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Future Circular Collider

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Manufacturing folder for reference design dipole short model: Deliverable D5.4

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DELIVERABLE REPORT

MANUFACTURING FOLDER FOR REFERENCE DESIGN DIPOLE SHORT MODEL

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Abstract:

Manufacturing folder for a novel high-field cosine-theta model magnet, suitable for the hadron collider designed in the scope of the EuroCirCol project, which is part of the international Future Circular Collider study.

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Delivery Slip

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1. INTRODUCTION

The specifications and parameters, set by the EuroCirCol WP5, have been implemented in the engineering design of a cos-theta dipole model magnet developed by Fermilab in the framework of the US Magnet Development Program (MDP), which includes Fermilab, LBNL, NHMFL and recently BNL. The magnet design and manufacturing has been in part adapted to the tooling used for the 11 T dipole for the HL-LHC upgrade project, which was available at FNAL when the activity started.

The status of advancement of the model magnet is well beyond the initial goal of EuroCirCol, going beyond the delivery of a manufacturing folder. At the time of the writing of this report, all magnet parts have been manufactured and the magnet is assembled and ready for testing (Figure 1).

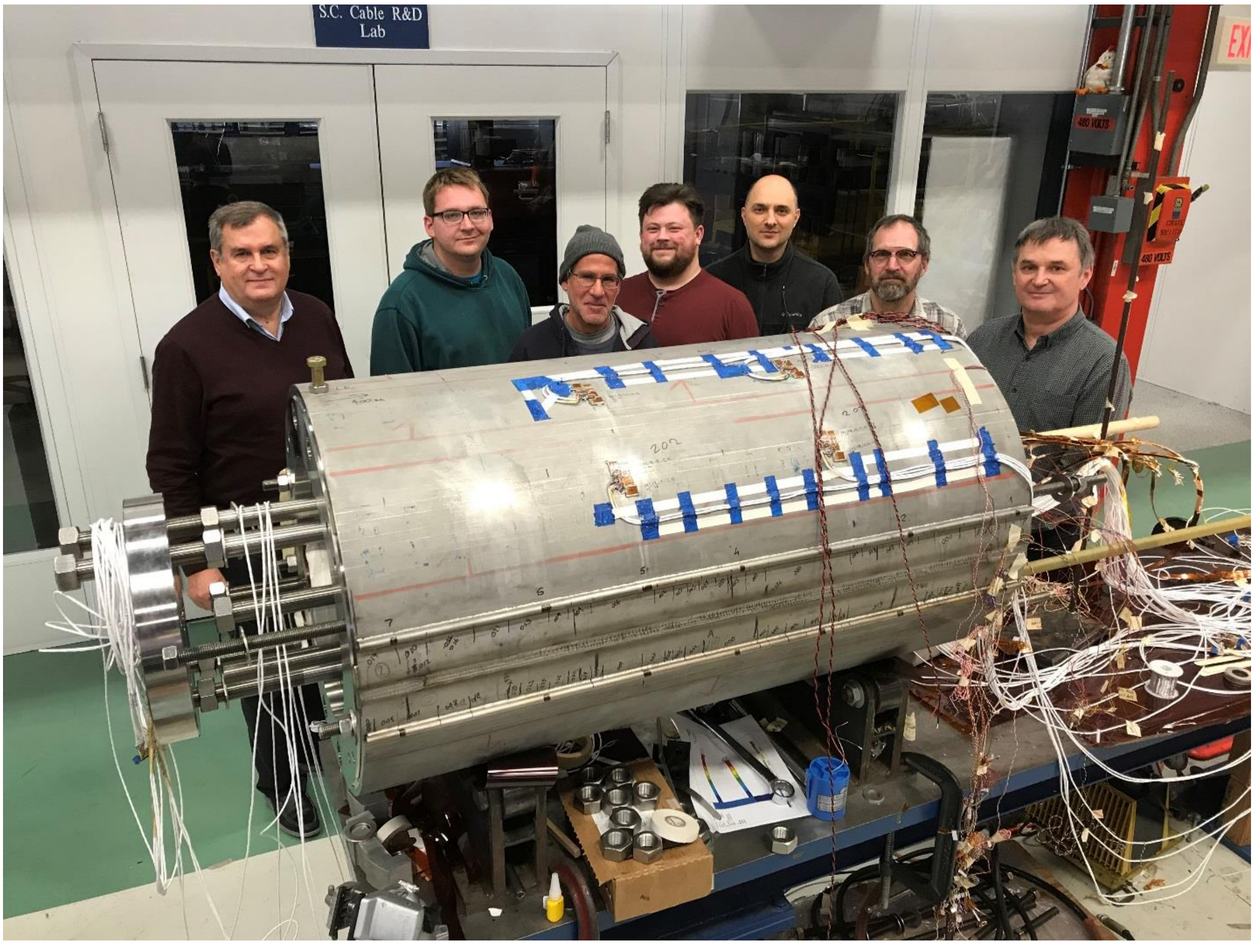

Figure 1 The cos-theta dipole model magnet with project leader A.V. Zlobin and his team (FNAL).

2. MAGNET PARAMETERS

The magnet is based on a 4-layer graded cos-theta coil with 60 mm aperture and cold iron yoke. To counteract the large Lorenz forces, a novel mechanical structure based on a vertically split iron yoke, locked by large aluminum I-clamps and supported by a thick stainless steel skin, has been developed at FNAL.

The main magnet parameters are summarized in Table 1.

Table 1 Main parameters of the cos-theta model magnet.

Parameter	*Unit*	*Value*
Magnet free aperture	mm	60
