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ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE
CERN EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

EIGHTY-THIRD SESSION OF THE COUNCIL

QUATRE-VINGT-TROISIEME SESSION DU CONSEIL

GENEVA - 19 June 1987

PROGRESS REPORTS PRESENTED TO COUNCIL

RAPPORTS D'ACTIVITE PRESENTES AU CONSEIL

I N D E X
T A B L E D E S M A T I E R E S

I	<u>RESEARCH DIVISIONS</u>	<u>Pages</u>
	Theoretical Physics Division (TH) (M. Jacob)	5
	Experimental Physics Division (EP) (B.D. Hyams)	7
	Experimental Physics Facilities Division (EF) (H. Wenninger)	9
	Data Handling Division (DD) (P. Zanella)	13
II	<u>TECHNICAL DIVISIONS</u>	
	LEP Main Ring Division (LEP) (G. Plass)	19
	Proton Synchrotron Division (PS) (R. Billinge)	21
	Super Proton Synchrotron Division (SPS) (B. de Raad)	25
	Technical Support Division (ST & TIS) (F. Ferger)	27
III	<u>ADMINISTRATION</u>	
	Direction of Administration (DA) (R.F. Heyn)	35
	Finance Division (FI) (M. Lazanski)	37
	Personnel Division (PE) (N. Blackburne)	39
IV	<u>DIRECTOR-GENERAL</u>	
	Services of the Director-General (G. Hentsch/W.O. Lock)	43
	CERN Pension Fund (G. Ullmann)	45

I RESEARCH DIVISIONS

- **Theoretical Physics Division**
- **Experimental Physics Division**
- **Experimental Physics Facilities Division**
- **Data Handling Division**

THEORETICAL PHYSICS DIVISION

The February telephone list of CERN-TH had 112 names. During the first four months of 1987, 93 preprints were registered. The main lines of research remained those of the 1986 annual report.

Superstring theory and phenomenology remained the dominating themes. Developments of particular interest there include orbifold compactifications with three families of quarks and leptons, a demonstration that 4-dimensional type II superstrings cannot yield the standard model as low energy limit, an approach to strings from membranes, the use of infinite Grassmannians in the formulation of conformal field theories on arbitrary surfaces, and a heterotic string loop calculation of the anomaly cancelling term (with perhaps the first case where a physically meaningful quantity, the mass of a U(1) gauge boson, is obtained from a one loop diagram in string theory.)

Contributions in cosmology included analysis of the implications of the observations of neutrinos from SN 1987A.

In collider physics, Drell-Yan massive lepton pair production has been specially studied with a view to identifying new gauge bosons or compositeness of old ones. Multiple production of Drell-Yan pairs has been analysed in connection with multiple parton interaction. A theory of coherence effects in initial jets has been given.

In lattice gauge theory, notable progress has been made in the calculation of weak matrix elements, and of matrix elements important in deep inelastic scattering.

In nuclear physics, possible signals for quark plasma formation in heavy ion collisions were further elucidated.

Theorists took part in the la Thuile workshop on physics at future accelerators.

In SIS, compared to the corresponding period last year, the number of preprints catalogued increased by over ten per cent., partly as a result of the burst of activity in both astrophysics and particle physics following the detection of neutrinos from SN 1987A. With space at a premium, a major effort had to be devoted to the elimination of many periodical issues, and rearrangement of the collection to provide room for the next few years. A project was presented to the management for the weeding-out of old books that are no longer of immediate use, and for the recataloguing of the remainder in the ISIS computer database, so as to be able to eliminate the card catalogue within the next two or three years. Ways are still being sought to reduce the financial requirements, but a small-scale start has been possible using a visiting librarian.

For ISIS, the major effort is in the transfer of the whole system to run under VM/CMS, although progress has also been made on extracting cost information for book purchases in different categories.

Publication of the updated List of addresses of high-energy physics institutes was delayed because of lack of staff, and the distribution of reprints was similarly affected.

Related to SIS operations, the first volume of 'History of CERN' was published by Elsevier, and presented to the public in February by the Study Team for CERN History. The first reports covering the subject matter of the second volume have also now been issued by the Team.

