EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH
ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE

CERN - PS DIVISION

PS/ PO/ Note 95-17 (Min.)

ELECTRICAL ENGINEERING WORKING GROUP (EEWG-1)
(PRELIMINARY MEETING)

L. Coull

Geneva, Switzerland
5 September 1995

Electrical Engineering Working Group * EEWG-1

(preliminary meeting)

Meeting held on Wed. 30th August 1995 in Conference Room 112-R-018

Present : J-C Brunet, J.Casas-Cubillos, L.Coull, K.Dahlerup-Petersen, D.Hagedorn, K.Henrichsen, A.Ijspeert, P.Proudlock, F.Rodriguez-Mateos, R.Schmidt, L.Tavian, J.Vlogaert.

Excused : A.Bézaguet, M.Teng, L.Walckiers.

1) L.C. presented first ideas as to how the EEWG could run. This is shown in summary form in Annex 1.

a) The basic idea is that the full EEWG meets once per month and is mainly an information exchange where the latest news from the various LHC committees, groups, working groups etc. is presented and discussed. There will also be a progress report from the sub-groups (see b)) and normally an in-depth presentation of at least one of the main working themes. Proposals from the EEWG will pass to the LHC project management through the LHCTC.

b) The activities of the EEWG are fairly wide, and it does not lead to an efficient use of the members' time to treat in detail all subjects in full committee. Therefore the subject list was divided into two main groups which seem to have a certain consistency - the **first** (**Gr1**) covers super-conducting lines, current leads (normal and HTc), feed-boxes, and bus-bars, and the **second** (**Gr2**) (old Quench Prot. WG ?) covers quench protection, and radiation environment problems (this will include some aspects of instrumentation) - (Annex 2). Two other subjects - the electrical sub-division of the machine (which may already be decided), and electro-magnetic compatibility and earthing, are more general and will be treated in the EEWG. At the EEWG meetings a progress report of the activities of each of these sub-groups will be given. These two groups (**Gr1** and **Gr2**) can be considered as normal meetings of persons working on the same or closely related subjects, but in view of the dispersed situation of the LHC personnel some more formalizing is required. To some extent this situation will change with the restructuring at the end of the year. LC will begin to have individual discussions with the participants and will organize first meetings of these groups. A preliminary list of participants (from the EEWG) was proposed and this will probably be augmented by others. It is however emphasized that the groups should be kept small.

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* The exact title of the assembly was discussed. The appellation "E.E.Committee" seemed perhaps too pretentious and certainly too all-embracing, "E.E.Task Force" too military, so finally "E.E.Working Group" was chosen.

2) A short discussion of these proposals ensued in particular in the context of HTc compared to normal current leads. The main studies in this domain (HTc) are being carried out by AI with a doctoral student in collaboration with Oxford Instruments. Since this is one of the more "urgent" matters to follow up LC will contact those mainly concerned for further clarification of the situation.

3) PP gave a presentation of the main decisions of the LHC Steering Committee from the previous three months. (Notes in Annex 3).

4) LT then gave a shortened version of his presentation to the LHCTC on the technical (and financial) considerations for having a separate cryostat for the helium transfer and hence a true four point cryo feed. This is now the accepted version for the machine. A full summary of his presentation can be found in the LHCTC minutes for 1st August (available soon on WWW). The projections are attached (Annex 4).

5) Next meeting 27th September at 9.30 in 112-R-022.

Agenda later.

LC

(1/9/95)

Preliminary distribution : A.Bézaguet, J-C Brunet, J.Casas-Cubillos, L.Coull, K.Dahlerup-Petersen, D.Hagedorn, K.Henrichsen, A.Ijspeert, P.Proudlock, F.Rodriguez-Mateos, R.Schmidt, L.Tavian, M.Teng, J.Vlogaert, L.Walckiers.

L.Evans

Electrical Engineering Committee.

1) Why an EEWG?

Inter-relatedness of activities. (Text of Lyn Evans).

Information exchange from :

a) LHC Steering Committee (PP)

b) LHC Technical Committee (LC + PP)

c) Other ad hoc "task forces" such as "Dynamic Effects" (PP) and the various group, section, etc. meetings. e.g. Cryogenics, PC's, Magnets, etc..

d) Tests - String (F.R-M + ?), ramp (LW), Cryo (?) etc..

Meeting Program :

General Info.

Reports from sub-groups (see 2))

Theme presentation (esp. initially).

Leading to internal information exchange, and recommendations to LHCTC or other persons requiring such info. (e.g. R.Perin bus-bar query).

Meetings last Wed. of each month. (9.30 to 12a.m.).

2) Sub-dividing into 2 sub-groups

Proposal - to form WG's of the people already working in the "designated" domains (qv).

Question : to what extent does this already exist and is the present situation satisfactory ? (cf Quench Prot.WG).

Two main WG's and 2 "general" topics (see list)

a) Proposed sub-division (Gr1 and GR2).

b) Proposed members (prelimin).

WG meetings irregular, short, progress reports, problems (techn., personnel, or financial). Résumé given to the EEC monthly.

Annex 1.

Topics for the Electrical Engineering Working Group.

1) **The electrical subdivision of the LHC machine.** (general)

2) **Superconducting dc power lines.**

3) **Current leads.**

4) **Feed boxes.**

5) **Bus-bars.**

Gr1

6) **The quench protection system and the cold diodes.**

7) **The radiation environment for components installed in the tunnel.** (Instrumentation ?)

Gr2

8) **Electromagnetic compatibility and earthing.** (general).

