Mitigation of disruption electro-magnetic load with SPI on JET-ILW

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The disruption mitigation system at ITER consists of shattered pellet injectors (SPI) that can inject up to 24 pellets from three different equatorial port plugs, which will be dedicated to the mitigation of electro-magnetic loads (EML), thermal loads and the avoidance and suppression of runaway electrons. Recently the JET-ILW was equipped with an SPI with a wide capability. Specifically: pellet diameter d = [4.57, 8.1, 12.5] mm and effective length/d ratio = [1.4, 1.6, 1.54]; pellet compositions of D2, Ne with D2 shell, D2+Ne mixture and Ar; propellant gas or mechanical punch to release the pellets.

The experiment was performed with ohmic plasma with I_p = 1.1-2.9 MA and D2+Ne pellet composition. The current quench (CQ) time, $\tau_{80\text{-}20}$, is the key characteristic of mitigation effectiveness. This study reveals (a) a marginal effect of pellet integrity prior to shattering and pellet size on $\tau_{80\text{-}20}$; (b) strong dependence of $\tau_{80\text{-}20}$ on Ne fraction; (c) SPI efficacy, in terms of $\tau_{80\text{-}20}$, does not depend on pre-disruptive I_p (in another words on the poloidal magnetic energy) for middle-sized pellets. The SPI was applied on plasmas with various statuses: normal ("healthy") plasma i.e., not prone to disruption, post-disruptive plasma and off-normal (affected by Locked mode) pre-disruptive plasma. This study shows that SPI effectiveness does not depend on plasma status. One of the results of the experiment was prevention of asymmetrical vertical displacement events (AVDEs) by SPI, which increases the safety factor q_{95} and, presumably, eliminates the excitation of the *m=1*, *n=1* kink mode, responsible for AVDE. In this regard, SPI is similar to the effect of Massive Gas Injection.

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