Bore field at short sample limit @ 1.9 K	T	17.0
Peak field at short sample limit @ 1.9 K	T	17.7
Current at short sample limit @ 1.9 K, I_c	kA	12.5
Inductance at I_c	mH/m	26
Number of cable strands (Cable1/Cable2)		28/40
Cable width (Cable1/Cable2) after reaction	mm	15.10/15.10
Cable mid-thickness (Cable1/Cable2) after reaction	mm	1.870/1.319

3. MANUFACTURING FOLDER

The manufacturing folder is composed of the following drawings.

- F10050785_15T Assembly
- F10050871_I-clamp
- F10050291_Iron Lamination
- F10047874_Coil assembly
- F10055320_Coil L1-2
- F10055321_Coil L3-4
- F10047809_L1 Pole LE
- F10047844_L1 Pole RE
- F10048996_L2 Pole LE
- F10049080_L2 Pole RE
- F10054821_L1 Splice Block
- F10054822_L2 Splice Block
- F10052356_L1 Wedge
- F10052369_L2 Wedge
- F10047811_L1 Spacer1 LE
- F10047813_L1 Spacer2 LE
- F10047825_L1 Spacer3 LE
- F10047843_L1 Spacer4 LE
- F10047863_L1 Spacer1 RE
- F10047864_L1 Spacer2 RE
- F10049005_L2 Spacer1 LE
- F10049010_L2 Spacer2 LE
- F10049011_L2 Spacer3 LE
- F10049013_L2 Saddle LE
- F10049084_L2 Spacer1 RE
- F10049085_L2 Saddle RE
- F10057949_L1 TSaddle LE
- F10057950_L1 TSaddle RE

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5. ANNEX GLOSSARY

SI units and formatting according to standard ISO 80000-1 on quantities and units are used throughout this document where applicable.

BPM	Beam Position Monitor
c.m.	Centre of Mass
DA	Dynamic Aperture
DIS	Dispersion suppressor
EIR	Experimental Insertion Region
ESS	Extended Straight Section
FCC	Future Circular Collider
FCC-hh	Hadron Collider within the Future Circular Collider study
FODO	Focusing and defocusing quadrupole lenses in alternating order
H1	Beam running in the clockwise direction in the collider ring
H2	Beam running in the anti-clockwise direction in the collider ring
HL-LHC	High Luminosity – Large Hadron Collider
IP	Interaction Point
LHC	Large Hadron Collider
LAR	Long arc
LSS	Long Straight Section
Nb_3Sn	Niobium-tin, a metallic chemical compound, superconductor
Nb-Ti	Niobium-titanium, a superconducting alloy
RFS	Radio Frequency Section
RMS	Root Mean Square
σ	RMS size
SAR	Short arc
SSS	Short Straight Section
TSS	Technical Straight Section