The Large Hadron Collider - Present Status and Prospects

L.R. Evans

LHC

Cryogenics

- 31,000 tons of material spread over 26.7 kms to be cooled to below 2 K.
- 8 cryoplants of 18 kW at 4.5 K ordered or upgraded.
- 8 multi-stage cold compressors, each handling 125 g/s of helium at 15 mbar have been ordered.

Conclusions

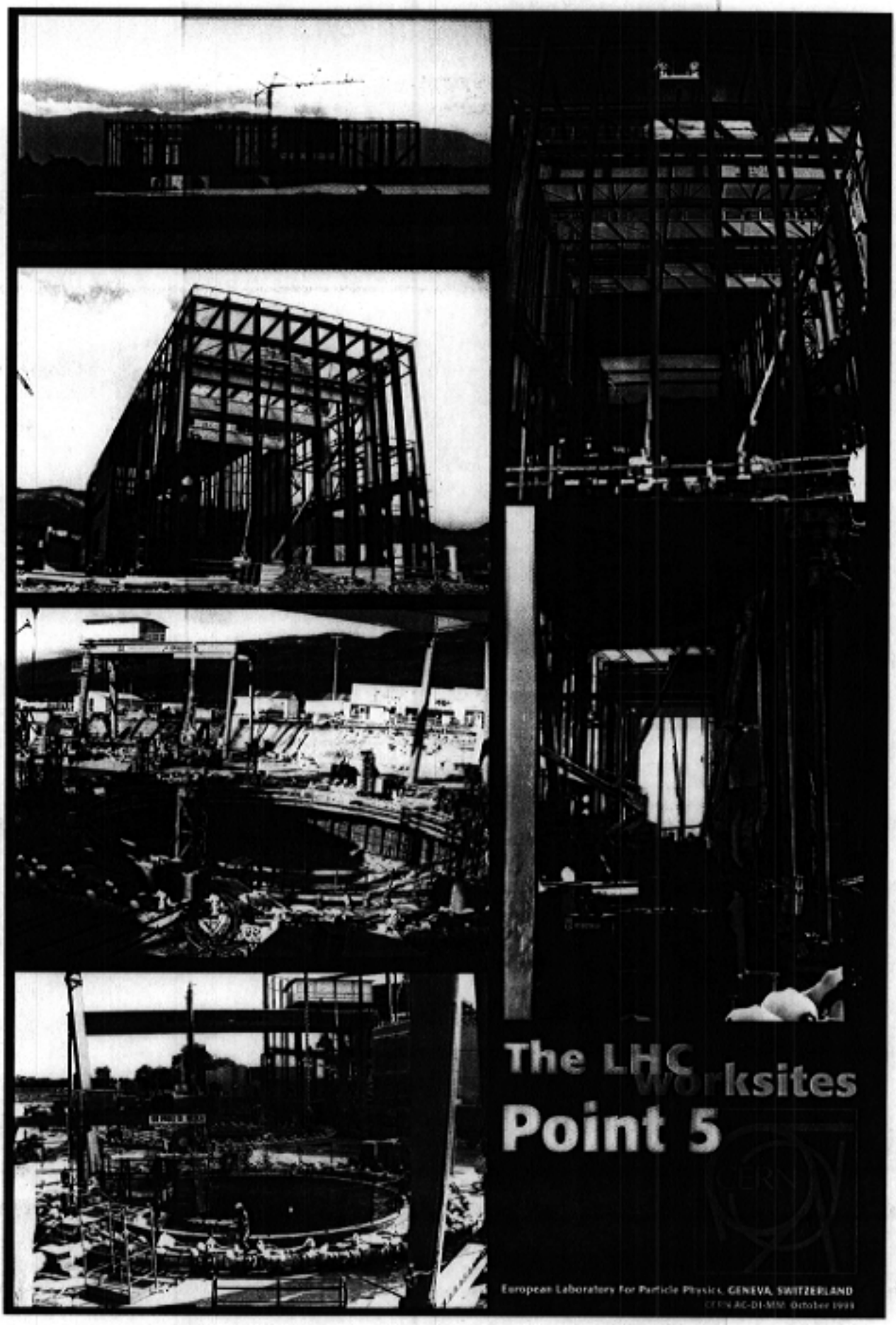
The LHC represents a technological step forward, stimulated by the need to achieve the best possible performance within the constraints of the existing infrastructure and at the lowest possible cost. The project is proceeding according to the foreseen schedule.

The LHC project

Collaborating institutes

- CEA / Saclay, Grenoble
- CNRS / Orsay, Annecy
- LBL / Berkeley
- FNAL / Chicago
- BNL / Upton
- TRIUMF / Vancouver
- IHEP / Protvino
- BINP / Novosibirsk
- INR / Moscow
- JINR / Dubna
- CAT / Indore
- BARC / Mumbai
- KEK / Tsukuba

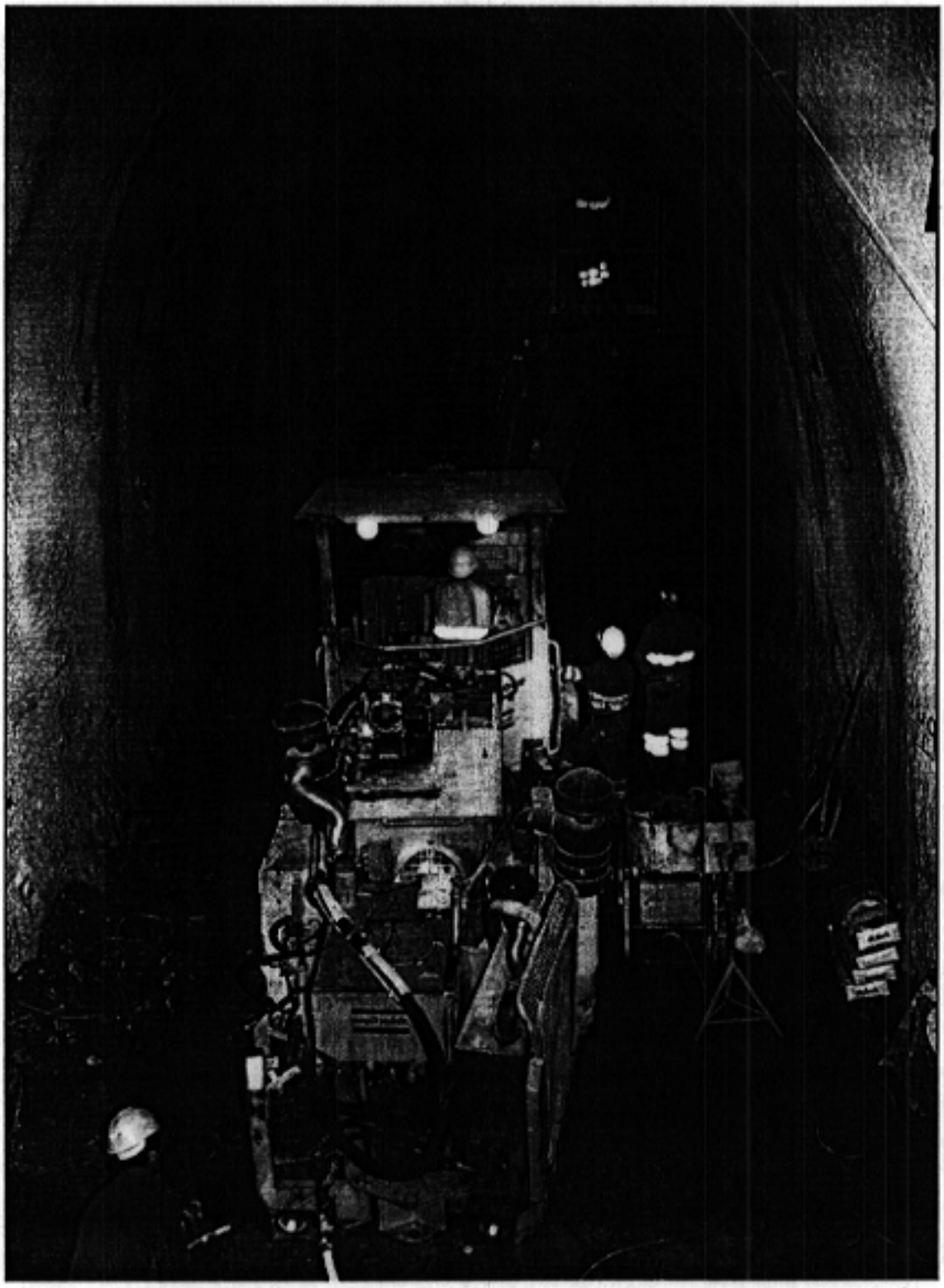
Point 5 - SX5 Steelwork erection - August 31, 1999 - CERN ST-CE