GR1 : AB, J-CB, AI, LT, MT, JV, (LC, PP)

GR2 : JC-C, DH, KH (VR), FR-M, KD-P, RS, LW, (LC, PP)

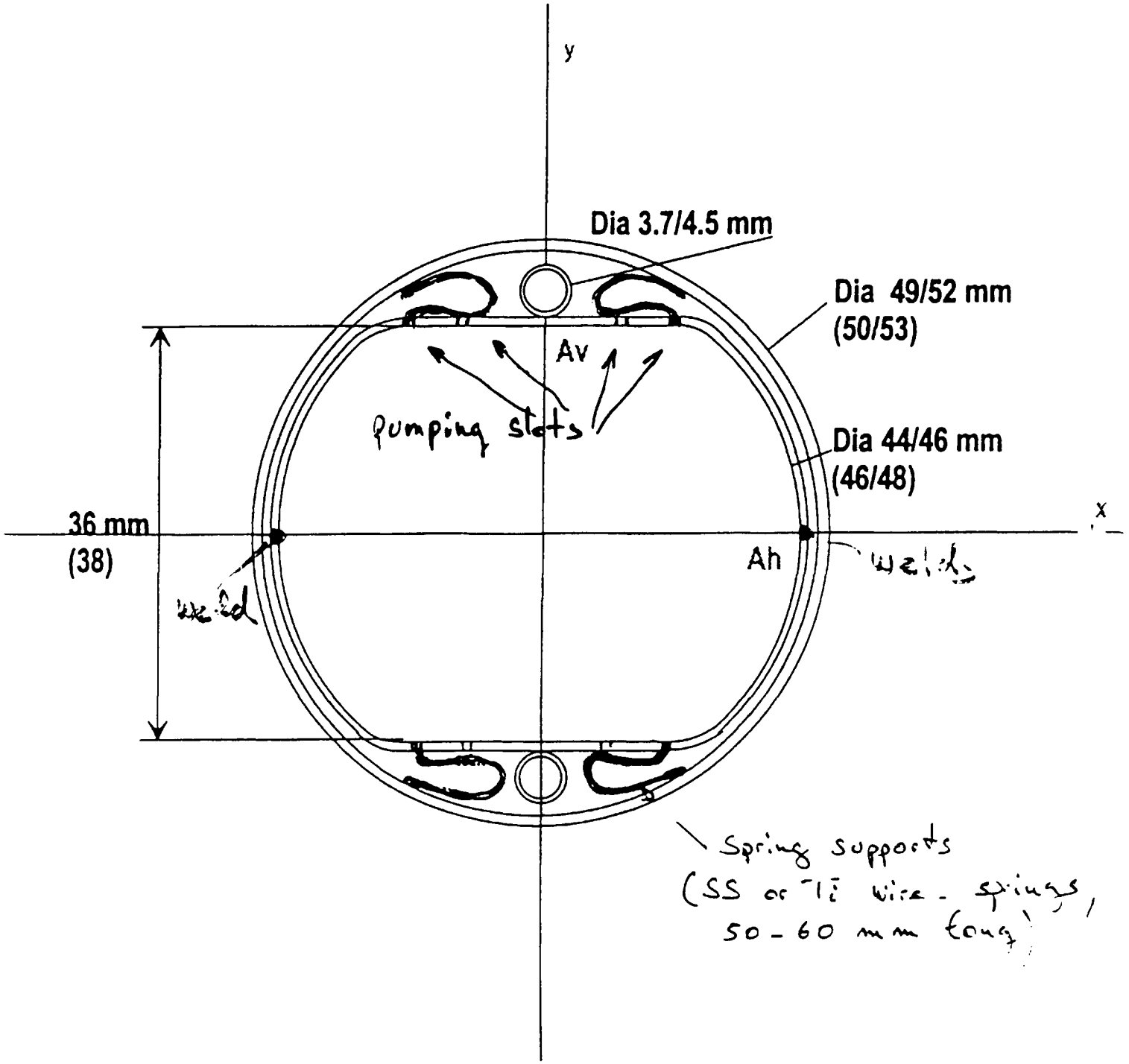
Annex 2.

1 LHC Steering Committee

- **30 May**
  - Separate RF in point 4
    - » not compatible with experiment
  - RD on superconducting cable (DL, RW, MW)
    - » 1200 tons needed
    - » Rc increase (stainless steel barrier), Ra decreased
    - » Cable tested facility requested
- **20 June**
  - Cryogenic true four point feed plus separate cryoline
    - » EE consequences, eg Sc lines in pt1 &7, Octant feed
  - Electrical Engineering WG announced
    - » Also Parameters WG, Dynamic effects WG

2 LHC Steering Committee

- **27 June**
  - Dismantling of Noell 1
  - New Beam Screen AP (Slide)
    - » Better mechanical aperture
    - » Reduce tolerances
    - » Screen to cold bore reduced (1.5 to 1mm)
- **11 July**
  - Beam spacing to 194mm (RP)
    - » Allow larger coil if necessary (15mm margin 15%)
      - 16 mm with Cu/Sc 1.4, one turn extra has 20%
    - » Reduces mechanical relaxation, Smaller press
    - » Cold mass unchanged and MQs easier



A new beam screen shape leaving more aperture for the beam
(minimum n1 = 6)
nominal dimensions are the same as in the present design

values in parenthesis,if validated by further studies,leave more margin (minimum n1 = 8)

FIGURE: NEWSCREEN

3 LHC Steering Committee

- -LHC Project notes
  - » Group leader authorization
  - » Jill keeps numbers, No other numbers
- Possibility of needing 230T/m MQ

υ **8 August**

- RF insertion in point 4 compatible with experiment
  - » Several RF hardware changes, reducing space
- MQ trim busbar
  - » Trim to remain for the moment
  - » AP to look into need.