The new SIS Group Leader arrives in May.

EXPERIMENTAL PHYSICS DIVISION

UA experiments

With the approaching commissioning of ACOL the upgrading of the UA1 and UA2 detectors has been proceeding actively. Among the improvements two totally new techniques have been introduced. UA1 has succeeded in demonstrating a working prototype of their new calorimeter. This novel device uses a room temperature liquid rather than liquid Argon. The engineering of the final calorimeter is proceeding. UA2 has successfully tested a section of their new vertex detector, a new concept using scintillation fibres viewed by image intensifiers and charge coupled devices.

Meanwhile UA1 and UA2 have continued their data analysis. An analysis of UA1 events with two or more jets has produced improved lower limits on the masses of supersymmetric particles. The limit for the squark mass is > 48 GeV/c and for the gluino it is > 51 GeV/c at 90% confidence level.

From the measured cross-section of W and Z production, followed by their lepton decays, UA2 has been able to give an upper limit (at 95% confidence level) of 6 to the number of different types of neutrinos. If one assumes that the top quark mass exceeds 74 GeV this limit would be 4 neutrinos.

By studying final states with two high- p_T jets UA2 have found the first evidence for the decay of W and Z bosons into quark-antiquark pairs. This shows as a "bump" in the two-jet invariant mass distribution above a background continuum.

Following CERN's successful acceleration of Oxygen ions to an energy of 3200 GeV physics analysis of their interactions is in full progress.

NA 34 has measured the transverse energy spectrum from O^{16} -Ag and O^{16} -W collisions. They estimate that energy densities of up to 3 GeV/fm³ are produced with a substantial cross section. They conclude that if sulphur beams can be accelerated in the SPS energy densities of 4 to 5 GeV/fm³ may be expected, values which may be sufficient to induce a phase transition to the quarkgluon plasma.

Over 100'000 streamer chamber pictures of O^{16} interactions with various targets have been recorded by NA35. Events have been seen with the highest multiplicity ever produced up to 400 charged particles from O^{16} - Au¹⁹⁷ collisions. In this kind of event they observe a total transverse energy of 60 to 80% of the maximum achievable if all the incoming energy were thermalized. This leads to an estimate of energy densities 15 times higher than in normal matter.

NA31 has recorded some 2×10^5 CP violating decays. $K_L^0 \rightarrow \pi^0 \pi^0$, in the quest of determining the mechanism of this process. The data are being analysed. As a by-product they have searched for, and observed for the first time, the rare decay mode $K_S^0 \rightarrow \gamma\gamma$, which has a branching ratio of $r(K_S^0 \rightarrow 2 \gamma) / r(K_S^0 \rightarrow \text{all})$ of $(2.4 \pm 1.2) \times 10^{-6}$.

At LEAR (the Low Energy Antiproton Storage Ring) a collaboration of the Universities of Washington, Mainz and FNAL have succeeded, for the first time, in slowing down and trapping anti-protons in a Penning trap. The antiprotons were held for over 100 seconds. This opens up the possibility of many intriguing new precision experiments measuring the properties of antiprotons.

The lifetime of a previously inaccessible nucleus, cadmium-130, has been measured at ISOLDE. This measurement, 195 ± 35 milliseconds, leads to a better understanding of the role of rapid neutron capture in supernovae, ruling out some of the possible models for heavy elements synthesis.

At the synchro-cyclotron stable beams were passed through the first analysing magnet of ISOLDE III for the first time, demonstrating the excellent mass resolution of this new installation.

EXPERIMENTAL PHYSICS FACILITIES DIVISION

1. SPS EXPERIMENTS

After a successful beam test of a prototype for the uranium TMP calorimeter, UA1 has placed the main orders for laser welding of its stainless steel boxes. The 2 mm uranium plates are already delivered and the 5 mm plates, the mechanical structure and the TMP liquid is being delivered.

For UA2, the assembly and cabling of the central calorimeter is finished. The central detectors (scintillation fiber detector, transition radiation detector and Jet vertex detector) are being installed. Cosmic radiation tests will start soon.

1.1 Omega spectrometer (W. Beusch)

Work is being done to satisfy the requirements of the experiments scheduled in 1987 with respect to vertex detection, particle identification and high p selection.