The LHC Worksites
Point 5

European Laboratory for Particle Physics, GENEVA, SWITZERLAND
CERN AC-DI-MM October 1998

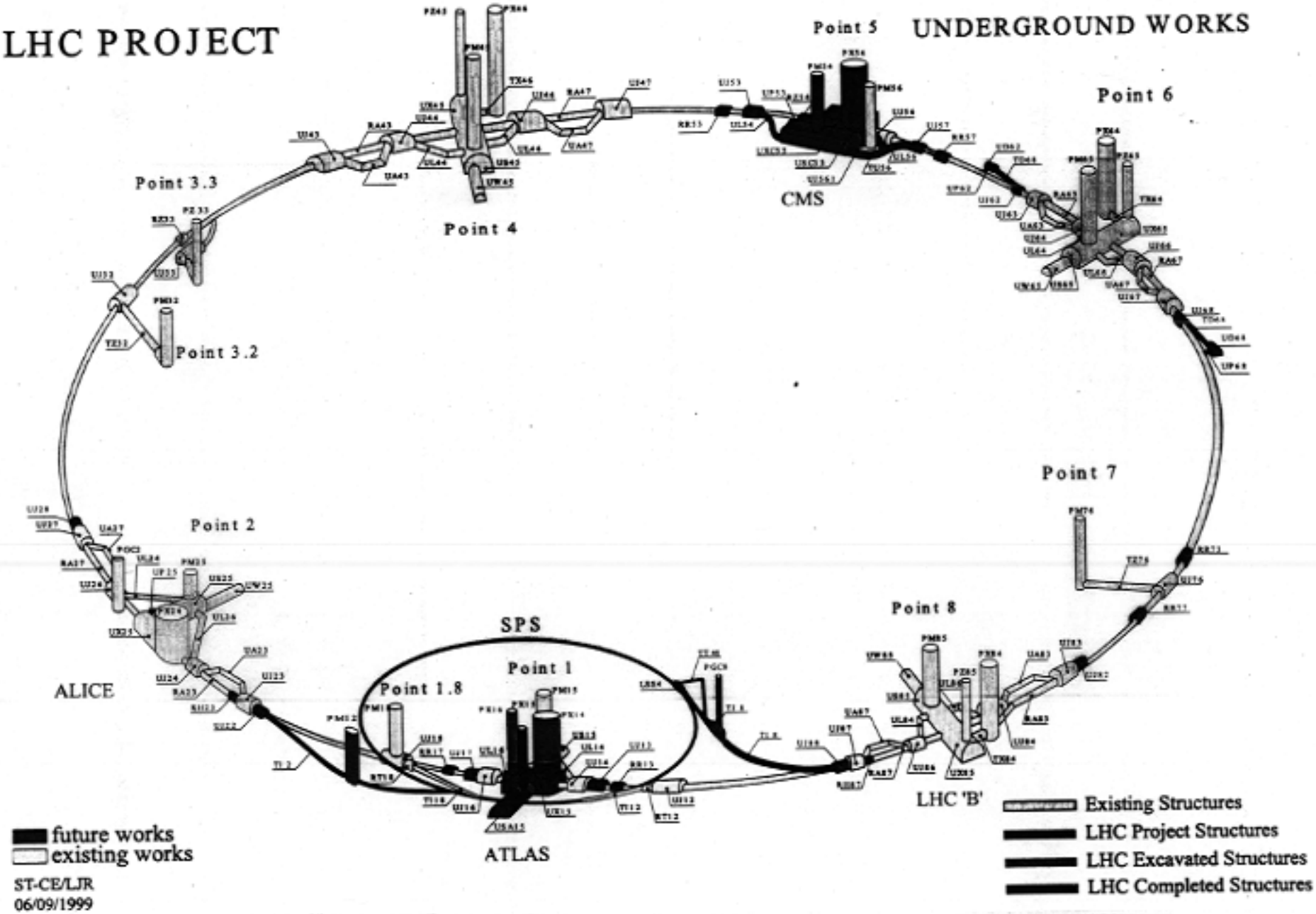
Point 5 - Ground freezing of PX54 shaft - August 20, 1999 - CERN ST-CE