4 LHC Steering Committee

- **15 August**
  - DOE visit 25-28 August
    - » Talks with DG plus some financial details
  - LHCMAC Chairman S. Tazzari, Sec. J. Jowett
    - » First meeting 13 to 15 November
    - » Technical review of latest version of LHC
    - » Open meeting except on 15 Nov.
  - Possible DOE financial review on 4-7 Dec
    - » ONE-OFF

5 LHC Steering Committee

- White book update delayed to incorporate latest mods.
  - » Separate cryoline
  - » True cryogenic four point feed
  - » Beam spacing of 194mm
  - » RF in point 4 with space for experiment
  - » New beam screen
  - » Modified powering scheme
  - » Minor cosmetic changes
- Corrections in by 15 Sept., 1st draft printed 1 October

6 LHC Steering Committee

- Future test stands, (PS BS VS) (Slides)
  - » #3 - 10 & 14m dipoles, - ready Jan 97
  - » #4 - 10 & 14m dipoles, - ready Summer 97
  - » #2 - SSSs only, - ready End 97
    - Manpower?
    - Powering?
- Cryostats and MFBs to follow
  - » 1st New style cryostat for Oct 96!!

- **Lyn on holiday**
- **Next meeting 19 Sept.**
  - Report from String Mini-workshop
  - Future plans for the String

P. Sievers / 15.08.95

MAGNET TEST PROGRAMME IN SM-18 (1996-1998)

V. Benda, Ph. Lebrun, V. Sergo, P. Sievers, B. Szeless, B. Vullierme

NOELL II 1995 (1996)

	OLD STYLE MAGNETS (tested on bench No. 1)	TEST 1996
I	ALSTHOM	Jan. - April
II	NOEL 1'	May - July
III	ELIN-HOLEC	Aug. - Oct.
IV	OLD STYLE QUADRUPOLE (SACLAY) + CRYOSTAT (Verification of SACLAY - Measurement + Field Directions + Axis, Commisioning of CERN - Quadr. Meas. System)	Autumn 96 - Spring 97

	NEW STYLE MAGNETS, ALL IN NEW STYLE CRYOSTATS + SEP. CRYOLINE		TEST
I	10 m - DIPOLE	NOELL 1 (Nov. 96)	Jan. - April 1997
II	10 m - DIPOLE	ALSTHOM 1 (Febr. 97)	May - July. 1997
III	10 m - DIPOLE	NOELL 2 (Dec. 96 or April 97)	? 1997
IV	10 m - DIPOLE	ALSTHOM 2 (Nov. 96 or Aug. 97)	? 1997
V	14 m - DIPOLE	CERN/INFN 1 (May 97)	Aug. - Oct. 1997
VI	14 m - DIPOLE	ANSALDO/CERN 1 (Oct. 97)	Oct. 1997/98
(VII	SHORT-STRAIGHT SECTION 1, TESTED AT SACLAY)		Autumn 1997
VIII	SHORT-STRAIGHT SECTION 2, TESTED AT CERN		Spring 1998

TEST SCENARIOS

MANDATORY: ONE NEW STYLE TEST STAND
No. 3 FOR BOTH 14 m DIPOLES

ready Spring 1997

- LONG-LARGE ANTI-CRYOSTAT
- LONG COIL
- MOLE
- NEW CRYOGENICS + MFB
- MFB FITTED WITH 1 PAIR OF 13 kA-CURRENT LEADS, 2 (4) PAIRS OF THE ADDITIONAL 500 A-CURRENT LEADS FOR AUX. SEXTUPOLES AND DECAPOLES, TEST OF DIODES (?)

P. Sievers / 15.08.95

PROPOSAL

- PROVIDE STAND No. 3 FOR 10 m DIPOLES AND FOR 14 m DIPOLES IN JANUARY 1997
  - NEW CRYOGENICS MUST BE READY
  - NEW MAGN. FIELD MEASUREMENT MUST BE READY FOR 14 m MAGNET
  - FALL BACK SOLUTIONS AVAILABLE FOR MEASUREMENT SYSTEM OF 10 m MAGNETS, IF NEW SYSTEMS NOT READY BY JANUARY 1997