T

1.2 NA 31

The liquid argon calorimeter improvement programme was finished and the calorimeter was brought into operation for the 1987 run.

1.3 NA 34

The 3 vertex drift chambers are reinstalled. A fast-bus readout and a current monitoring have been newly implemented.

2. PREPARATION OF LEP EXPERIMENTS

2.1 ALEPH

The coil is finished and tested at 1/2 current at Saclay. It is on its way to CERN, where it will arrive on the 2 June 1987. Then it will be installed and tested in the iron yoke during the summer. The test of the hadron calorimeter - barrel part - continues without any major difficulty, and in parallel, the end-caps are equipped. The first end-cap is now finished and partially assembled. The TPC is now under tests with three detectors. The delivery of the remaining detectors from MPI Munich is continuing as foreseen. The first electronics circuits (TPD) are delivered and the delivery will be as scheduled. The gas system works. The electronics barracks are now equipped with racks, electrical and water supplies and air conditioning. The production of auxiliary equipment is as scheduled.

2.2 OPAL

The equipments for the coil fabrication are passing the final tests before starting the coil winding. The yoke parts are being equipped with the chambers for hadron calorimetry measurements. The mechanical parts of the Jet chamber are being assembled. The laser calibration system to map the Jet chamber is completed and tested. The gas system for the central detector is nearly completed, the flow control for other detectors is in fabrication. Eight out of the ten units of the e.m. barrel are completed, three are calibrated. Preparation of the last two units are well advanced. One quarter of the e.m. endcaps is completed, a second quarter is assembled and partly cabled. For the remaining half, nearly all glass modules are prepared. The mechanical structure of the e.m.e. presampler is in fabrication and all components are ordered. Eight out of the twenty-three electronic huts to house the front end electronics are delivered, one is in use, three more are equipped. One of the mobile buildings to house the DAQ computer and terminals is completed, the other is being assembled. The production of the integrated ADC (CIA) is progressing well.

2.3 L3

All 6000 t of Soviet iron for the yoke and the 1000 t of pole pieces manufactured in Switzerland are ready at CERN for installation. The welding of coil packages will be completed on July. Pillars for the magnet have already been installed in the L3 underground area. A contract for the 300 kA power supply has just been placed. Half of the 7800 crystals of the BGO barrel detector have now been delivered to CERN; quality continues to be excellent. Equipment and installation in the first detector half is proceeding well. Beam calibration will start end of July. The assembly of muon chambers is continuing, a major step was the successful safety presentation of the first fully equipped octant stand in April. The main design effort is now oriented at ordering special handling devices for the detector installation and defining all services in detail. The assembly of the four L3 counting houses was carried out by the French supplier and are being now equipped with cooling, racks and the on-line computer system. The manufacturing of all major parts for the L3 support tube was finished in Sweden. Delivery to CERN will be in September.

2.4 DELPHI

DELPHI activities are concentrated on the several detectors and infrastructure. All quartz plates for the B-RICH passed the severe acceptance tests. Test facilities and the production line for the drift tubes were completed. Moulds for mirrors are finished, tested and sent to industry. Vessel production should be completed by August. For the HPC, the front-end electronics was finalized and the assembly line for the calorimeter modules almost completed. More than half of the production of the TPC sector plates is terminated, several plates are under test. All electronics huts are assembled and most of their infrastructure is completed. For the B-yoke, 20 of 24 modules are equipped with hadron calorimeter planks, 14 also with μ -chambers. Hard and software for a basic data acquisition system is finished and will be used in the next beam tests.

2.5 Cryogenics for LEP Experiments

The first three months of 1987 saw the delivery and acceptance tests of the control equipment, the delivering of the first main compressor and the assembly and tests of the liquid helium pumps for the DELPHI solenoid. Design and procurement procede.

2.6 Experimental areas

Successful tests of the forward radiation shielding have been made at the manufacturer in Portugal under normal load and overload. For the General Surveillance System (GSS) reception and tests of power supplies were made, and the development of network interconnections to communicate with the LEP machine and with experiments is in progress. The "sniffing" system to detect gas leaks and smoke (SDN) is under construction.

