

A LEAK LOCALISATION TECHNIQUE FOR ITER WATER COOLING CIRCUITS

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If a water leak occurs from one of the water cooling circuits into the ITER vacuum vessel of sufficient size to prevent satisfactory plasma operation, it must be repaired the leak for operations to continue. Localisation of the leak will be essential before repairs can be contemplated, preferably to the level of a specific portion of the particular cooling circuit. Remote replacement of a cooling circuit module is the most likely technique. A technique to allow localisation of leaks has been investigated at the Forschungszentrum Karlsruhe where a suitable tracer material is injected into a water circuit and the tracer is looked for in the exhaust of the ITER cryopumps after full regeneration using a gas chromatograph-mass spectrometer (GC/MS). By using several tracers, sequentially adding them to the ITER water circuits and progressively isolating sections, it should be possible to identify the leaking section, possibly to a particular module. The tracer material should be soluble in water (~1%) and have a relatively low molecular weight.

This detection method can start after tokamak operations have stopped and with the vacuum vessel held under vacuum by one or more cryopumps. The major vacuum constituent will be water with lower levels of hydrogen isotopes, impurities and the tracer material, all of which will be condensed on the cold sections of the cryopumps.

The method then relies on a sequence of refinement processes to separate the tracer material from the water and other gases on the cryopump. Firstly the cryopump is progressively regenerated up to about 273 K while pumping away the lighter gases. Heating the cryopump above this temperature will release water and heavier molecules including the tracer. Samples of these gases will be dried and trapped before injecting into a GC/MS combination to look for the tracer and hence confirm the leaking circuit.

This method has been experimentally verified on the TIMO facility, a half-scale model ITER cryopump. The results of these tests will be presented and the sensitivity and practicality of the method discussed.