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Daresbury Laboratory Short Pulse Klystron Modulators

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DTI successfully tested the first of three klystron modulators for the CLARA at Daresbury Laboratories, UK, on February 20, 2018. This high power modulator is designed to pulse 70 MW-class klystrons at an average beam power of 250 kW. Each system provides 450 kV, 545 A cathode pulses, with a 3.0 μ s flattop better than $\pm 0.02\%$. Installation of the first modulator in with its klystron is scheduled for the spring of 2018, with delivery of the next two modulators in the summer of 2018.

The customer-supplied klystron is mounted directly on the oil-filled modulator tank, which contains the pulse circuitry and a passive pulse corrector with automated adjustment. This unique passive circuitry delivers the extremely flat output pulse required for advanced accelerator applications. The modulator tank lid is split into two separate sections for ease of service. The primary section of the tank houses the solid-state switches and main storage capacitor. The secondary section of the tank houses the pulse transformer and tube socket. The modulator is energized by a standard DTI switching power supply, providing 40 kV, 250 kW average power. The CLARA systems are hybrid modulators, with the 40 kV solid state switch driving the primary of a 12:1 pulse transformer at over 6 kA peak. This design provides high efficiency, simple operation, and substantial margins with respect to output voltage, current, pulse width, PRF, and average power for high reliability. A secondary function of the solid state switch is circuit protection, eliminating the need for a crowbar. When an arc occurs, the fault is sensed and the switch will open in less than 1 µs to disconnect high voltage from the klystron cathode. The current rate of rise is limited to a safe value by the inductance of the pulse transformer. System controls and low power support circuitry are mounted in a standard rack.

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