3. TECHNICAL SUPPORT FOR THE CONSTRUCTION OF THE LEP MACHINE

Technical support for the construction of the LEP machine continued. Activities concerned vacuum equipment, field mapping of dipole magnets, and instrumentation. Very active preparation is being made for long-term tests in the SPS of a first superconductive cavity, designed for LEP.

4. DETECTOR DEVELOPMENTS

Work to determine and improve the reliability of microstrip detectors continues, and development of an ASIC low noise amplifier chip for use in collider experiments is well under discussion and study.

Progress has been made with the development of scintillation fibre detectors; this new technique may find application in the study of the production and decay properties of beauty flavoured hadrons.

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DATA HANDLING DIVISION

The major activities in the Computer Centre since the beginning of this year have been, besides the normal day-to-day running and control of the various services, in the areas of a few distinct projects. The final adjudication of the controlled access system to the Computer Centre is about to be made (by mid-May) and site preparation for the Cray arrival is well on schedule. The re-arrangement of the "barn" will be completed well before the end of the year when L3 and ALEPH intend to move in their computer systems. Intensive work is invested in the re-organization of the tape services following the departure of our tape receptionist at the end of 1986.

In the software area, preparations for the introduction of a service on a CRAY X-MP/48 computer are under way. The machine is to be installed in the autumn, but the export licence has not yet been obtained.

The Computer Centre VAX/VMS service has been expanded, with the installation of a VAX 8800 and the upgrade of the existing three VAX 8600 systems to become 8650s, and now provides facilities for a wide community of physicists and engineers.

Consolidation of the VM service continues, and this now handles more simultaneous interactive users, and delivers more batch power, than any other system at CERN. The total number of weekly users has grown to nearly 1400.

The Programme Library has been installed on the Bologna Cray X-MP/48 under CFT77, as part of a collaboration to prepare for the arrival of the CERN machine. The new documentation filing and retrieval system CERNDOC has also been given to its first users, and the first version of a modest expert system released. The installation of the GTS-GRAL graphics software is proceeding on schedule. First steps to build a comprehensive data base of user registration and accounting data have been taken, and preparatory work for the introduction of the Cray computer has begun.

There are now over 50 Apollo personal workstations at CERN and over 30 of these are connected to the main Apollo Domain ring, which gives users access to the central services supported by the division.

The OCS (Office Computing Systems) group was created and started work on April 1. Together with the existing ADP group it makes up the MIS (Management Information Systems) unit. During this very short period, most of the effort went into structuring the group, preparing a Programme of Work for the next 12 months period, and in recruiting staff. Despite the small number of currently active staff, OCS already had many contacts with industry, initiated some studies and, as usual, did the necessary firefighting.

The consolidation of the office systems in the DG Services, started last year by DOC, but now in OCS, required constant attention and is the area where progress is most visible. With the help of the PS divisional representative, the link-up of the Notis clusters with the central IBM system was completed successfully and provides access to VM from every terminal on the clusters.

An MIS Board was created for coordination of the divisional activities. It convenes every two weeks in order to make rapid progress towards an agreed programme of work with associated priorities.

A joint project was launched with Digital Equipment (DEC) to investigate some areas where both CERN and DEC are interested to perform mutually beneficial small-scale research and development. Three areas of initial interest are: use of large VAX clusters in the CERN Computer Centre environment, communications and networks, on-line distributed real-time systems. Efforts were devoted to improving coordination of CERN services involved in the use of DEC computers and networks, the end-users and the company. In collaboration with FI Division the administrative procedures were simplified. Attention was also devoted to field service and computer security aspects.

Work in support of data communications has continued at full speed. Notable achievements included successful installation of an ISO-standard communications package for use in on-line computing systems, the transfer of the GIFT file-transfer gateway to a new micro VAX, and an upgrade of the X.25 packet-switching equipment.

A major event was the transfer of the telephone, telex and telefax services to DD, so that traditional and computer-oriented telecommunications are now under the same management. This transfer has been followed by the opening of a preliminary service on the new digital telephone exchange for LEP (in collaboration with SPS Division for the technical aspects).

