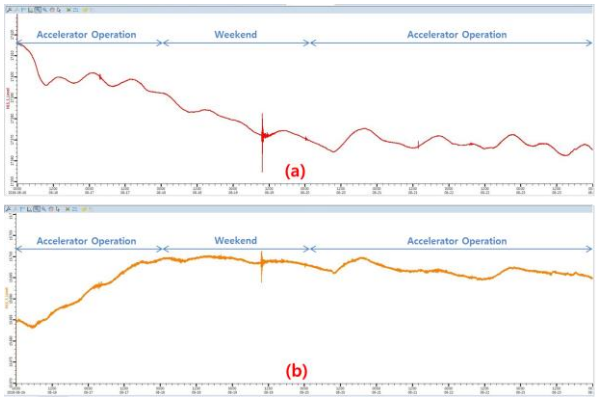

Fig.6. Tendency of water level after modified of HLS electronics layout: (a) HLS1, (b) HLS5

5. Conclusions

The HLS has been installed and operating at KOMAC. In the initial operation of HLS, it was found that the accelerator operation affected the HLS electronic. With this problem, the HLS vessel and its electronic were installed separately using the extended lines. In the short time, the abnormal signal of HLS did not appear. In the future, HLS must synchronize its positions by using the laser tracker and it is necessary to discuss how to handle the measured data in terms of relative value or absolute value.

REFERENCES

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