Fermilab

9/5/91
TS-SSC 91-176

To: Randy Riecken

From: Jim Strait

Subj: Elimination of collar spot welds

I just came across the attached electonic mail messages from Jon Turner of the SSCL enginering group which he sent me in response to a request of mine some time ago to calculate cases similar to those you proposed at the SDR last week. It shows that even with close fitting pins (analogous, I believe, to your flanged holes) there is a 40% increase in the collar deflection with preload over the spot welded case. This seemed undesirable to us for several reasons, so we have not pursued this option. (I had intended to ask him to calculate the case of semi-perfs placed at the same location as the spot welds, but never got to it.)

The larger deflection with prestress will result in a larger magnet-to-magnet variation in the collared coil dimensions resulting from the magnet-to-magnet variation in prestress. If a vertically split yoke design is used, this will result in an additional contribution to the random variations in the harmonics. I believe that with the present design (spot welded pairs) the contribution to harmonics variations from prestress variation driven collar deflections is negligible, so a 40% increase may not be a problem. However, the effect would have to be evaluated quantitatively to verify this conjecture.

If a horizontally split design is chosen then the larger variation in the collar vertical radius would have to be taken out by the shell tension in order to close the yoke mid-plane gap. Because the relative dimensions of the collar OD and the yoke ID have to be set to give an appropriate amount of interference for the smallest possible collared coils, the maximum yoke-collar interference becomes 40% larger without the spot welds and a larger shell tension is required to close the yoke-gap for the high prestress coils. (The magnitude of the increase would have to be evaluated quantitatively.) This increases the likelihood of there being an open gap for a large fraction of the magnets. The consequent sliding between the yoke and collars and between the yoke and shell under thermal cycling seems undesirable to us.

cc: R.Bossert, J.Carson, S.Delchamps, A.Devred, C.Goodzeit, W.Koska, M.Lamm, M.Packer, E.G.Pewitt, J.R.Turner, H.Trenham, M.Wake, R.Williams

From: SSCVX1::JRTURNER "Jon R. Turner" 14-JAN-1991 20:22:10.58
To: FNAL::JBS
CC: JRTURNER
Subj: Results

I survived my trip to Tokyo and have some results for you. I have three seperate cases. 1) the original case with spot weld and no pin, 2) no spot weld and a pin with a very small interferance fit in the hole, 3) no spot weld and a pin with a .06 mm diam. clearance between pin an hole.

case 1) vert def. = .11 mm
case 2) vert def. = .15 mm
case 3) vert def. = .22 mm

The inner coil stress in each case was 70 MPa and the Outer was 55 MPa. The horizantol defelection in each case was aprox. 0 mm.
I will explain the results more thoroughly in a note tomorrow.
Ciao,
Jon

From: SSCVX1::JRTURNER "Jon R. Turner" 15-JAN-1991 12:34:51.57
To: FNAL::JBS
CC: JRTURNER
Subj: About the results

The results I presented yesterday indicate that if there is a clearance between the pin and the hole, the vertical collar deflection increases significantly. The reason for this is that this allows the front and back collar to rotate with repect to each other so that only one collar supports the load from the coils at the pole. The keys do not penetrate the collar deeply enough to prevent this rotation. In the previous C358 collars, the keys were relatively large with respect to the collars and were therefore able to prevent this rotation. The DSX201 design uses the same 4.9 mm key but the collars are a bit wider and therefore this rotaion is more pronounced. It would seem that because there are two keys, they should be able to somewhat offset each others rotation but this does not seem be be the case for some as yet not understood reason. I am currently doing a run with 7 mm wide keys to see if this supports the theory I just presented and helps to prevent the rotation in the collars. In other words, I am doing some more runs to see if this theory is correct and I will let you know what I find out. Also, I would like to know what you think the tightest possible clearance between the pin and hole could be. Finally, in the model I am using, I left the pin hole location and size the same as in the DSX201 design. If you would like me to change the location or size of the pin let me know. Otherwise, I will let you know when I have some more results.
-Jon