In the area of off-line data processing, the work on PAW (Physics Analysis Workstation) has reached a stage at which a first release can be made to selected users. The preparatory work for the introduction of this package and of the new HBOOK4 into the Programme library has begun.

Preparations for the new collider run mean planning central computing resources, as well as direct involvement in the experiments. Work for the LEP collaborations continues.

Physics groups and others continue to make heavy use of all the services offered in the field of on-line computing.

First versions of the essential modules of the new MODEL software for LEP data-acquisition are now available, and are being used by the Collaborations. A major new release of the Valet-Plus microcomputer system has been made, including data recording

facilities: over 100 of these are now in service. An enhanced version of the intelligent CERN Fastbus Interface has been introduced, and design of the next generation CERN Host Interface for Fastbus and VME is well advanced. We have participated in the definition of a new International Standard for Fastbus software, and implementation has now started.

Evaluation of 6250 bpi tape equipment has led to selection of suitable standards and to maintenance arrangements for both VAX and VME-based equipment. The promising new Remote Procedure Call technique has been implemented and tested in a range of data-acquisition, test and control environments. Substantial progress has been made in the rationalisation of the minicomputer pool; older equipment has been phased out to save maintenance costs and take advantage of modern technology. The online database has undergone extensive transformation to make it effective and maintainable.

A VAX-8530 has been ordered and will replace the overloaded VAX-785 of PRIAM's central UNIX service in summer 1987. New versions of the Fortran and C cross-compilers from ACE for the MC68000 have been installed and a code-generator for the MC68020 for these compilers is on order for delivery in June. The frontends for Fortran and C of the PRIAM cross-compiler suite are progressing and generated interpass code for the first time. A new version of the macroassembler now handles all instructions for the MC68020 and its coprocessors. A new release of MoniCa supports the floatingpoint coprocessor and has been internally restructured as a first step towards Remote MoniCa.

New development and testing tools for the RMS68K multitasking real-time kernel have been released, offering many additional facilities. They have all been successfully installed on the AEB Fastbus processors of UA2.

PRIAM started a working group comprising all European designers of crate interconnections for VMEbus. This group is writing a functional specification for a standard VMEbus Inter-Crate connection, named "VICbus".

To improve our electronic design capability, the existing DAISY schematic capture workstations were upgraded with more memory and disk space, a further DAISY station was ordered and preparations were made to install a Racal-Redac VISULA station for PCB layout and routing.

A service was established for consultancy to engineers in the use of analogue circuit analysis programmes, especially I-SPICE, the version of SPICE with interactive pre- and post-processors installed on the central VAXs. Informatics support was also given to engineers using finite element analysis programmes.

The design of the CERN Host interface (CHI) for the connection of computers from the VAX range to Fastbus and VMEbus progressed to the stage of testing the prototype. Work was started on an optical link for this interface.

Deliveries of XOP fast trigger processors to L3 and UA2 were completed and work continued with the testing of interfaces for these machines. Studies started on methods of implementing a fast tracking trigger.

The 3081/E emulator farm is operational since last year and several users are using it for data and Monte-Carlo productions. The farm is currently controlled by an IBM 4361 Host. Next year the 4361 will be replaced with an IBM 9375 and IBM 3480 cartridges tapes. The Harvard and Rome farms have both installed a VICI (VME to IBM channel) interface and are therefore compatible with the CERN farm.

The UA1 technical run in October will use six 3081/E's (with 3 Mbytes each) in the data acquisition system. At the moment there are five emulators with 1 MByte each. A Fastbus-3081/E interface has been designed and constructed as a contribution to the DELPHI and LEP3 on-line data acquisition systems. The INFN A.P.E. machines, designed in collaboration with the emulator team, are working and give impressive results.

II TECHNICAL DIVISIONS

- LEP Main Ring Division
- Proton Synchrotron Division
- Super Proton Synchrotron Division
- Technical Support Division

LEP MAIN RING DIVISION

LEP CONSTRUCTION PROJECT

Following the successful completion last year of the LEP Pre-injector and the modifications to the PS as far as electrons are concerned, the emphasis has since turned to the production of positrons. The first positron beams in this system were created in March and by the end of April it was possible to transfer them to, and accumulate them in, the Electron Positron Accumulator. Work has since concentrated on optimization of machine settings ready for supplying positrons to the PS in June this year.

