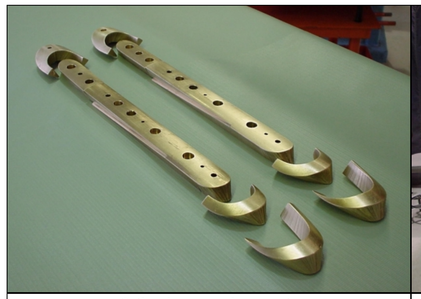
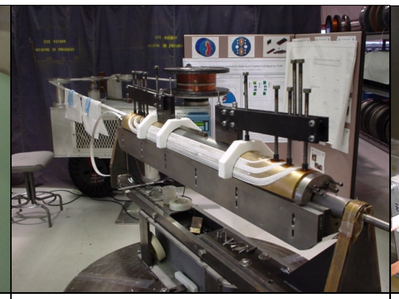
Nb_3Sn superconducting magnet fabrication and test

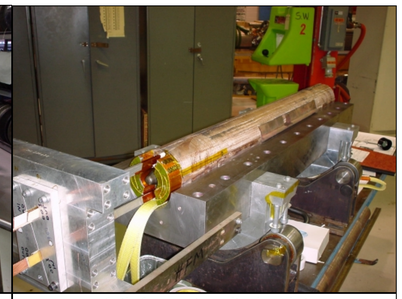
Shell type dipole fabrication



Coil end parts cut by water jet

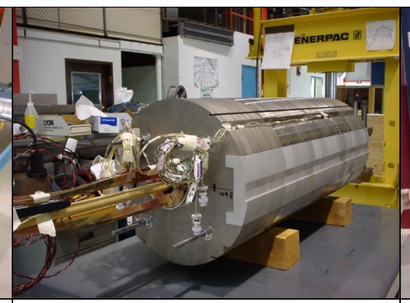


Wound outer half-coil



Coil after reaction spliced to NbTi

Impregnated coil



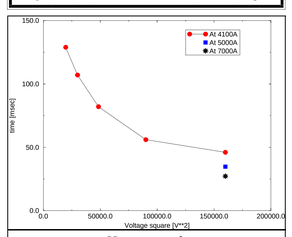
Yoked magnet

Complete assembly

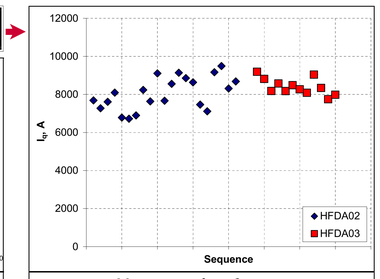
Shell type dipole testing

Magnet prepared for testing

All the quenches in both magnets originated in the splices with NbTi cables. There was no training.



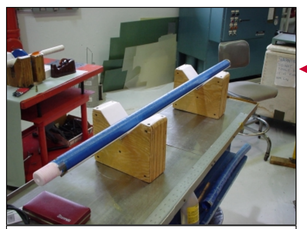
Heaters study



Magnet quench performance

Calculated and measured geometrical harmonics in the magnet body at I=3000 A

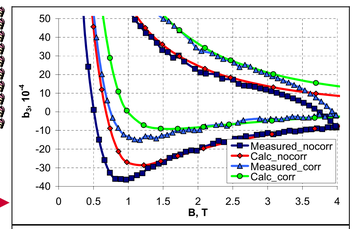
n	Calculated		HFDA02		HFDA03	
	b_n	$\sigma_{an,bn}$	a_n	b_n	a_n	b_n
2	-	1.20	-9.6	-4.1	1.93	7.13
3	0.00	0.56	0.2	-4.0	-0.81	-2.36
4	-	0.28	-1.1	-0.4	-0.75	0.19
5	0.00	0.10	-0.3	0.0	-0.04	-0.53
6	-	0.05	0.3	0.0	0.03	-0.12
7	0.00	0.02	0.1	0.1	-0.03	0.04
8	-	0.01	-	-	-	-
9	-0.09	0.00	0.2	-0.2	-0.04	-0.01



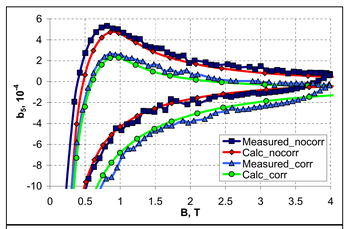
Passive persistent current corrector

Passive corrector of the persistent current effect has been manufactured according to the proposed geometry and cold tested together with HFDA02.

