PROGRESS REPORT OF THE PROTON SYNCHROTRON GROUP
by O. Dahl (28 December 1953)

1. Specification of Machine for 25 GeV, 12,000 Gauss

After presenting a 30 GeV machine specification and cost estimate to the Accelerator Conference and to the 7th Session of the Council in October, the Council decided that the machine must be restudied for an energy of 25 GeV with a field of 12,000 Gauss. This, of course, means that the orbit radius will now change to about 72 meters and the mean machine radius to about 94 meters. To work out a complete new machine specification we do, however, need to know how much the design assumptions should be changed as a result of magnet model work now going on and as a result of various factors discussed during and since the Conference. This work has not yet progressed far enough to justify a new assessment of the type presented to the Conference. It is possible, however, to say that the aperture does not change by more than about 5% on reducing the peak energy from 30 to 25 GeV, if we use the same basic assumptions.

2. Revised Cost Estimates

Similarly the overall cost would only be reduced by about 10% if the energy were reduced from 30 to 25 GeV without making any changes in the basic design assumptions. Such reductions, though worthwhile, are likely to be smaller than the reductions made by changes in the basic assumptions and by differences between cost estimates and actual tenders. It is not, therefore, worthwhile to quote a new absolute overall cost figure. The costs over the first two years, being mainly design costs, will, of course, be very little affected by the overall machine cost. It is possible to say that, assuming March 1st as zero date, the total cost of the proton synchrotron programme should be 2.7 million S.F., of which 0.8 million is assumed to come from the funds of the General Laboratory.
3. Conference Report

The Accelerator Conference in October left the Group with a considerable task preparing the reports for publication. Preliminary notes on the Conference have been sent out to Conference Members and will be given wider circulation in January. The final report is also expected to be ready for circulation in January; this report will be issued in 1200 copies and will be sent to the leading institutes in Europe and the U.S.A. and to the national delegations.

4. Magnet Model Work

A large programme of magnet model manufacture and measurement is now being carried out. The purpose of the programme is to provide information leading up, through a series of models, to the final magnet design. Techniques for measurement will develop in step with the model programme. The status of the various models is:

**Model 1** This model was completed in Paris in April 1953. It is a small D.C. model and although originally designed for an n-value of 4200 is entirely suitable for developing D.C. magnetic measuring techniques in fields with high gradients. It is being used to develop such techniques in Paris.

**Model 2** This small model was built in Bergen in July 1953. Assembled from transformer laminations it gave approximate information about total iron weight and electrical characteristics so that approximate cost estimates could be made for the final magnet and its power supply. It now forms an 1/8 scale model for the 30° GeV "Conference" machine. It is being used in Geneva to study stray fields and thus calculate the behaviour of emergent particle beams.

**Model 3** Model 3, a 6 ton A.C. magnet, was originally designed to be a full scale dynamic model for n=4200 but was modified during construction to become a 1/3 model for n=400. It was designed in Paris and has been constructed there. Construction is complete and one half of the model is now set up in the Institut de Physique where magnetic measurements are being made on it. The other section is being fitted with an extra set of experimental pole pieces. Although many of its design details are already obsolete, it is entirely adequate for initiation of the Geneva modelling programme. With it, many studies can be made of field and flux distributions, of saturation effects and of dynamic effects, as well as of measuring equipment. This model is made in two sections each 1 meter long.

**Model 4** In order that a more up-to-date model will be available as the measurements on Model 3 come to a conclusion, a flexible D.C. magnet has been designed for construction during the first months of 1954. Cheapness, flexibility with respect to design modifications, and ease of construction are aimed at. The magnet is a full-scale model of weight 6 tons, and 75 cm in azimuthal length.
The design has been discussed with a local firm which is prepared to undertake construction, and the order has been placed with this same firm, under authorization of the Interim Finance Committee. The magnet, with its test gear, will cost 100,000 S.F. and will be delivered in May.

Model 5: Probably information derived from models 3 and 4 will make possible a preliminary design for the final magnet. Model 5 will then be a dynamic (A.C.), full-scale model based on this information. Its design should begin as soon as possible after completion of Model 4 so that it can be available during the latter half of 1954.

5. Building

The tentative plans for the final building will now be worked upon by the Group and the architect (Steiger), basing the design on the plans presented to the Accelerator Conference, with some adjustments corresponding to the reduced machine size. The programme calls for a substantial part of the P.S. building to be ready for occupation towards the end of the second year. It will therefore be necessary to design the buildings with a view to early completion of some parts.

Until this accommodation is ready plans are being made to continue to house an extended Proton Synchrotron Group in the Institut de Physique, as has been reported by the Secretary General. Based upon experience with the Group during the last month or so, we are quite satisfied that this arrangement will prove satisfactory.

