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CERN SCIENTIFIC ACTIVITIES DURING LEP CONSTRUCTION

At its session in December 1979, the Council discussed a document presented by the CERN Management entitled "The Next Major Accelerator Project for Europe (LEP)" (CERN/1347). The Council agreed that studies of the Project should continue as proposed in this document and that the Scientific Activities and long-term budgets of the Organization should be planned on the assumption that the LEP machine described in the "Pink Book" (CERN/ISR-LEP/79-33) would be constructed at CERN starting at the beginning of 1982.

The Management strongly recommends that a total net budget of 643 million Swiss francs per year at 1980 costs (620 million Swiss francs at 1978 costs) be made available to CERN during the years of LEP construction. In the present document, the problems concerning the Scientific Activities of the CERN Laboratory during the years of LEP construction are discussed and proposals are made for budget and staff allocations during this period. The analysis given shows that a total net budget level of 623 million Swiss francs per year at 1980 costs (600 million Swiss francs at 1978 costs) which was put forward by the Directors-General in 1978 would result in a construction time for LEP which is much longer than is now recommended by the Scientific Policy Committee and/or would mean severe reductions in the Materials budgets which could be allocated to the SPS Scientific Activity on which the majority of the users of the CERN Laboratory will depend during the years of LEP construction.

CERN SCIENTIFIC ACTIVITIES DURING LEP CONSTRUCTION

Introduction

1. At its session in December 1979, the Council discussed a document presented by the CERN Management entitled "The Next Major Accelerator Project for Europe (LEP)" (CERN/1347). This document discussed the major issues raised by such a project which may be summarized as follows:

   (a) The choice of a large electron-positron colliding beam machine (LEP) as the next major accelerator project for Europe.

   (b) The size and site for the machine.

   (c) The time scales for decisions on the project.

   (d) The level of the CERN budgets during the construction of the project and its effect on the other Scientific Activities of CERN.

   The views of the Scientific Policy Committee and of the European Committee for Future Accelerators (ECFA) on these major issues were also presented to the Council. The Council agreed that studies of the project should continue as proposed in document CERN/1347 and that the Scientific Activities and long-term budgets of the Organization should be planned on the assumption that the LEP machine described in the "Pink Book" (CERN/ISR-LEP/79-33) would be constructed at CERN starting at the beginning of 1982.

2. Of the major issues listed above, therefore, only the question of the level of the CERN budgets during the construction of the LEP machine and its effect on the other Scientific Activities at CERN was left open. The Directors-General predicted at the Programme Meeting of the Committee of Council held on 27 April 1978 that LEP could be built and a reduced but satisfactory programme of research activities carried out at CERN during the LEP construction period with a budget level of 600 million Swiss francs per year at 1978 costs provided that the ISR and SC machines were closed down at the start of LEP construction. At the December 1979 session of Council, Delegates expressed differing views on the level of CERN budgets; the lowest figure mentioned was 580 million Swiss francs per year at 1978 costs but some Delegates suggested

that a higher figure than 600 million Swiss francs per year at 1978 costs should be envisaged when LEP construction starts. The Chairman of the Scientific Policy Committee, at the December 1979 session of Council, said that the Scientific Policy Committee would be examining the effect of LEP construction on the other Scientific Activities of CERN early in 1980 and would report later to Council on this question.

3. At its meeting on 26 and 27 February 1980, the Scientific Policy Committee discussed this matter at length. The CERN Management presented models of the years of LEP construction based on well-defined policies concerning the SC, ISR, PS, SPS, Theory and Miscellaneous Scientific Activities, and different budget levels which spanned the range of levels suggested by Council Delegates in December 1979. It was decided to retain three levels for planning purposes equivalent to 580, 600 and 620 million Swiss francs per year at 1978 costs. The models showed that once the policies were settled for the SC, ISR, PS, Theory and Miscellaneous Scientific Activities and Materials budgets allocated to them, which in total reduce to about 6% of the available Materials budgets from 1984 onwards, the real problem was the balance to be established between the SPS Research Activity during LEP construction and the LEP construction time. The majority of the research physicists from the Member States using the facilities of the CERN Laboratory are now concentrated on research programmes based on the SPS machine which in future will be operated both as a fixed-target proton accelerator and as a proton-antiproton colliding beam machine. After the phasing out of the ISR Activity, the number of SPS users is expected to increase further. It is therefore very important to these users that the SPS Research Activity is operated at the maximum possible level during the LEP construction period. On the other hand, the European particle physics community is anxious to start experiments with the LEP machine as soon as possible. The Scientific Policy Committee unanimously recommended at its February 1980 meeting that all possible efforts should be made to plan the construction of LEP so that experiments may start at an initial energy of 50 GeV per beam at the earliest possible date and preferably five years from the start of construction. It will be very difficult for the CERN Management to reconcile these two requirements but clearly its task will be less difficult the higher the total CERN budget during the years of LEP construction.

