Concept study on pulsed power drivers operating at 1 to 3 MV for flash radiography

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Abstract

Summary form only given. The Hydrus project at AWE will provide a new facility for hydrodynamics research that will require enhanced flash radiographic diagnostics. Some classes of experiment that AWE performs require a sub-100 ns flash radiographic source with a source diameter less than 1 mm in diameter and an X-ray spectrum end point energy of 1-2 MeV. That necessitates a peak accelerator voltage ranging from 1 to 3 MV depending on the output pulse shape and the angular distribution of electrons incident on the X-ray converter. The electron beam diodes considered for this source were the standard positive polarity rod pinch and the lower impedance plasma filled variant of that diode. Studies of generic pulsed power drivers determined the ideal impedance of accelerators to drive the two very different impedance histories assumed for those diodes. The effect of the vacuum transmission line necessary to connect the machine to the diode in a configuration suitable for the intended experimental facility was also taken into account. A number of possible architectures for accelerators, based on existing pulsed power systems, were then considered and modelled. That resulted in several concepts for radiographic machines that were put forward for down-selection. The decision as to which concepts to pursue was based on optimisation of the overall radiographic chain and practical considerations in constructing and operating such systems. The preferred option is an induction voltage adder driving a plasma filled rod pinch diode to provide a high resolution, low energy X-ray source and utilising stacked image plates to capture the radiograph