6. Linear accelerator

It has not been possible until now to make any studies of the linear acc. injector due to limited staff available. It will be possible at this time, however, to make 2 persons available, and to increase this number as recruiting becomes possible.

7. Schedules of Cost & Manpower over the first 3 years

Although, as explained in paragraph 2, no accurate figures can be given at this stage, schedules of cost and manpower have been worked out in detail and may be taken as a fairly reliable guide, at least over the first 3 years. This is particularly so because a less expensive machine would probably be built more quickly. The results are given in the following tables A) and B):
A) **TENTATIVE COSTS FOR FIRST 3 YEARS**

a) **From P.S. Group Funds**

<table>
<thead>
<tr>
<th>Item</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnet</td>
<td>0.2</td>
<td>5.4</td>
<td>8.0 million S.F.</td>
</tr>
<tr>
<td>R.F. System</td>
<td>-</td>
<td>-</td>
<td>0.2</td>
</tr>
<tr>
<td>Vacuum System</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Injection</td>
<td>0.4</td>
<td>0.4</td>
<td>0.5</td>
</tr>
<tr>
<td>Buildings</td>
<td>-</td>
<td>2.6</td>
<td>6.0</td>
</tr>
<tr>
<td>Design, assembly and testing</td>
<td>0.7</td>
<td>1.3</td>
<td>1.6</td>
</tr>
<tr>
<td>Salaries</td>
<td>0.7</td>
<td>1.3</td>
<td>1.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2.0</strong></td>
<td><strong>11.0</strong></td>
<td><strong>17.9</strong></td>
</tr>
</tbody>
</table>

b) **From other Laboratory Funds**

<table>
<thead>
<tr>
<th>Item</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shop machinery</td>
<td>0.1</td>
<td>0.2</td>
<td>0.1 million S.F.</td>
</tr>
<tr>
<td>Electronic equipment</td>
<td>0.1</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>Office &amp; lab. furniture</td>
<td>0.2</td>
<td>0.15</td>
<td>0.05</td>
</tr>
<tr>
<td>Travel</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Maintenance, cleaning, power, heat, transport, library, etc. i.e. general overheads</td>
<td>0.6</td>
<td>1.2</td>
<td>1.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1.1</strong></td>
<td><strong>1.8</strong></td>
<td><strong>1.5</strong></td>
</tr>
</tbody>
</table>

c) **Notes**

Note that the cost schedule assumes that no payment is made with the order, half payment made when half-completed and full payment when fully completed. Normal materials used by the staff are assumed to be equal to their salaries and only large items ordered by them are recorded separately.
B) TENTATIVE MANPOWER ESTIMATES FOR FIRST THREE YEARS

<table>
<thead>
<tr>
<th>Grade</th>
<th>Average for year</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>L1 and L2 Director and Deputy</td>
<td>year 1</td>
<td>year 2</td>
<td>year 3</td>
<td></td>
</tr>
<tr>
<td>L3 and L4 Senior Leading and Scientific</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>L5 Junior Leading and Scientific</td>
<td>15</td>
<td>16</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>T1 and T2 Graduate Technical Staff</td>
<td>3</td>
<td>8</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>T3 and T4 Technical Staff and Assistants</td>
<td>5</td>
<td>18</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Technical Grades in Design, Drawing and</td>
<td>3</td>
<td>9</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Building Offices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junior Administrative Grades</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Workshop Industrial Grades</td>
<td>6</td>
<td>12</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Electrical Industrial Grades</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>48</td>
<td>84</td>
<td>109</td>
<td></td>
</tr>
</tbody>
</table>

The number of staff at present on contract is 15 with an effective staff of about 20. Estimated peak staff is 128 in the 4th year. Operation is assumed in the 6th year.
PROGRESS REPORT OF THE SYNCHRO-CYCLOTRON GROUP
by C.J. Bakker (15th October — 31st December 1953)

1. Composition of the Group
No change.

2. Group Meeting
A Group meeting was held in Uppsala, Sweden, on November 25 — 27. All the work of the Group was thoroughly discussed.

3. General lay-out
The architect Steiger Jr. attended the Uppsala meeting to discuss more details of the cyclotron building. Apart from minor details which still have to be discussed between the SC-Group and the architects, the latter are in a position to prepare final drawings of the SC-building.

4. The magnet
Measurements on the 1/10 scale model are being continued.
The final specifications and technical descriptions of the magnet frame and the coils are nearly completed. A schedule of erection of the magnet has been prepared. It is intended to send out invitations for final bids to the competing firms about six weeks before the expected "zero date".

5. Vacuum chamber and pumping lay-out
The design is ready. Invitations for final bids to competing firms are being prepared.

6. The high frequency system
No essential changes in the design have been made. A new quarter scale model will be constructed and tested. The vacuum test bench for testing a 1/7 scale model will be ready in January. The electric circuit of the h.f. system has been designed.
7. Control and power supply

New drawings on the control of the vacuum system have been prepared. The lay-out of the equipment room has been forwarded to the architects. A schematic overall power diagram is in preparation. A typical alarm set is being built and will be tested.