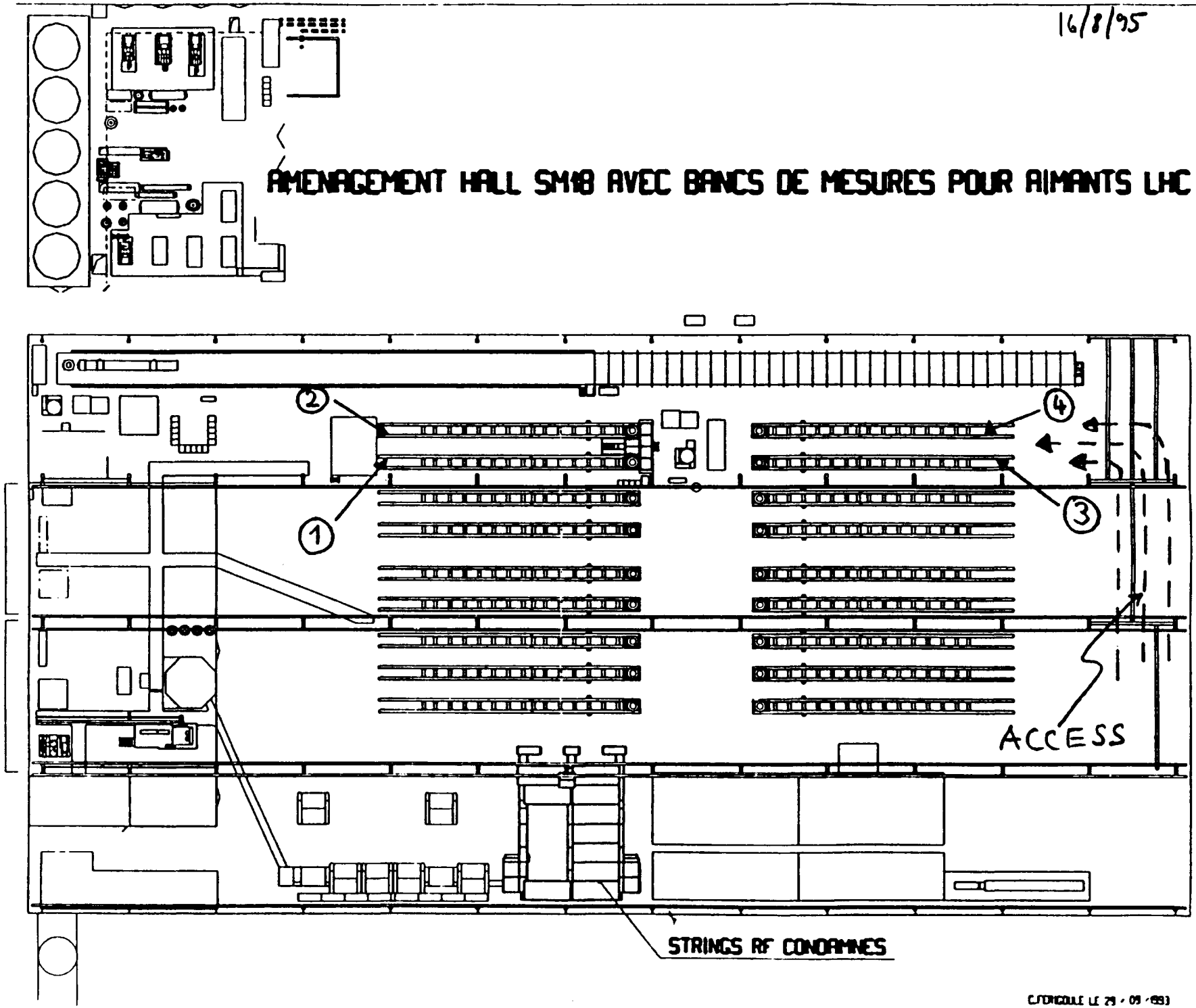
- LAUNCH ALSO BENCH No. 4, READY SUMMER 1997 (OPTION)

- LAUNCH ALSO BENCH No. 2 FOR SSS ONLY, READY END 1997 (FALL BACK SOLUTION FOR 10 m NEW STYLE, IF READY AUTUMN/SUMMER 1997)

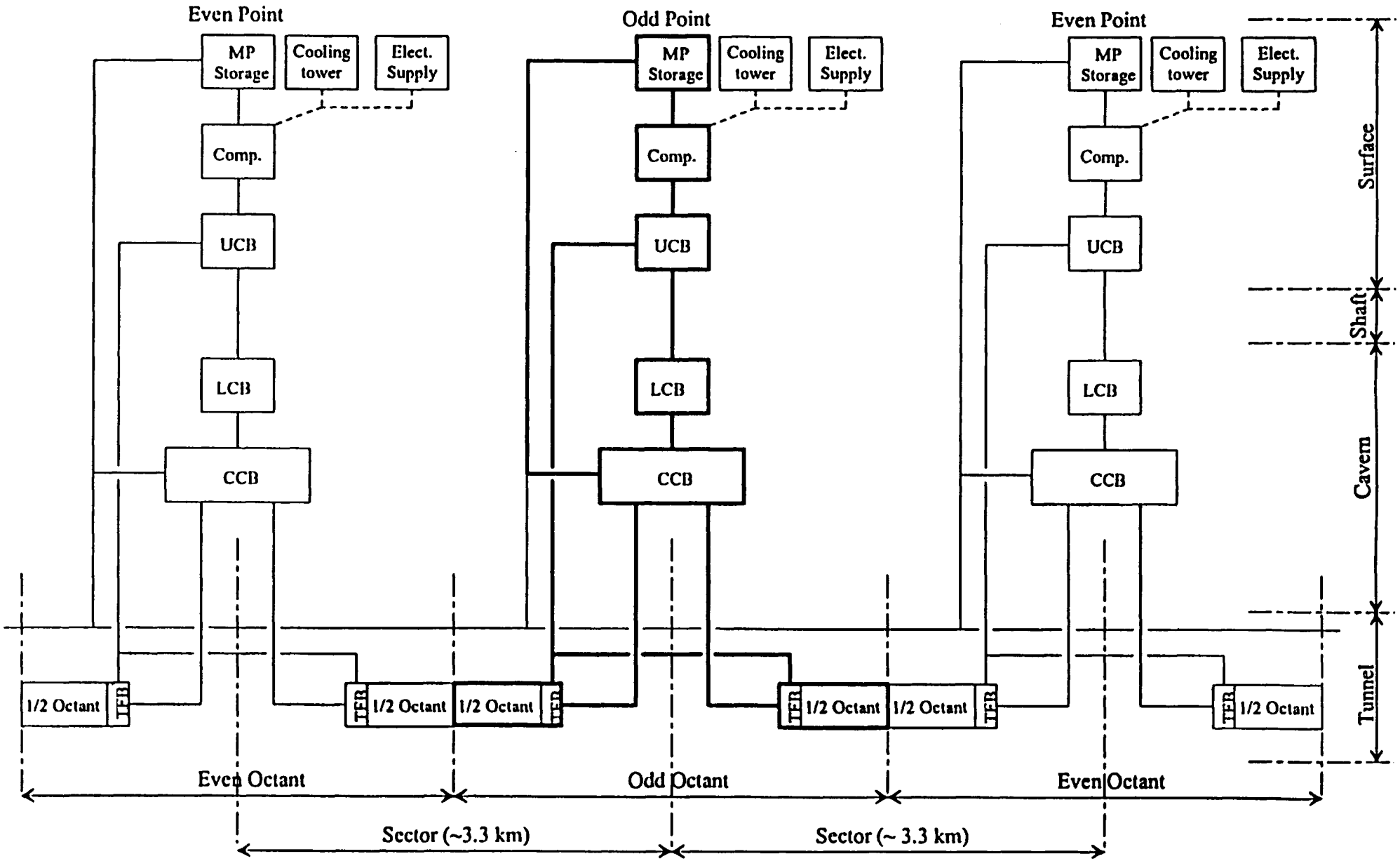
- IMPORTANT:
  - SPECIFY WHAT TO TEST (e.g. Aux. Magnets)
  - SPECIFY TEST EQUIPMENT (e.g. current leads, signal cables...)
  - SPECIFY CRYOGENIC TEST CONDITIONS (e.g. high voltage conditions, velocity of cool down, allowed thermal gradients,...)
  - PROVIDE MANPOWER FOR CONSTRUCTION AND TESTING