High corrector performance was experimentally demonstrated!



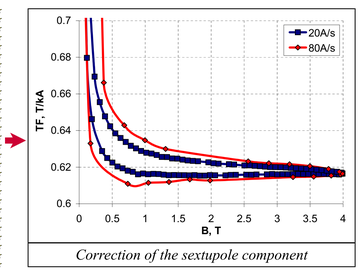
Correction of the sextupole component



Correction of the decapole component

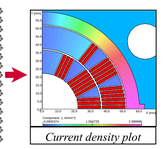
There was no ramp-rate dependence observed in harmonics, thanks to the stainless steel core inside of the cable.

However, there was found a large ramp-rate dependence in the transfer function.



Correction of the sextupole component

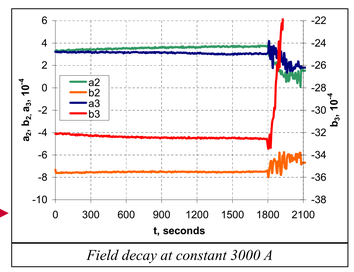
Numerical analysis shown that source of the dynamic effect in TF is Al spacer outside of the coil.



Current density plot

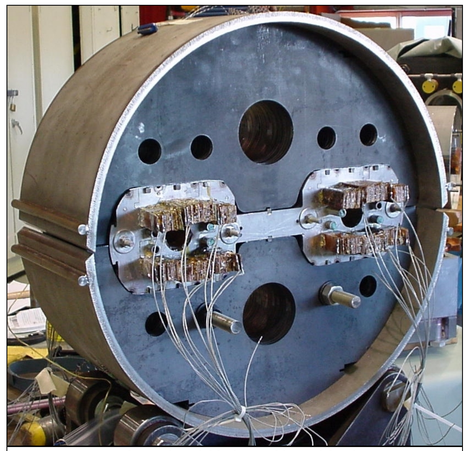
There were field decay measurements done at I=3000 A during 30 min. Maximum harmonics change is ~0.5·10^{-4}, that is an order of magnitude smaller than in NbTi magnets.

No "snap back" effect was observed.



Field decay at constant 3000 A

Common coil magnet R & D

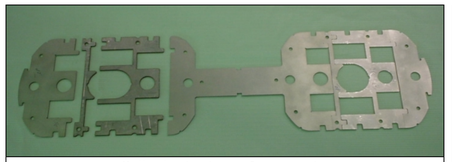


Mechanical model before welding of the skin

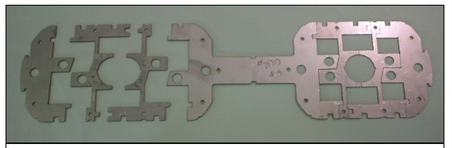
TABLE II
ELECTRICAL INSULATION TEST

Turn-to-turn:	KAPTON						E-GLASS TAPE					
block #	1	2	3	4	5	6	7	8	9	10	11	12
Ground Insulation test												
B V (kV)		S				2.3		3.3		3.3	1.9	3
Max V (kV)	3		3	3	4.5		4.5		4.5			
Turn-to-turn insulation test												
B V (kV)	2.8	1.3	1.5	2.2		1.4	1.4	2.5	1.9		1.6	
Max V (kV)					3					3		3

