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Effect of Splice Field on Quench Current

The splice between inner and outer coil is made at out side the coil. The splice is preformed so that the inner lead once goes to the center of the coil and goes up to the outer coil level. Therefore, the conductor in the pole turn at close to the end part sees a little different field than other straight part of the conductor. Basically, the field opposite to the lead side is enhanced because the lead come close. The field, B, produced by a single cable at distance r is approximated by a filament current, I.

$$B = \frac{\mu_0 I}{2\pi r} \tag{1}$$

This much of field is the contribution of the opposite turn to the field at pole turn when we replace r with the distance between pole turns, w. At the above mentioned end straight section,r becomes $w/2$ and the increase of the field is

$$\begin{aligned}\Delta B &= \frac{\mu_0}{2\pi \frac{w}{2}} - \frac{\mu_0 I}{2\pi w} \\ &= \frac{\mu_0 I}{2\pi w}.\end{aligned} \tag{2}$$

This is just like having doubled current in the opposite turn. For the convenience of units;

$$\Delta B(Tesla) = 0.02 \frac{I(kA)}{w(cm)}. \tag{3}$$

Taking $I = 7000A$ and $w = 2cm$, equation(2) gives

$$\Delta B = 0.14T \tag{4}$$

This is not negligible. Since the inner conductor has I_c dependence of about $4kA/T$, The quench current will be lowered by $560A$ at this point. Since the splice lead is short (but longer than the distance ,w) , the 3D effect will reduce the enhancement. Still at least a few hundred ampares may be affected by this field. Iron yoke does not cover this region and the highest field may not be exactly this point, but if there is same order of instability near end, the probability to have quench in the opposite lead side should be higher. Recent observation of quenches at straight section near lead end in the opposite side of the lead can be interpreted as the effect of this splice field. If we change the shape of the splice, we could recover this loss of current margin. Does it worth to do?