16/8/95

AMENAGEMENT HALL SM18 AVEC BANCS DE MESURES POUR AIMANTS LHC

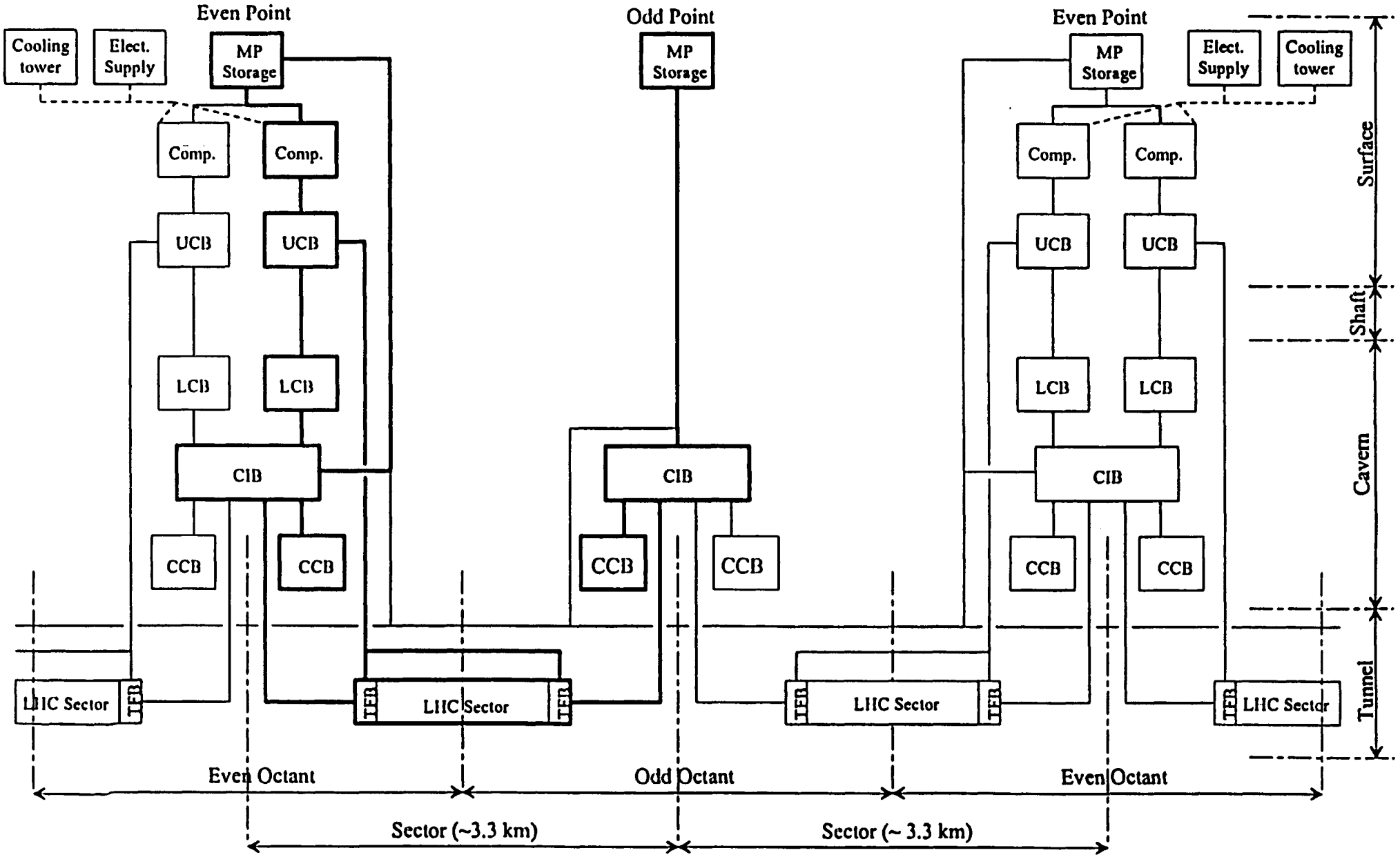


C.TERRIOLLE LE 29 / 09 / 93



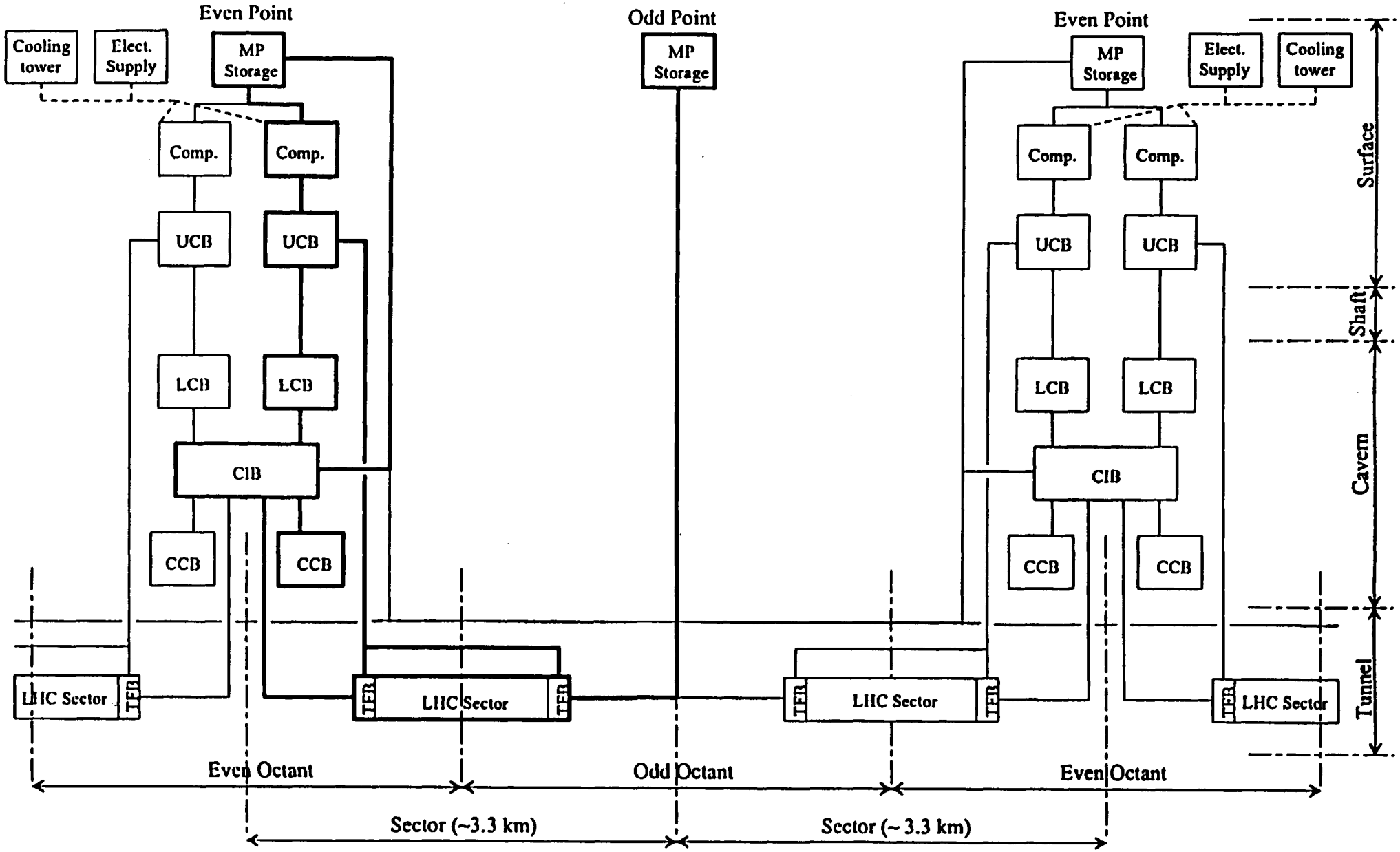
LHC 8-POINT FEED : CRYOGENIC BLOCK DIAGRAM

UCB: Upper Cold Box
LCB: Lower Cold Box
CCB: Cold Compressor Box
TFB: Tunnel Feed Box



