DESIGN OF JET[1] ELM CONTROL COILS FOR OPERATION AT 350 C

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A study has confirmed the feasibility of designing, fabricating and installing resonant magnetic field perturbation (RMP) coils in JET with the objective of controlling edge localized modes (ELM). A system of two rows of in-vessel coils, above the machine midplane (Figure 1), has been chosen as it not only can investigate the physics of and achieve the empirical criteria for ELM suppression, but also permits variation of the spectra allowing for comparison with other experiments. These coils present several engineering challenges. Conditions in JET necessitate the installation of these coils via remote handling, which will impose weight, dimensional and logistical limitations. And while the encased coils are designed to be conventionally wound and bonded, they will not have the usual benefit of active cooling. Accordingly, coil temperatures are expected to reach 350C during bakeout as well as during plasma operations from Ohmic heating. These elevated temperatures are beyond the safe operating limits of conventional OFHC copper and the epoxies that bond and insulate the turns of typical coils. This has necessitated the use of an alternative copper alloy conductor C18150 (CuCrZr). More importantly, an alternative to epoxy had to be found. An R&D program was initiated to find the best available insulating and bonding material. The search included polyimides and ceramic polymers. Ultimately, these ELM coils must not only withstand the elevated thermal conditions, but the structural stresses resulting from electromagnetic loads, which include eddy current and halo current effects. Not only do these loads affect the performance of the coils and cases, but impacts the design of joints, leads, jumpers, and the mounting of these coils to the interior vacuum vessel wall. This paper will detail these efforts as well as elaborate on the unique aspects of the ELM coil design.

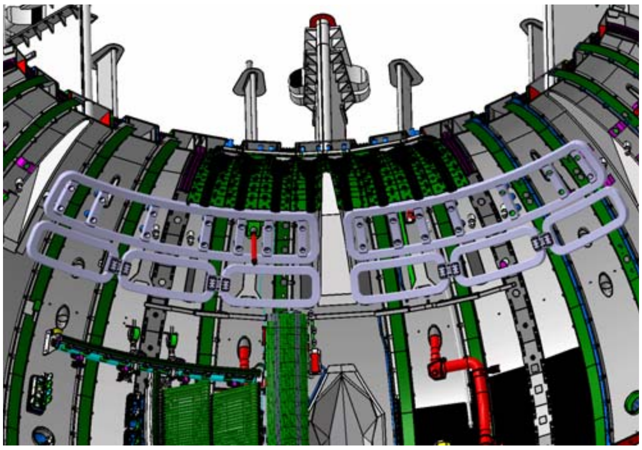

Figure 1- Mechanical layout of ELM coils inside the JET vacuum vessel.