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Evaluation on the operational state of turboexpanders in a helium refrigerator for nuclear fusion experimental devices using principal component analysis

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In a nuclear fusion experimental device using superconducting magnets, it is necessary to continuously supply liquid helium to the magnets. Therefore, the stable operation of a helium refrigerator is required during the plasma experiments. Turboexpanders, which are core equipment of the helium refrigerator, contain many parameters to be monitored constantly. During the operation of the helium refrigerator, the parameters of the turboexpanders are being evaluated by experienced operators of the helium refrigerator. In this study, we propose the application of a machine learning technique to the operational state evaluation of the turboexpanders. Using the machine learning technique, not only manpower saving but also objective evaluation is expected for the refrigerator operation.
To develop the evaluation model of the turboexpanders, the operational data of the cryogenic system in the large helical device (LHD) were used. The helium refrigerator in the cryogenic system is equipped with seven helium turboexpanders. Regarding the machine learning technique for the evaluation model, the principal component analysis which is one of unsupervised learning techniques was applied. This paper describes the details of the evaluation model and the evaluation results of the helium refrigerator in the LHD cryogenic system.

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