LHC PSEUDO 4-POINT FEED: CRYOGENIC BLOCK DIAGRAM

UCB: Upper Cold Box
LCB: Lower Cold Box
CIB: Cryoplant Interconnection Box
CCB: Cold Compressor Box



LHC REAL 4-POINT FEED : CRYOGENIC BLOCK DIAGRAM

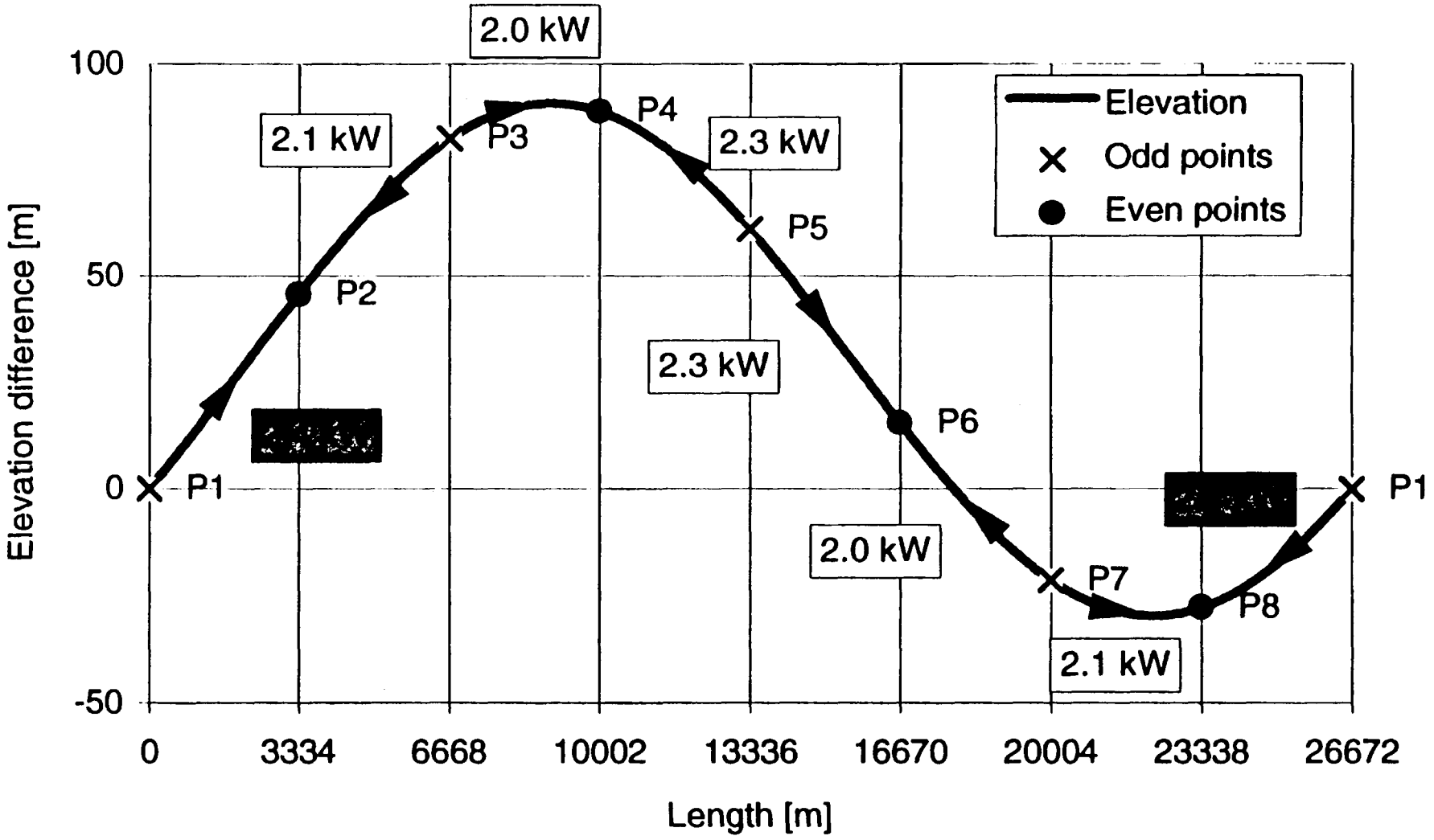
UCB: Upper Cold Box
LCB: Lower Cold Box
CIB: Cryoplant Interconnection Box
CCB: Cold Compressor Box
TFB: Tunnel Feed Box

