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#04-29 Development of an LVDT Conditioning unit for use on LVDTs in a research reactor

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Research into materials and fuels for nuclear power reactors is carried out in so-called research reactors where various types of fuels and materials can be monitored online by in-core instruments. At the Halden reactor in Norway, online measurements such as cladding elongation, inner fuel rod pressure, fuel swelling, material creep and stress relaxation were based on Linear Variable Displacement transducers (LVDT). These LVDTs require custom made conditioning units, with some particular requirements such as low driving frequency, ac constant current through the primary coil and high stability over a long period of time. In relation to the closure of the Halden reactor (June 2018) and the ensuing reorganizations at the Institute for Energy technology (IFE), the required LVDT conditioning units are no longer manufactured by IFE in Halden and the production of the LVDTs is almost terminated. Therefore, a project was started at SCK CEN to develop both LVDTs and the required conditioning units, having similar characteristics as those used at Halden. While the development of the LVDTs is still ongoing, the development and testing of the conditioning unit for a 4-wire LVDT has been completely finished and tested. In contrast to the conditioning unit developed at Halden, the system developed by SCK CEN is based on a digital system, using a commercially available chip by TEXAS Instruments. The device implements a digital demodulation algorithm that not only extracts the amplitude but also the phase of the signal with respect to the primary excitation. Additional circuitry was needed to reverse the polarity of the DC output signal at the zero crossing of the LVDT, based on the phase of the signal. The system is set to drive the primary coil of the LVDT in constant current mode, at an operating frequency of 1 kHz. This frequency is a factor 2.5 higher than the frequency which was used at Halden while still being compatible with long signal cables and in-core use. As a result, for the same LVDT, the sensitivity of the LVDT is increased by a factor 2.5 as well. The external circuitry allows obtaining 50 mA current over a load resistance of 400 Ohm. This high resistance is required because of the combined resistance of coils and signal cables at high temperature. The overall performance was tested on existing LVDTs produced at Halden and was found to be excellent.
The present system is made to fit in a 19-inch rack, containing 6 independent LVDT conditioning units, each with their own frequency and current generator. The unit has been CE and EMC approved.

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