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Wed-Af-Po3.23-05 [90]: The Axial Displacement and Its' Effects on the Mechanical Behavior of Pulsed High-field Magnets

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Traditional pulsed design software, such as PULSE and PMDS, only analyzes the stress distribution on the mid-plane of magnets. The calculations are under the assumption of the constant strain and adjacent materials are perfectly bonded together. These approximate calculations are effective in most cases but cannot take the axial elastoplastic of magnets in consideration and could make significant errors in high-field operation conditions. In this paper, the axial displacement and its' effects on the mechanical behavior of pulsed high-field magnets are studied. 2-D finite element analyses (FEA) of magnets are taken in ANSYS, with the contact pairs inserted in all the interfaces between the conductors and the reinforcements. Simulations show that the accumulation of the axial compression along the axis leads to a large axial displacement at the end of the magnets, which enhances the risk of short circuits of the windings. Besides, the axial displacement makes the calculated contact status different from 1-D results. The stress distribution of magnets is totally changed. Furthermore, several influencing factors of the axial displacement of magnets, which couldn't be account in 1-D simulations, are found out. First of all, the distribution and the dimension of the cross-section of the conductors. A flatter magnet has a better axial stability. Secondly, the transverse stiffness of the materials. High transverse stiffness makes a new requirement for the selection of the materials of magnets. Last, the friction coefficient of the interfaces between the conductors and the fiber reinforced plastic (FRP). These results indicates that analyses of the axial mechanical behavior are necessary for the design of magnets over 75T. The factors mentioned above must be account.

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