LHC Real Cryogenic Four-Point Feed Advantages

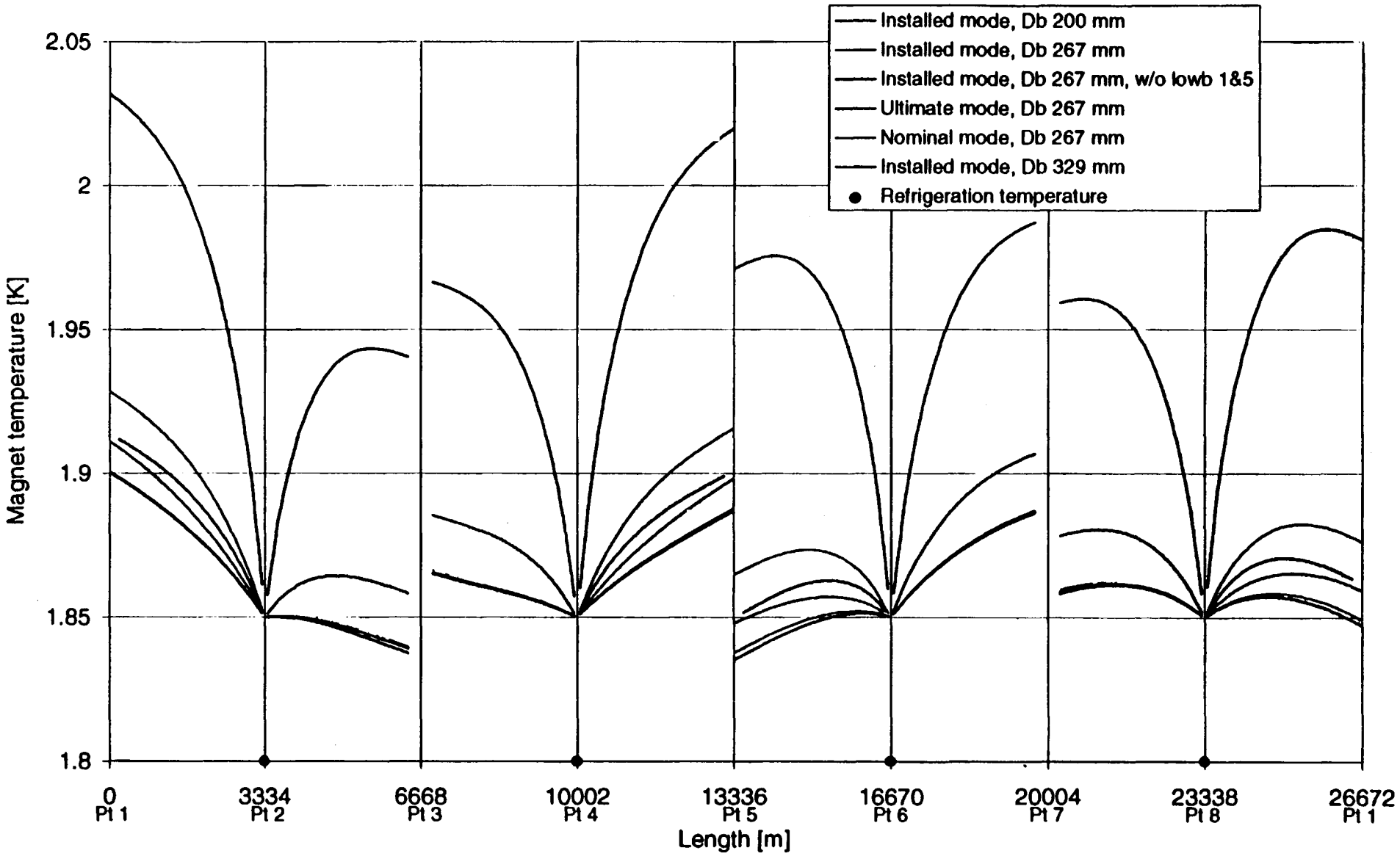
- Group all equipment in cryogenic "islands" at even points
  - share common infrastructure
  - no cryogenic caverns at odd points
  - no power & utility requirement at odd points
  - opens possibility of mixed compression schemes
- Eight CCBs of 100 g/s instead of sixteen CCBs of 50 g/s, with no loss of redundancy
- Suppress four CIBs at odd points
- Suppress line D' (27 km of cold DN100 pipework)
- Remove uncertainty of CCB operation at odd points
  - transients in 2 x 3.3 km of pipework
  - coupling of LCB-CCB link with magnet cryostats

