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Development of a divisible pressure-resistant accumulator for the cryogenic hydrogen system at J-PARC

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At the J-PARC, supercritical hydrogen with a pressure of 1.5 MPa and a temperature below 20 K is used as a moderator material to provide a pulsed cold neutron beam. The J-PARC cryogenic hydrogen system provides the supercritical hydrogen to three moderators and removes total nuclear heating of 3.75 kW for a 1-MW proton beam operation. A heater and a cryogenic accumulator with bellows structure are prepared to mitigate the pressure fluctuation caused by the sudden heat load because the hydrogen loop is filled with the incompressible supercritical hydrogen. The 1st accumulator had an internal leaking from the welding bellows, which has a diameter of 520 mm and a design pressure of 2.0 MPa, due to its poor weld in February 2010. Since then, we had used a tentative accumulator, where the welding bellows diameter was reduced to 353 mm and design pressure was also reduced to 0.94 MPa to manufacture it using the existing reliable welding technology. The bellows had unexpected large hysteresis in the expansion and the contraction. We had developed the 3rd accumulator with a pressure-resistant of 2.0 MPa and a long-life operation to achieve the stable operation for higher proton beam power since 2014. A divisible structure is adopted to shorten the replacement period unlike the existing accumulators. We have installed the 3rd accumulator into the hydrogen cold box in November 2013. It has been confirmed through the cryogenic test that it meets our requirements.

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