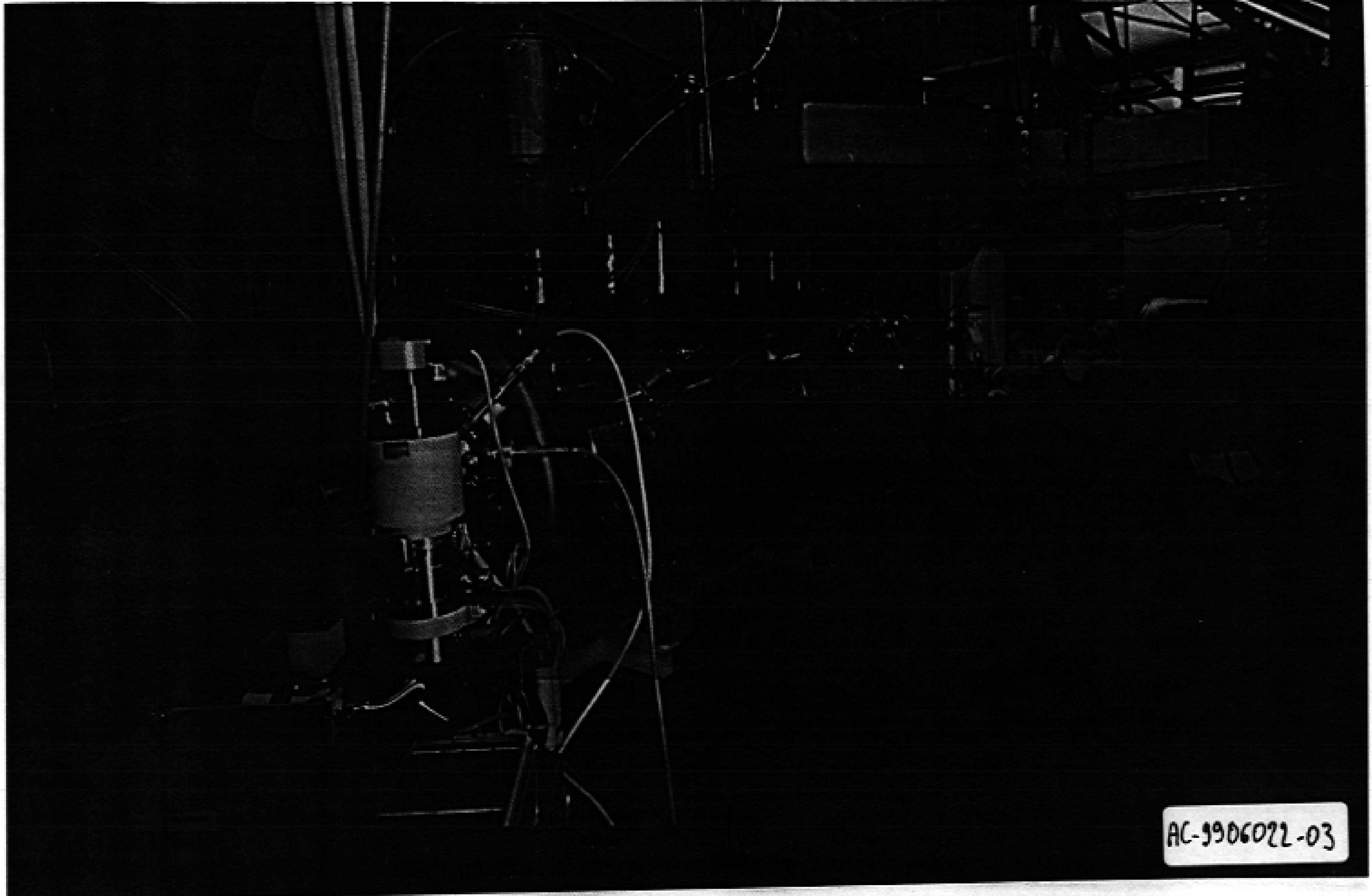


Point 1 - USA 15 cavern excavation works - 13.09.99

Point 1 - General view - May 18, 1999 - CERN ST-CE

LHC PROJECT


Point 5
UNDERGROUND WORKS
Point 6
Point 4
CMS
Point 3.3
Point 3.2
Point 7
Point 2
Point 8
SPS
Point 1
Point 1.8
ALICE
LHC 'B'
ATLAS
future works
existing works
ST-CE/LJR
06/09/1999
Existing Structures
LHC Project Structures
LHC Excavated Structures
LHC Completed Structures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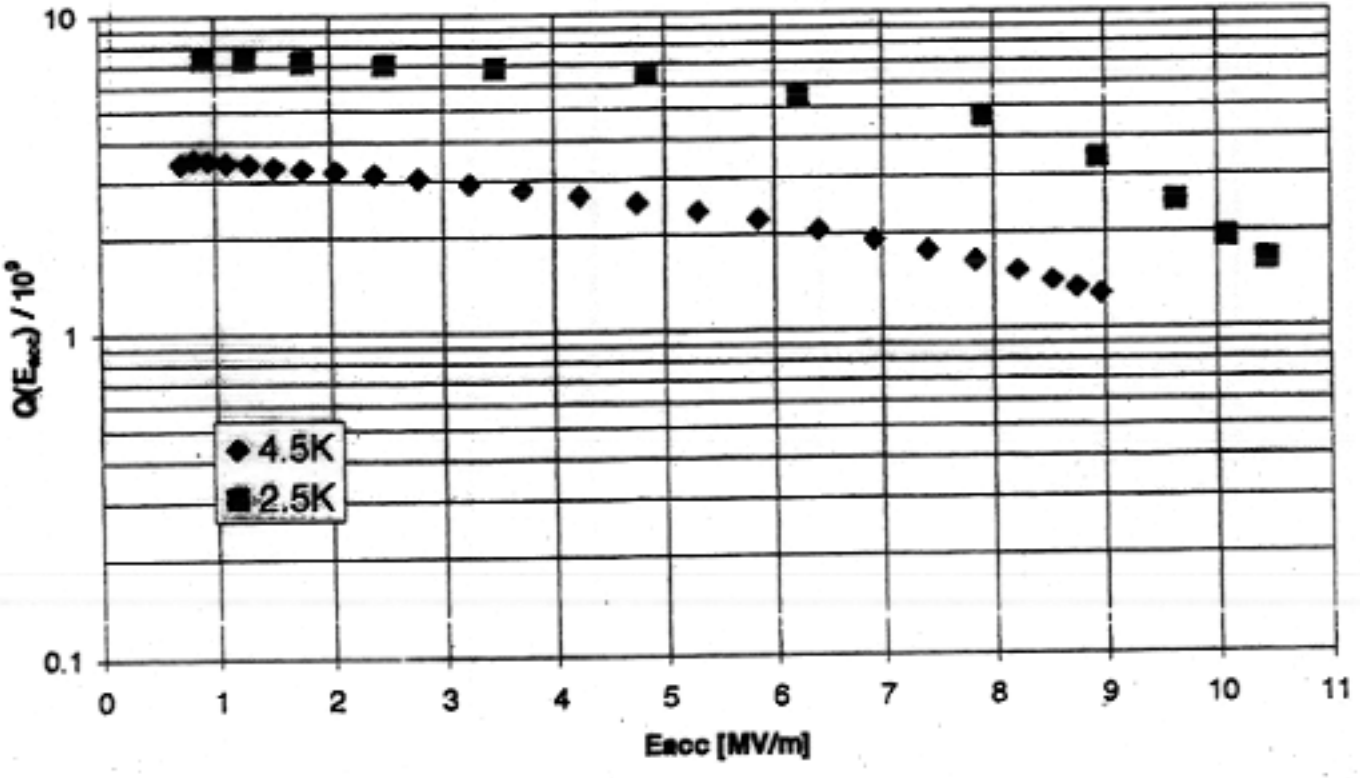
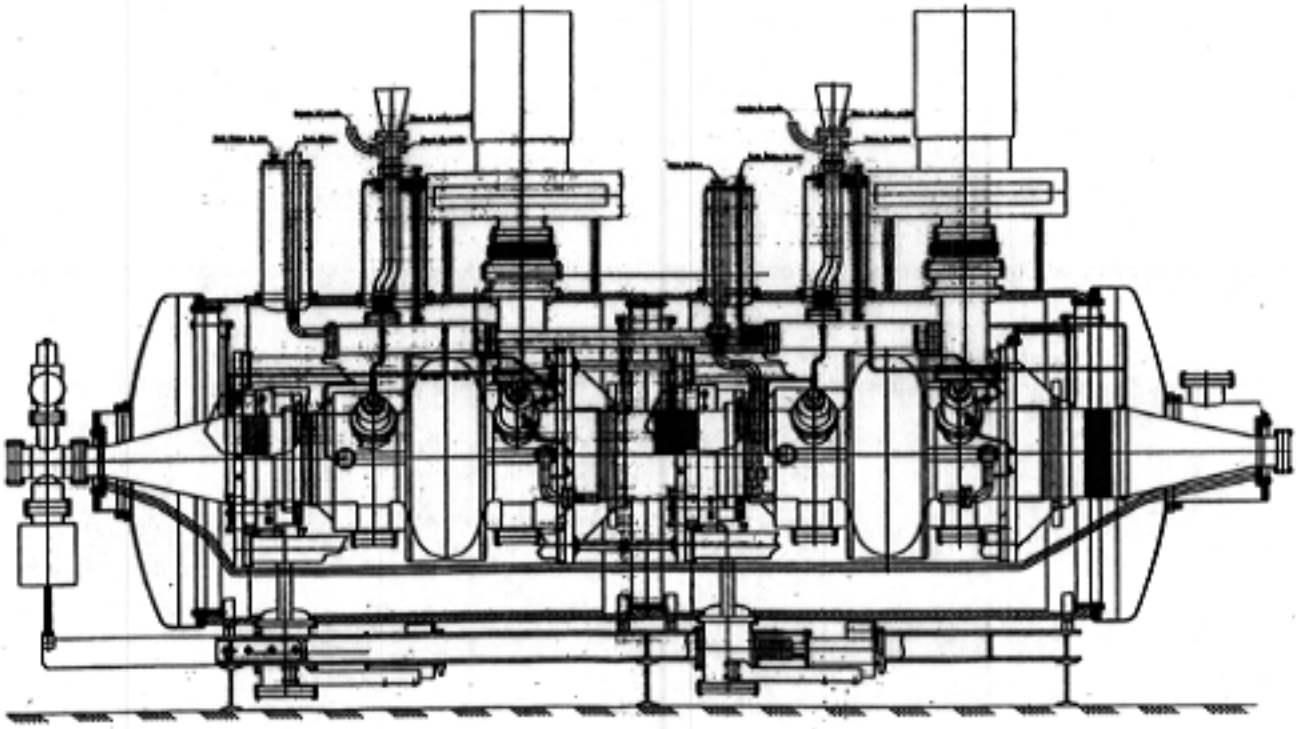
Cavity LA16.1A