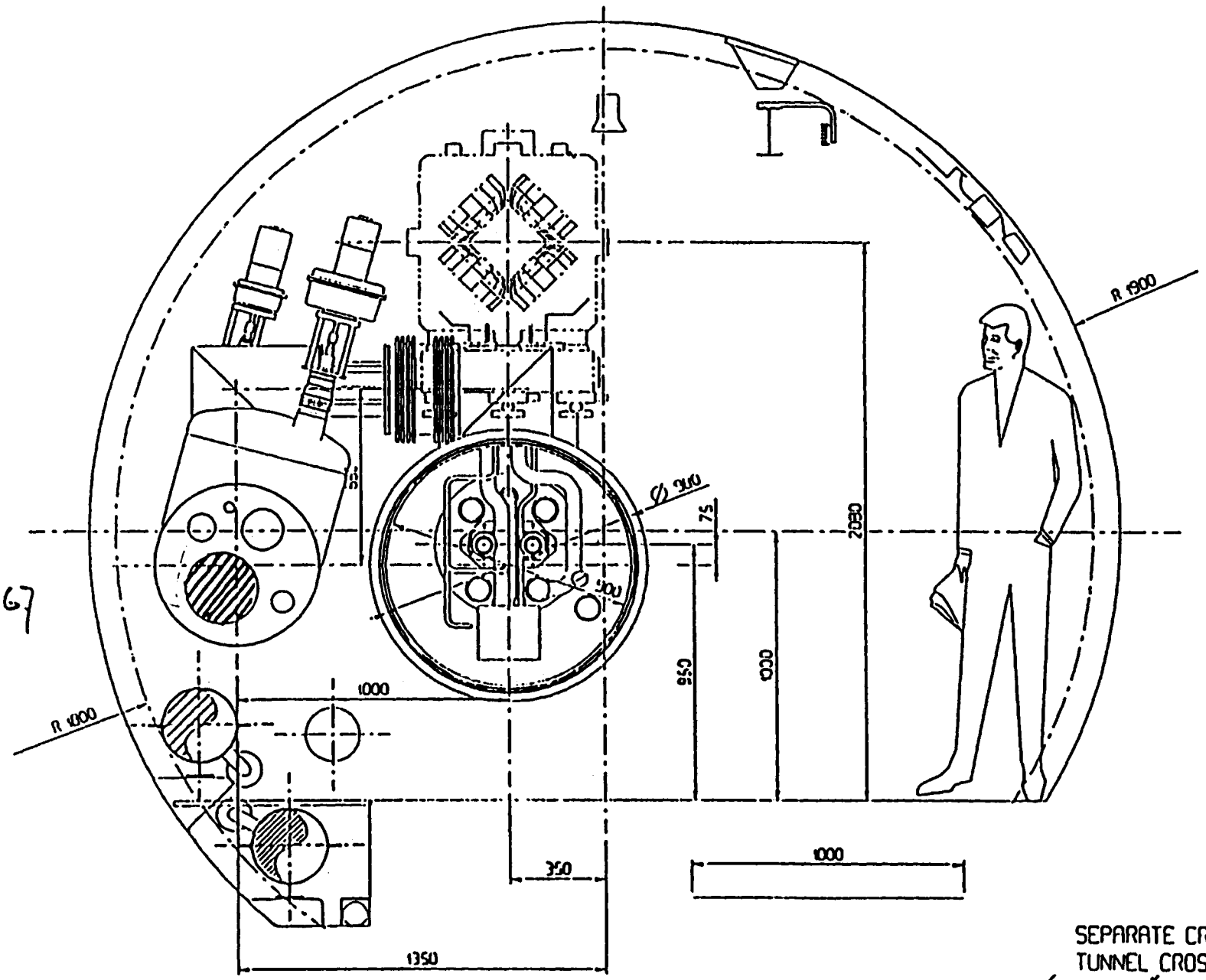
PhL/1995

Elevation difference of LHC points



Magnet temperature profiles for different modes and pipe B diameters





$\phi_{int} = 267$

SEPARATE CRYOLINE STUDY
TUNNEL CROSS-SECTION .
("TRUE" 4 FEED POINTS)

CONCLUSIONS

- Real 4-point feed gives a more rational cryogenic system.

- Real 4-point feed scheme is only possible with:
  - Separate CryoLine,
  - Pumping line diameter $\geq$ 267 mm,
  - Warmest magnet temperature $\leq$ 1.93 K.

- Corresponding cost savings:
  - On cryogenics: $\approx$ 30 MCHF,
  - On civil engineering: $\approx$ 30 MCHF.

DISTRIBUTION LIST
EEWG MINUTES

A. Bézaguet (AT)

J-C. Brunet (MT)

J. Casas-Cubillos (AT)

L. Coull (PS)

K. Dahlerup-Petersen (SL)

L.Evans (DG)

D. Hagedorn (AT)

K. Henrichsen (AT)

A. Ijspeert (AT)

P. Proudlock (SL)

V.Remondino (AT)

F. Rodriguez-Mateos (AT)

R. Schmidt (SL)

L. Tavian (AT)

M. Teng (ST)

J. Vlogaert (AT)

L. Walckiers (AT)