Operation of the BigRIPS cryogenic plant

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Based on the RIBF beam time schedule, we performed two continuous operations of the BigRIPS cryogenic plant in 2017. The first operation period was from Feb. 28 to July 21 and the second was from Sept. 16 to Dec. 15 after the summer maintenance. The total operation time of the compressor unit was 64,869 h.

At the beginning of the second operation, we had a significant incident. When we started the refrigerator after the purification operation, the interlock system stopped the rotation of the expansion turbines. The reason was poor cooling water flow caused by impurities in the cooling water system. We found that the water pipelines for the refrigerator system were badly blocked up by muddy impurities and the pipes had rusted away (Fig. 1). After flushing the water channels of the turbine system, we started the refrigerator using the independent chiller unit of ORION RKE3750A, and this temporary cooling system worked well for 2 months of the second operation period. We will replace the entire piping of the cooling water system for the BigRIPS cryogenic plant in March 2018.

Except for the incident stated above, we operated the cryogenic system without any trouble. Figure 2 shows the vibration acceleration in the vertical and horizontal directions as a function of the total operation time. We have regularly measured the vibrations of the main compressor unit both at the high-pressure and low-pressure sides since 2015. After the replacement of the damaged baring unit in Dec. 2016, which corresponds to the operation time of 59,218 h, the vibration acceleration stayed less than 8 m/s^2 and the compressor unit worked well during the entire operation period in 2017.

Another important observation for the cryogenic system is the low oil contamination in helium gas. By measuring the operation interval of the drain valves of the coalescer vessels in the compressor unit, the oil contamination level of the coalescer vessels was evaluated.[1] Figure 3 shows an estimate of the oil contamination level at the entrance of the third coalescer vessel as a function of the coalescer filter operation time. The navy blue, green, and yellow diamonds represent the estimates for the 2008–2009, 2010–2011, and 2012–2013 operations, respectively. The coalescer filters used in these periods were discontinued.[2] The estimate for the 2014–2015 and 2016–2016 operations with the new coalescer filters are shown with pink and red diamonds, respectively. The oil contamination values measured using the oil check kit are also shown. The open triangles, squares, and circles represent the results for the 2008–2009, 2010–2011, and 2012–2013 operations. The results with new coalescer filters for the 2014–2015, and, 2016–2017 operations are indicated by the open diamonds and circles, respectively. Both estimates of the oil contamination level are consistent with each other, and the performance efficiency of the new filter elements seems to be better than that of the discontinued ones.

Fig. 1. Blocked cooling water piping for the turbines.

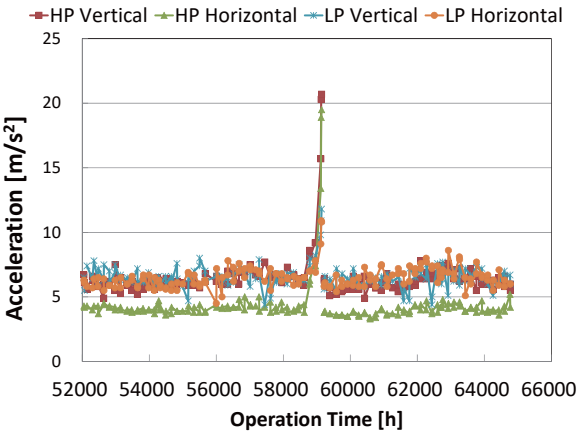

Fig. 2. Vibration acceleration of the compressor unit.

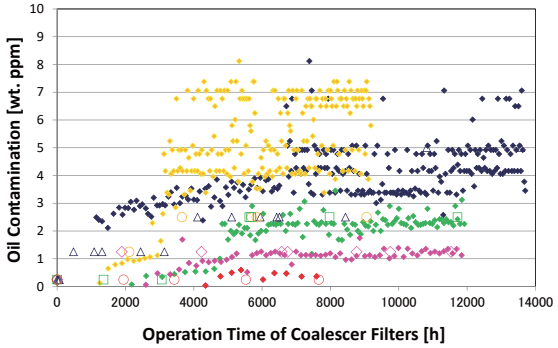

Fig. 3. Oil contamination at the entrance of the third coalescer vessel.

References

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2) K. Kusaka *et al.*, RIKEN Accel. Prog. Rep. **50**, 285 (2017).

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