STRUCTURAL ANALYSIS OF THE NEW JET TAE ANTENNA

P. H. Titus[1], J. Snipes[1], A. F. Fasoli[2,1] ,D.Testa[2,] B.Walton[3], and JET-EFDA contributors

[1]*MIT Plasma Science and Fusion Center, 185 Albany St. Cambridge MA 02139*
titus@psfc.mit.edu
[2]*Centre de Recherches en Physique des Plasmas, Association Euratom - Confédération Suisse, Ecole Polytechnique Fédérale de Lausanne, CH-1015 Lausanne, Switzerland*
[3]*Euratom/UKEA Fusion Association, Culham Science Center, Abingdon,UK*

In this paper the mechanical design of the new active MHD antennas for JET is described and the structural/mechanical analysis for the antennas is presented. These new antennas replace the existing n = 1 or 2 saddle coils with a set of eight smaller antennas designed to excite Toroidal Alfven Eigenmodes (TAE's) with high toroidal mode number (n ~ 10) in the frequency range of 30 kHz - 500 kHz. TAE's with these higher mode numbers are expected in ITER and could enhance the loss of fast alpha particles in a burning plasma regime. By studying the properties of stable TAE's excited actively by these antennas, high performance regimes of operation avoiding unstable fast particle driven modes can be found. Design details have evolved. Currently one antenna assembly consists of four rectangular windings of 4 mm Inconel 718 wire, with 18 turns, wound on alumina-oxide spool pieces. Two of these assemblies will be installed at toroidally opposite positions. Antenna wires are protected from the plasma heat flux by CFC tiles mounted on mini-limiters, located between the individual windings. The main structural element is a 60 X 120mm Inconel 625 box section. The support scheme utilizes cantilevered brackets that connect to the saddle coils, and “wing” brackets which add support to the top of the frame. Conservative estimates of the disruption currents in the MHD antennas and frame were used to calculate loading and resulting stress in the antenna structure. Fields, field transients, and halo current specifications were provided by JET. The frame originally was designed as a continuous loop, and was converted to an open structure to break eddy current loops. Antenna eddy currents were computed assuming the antenna is shorted. In the latest design, frame forces primarily result from halo currents entering around the mini limiters that now protect the antenna windings. Accelerations due to the vessel disruption dynamic response were included in the loading. The dynamic response of the antenna and frame is computed using a time transient analysis with the loading assumed as half a sine wave.