

Advancement and high-level customization of classic NDT ultrasound transducers and tools towards contemporary and future growing testing demands in power generation industry

Marko Budimir¹

¹-, INETEC- Institute for Nuclear Technology ltd, Croatia

One can trivially observe, by glancing reference literature, a significant and steady growth of ultrasound NDT/NDE industrial scope, as well as its accompanying technical demands – the corresponding industries, such as power generation industry, processing industry, oil and gas industry, transport systems industry, even medical industry can be put in this subdivision, develop very rapidly and are in a constant need of completely new and innovative, or highly customized, ultrasound non-destructive evaluation solutions, methods, techniques and technologies. Industrial researchers who do not cope with that fast pace will most probably be left behind in this dynamic race on a global scale. By forming an advanced ultrasound transducers design and development laboratory more than a decade ago, INETEC – Institute for nuclear technology has joined the race and caught up the rhythm with big players on the market, even taking over a lead in some directions, such as ultrasound NDT of nuclear reactor pressure vessel heads (RPVH). Through many research and development collaborative projects, both internal and international, the lab successfully addressed key current subjects such as optimization, customization and miniaturization of phased array ultrasound transducers, using of composite piezoelectrics as acoustically active materials to increase signal-to-noise ratio, using piezoelectric thick films for very high ultrasound frequencies and using high temperature piezoelectrics for ultrasound NDT online monitoring solutions. The research level of the ultrasound transducers in the lab has recently been additionally elevated by including advanced ultrasound signal analysis based on deep learning software algorithms (artificial intelligence). In this paper we present the rapid advancement of INETEC ultrasound NDE transducers for power generation industry through the lab's various TRL 7-9 original, customized and innovative products and solutions focused on miniaturized 10-16 elements phased array transducers, high-frequency transducers above 10MHz of central frequency, high-temperature ultrasound transducers that can perform ultrasound testing up to working temperatures of nuclear power plants reactor pressure vessels and YOLO and SSD deep learning algorithms for flaw detection on ultrasound images obtained by the transducers. Furthermore, we present our research directions and strategic issues towards further technology advancements that follow both materials science achievements and new demands within this industry.