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Role of NBI ion sources in achieving the world-record fusion power at JET

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The Joint European Torus (JET) completed its extraordinary experimental lifetime in December 2023. JET had the unique capability to operate with tritium and exploited this to complete deuterium-tritium (D-T) experiments in both 2021 and 2023. These experimental campaigns, known as DTE2 and DTE3, broke the world record fusion energy record, achieving 59MJ and 69MJ respectively. Further to the record, a large experimental programme in D-T provided a wealth of data in both physics and technology.
High input power to the tokamak plasma was required to reach the plasma temperatures relevant for D-T fusion reactions. The majority of this power was provided by the Neutral Beam Injection (NBI) system. NBI is a flexible auxiliary heating method for tokamak plasmas, capable of being efficiently coupled to the various plasma configurations. NBI was first used on JET in 1986 and is composed of 16 ion sources on two separate beamlines. Following a series of upgrades to the ion sources and beamlines it was possible to achieve >32MW of power to the plasma in either deuterium or tritium.
The development and operational experience of increasing the power delivered by the JET NBI ion sources to the level required to achieve this fusion record across the 2021 and 2023 JET D-T experiments are explored in this contribution.

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