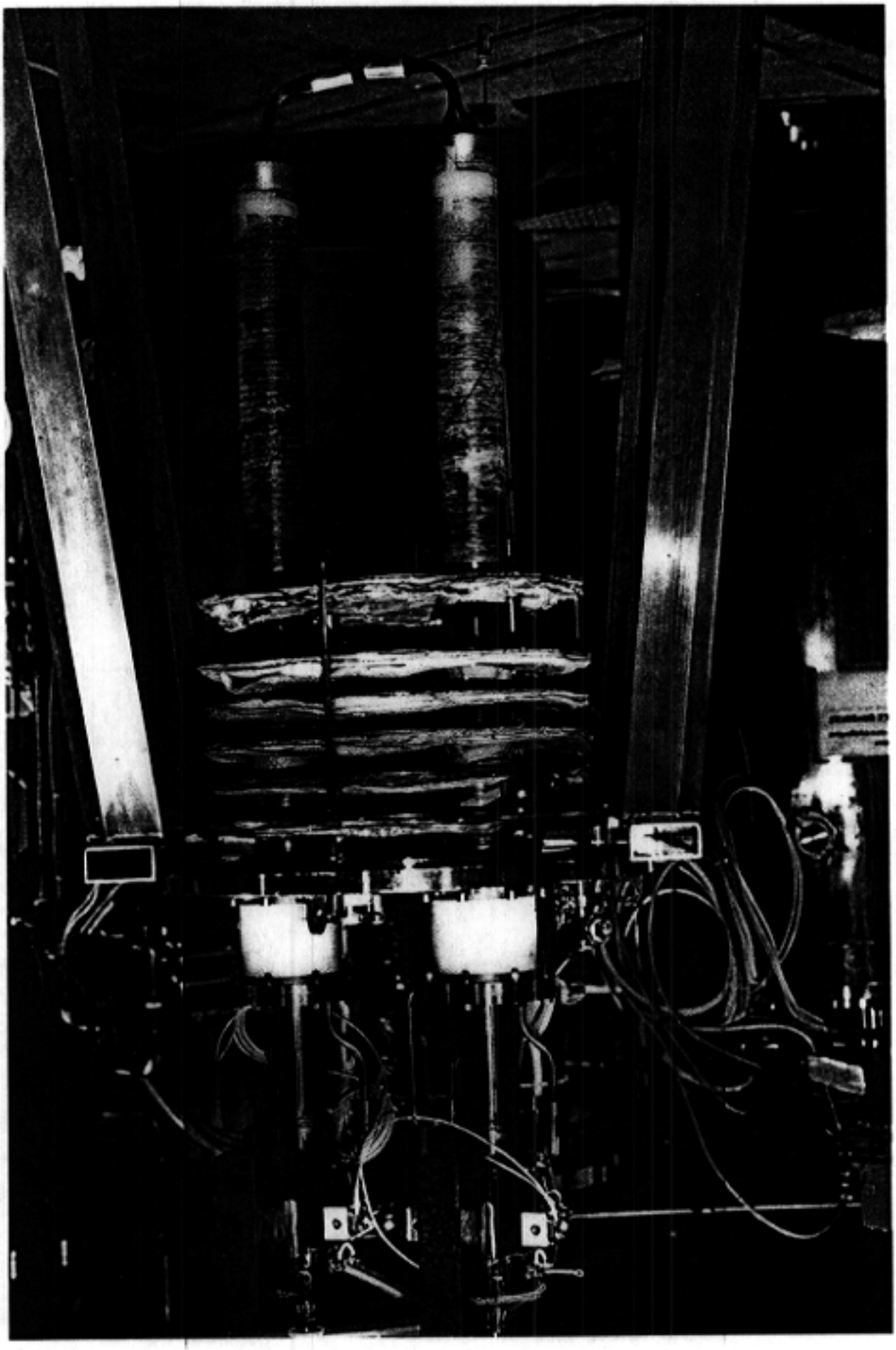
TEST OF THE LHC PROTOTYPE CRYOMODULE

(JULY 99)

- 300 kW INPUT POWER/CAVITY
- 8 MV/m MAX FIELD

) NOT LIMITED BY CAVITY

- VARIABLE POWER COUPLER OK : CHANGE COUPLING UNDER POWER POSSIBLE
- HOM COUPLERS OK
- TUNING SYSTEM OK (1st VERSION)

