

# Technical and Engineering challenges for long pulses on JET ITER Like Wall

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The typical pulse on the JET tokamak is  $\sim 10$ s during the main phase of the discharge, however long discharge operation ( $>30$ s) is possible with sufficient preparation and care. During the last period of JET operation in 2023 long pulses in deuterium plasmas were developed to assess the sustainment of the plasma performance over several times the current resistive time scale and to address plasma-wall interaction physics in a full metallic environment with the ITER-like wall (ILW), with a W divertor and a Be first wall [1]. Two types of long duration discharges were successfully developed for this purpose: (i) a 30s ELMy H-mode with combined 12-14MW neutral beam heating (NBI) and 2MW of ion-cyclotron resonance heating (ICRH) and (ii) a 60s long pulse with 4-5MW of NBI and 2MW of ICRH. Both operational scenarios are based on previously developed hybrid-like plasmas at JET [2] with  $IP=1.4MA$  and  $B_0=1.9T$  ( $q_{95}\approx 4$ ). This was the first time that NBI could be used for durations longer than 30s on JET.

To prepare for the long pulse operation an analysis of heatloads was required to ensure the pulse was safe for the machine, this defined a number of choices on Bt and plasma configuration. While the 30s pulse was within the control and protection systems commissioned operating envelope the 60s pulse was beyond these systems normal operation. The control, diagnostic and protection systems were adapted and tested as far as possible to ensure they would work in the real pulse and a number of issues resolved over a series of 'dry runs'. A broad team of experts was convened to review all these aspects and support the pulses on the days they were carried out. Significant modifications were required to carry out the experiment which had to be reversed before going back to standard operations. Even with these extensive preparations issues were found in the pulses, in particular on the heating systems and plasma shape controller. These were resolved leading to the success of the 60s pulse.

The technical details of these preparations and their implementation will be presented in this contribution while the results of the pulses will be shown separately [3].

[1] G. F. Matthews et al 2011 Phys. Scr. 2011 014001

[2] J. Hobirk et al 2023 Nucl. Fusion 63 112001

[3] E. Lerche –Long pulse operation with the JET ITER-Like Wall this meeting

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