

Contents

1	Why LEP and Why at CERN?	1
1.1	Is Curiosity-Driven Research Justified?	1
1.2	Colliders Surpass Accelerators	3
1.3	The Stage for a World Facility	6
1.4	The Birth of LEP	8
	References	10
2	The Difficult Decision of LEP's Size and Energy	11
2.1	The Optimization of Construction Cost	11
2.2	The LEP Studies	14
	References	17
3	The Approval, or How To Persuade Governments	19
3.1	The Unification of CERN	19
3.2	Adapting to the Austere Conditions	22
3.3	The Final Proposal – with the LHC in Mind	23
3.4	The Painful Approval Procedure	26
3.5	The Thorny Consequences of a Limited Budget	28
	References	30
4	The Tunnelling Adventure	31
4.1	The Different Elements of Civil Engineering	31
4.2	The Geology and Hydrology	34
4.3	The Choice of the Final Position	35
4.4	The Tunnelling Strategy	38
4.5	The Civil Engineering – Expectations and Reality	42
4.6	Geodesy	49
4.7	The Arbitration	50
4.8	What Else?	51
	References	52

5	The Environment – People and Nature	53
5.1	Dialogue with the Population	53
5.2	Radiation Safety – Hazards for the Population?	54
5.3	Legal Problems	55
5.4	The Environmental Study – <i>Étude d'Impact</i>	57
5.5	Energy Consumption	58
5.6	Additional Measures	59
	References	60
6	LEP – The Technical Challenge	61
6.1	How Does a Collider Work?	62
6.2	The ‘Concrete’ Magnets	65
6.3	The Vacuum System	69
6.4	The Radio-Frequency Accelerating System	71
6.4.1	Copper Cavities	71
6.4.2	Superconducting Cavities	75
6.5	Other Components	78
6.5.1	Transport in Tunnel	78
6.5.2	Control System	80
6.5.3	Conventional Equipment and Safety	81
6.6	Injection System	82
6.7	The Final Steps	84
6.7.1	Installation and Dismantling	84
6.7.2	Dismantling	85
6.8	The First Collisions	86
	References	89
7	The LEP Experiments – Institutions in Themselves	91
7.1	The Approval of the LEP Detectors	91
7.1.1	A Meeting in the Swiss Alps and Letters of Intent	92
7.1.2	The LEP Experiments Committee	94
7.1.3	The Conditional Approval	95
7.1.4	A Typical Detector and Detection Methods	98
7.2	The Four LEP Detectors	102
7.3	Data Acquisition and Evaluation	108
7.4	Organization and Management of the Collaborations	110
	References	112
8	What Have We Learned from LEP? – Physics Results	113
8.1	What Is the Standard Model?	115
8.2	Building Blocks of Matter	115
8.3	The Forces of Nature	118
8.4	Symmetries – the New Paradigms	121
8.5	The Symmetries of the Standard Model	122

8.6	The Z Factory – Results from LEP 1	124
8.6.1	Results for the Weak Interaction	127
8.6.2	Results for the Strong Nuclear Force	130
8.7	Results from LEP 2	132
8.7.1	W Particle Production	132
8.7.2	Looking for the Invisible – the Top Quark	135
8.7.3	The Higgs Particle – Disappointment but!	137
8.7.4	Hints Beyond the Standard Model	138
8.8	Summary of LEP Results	140
	References	141
9	Creating New Technologies	143
9.1	Basic Research Leads to Quantum Jumps in New Technologies ...	143
9.2	The Technological ‘Spin-Off’	145
9.2.1	Transfer Through Patents and the World Wide Web	145
9.2.2	Joint-Development Contracts	146
9.2.3	Technology Transfer by Procurement	148
9.2.4	Technology Transfer by People	150
	References	152
10	Unloved but Necessary – Management and Finances	153
10.1	The Kendrew Committee	153
10.2	The Abragam Committee	155
10.3	Personnel Policy	158
10.4	The LEP Management and Budget	161
10.5	The Total CERN Budget	163
	References	166
11	How To Invite the Pope? – VIP Visits	167
	References	178
12	CERN – Bringing Nations Together	179
	References	183
13	The Complicated Transition from LEP to the LHC	185
	References	191
14	The Dramatic Last Period of LEP	193
	References	197
	Acknowledgments	199
	Appendix: CERN Organigram 1984	201

Appendix: Leading CERN Staff During the LEP Project	203
Glossary	205
Index	209