4. In this document the problems concerning the Scientific Activities of the CERN Laboratory during the years of LEP construction are discussed and proposals are made for budget and staff allocations during this exciting but difficult period in the life of the Laboratory.

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Planning Procedure

5. As agreed by the Council in December 1979, the planning assumes that LEP construction starts at the beginning of 1982. The two important planning parameters which determine what can be carried out at the CERN Laboratory in the future are the Materials budgets and the manpower available.

6. The Materials budgets cover the cost of the materials used in operating the Laboratory and all its existing facilities and the cost of materials used in constructing new equipment which adds to or improves the facilities provided by the Laboratory to its users. In the case of CERN its facilities include not only the particle accelerators and colliding beam machines, their experimental areas and all their experiments, but also the site of the Laboratory with its technical infrastructure and all the technical and administrative services such as computational facilities, transport, housing and stores facilities which are used not only by the staff of CERN but also by the 1800 researchers from universities and national laboratories whose research is based on CERN.

7. The manpower available at CERN, measured in man-years, is mainly composed of CERN staff but in addition firms are contracted to carry out work for CERN. This work is either carried out on the premises of the firms or on the site of CERN. The cost of of the CERN staff manpower is determined by the number of man-years and the cost per man-year fixed by the Council when it decides on CERN salary scales and allowances. Multiplying the two together gives the major part of the Personnel budget, the remainder being the salaries and allowances paid to Fellows and Associates. The cost of the manpower provided by firms whether the work is carried out at the premises of the firm or on the CERN site is paid from the Materials budgets. In this document and from the point of view of planning it is the CERN staff manpower which is of primary importance.

8. The work at CERN is divided into Scientific Activities and the costs of each Activity are estimated in the document "Scientific Activities and Budget Estimates" for the years ahead. It has become accepted that each Scientific Activity is broken down under four headings.

1. Experiments and Data Analysis
2. Machines and their Experimental Areas
3. Electrical Power and Water
4. Technical and Administrative Services.

The costs of the common technical and administrative services are allocated on a proportional basis to each Activity. Where, for example, an Activity like the SPS or ISR involves an injector machine like the PS the costs of operating the PS machine as injector are allocated proportionately to the other Activities, the remaining costs being allocated to the PS Activity. This method of costing the different Activities is strictly correct as regards their true cost to the CERN Laboratory. From the point of view of planning over periods of many years, it is more useful to work in terms of materials operating costs and the material costs of new equipment as pointed out above (paragraph 7). Following this approach the four headings for each Scientific Activity become:

1. Operation
2. New Equipment
3. Electrical Power and Water
4. Technical and Administrative Services.

The first heading includes the materials costs for operating the machines, their experimental areas, their experiments and the materials costs for data analysis. Clearly, if no investment is made under the second heading then the Scientific Activity continues without any new major facility being added. With these preliminary remarks in mind, each of the present Scientific Activities can be examined in the light of present policies and its Materials budget allocations estimated for the years ahead.

SC Activity

9. It was planned to close down the SC Activity at the start of LEP construction. Now it is accepted that it should be reduced to run only as injector to the ISOLDE experimental facility. Also it is being discussed whether ISOLDE physics would not be better carried out in the long term at the Swiss National Laboratory (SIN) at Villigen where a synchrocyclotron of the same energy as the CERN synchrocyclotron but of much higher beam intensity is in operation. The materials cost of operating the SC Activity for ISOLDE only is estimated at 2.7 million Swiss francs per year. This level according to present planning will be reached in 1983. 1982 is a transition year in which the materials operation costs are estimated to be 5.3 million Swiss francs as compared with the 1980 and 1981 costs of 6.1 million Swiss francs each year. For planning purposes the possible move of ISOLDE to SIN is not taken into account.