Steady progress has continued on the civil engineering aspects. At the end of January the tunnelling machine excavating the octant 2-3A section of the Main Ring arrived at the underground chamber UJ 32 so completing the vast majority of the tunnelling operations in the Plaine section. Concrete lining of the tunnel is now being pushed ahead and following completion of octant 1-2 last year, octant 8-1 is expected to be completed by June. In the Jura section of the tunnel, where work had to be stopped last September due to geological problems, excavation work was restarted in February. A new technique more appropriate to the difficult conditions now being encountered is being used and currently the rate of advance is some 10 m per week. On the surface the building programme continues to schedule and in June the proposal for the 16 buildings which more-or-less complete this programme will be presented to the Finance Committee for adjudication. Needless to say, all of this construction work has required very intense and sustained support from the surveying team.

Installation of the LEP infrastructure has followed closely on the heels of the civil engineering. On the surface the 66 kV network has been completed while work has continued on the pipework and fire-detection systems at all the even Points as well as construction of cooling towers at Points 2 and 4. Already the pit PM 15 installation is complete, PM 25 will follow in June, and PM 45 has been started. The mono-rail in octant 1-2 of the tunnel is now operational, the whole electrical distribution system completed and the pipework installation well advanced. Installation of octant 1-8 has also started.

A complete RF unit consisting of sixteen cavities and two 1 MW CW klystrons was run up to full power and a European-made, high-power, circulator successfully tested. More than 100 cavity assemblies are ready for installation while the first two complete RF units are being readied for installation in late summer this year. On the magnet front the last of the 3360 steel-concrete cores was cast in March. The prototype superconducting quadrupole complete in its cryostat, and that of the special orbit correctors have been tested and series production started. The first of the 11 m long mobile cantilever girders, of the quadrupole magnets have been delivered.

Supply of the vacuum components has progressed well with 2100 of the 2800 chambers already manufactured. Forty per cent of these have been tested to better than 2.10 torr ready for installation together with 1400 of the 1740 ion pumps and almost all of the 720 valves. All major specifications of the LEP power convertor equipment have now been issued and most of the required contracts placed with industry. The beam instrumentation programme has also continued to schedule.

Plans of the installation of radioprotection equipment for Points 1, 2 and 3 have been completed and a prototype radiation control unit built and tested in the laboratory. Following the completion of high-level dosimeter tests at DESY and CERN, colour dose indicators have been selected for use in LEP. The first unit for the control and recording of personnel entering the underground areas was installed at PM 15 in May.

Theoretical studies have continued on consistent configurations for several energies and currents for Phase 1 operation together with the insertion layout and performance estimate for the machine upgrade to 100 GeV.

PROTON SYNCHROTRON DIVISION

This year's regular shutdown, which will come to an end in May when the PS Ring is closed for electrical tests, was much longer than usual to accommodate some major modifications to the constantly developing PS complex. The machines may not have been running, but a long machine shutdown does not mean a lack of work.

The PS vacuum chamber, in all magnet units and some straight sections, has been changed in order to provide a better vacuum in the presence of the strong synchrotron radiation caused by the acceleration of electrons and positrons for LEP. At the same time a new "figure-of-eight" winding has been installed on all 101 magnet units, to improve the quality of the magnetic field at high energies and enable the beam intensity available for antiproton production to be increased.

The other major project coming to fruition during this period was ACOL, comprising the construction of the AC (Antiproton Collector) ring as an upgrade to the AA facility, and a complete overhaul of the AA itself. The aim is to increase the antiproton production rate by a factor of ten. By the end of April the AA ring was back under vacuum and all of the AC magnets had been mapped, shimmed, and installed on schedule. A new target station for antiproton production has been built, incorporating a lithium lens for focusing of the antiprotons downstream of the production target. The AC ring requires several different r.f. cavities and the "rebunching" cavities, for the transfer of beam from AC to AA, are now ready. The larger bunch rotation cavities, used at injection, have been delivered, and one is being tested. The other will be commissioned once the results of the tests are complete. In order to have efficient stochastic "pre-cooling" throughout the entire AC cycle of 2 seconds the transverse pick-up electrodes are movable, and they follow the shrinking beam envelope during the cooling process. The AA stochastic cooling systems have also been improved to cope with the higher antiproton fluxes available from the AC ring. Work on the ACOL project has been spread throughout the division, as well as heavily involving drawing offices, workshops and specialist design groups. This wide-ranging collaboration has enabled the construction and installation of the new ring to be completed in a very short time.