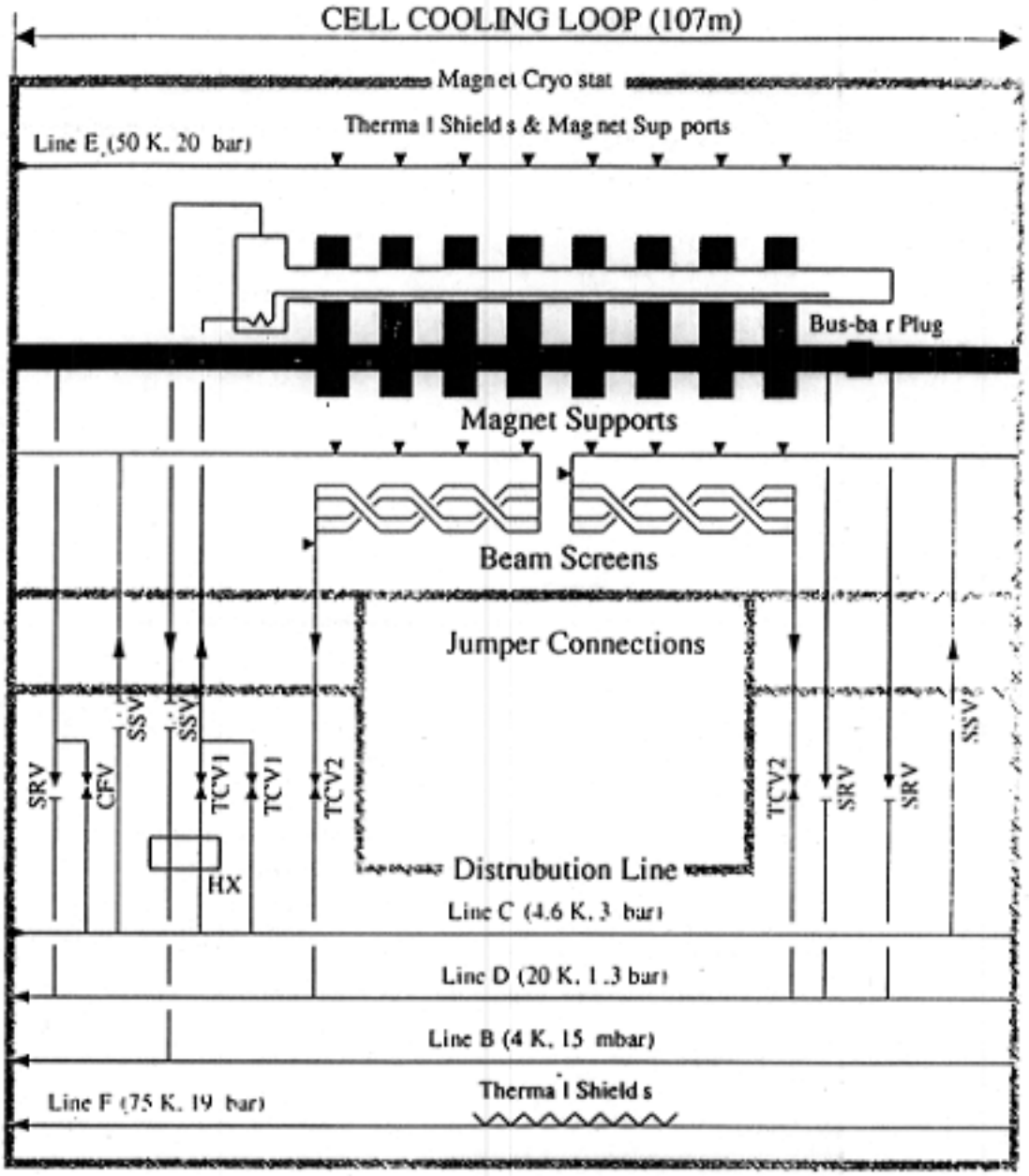


HTS current leads

- Total current > 3.5 mA with currents from 13 kA (main dipoles) to 100 A (orbit correctors).
- Leads for the higher current (600 A - 13 kA) are made from HTS materials in order to reduce liquefaction requirements.
- A number of 13 kA prototype leads have been successfully tested.