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PS Activity

10. The policy is to continue to operate at CERN an active intermediate energy physics programme using the PS machine and to construct a new experimental facility which is a low-energy, high-intensity antiproton source, called LEAR. It is planned that this new facility will be completed in 1982. In 1980, the PS Activity Materials budget is 14.0 million Swiss francs. In 1981 and 1982, due to the construction of the LEAR facility, the PS Activity Materials budgets are higher: 19.6 million Swiss francs in 1981 and 16.3 million Swiss francs in 1982. In 1983, it returns to an operation budget level of 13.3 million Swiss francs.

ISR Activity

11. The policy was to close down the ISR Activity when LEP construction starts. Now it is proposed that 1982 is the last year of full operation and that this Activity will be terminated at the end of 1983. Consequently, the Materials budgets for the ISR Activity are estimated to be:

1980 - 43.2 MSF
1981 - 38.3 MSF
1982 - 26.4 MSF
1983 - 15.7 MSF.

In 1984, a small Materials budget of 0.8 million Swiss francs is foreseen to complete the data analysis of the last experiments and from 1985 onwards zero budgets are allocated.

Theory Activity

12. It is planned to continue the present level of the Theory Activity throughout the years of LEP construction. The Materials budgets therefore remain constant at 1.3 million Swiss francs per year.

Miscellaneous Activities

13. It is planned to continue the present level of the Miscellaneous Activities (now mainly Special Detector Development) throughout the years of LEP construction. The Materials budgets therefore remain constant at 1.2 million Swiss francs per year.

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Addition of the Activities Mentioned Above

14. It is convenient at this point in the procedure to add together the Materials budgets for the Activities mentioned above since the policies concerning these Activities are the most generally agreed and the total expenditure on these Activities becomes a small fraction of the total Materials budgets available (about 6% in 1984). Hence variations in these Activities will hardly affect the main problem which is discussed below. The sum of the Materials budgets each year for these Activities is as follows:

1980	65.9 MSF net, at 1980 costs
1981	66.5 MSF
1982	50.5 "
1983	34.2 "
1984	19.3 "
1985 onwards	18.5 "

SPS Activity

15. The Materials budget for the SPS Activity in 1980 amounts to 240.1 million Swiss francs of which the expenditure on new equipment is 89.8 million Swiss francs. The new equipment under construction mainly concerns the proton-antiproton modifications to the SPS machine and includes the CERN expenditure on the five new experiments which will use this new facility. In addition, there is new equipment under construction to increase the intensity of the SPS machine and a new high-intensity hall coming into service with two new experiments in the North Experimental Area of the SPS. The materials expenditure on all this new equipment comes to an end in 1982. The Materials budget for operation of the SPS Activity in 1980 amounts to 150.3 million Swiss francs including expenditure on electrical power and water and the share borne by the SPS Activity of the materials costs of the CERN technical and administrative services. However, 1980 is not a full year of operation of the SPS Activity since the SPS machine is closed down for the second half of the year to complete the constructions for the proton-antiproton colliding beam facility and to install the new equipment. Not surprisingly, when the SPS starts up again in 1981 it is proposed that the operation costs increase from 150.3 million Swiss francs in 1980 to 169.1 million Swiss francs in 1981. In 1982, the new proton-antiproton colliding beam facilities should be fully exploitable and the question is what will be the Materials budget for the SPS Activity at that time. Undoubtedly there will be more to operate in 1982 than there was in 1979 which was the last full year of SPS operation since all the proton-antiproton facilities and two new underground experimental halls

with their experiments will be available. Also, it is difficult to determine now whether it will cost more or less to operate the SPS machine in a mixed fixed-target and colliding beam mode than in a purely fixed-target mode as at present. Arguments can be made in both directions which will only be clarified by experience. An estimate, taking into account the extra facilities to be operated, is that overall the Materials budget for SPS Activity Operation including power and water bills and its share of the services will be 11 million Swiss francs higher in 1982 than in 1981. This would give a Materials budget for SPS Activity Operation of about 180 million Swiss francs for 1982. However. as will be shown later on, such an amount of money will not be available with the foreseeable total CERN budgets during the years of LEP construction if LEP is to be built within a reasonable time. Therefore some reduction in the Materials budgets of the SPS Research Activity when LEP construction starts seems inevitable and for planning purposes a constant Materials budget level of 166 million Swiss francs per year from 1982 onwards is allocated. This is about 8% less than the estimate mentioned above.