8. The workshop

The lay-out of the workshop, combined for the synchro-cyclotron and the general laboratory, is under discussion with the Laboratory Group.

9. Staff during building period

It is estimated by the Group that the required staff in the middle of the 1st year will be 20 men, in the middle of the 2nd year 40 men, in the middle of the 3rd year 60 men and from then on constant, with more emphasis on scientific staff.

10. Space

The required space in Genova during the first year is estimated to be 2 office rooms of 30 m$^2$ each, 2 office rooms of 20 m$^2$ each and workshop space of 40 m$^2$.

In the 2nd year the Group will need 4 office rooms of 30 m$^2$ each, 4 office rooms of 20 m$^2$ each and workshop space of 200 m$^2$.

11. Cost estimate

Better insight in the cost of the Synchro-cyclotron under design led to a revised report SC 56 which is shown in the annex. The total cost of 17 million Swiss francs is not changed.

12. Previous progress reports

Cern/SC 19, annex III/II in Minutes of the Amsterdam meeting CERN/Gen/4.
Cern/SC 35, annex V/II in Minutes of the Brussels meeting CERN/Gen/6.
Cern/SC 65, annex V/II in Minutes of the Paris meeting CERN/Gen/10.
# Cost Estimate of Synchro-Cyclotron

<table>
<thead>
<tr>
<th>Item</th>
<th>Total</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
<th>4th Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnet (including coils)</td>
<td>6,00</td>
<td>3,00</td>
<td>3,00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Motor generator set for magnet</td>
<td>0,25</td>
<td>-</td>
<td>0,25</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Vacuum chamber and vacuum pumps and vacuum valves</td>
<td>0,60</td>
<td>0,30</td>
<td>0,30</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>High frequency system, including rectifier</td>
<td>0,70</td>
<td>0,35</td>
<td>0,35</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Control system, including intercommunication system</td>
<td>0,40</td>
<td>0,10</td>
<td>0,20</td>
<td>0,10</td>
<td>-</td>
</tr>
<tr>
<td>General electric supply, including high + low voltage cables</td>
<td>0,30</td>
<td>0,15</td>
<td>0,15</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ion source + electric supply, large small target, gas supply</td>
<td>0,25</td>
<td>-</td>
<td>-</td>
<td>0,25</td>
<td>-</td>
</tr>
<tr>
<td>Cooling systems (for magnet a.o.)</td>
<td>0,20</td>
<td>-</td>
<td>0,20</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Demineralizer, degassing equipment</td>
<td>1,10</td>
<td>-</td>
<td>-</td>
<td>0,55</td>
<td>0,55</td>
</tr>
<tr>
<td>Heavy apparatus</td>
<td>0,90</td>
<td>-</td>
<td>-</td>
<td>0,45</td>
<td>0,45</td>
</tr>
<tr>
<td>Instrumentation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation and erection in so far as not included in figures above</td>
<td>0,20</td>
<td>-</td>
<td>0,10</td>
<td>0,10</td>
<td>-</td>
</tr>
<tr>
<td>salaries staff during building period</td>
<td>2,60</td>
<td>0,40</td>
<td>0,60</td>
<td>0,80</td>
<td>0,80</td>
</tr>
<tr>
<td>Special requirements for SC building</td>
<td>4,00</td>
<td>1,00</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Unforeseen (including transfer of staff, insurances)</td>
<td>2,50</td>
<td>0,80</td>
<td>0,75</td>
<td>0,55</td>
<td>0,40</td>
</tr>
<tr>
<td></td>
<td>17,00</td>
<td>6,10</td>
<td>5,90</td>
<td>2,80</td>
<td>2,20</td>
</tr>
</tbody>
</table>
PROGRESS REPORT OF THE LABORATORY GROUP
by L. Kowarski (16 October - 31 December 1953)

1. Provisional setting up of CERN in Geneva

Mr. Preiswerk, acting as permanent representative of the Secretary General, has considered with the Geneva authorities the different possibilities for allowing the temporary setting up of CERN services (actually the PS Group, later on the L and SC Groups). The following premises shall be rented to CERN by the authorities: a villa comprising 13 rooms to be used as offices (near the airport); some hangars for workshops and laboratories and, if necessary, some supplementary barracks. On the other hand, the habitable surface offered to the PS Group by the Institute of Physics shall be increased in order to cover the enlarged needs of this Group.

2. Administrative nucleus

Mr. Groeneveld Meijer has organized a Purchasing Office in Geneva. His activities are mainly devoted to the SC Group but he has started to put into shape some questions related to the general equipment (i.e. purchasing of material within the framework of the International Organizations System set up in Geneva).