Cartridge of Linde
Cold Compressor Prototype

CRYOGENIC DISTRIBUTION SCHEME OF LHC



CR331

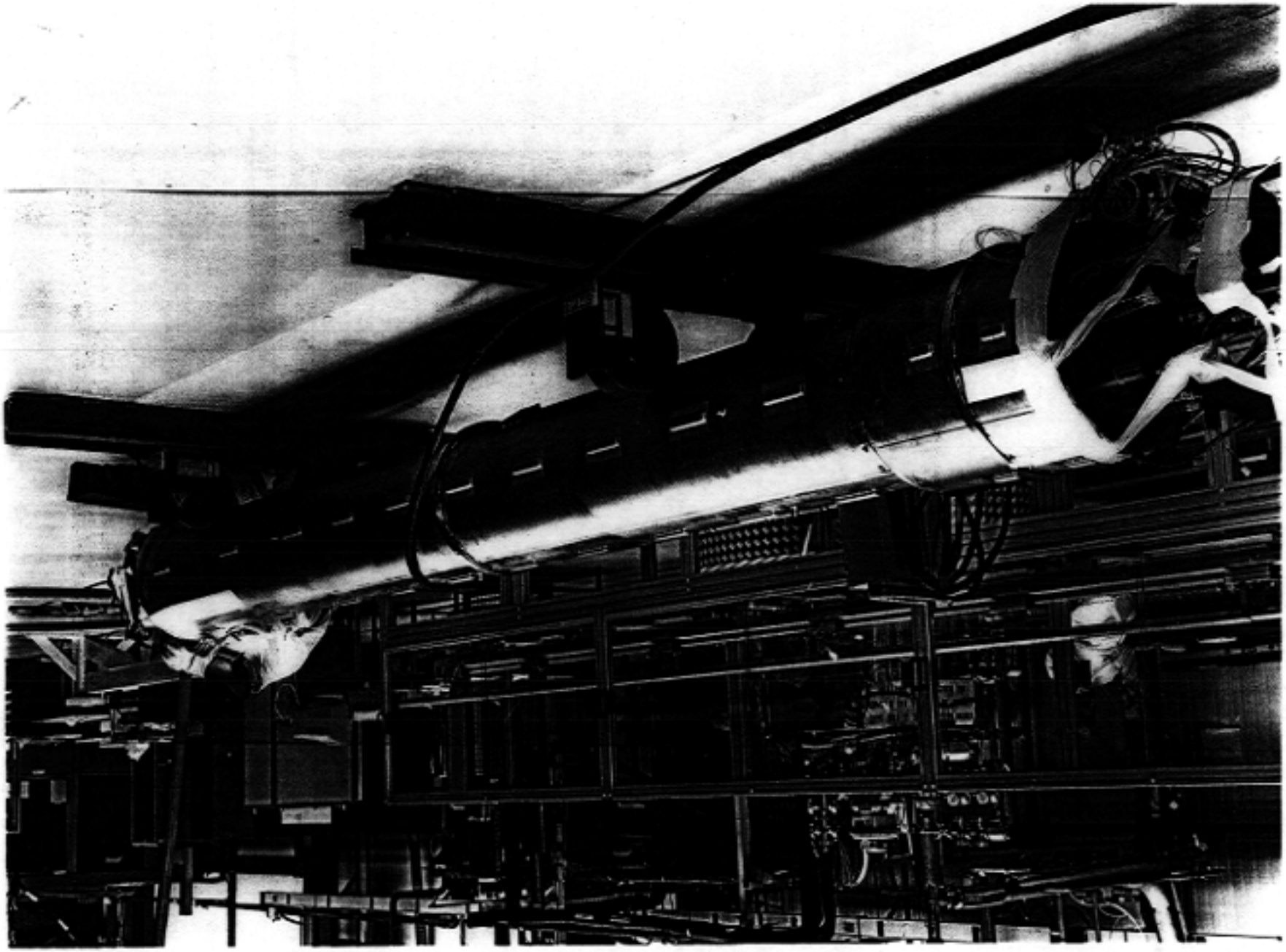
Superconducting correctors

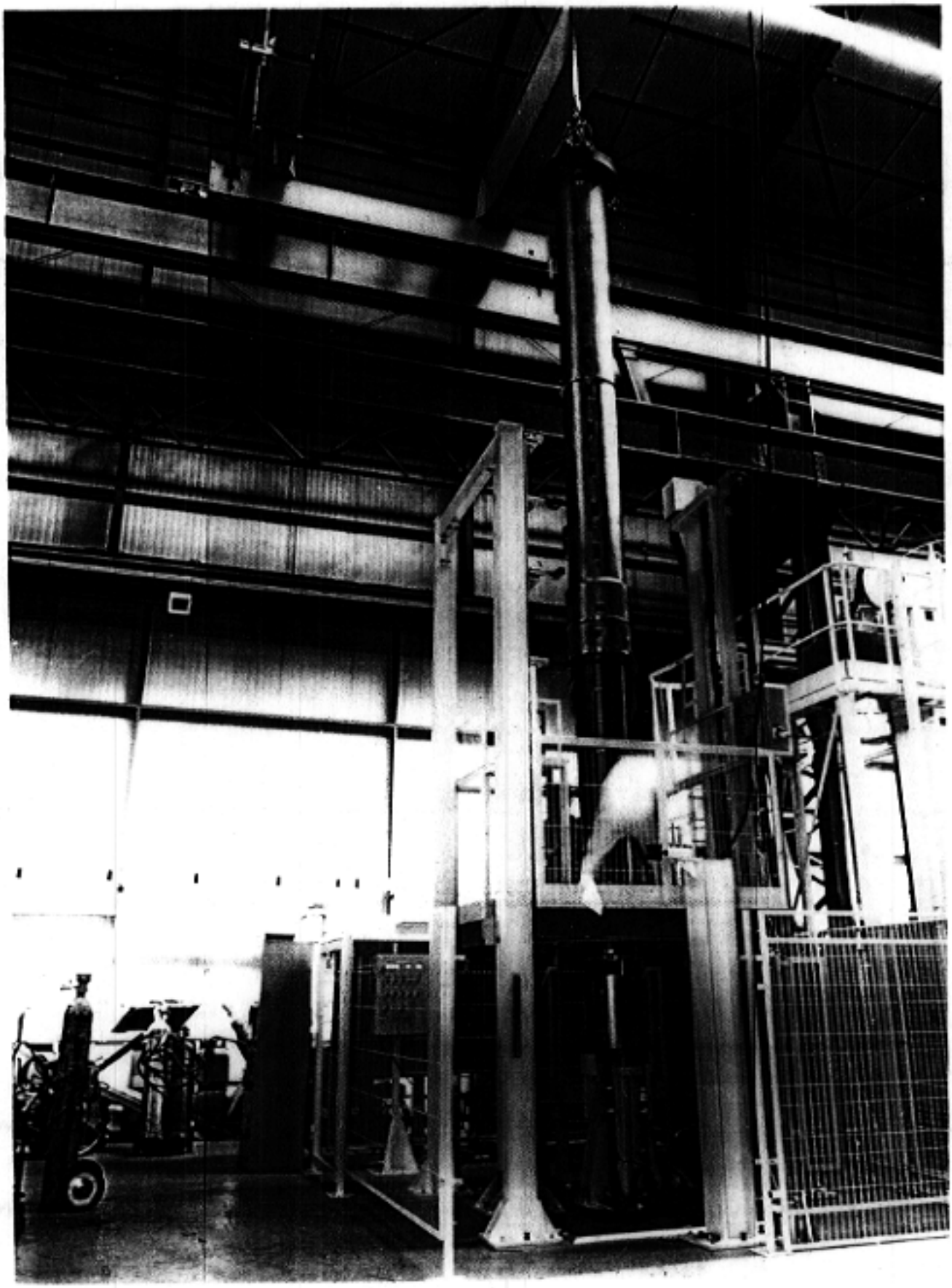
- Spool sextupole and decapole/octupole.
- Chromaticity sextupole and c/o dipole.
- Landau octupoles
- Trim and skew quadrupoles.
- All made with "scissors lamination" technique.