Summary so far

16. The planning has up to this point taken account of the evolution of the SC, PS, ISR, SPS, Theory and Miscellaneous Scientific Activities according to the policies proposed for these Activities. It has dealt with the ongoing Operation expenditures, including the costs of electrical power and water and the charges for the services, and taken into account the expenditures for new equipment now under construction, the costs of which will be paid off by the end of 1982. From 1983 onwards, the Materials budgets for all these Activities are entirely allocated for Operation and nothing has yet been allocated for any new equipment not already under construction.

17. Since it is certain that some new equipment will be necessary for the proton facilities of CERN during the years of LEP construction, especially some new experiments for the SPS, a sum of 10 million Swiss francs per year is allocated for this. It should be remembered that in the case of new experiments the teams from the Member States who use CERN also contribute to these experiments either financially or by building equipment, using national funds. It is estimated that this contribution adds the equivalent of another 10-15 million Swiss francs per year to the investment in experiments. Hence to the CERN investment of 10 mil-

lion Swiss francs per year in new equipment there may be added another 10-15 million Swiss francs from national funds for experiments. Nevertheless, this is a very small investment in new equipment each year especially since it must cover not only new experiments but also any new machine improvements or experimental area modifications or site renovations.

18. The next problem is the Materials budgets needed for LEP construction. To tackle this problem there are two approaches possible. One approach is to estimate the necessary budgets for LEP construction which will enable a certain energy per beam to be reached within a given time and add to these budgets those established above for the other Scientific Activities to give the total required Materials budgets for CERN during the years of LEP construction. The other approach is to make an assumption of the total Materials budgets for CERN which might be made available during the years of LEP construction, deduct from these the estimated Materials budgets for the other Scientific Activities and from the Materials budgets so left for LEP construction calculate how long it will take to reach a given beam energy with LEP. Since it is most likely that it will be the total Materials budgets made available to CERN which will be the determining factor, the second approach has been adopted in this document.

Total Materials Budgets for CERN during LEP Construction

19. When the Directors-General put forward the idea in 1978 that LEP could be constructed and a reduced, but satisfactory, research programme carried out at CERN during the years of LEP construction with a total budget level of 600 million Swiss francs per year, provided the ISR and SC machines were closed down at the start of LEP construction, the total 1978 budget at 1978 costs was 615 million Swiss francs and the Materials budget was 349 million Swiss francs. Hence a total budget of 600 million Swiss francs at 1978 costs meant a reduction of the Materials budget to 334 million Swiss francs at 1978 costs which at 1980 costs amounts to 336 million Swiss francs. For the years 1980, 1981 and 1982, the CERN Management has agreed to reduce the Materials budgets by 2 million Swiss francs per year and to transfer these sums to the Personnel budget in order to slow down the rate of staff reductions. Hence in 1982, which is assumed to be the first year of LEP construction, the Materials budget would be 330 million Swiss francs at 1980 costs. For planning purposes, three different levels of Materials budgets are used in the present document for 1982, which is assumed to be the first year of the LEP construction, as follows:

Level A 310 MSF net at 1980 costs
Level B 330 "
Level C 350 "

It can be seen that the original Materials budget mentioned by the Directors-General in 1978 (330 million Swiss francs at 1980 costs) is the middle figure. The Materials budget now available in 1980 (312 million Swiss francs at 1980 costs) is close to the lower figure. The corresponding total net budgets at 1978 and at 1980 costs are:

	1978	1980
Level A	580 MSF net	602.5 MSF net
Level B	600 " "	622.5 " "
Level C	620 " "	642.5 " "

This range of total net budgets includes the lowest figure mentioned at the Council session in December 1979.

Materials Budgets Available for LEP Construction

20. Using the total Materials budgets just mentioned and the allocations to the other Scientific Activities described above, the Materials budgets available for LEP construction can be calculated for each of the three total Materials budget levels. The table on the next page gives the result.

21. The build-up of expenditure on LEP construction after the start of the project at the beginning of 1982 fits well with previous experience of such very large projects. The important issue, of course, is the integrated investment in LEP construction during the course of its construction since this determines when it can first operate at whatever stage of completion is judged to be sufficient for the first experiments.

22. The Scientific Policy Committee has recommended the earliest start possible for physics experimentation and has discussed a "stripped down" version of LEP which could reach 50 GeV per beam. This corresponds to what has come to be called the Stage 1/6 LEP.

