

## Present status of the BigRIPS cryogenic plant

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After the September 2017 incident wherein water pipelines for the refrigerator system were severely blocked by muddy impurities, we replaced the entire piping of the cooling water system for the BigRIPS cryogenic plant in March 2018. Figure 1 shows the new cooling water pipelines for the compressor unit and refrigerator. We changed the cooling water system for the refrigerator from the cool-water system using cooling towers to the chilled-water system using RIBF absorption chillers. The cooling efficiency of the turbine system has greatly improved.

Based on the RIBF beam-time schedule, we performed two continuous operations at the BigRIPS cryogenic plant in 2018. The first operation lasted from Apr. 17 to June 18 and the second from Sept. 28 to Dec. 17. We operated the cryogenic system without any trouble in both periods. We measured the vibrations of the compressor unit and observed the low oil contamination in helium gas during operations. The total operation time of the compressor unit was 68,291 h.

Figure 2 shows the vibration acceleration in the vertical and horizontal directions as a function of the total operation time. We measured the vibrations of the compressor at the high-pressure and low-pressure sides since 2015. Except the rapid increase of the vibration acceleration at the operation time of 59,000 h, which indicates the damage in the baring unit that occurred in Dec. 2016,<sup>1)</sup> the vibration acceleration stayed less than 8 m/s<sup>2</sup> during the operation period.

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. By mea-



Fig. 1. New cooling water piping for the compressor and refrigerator.

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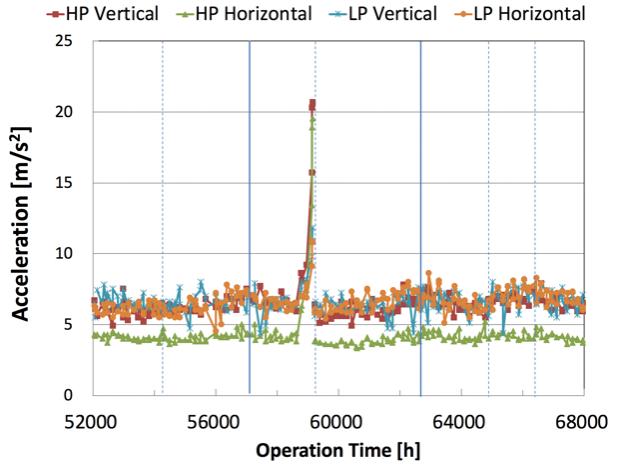


Fig. 2. Vibration acceleration of the compressor unit.

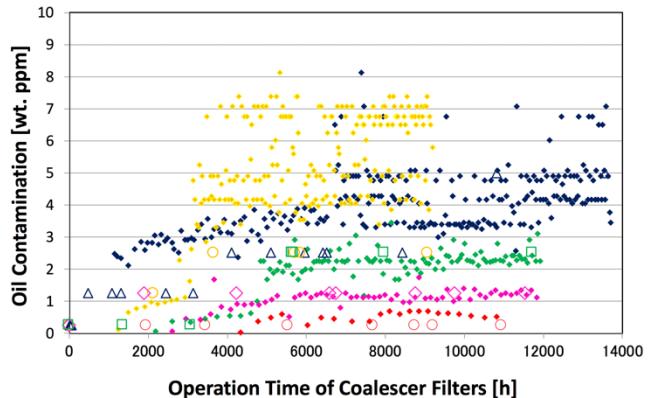


Fig. 3. Oil contamination at the entrance of the third coalescer vessel.

suring the operation interval of the drain valves of the coalescer vessels in the compressor unit, the oil contamination level was evaluated.<sup>2)</sup> The navy blue, green, and yellow diamonds represent the estimates for the 2008–2009, 2010–2011, and 2012–2013 operations, respectively. The estimate for the 2014–2015 and 2016–2018 operations 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 for the 2014–2015 and 2016–2018 operations are indicated by the open diamonds and circles, respectively. Both estimations of the oil contamination level are consistent with each other and the performance efficiency of the latest filter elements seems to be better than that of the others.

### References

- 1) K. Kusaka *et al.*, RIKEN Accel. Prog. Rep. **50**, 285 (2017).
- 2) K. Kusaka *et al.*, RIKEN Accel. Prog. Rep. **41**, 309 (2010).