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Redesign and rebuild of the Coils for the 60 T Controlled Waveform Magnet at the NHMFL

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Driven by the 1.4 GW generator, the 60TCW magnet was the most powerful controlled waveform system in the world and had always been one of most important magnets to the NHMFL and high-field research community because of its following unique features: (1) quasi-static field up to 60 T with 100 ms flat-top and total pulse-length of 2000 ms, (2) variable magnetic field waveforms such as staircase and triangle with flat-top (3) relative large bore (32 mm) and (4) very fast cooling time (20 minutes) between pulses. The magnet is composed of nine concentric coils, with each coil consisting of several conductor winding layers reinforced by a high-strength metallic shell. In late 2014 the magnet failed in coil 7 where the stress level was the highest. The simulations that followed indicated that the overall strength of the coil would increase by replacing a section of the reinforcing shell with Zylon fiber-epoxy composite. This reduces the stress and thus significantly lowers the level of plastic deformation in the windings. The role of the metal and Zylon fiber reinforcing layers in bearing the axial and radial Lorentz forces has been studied to optimize the magnet design. The results of the optimization will be discussed as well as challenges that have been presented in rebuilding the individual coils of the magnet.

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