ALLOCATIONS OF MATERIALS BUDGETS
(Million Swiss francs net, at 1980 costs)

	Scientific Activity	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Operation	(SC	6.1	6.1	5.3	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
	(PS	12.3	13.1	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3
	(ISR	36.7	35.7	26.4	15.7	0.8	-	-	-	-	-	-
	(Theory	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
	(Misc.	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
	(SPS	150.3	169.1	165.7	165.7	165.7	165.7	165.7	165.7	165.7	165.7	165.7
	Total (Operation)	208.0	226.5	213.2	199.9	185.0	184.2	184.2	184.2	184.2	184.2	184.2
	New Equipment	92.0	80.0	29.9	10.4	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	Totals	300.0	306.5	243.1	210.3	195.0	194.2	194.2	194.2	194.2	194.2	194.2
	Budget A	306	315	310	308	306	304	303	302	302	302	302
	Budget B	306	315	330	328	326	324	323	322	322	322	322
	Budget C	306	315	350	348	346	344	343	342	342	342	342
	LEP A	6	9	67	98	111	110	109	108	108	108	108
	LEP B	6	9	87	118	131	130	129	128	128	128	128
	LEP C	6	9	107	138	151	150	149	148	148	148	148

23. At the present time the Stage $\frac{1}{6}$ LEP consists of the following:

1. Sufficient equipment installed in a tunnel 30 km in circumference to enable 50 GeV per beam to be reached.

2. Four experimental halls and their adjacent klystron galleries and access pits or galleries.

3. Four other access pits or galleries at the intersection points where in future another four experimental halls and adjacent klystron galleries could be built.

4. Some initial experiments sufficient to start the physics programme.

24. This Stage $\frac{1}{6}$ LEP could be extended in energy per beam later on by first adding more copper RF cavities and klystrons at the four intersection points. At the Stage $\frac{1}{6}$ only 16 klystrons and 128 cavities are needed to give 49.4 GeV per beam and to minimize costs these should be installed at only two of the four intersection points. To go to the next energy stage, called Stage $\frac{1}{3}$, copper cavities and klystrons could be installed at the other two intersection points. This would give 62.3 GeV per beam. If all four intersection points are completely filled with copper cavities and the necessary number of klystrons installed, a maximum energy of 76 GeV per beam might be reached. If instead superconducting cavities become available and can give 3 MV/m and these are used to fill up all four intersecting regions then 86 GeV per beam might be reached. To reach the ultimate energy per beam of 130 GeV, it will be necessary to use superconducting cavities and install them at all of the eight intersecting points. This would require new civil engineering work at that time and no doubt either then or previously the other four experimental halls would be constructed. Therefore, Stage $\frac{1}{6}$ LEP as now defined, whilst reducing to the minimum the cost up to the time that the first physics can start, is capable of being extended in energy in a reasonable way in the future.

25. The cost of this Stage $\frac{1}{6}$ LEP is still a matter for study but the most recent estimate puts the Project cost at about 900 million Swiss francs without any allowance being made for the initial experiments.

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26. Using this Project cost, it is then possible to see when the integrated investment in LEP reaches this amount for the three Materials budget levels. The answer is:

Level A	1990)	
Level B	1989)	Bill-paying
Level C	1988)	

These are the years in which all the bills for the construction of the Stage $\frac{1}{6}$ LEP can be paid off. It is normal that bill-paying on a large project still goes on after the equipment is delivered and installed. If this is the case for LEP then the commissioning of the machine at the Stage $\frac{1}{6}$ could start about a year earlier than the end of the bill-paying. If the commissioning goes smoothly, the first physics experiments can start soon afterwards. Hence it is not unreasonable to expect that physics experiments could start in the following years for the three levels of Materials budgets:

Level A	1989)	Commissioning
Level B	1988)	and first
Level C	1987)	Experiments

In terms of the years after the start of the LEP construction programme this gives:

Level A	8th year)	Commissioning
Level B	7th year)	and first
Level C	6th year)	Experiments

As can be seen from this analysis, even the higher budget Level C does not satisfy the recommendation of the Scientific Policy Committee which mentioned a time of five years after the start of LEP construction for the first physics experiments. This raises the next question.

Can LEP be built faster and how?

27. It should be clear from the analysis given above that there are three principal ways in which LEP might be built faster:

1. Higher Materials budgets for CERN than Level C.
2. Further reductions in the SPS Scientific Activity Materials budgets.
3. Further reductions in cost of Stage $\frac{1}{6}$ LEP.