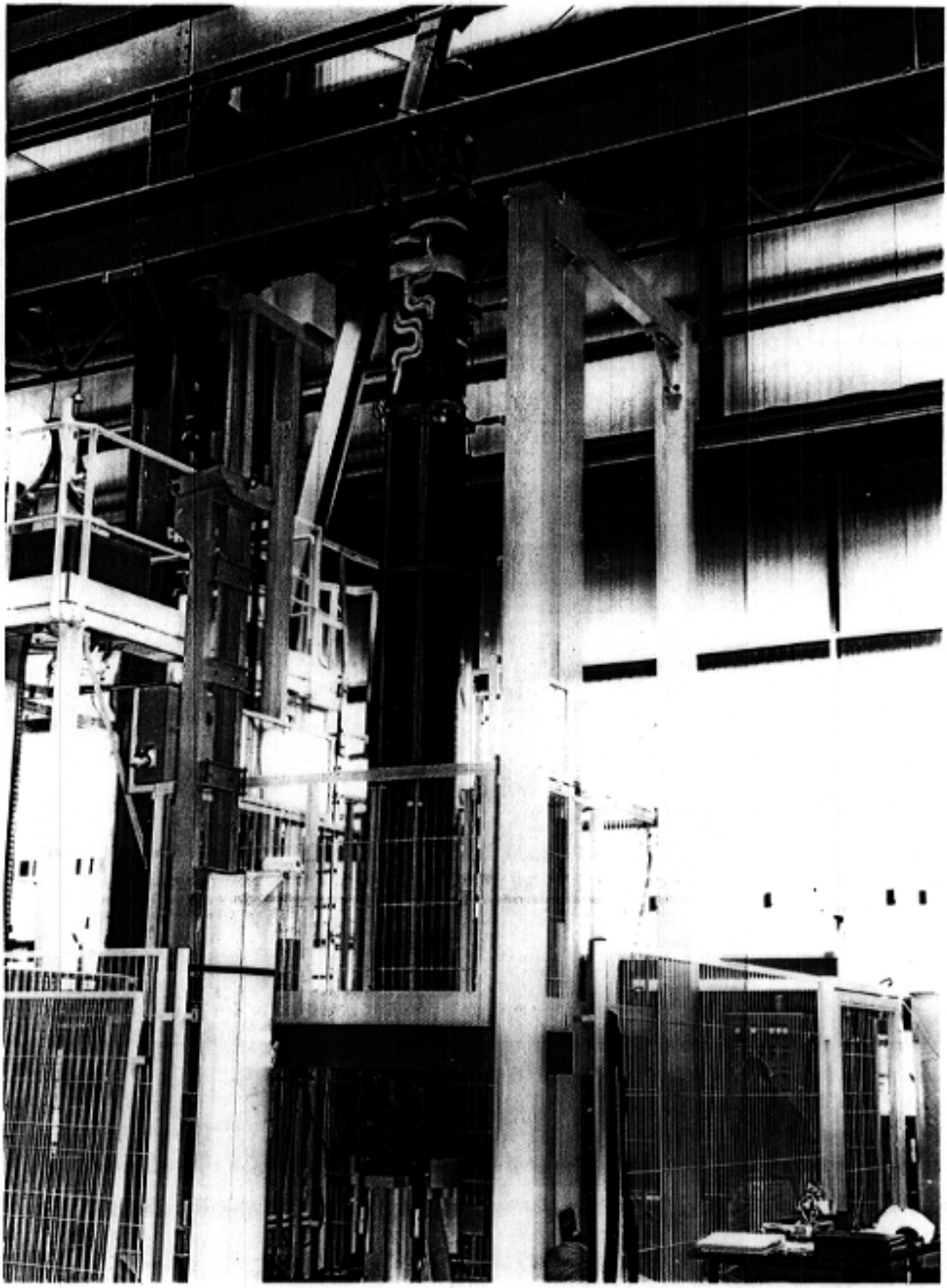
LHC

Main characteristics of FNAL and KEK inner triplet quadrupoles

		FNAL (Q2a, Q2b)	KEK (Q_1, Q_3)
Nominal gradient	(T/m)	205	205
Nominal current	(A)	10630	6050
Magnetic length	(m)	5.5	6.3
Overall length	(m)	5.77	6.68
Coil inner diameter	(mm)	70	70
Stored energy	(MJ)	1.1	1.9
Working point	(%)	80	80





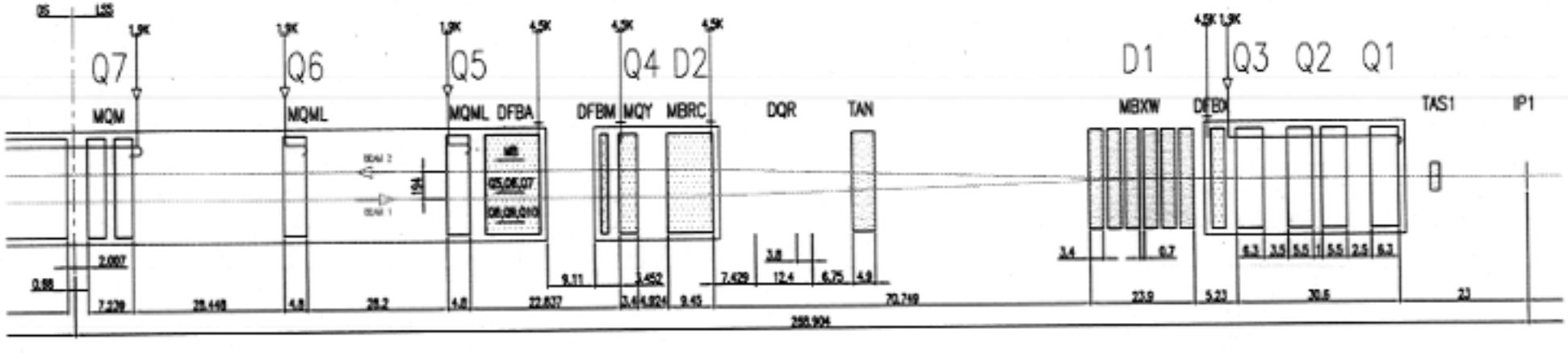


Dipole Parameters

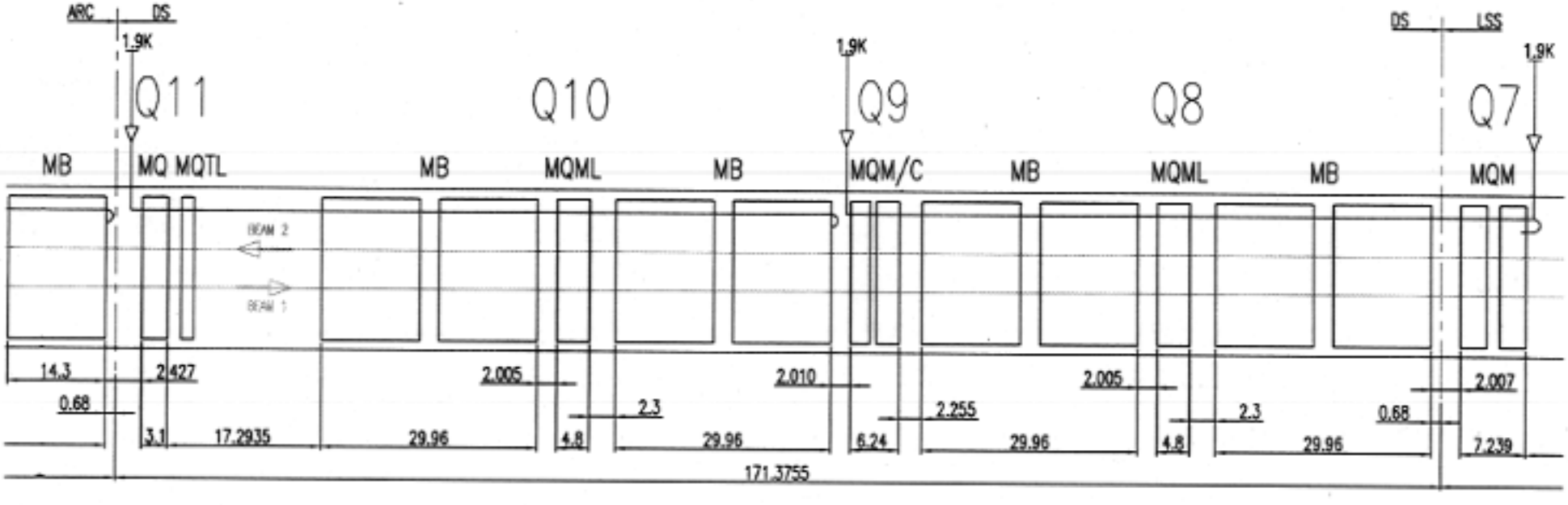
Operational field	(T)	8.3
Coil aperture	(mm)	56
Magnetic length	(m)	14.3
Operating current	(A)	11500
Operating temperature	(K)	1.9
Coil turns per beam channel:		
inner shell		30
outer shell		50
Distance between aperture axes	(mm)	194
Outer diameter of cold mass	(mm)	570
Overall length of cold mass	(mm)	15140
Outer diameter of cryostat	(mm)	980
Overall mass of cryomagnet	(t)	31
Stored energy for both channels	(MJ)	7.4
Self-inductance for both channels	(mH)	114
Quantity		1232