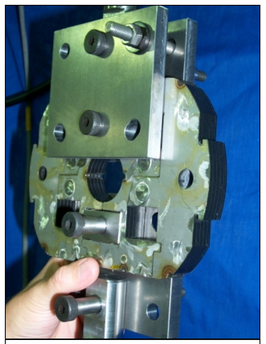
Test of electrical insulation



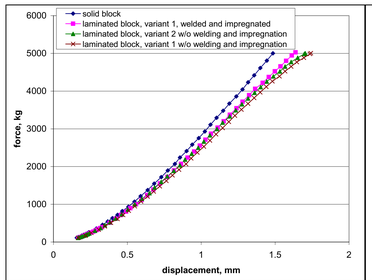
Collar laminations – 5 part version



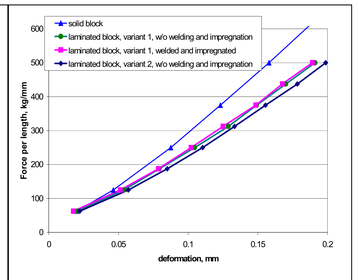
Collar laminations – 3 part version



Test of collar laminations



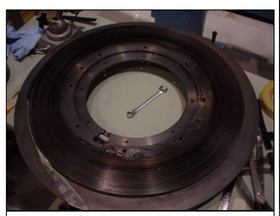
Test of collar laminations under tensile load



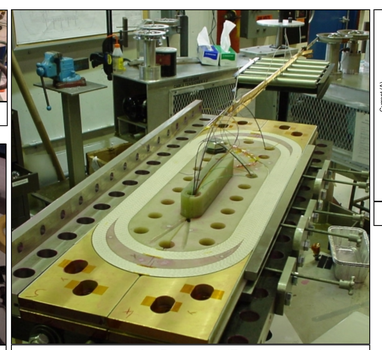
Test of collar laminations under compression

React & Wind Racetrack

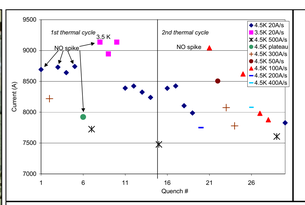
Reaction retort

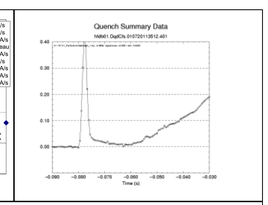


Reacted cable on the reaction spool

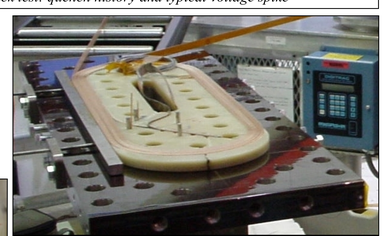


Assembly of the 1st Racetrack (E-glass insulation)

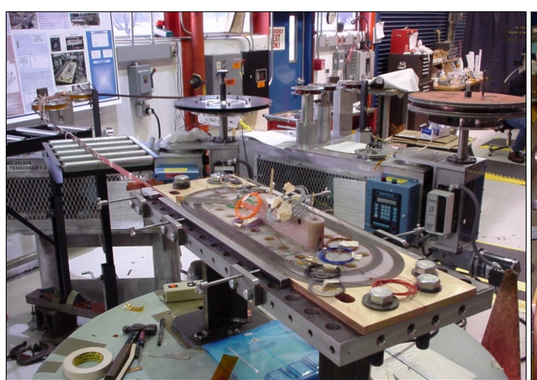




1st Racetrack test: quench history and typical voltage spike

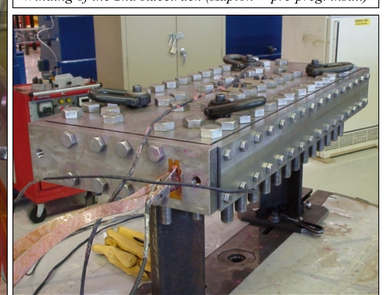


Winding of the 2nd Racetrack (Kapton + pre-preg. insul.)



1st coil of the 2nd Racetrack, winding table and tensioners

Quench heater



Racetrack mechanical structure