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In this article, we proposed a novel theoretical electromagnetic model of an eddy current probe used as a position sensor with respect to a tube in a fast reactor under standby conditions while immersed in a liquid metal coolant. In these circumstances the coil position cannot be guided by optical aids but electromagnetic sensing can be used. Initially, we derived analytical expressions for the quasi-static time-harmonic electromagnetic field of a circular current filament via the transverse magnetic potential expressed in terms of a single layer potential. This is then used to deduce the field of a circular sensor coil near a conductive tube, the axis of the coil having an arbitrary direction with respect to that of the tube. The fields for both internal and external tube coils have been determined and used to deduce coil impedance variations with frequency, location and orientation. Experiments have been carried out to ensure the model prediction can be used to guide the probe to a desire position with respect to the tube.

References: