MEDIUM-SCALE EXPERIMENTS ON COMBINED HYDROGEN-TUNGSTEN DUST EXPLSION HAZARD IN ITER

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Experimental results are presented on combined hydrogen/tungsten dust explosions. The experiments are to support development of a numerical code to model LOCA or LOVA accidents in ITER involving hydrogen/dust explosion hazard. The code is to predict pressure and temperature loads on ITER structures resulting from such explosions. The code uses an analytical solver to model gas dynamics and phenomenological constants to model the explosion mixture reactivity, the constants such as efficient flame velocities and flame propagation limits.

The experiments have been performed in two combustion tubes of different inner diameters, 15 and 35 cm. The tube lengths were 3 and 6 m. Mixtures of fine tungsten dust of 0.5 micron characteristic particle size and hydrogen with air at normal initial conditions have been tested. The hydrogen concentration ranged from 6 to 20 vol. %; the dust cloud concentration varied from 0.5 to 8 kg/m^3. The mixtures were ignited by a weak electric spark. The tests were performed in closed (bigger tube) and open-end (smaller tube) geometries. The pressure loads were measured by fast pressure transducers; the process of the flame propagation along the tubes was studied using an array of thin thermocouples recording the flame-arrival times. The signal amplitudes allow estimating possible thermal loads. Depending on the hydrogen concentration, the dust can participate in the combustion process enhancing its severity or mitigate it acting as a thermal think agent.