LONG STRAIGTH SECTION (LEFT OF IR1)

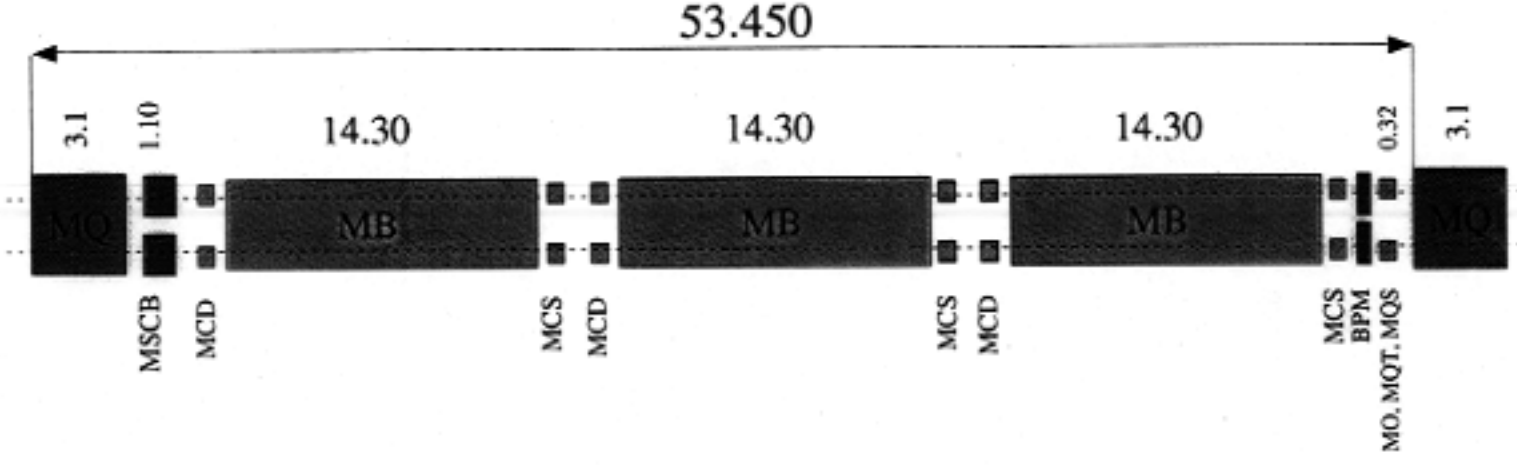
ATLAS



DISPERSION SUPPRESSOR (LEFT OF IR1)

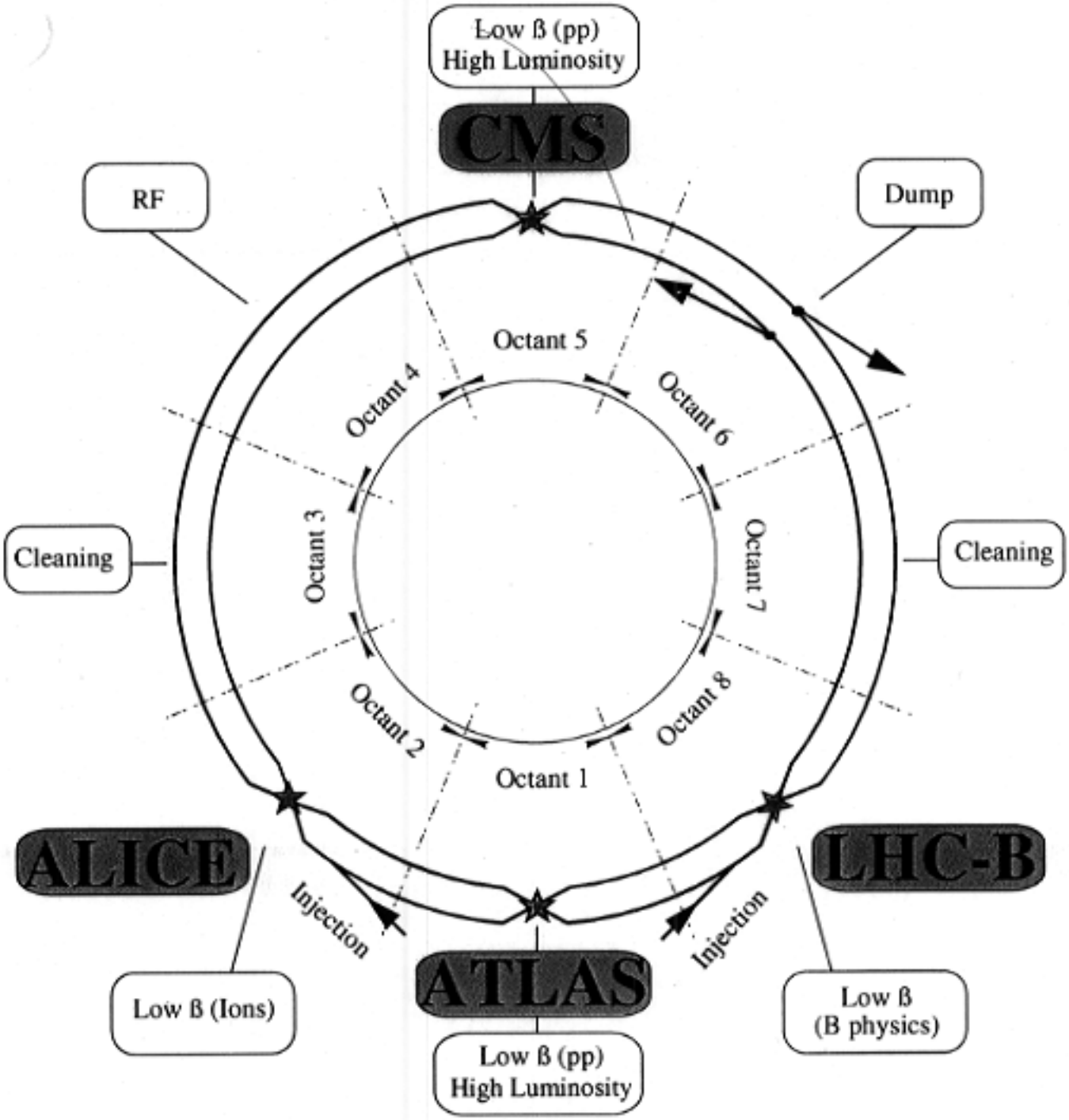


Schematic layout of LHC half-cell wtih 23 periods per octant



MQ : Lattice Quadrupoles	**MB** :Dipole magnet	**MO** : Landau Octupole	**MCS**: Local Sextupole corrector
MSCB : Combined Sextupole and Dipole correcteur		**MQT**: Tuning Quadrupole	**MCD**: Local Decapole corrector
		MQS: Skew Quadrupole	**BPM** : Beam position monitor

HF226/AC 05/97



LHC layout

HF239 EXP.

Acknowledgements

On behalf of the CERN LHC design team, I would like to acknowledge the enthusiastic collaboration of our colleagues from laboratories in Canada, India, Japan, Russia and the USA as well as from laboratories in the CERN Member States in the realisation of this project.