Mr. Penney has prepared some Notes on the recruitment procedure, on the rules concerning travel and transfer allowances and on the structure of the future administrative services. He has also helped the PS Group with some running questions concerning the personnel.

Mr. Christinger has dealt, mainly within the framework of the PS Group but also on a more general plan, with questions related to the housing, the clearance and the relations with the Swiss Government in view of the present and future application of the different immunities granted to the CERN Staff.
3. Buildings

Mr. Steiger, according to his contract with CERN, works on the detailed project (with estimate) of the buildings and fixed installations. He keeps a permanent contact with Mr. Preiswerk and with the other Groups (November: SC Group in Uppsala; December: PS Group in Geneva). Mr. Steiger, in particular, has taken into consideration the recommendations presented by the ad hoc CERN Organizational and Building Sub-Committee (7th Session of CERN) especially as regards the workshops for the SC and the General Services.

In the course of a journey to USA, Mr. Steiger discussed the design of CERN with American experts (Brookhaven, Berkeley, Chicago, etc...). He had therefore the opportunity to gather many useful information.

The Services Industriels of Geneva have given data on the main-power supply which has been incorporated in the design.

4. Candidatures

Candidatures for the position of Instrumentation Officer have been presented by several Member States. The appointment shall take place within a short delay.

Other appointments, within the framework of the transitory CERN, are on hand in view of the starting of different activities (library, technical secretariat of site and buildings).

5. Information

A study of the local resources (of Geneva and international) in libraries and periodicals to be consulted is in progress.

The stand of CERN at the Exposition d'Electricité (Geneva, 1st week of November) has given a good result. A descriptive folder issued in this occasion was rapidly exhausted; a more complete brochure comprising the official text and an explanatory comment is being printed.
EUROPEAN COUNCIL FOR NUCLEAR RESEARCH

Eighth Session

GENEVA

14th-16th January, 1954

PROGRESS REPORT OF THE THEORETICAL STUDY GROUP

by N. Bohr (21st October - 31st December 1953).

(1) The work of the Group has continued on the lines described in the previous reports. The list of the lectures and colloquia as well as of the publications which appeared in the period is given in the Appendix. Reprints of the publications can be acquired, as long as available, by requisition to the office of the Group.

Since the last report

E. Eriksen from Norway
and

P.O. Fröman from Sweden
have joined the Group as junior members.

During the period the Group has had visits for discussions by

H.E.G. Casimir from Holland
E.D. Courant from U.S.A.
W. Heisenberg from Germany
L. Leprince-Ringuet from France
J.R. Oppenheimer from U.S.A.
H. Trochidis from France
G. Wataghin from Italy.

(2) Among the applicants for the participation in the work in Liverpool the CERN Co-operation Committee has, at its meeting in Geneva on October 25th, decided to appoint

Dr. G.O.J. von Gierke (Germany)
Dr. D. Harting (Netherlands)
as from January 1954, and

Mr. G. Pidocaro (Italy)
from the autumn 1954. The second candidate to start in the autumn will be chosen at the next meeting of the Committee in connection with the 8th Session of the Council in Geneva.
APPENDIX

List of Lectures and Colloquia

A. Mesons and the Field Theory of Nuclear Forces

C. Møller (October 21) : On Pais' generalization of the isotopic spin formalism.

P. Kristensson (October 26, 28) : Configuration space representation for nonlinear fields (Bethe-Salpeter equations).

B. d'Espagnat (October 30) : On elastic scattering of mesons by nucleons and mesoproduction of mesons.

R. Haag : **Weekly lectures on the relativistic quantum theories of interacting particles.**

C. Watson (November 24) : An attempt to a non-local field theory.

L. Loewenstein-Ringuet (November 25, 27) : Heavy mesons.

J.R. Oppenheimer (November 30) : Discussion on "curious particles".

W. Heisenberg (December 2) : Problems in connection with the quantization of waves.

N.N. Hugenholtz (December 14, 16) : On the Tamm-Dancoff method.

B. Nuclear Constitution

A. Bohr : **Weekly lectures (continued) on collective and individual particle aspects of nuclear structure.**

L. Wilcuts (December 4) : Isotope shift anomalies and nuclear structure.

C. General Topics

A.E. Edmonds : **Weekly lectures on angular momentum in quantum mechanics.**

L.L. Foldy (November 9) : Operators and observables in isotopic spin space.

J. Lindhard (November 20) : Properties of a gas of charged particles.

P.O. Fröman (December 18) : On the use of the grand canonical ensemble in the treatment of an ionized gas, especially in astrophysical problems.
D. High Energy Physics and Accelerators

E.D. Courant (October 23): Recent Progress in Brookhaven.

List of notes and publications


CERN/T/114-2: L. Michel: Comparison of the Hypothesis of the Universal Fermi Interaction with Experience.