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Digital valve system for ITER remote handling – design and prototype testing

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ITER-RH system is used to exchange the divertor's 54 cassette assemblies in the vessel. Water hydraulics and servo valves are currently used in the task requiring high accuracy tracking and the use of de-mineralized water. The main concern has been robustness of the technology. Only few suitable commercial water servo valves exist and problems e.g. with jamming and wear been encountered. A possible mitigation is to use redundant valves but ensuring required level of water cleanliness is still an issue.

An alternative option is to use digital technology where on/off valves and intelligent control is used to produce proportional output. So far, no proper high-pressure on/off valves existed in the market and therefore a new concept was developed and tested with promising results. The valve has very fast response time, flow capacity that suits well for the required velocities and is compatible with de-mineralized water. In addition, the valve is not sensitive against water cleanliness and can be made rad-hard when necessary.

A mock-up of the remote handling system was used as test bench. The system was simulated in order to dimension the valve system and to tune the valve controller. A complete valve package with 16 prototype on/off valves and a manifold was manufactured and assembled. The rest of the components were off-the-shelf and the result is fully compatible to be used as direct replacement for the servo valve system.

Long-term tests of 60 working days and 2000+ hours was made. A new level of performance was demonstrated throughout the tests as tracking accuracies were approximately ten times better than with servo valve. Although some design faults where detected and system had faulty components, tracking accuracy was very good. Tracking and positioning capability of digital valve system exceeds all requirements and seems applicable for ITER-RH application.

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