28. Whether higher Materials budgets than Level C can be made available to CERN during the period of LEP construction is for the Member States of CERN to decide. The present CERN Management strongly recommends that at least the Level C should be provided.

29. Already in this analysis the Materials budgets for the SPS Scientific Activity have been reduced by 8% below the level which would give a satisfactory exploitation during the years of LEP construction. To speed up LEP construction by one year if, say, only the Level B Materials budgets are made available, requires 130 million Swiss francs. If this is taken from the Materials budgets of the SPS Activity then they would have to be further reduced by about 20 million Swiss francs per year. This would mean that they are reduced by over 20% below what is regarded at present as a satisfactory level.

30. As can be seen from the description of the Stage $\frac{1}{6}$ LEP given above it is a much reduced version of what was originally considered by the European physics community to be a desirable LEP machine. Admittedly, it is only the first stage of construction and can be extended and improved later on. It can always be hoped that further economies can be made in the cost of the components of the Stage $\frac{1}{6}$ LEP and work is going on energetically at CERN to find ways of reducing these costs. However, after four years of studies it is not very likely that the cost of the Stage $\frac{1}{6}$ LEP can be reduced substantially, e.g. by another 130 million Swiss francs in order to reduce LEP construction time by one year.

CERN Staff available during the LEP Construction

31. According to present planning, the CERN manpower will continue to be reduced in the coming years from the present level of 3510 man-years to a stable level of about 3430 man-years in 1985. The manpower required for LEP construction will be built up during 1982 and 1983 to a level of about 1000 man-years. This includes 600 man-years per year for the machine project, 50 for constructing experiments and 350 man-years per year are allocated to the Project as its share of the technical and administrative services.

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32. The closure of the ISR, the reduction in SC operation and the sharp decrease in the construction of new equipment for the proton facilities of CERN will release the manpower for constructing LEP. It is worth pointing out that LEP manpower will have to come from all the Divisions of CERN. Closing the ISR only releases about half the manpower required to build the LEP Machine Project.

33. Estimates have been made of the redeployment of CERN manpower which will be necessary at the start of LEP construction and the following table gives a summary.

CERN Manpower (Man-years)

Scientific Activity	1980	1981	1982	1983	1984	1985	1986	1987	1988
SC	123	116	108	57	57	57	57	57	57
PS	238	230	217	209	209	209	209	209	209
ISR	623	592	490	316	14	-	-	-	-
SPS	2369	2385	2260	2178	2175	2144	2124	2084	2054
Theory	40	40	40	40	40	40	40	40	40
Misc.	21	21	20	20	20	20	20	20	20
LEP	96	101	330	630	925	960	980	1020	1050
Total	3510	3485	3465	3450	3440	3430	3430	3430	3430

34. From the studies so far carried out, it is clear that CERN manpower will be another strong limitation on the Scientific Activities at CERN during LEP construction and on the speed at which LEP can be built. It has been suggested that more of the work should be given out to the national laboratories and universities in the Member States. Certainly, if the teams of physicists now using the CERN facilities could bring with them more technical help for their experiments this would considerably ease the problem for CERN. For LEP construction, it has already been

envisaged that some of its components could be built in the national laboratories. Up to now only the Orsay Laboratory has responded positively and is designing the LEP pre-injector. Apart from some individuals and the collaboration on the development of superconducting cavities, the response from the national laboratories has been minimal. It should be remembered that most of them have in recent years acquired new accelerator projects for fields of research other than high-energy particle physics and their staff are fully engaged in building these projects. Perhaps later on some help will become available.

Concluding Remarks

35. As already mentioned, the Management strongly recommends that a total net budget of 643 million Swiss francs per year at 1980 costs (620 million Swiss francs at 1978 costs) be made available to CERN during the years of LEP construction. The analysis given above shows that a total net budget level of 623 million Swiss francs per year at 1980 costs (600 million Swiss francs at 1978 costs) which was put forward by the Directors-General in 1978 would result in a construction time for LEP which is much longer than is now recommended by the Scientific Policy Committee and/or would mean severe reductions in the Materials budgets which could be allocated to the SPS Scientific Activity on which the majority of the users of the CERN Laboratory will depend during the years of LEP construction. Considering the size of the LEP Project and the reductions and closures of facilities that its construction will require at the CERN Laboratory, it does not seem unreasonable to consider increasing the budget level by 8% above the 1980 budget in two years' time.

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