Design and performance of a novel large volume twin cell heat flow calorimeter, for the measurement of tritium.

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This paper describes the design, commissioning and operation of a large volume twin cell heat-flow calorimeter for the measurement of samples containing tritium. The advantage of the twin cell heat-flow method over the isothermal single cell instruments currently used is that increased measurement precision can be achieved for large volume measurement cells with long measurement time constants. The Instrument makes use of high output voltage thermopile differential temperature sensors and enhanced thermal insulation to achieve a significant sensitivity improvement with a LOD of ~0.5 mW (500 GBq) in a measurement cell of approximately 50 litres in volume.

Importantly, the new instrument provides our laboratory with a means to assay the tritium content of bulk storage vessels without the need to remove their storage overpack thereby reducing handling tasks and the overall radiological risk to the operators and the environment. The elimination of direct vessel handling and the requirement for a glove-box environment when working with high inventory items provides a significant operational advantage as well as risks being ALARP.

The design and theoretical aspects of the calorimeter is described. Commissioning data based on electrical as well as tritium samples is presented. The performance of the thermal insulation, the instrument precision, its accuracy, the effects of different packaging options for the sample, room temperature fluctuations and the operational range of the calorimeter are discussed.