MA-m & Downstream Coil I.R. with B(z) = 1.5 T at 4.2 m, 4.5 m & 5 m

Bob Weggel   Magnet Optimization Research Engineering (M.O.R.E.), LLC   Nov. 22, 2013

The graph below describes two important parameters of Target Magnets whose field profile ramps from 15 T at z = −50 cm to 1.5 T at L = 4.2 m, 4.5 m or 5.0 m. As in the study of 11/19/2013, the Target Magnet has only two solenoids: a main one surrounding the target region and a subsidiary one near the end of the field ramp. If needed for field homogeneity, the upstream coil is notched near its midplane. The current density is 18 A/mm^2 in the main coil and 45 A/mm^2 in the subsidiary one, much like comparable coils in "Target15to1.5T5m1+5.xlsx" of 6/18/2013. Iteratively adjusting the ends and outer diameter of each coil (and of the notch, if any) minimizes the megamp-meters of conductor while attaining a chosen field homogeneity over the target region from z = −100 cm to zero. In addition, the optimization program adjusts the inner radius of the downstream coil, in order that the ramp bottom out at the chosen distance.

The lowest-cost system has a field homogeneity of 4% and tapers to 1.5 T at 4.2 m. It uses (182+400) = 582 MA-m of conductor; the inner radius of its downstream coil is 94 cm. To increase L to 5.0 m requires (223 + 400) = 623 MA-m of conductor (an increase of 7%) and a downstream-coil I.R. of 171 cm.

Conductor MA-m & Downstream Coil I.R.; B(z) = 15 T at –50 cm & 1.5 T at z = L