In addition to the work directly related to the ACOL project, which includes the addition of a complete new CAMAC loop to the AA computers for the AC ring, the Controls staff have also undertaken a considerable amount of work on top of the normal shutdown system maintenance. A second development computer, another NORD 500, was made available, and there is now a direct link between the PS administration computer system and the two control system development computers. All of the equipment for the control of power supplies has been standardized, and a new link between the PS and Linac II control systems has been installed and put into operation. A large amount of

controls effort has also been devoted to the running-in of LPI with positrons, but this is dealt with in the LEP report. The old NORD 10, which controlled the PLS, synchronising events within the supercycle, has finally been replaced with a NORD 100 compact.

Both Linacs and the Booster have had normal shutdown maintenance programmes and these machines have undergone some important modifications during the first six months of 1987. New r.f. power amplifiers have been installed on Linac 1, and they have behaved extremely well in tests, even at the power levels required for oxygen ion acceleration. Work on the new sulphur ion source, scheduled to produce beams later this year, is proceeding well. During test running of Linac II some experiments were made to detect light produced by beam excitation of the residual gas in the 750 keV line. It is hoped to use this technique to improve emittance measurements ahead of the linac. Work continued on the RFQ preinjector for Linac II. The limited "energy upgrade" for the PS Booster has meant that two of the four rings will be able to supply beam at 1 GeV for ACOL running by October 1987. Low-level electronics, recently much modified and in a rather chaotic state, was tidied up, and the alignment of the main dipole stacks was checked.

The first customer for antiprotons in 1987 will be LEAR, and as part of the consolidation programme, several important machine modifications are under way for operation in the post-ACOL era. A number of quadrupoles in the PS/LEAR transfer line are being moved to modify the optics of the line and increase transverse acceptance for the injected antiproton beam at the higher ACOL intensities. At the same time a number of beam position pick-ups are being installed in the transfer channel. The LEAR power supply zone has been completely rebuilt for the installation of new, more stable power supplies, which are essential for ultra-low momentum operation. At the same time a new CAMAC loop and new digital function generators will be installed. These function generators, which control the power supplies during the machine cycle, provide greatly increased flexibility for machine operation by allowing the power supply control functions to be updated on-line. In conjunction with the hardware upgrading, a large amount of new software is being prepared for the existing control system and the new MicroVax work station. Before the end of 1987 it is hoped to begin testing the LEAR electron cooler, which will be installed in section 3 of the machine at the end of the shutdown. The rapid progress on the LEAR consolidation programme has been made possible by the close collaboration of several groups inside the Division.

The reconstruction of the LEAR experimental area, in the South Hall, for the new experiments is on schedule and will be completed by September 1987, for the eagerly awaited restart of antiproton physics. This reconstruction includes the installation of a 350-ton magnet for the OBELIX experiment (PS 198). The monitoring system for LEAR extracted beams, using multiwire proportional chambers, has been completely overhauled. The long shutdown has also been used to modify some of the radiation shielding of the East Hall primary beam, the aim being to reduce the background radiation levels in one of the test beam areas.

The only machines in the PS complex running during this period were the SC and LPI. The LPI machines are covered in the LEP report, but positron production and storage are under way, and it is planned to inject positrons into the PS in mid-June. Following a vigorous maintenance programme during the first few weeks of the year, the SC start-up was particularly gratifying. Good operating conditions were available less than one week after the machine switch-on, for both regular machine users, and parasitic users in the Neutron Hall. The first beam was obtained in ISOLDE III in February, and its properties were close to the calculated values. Following the excellent results observed with the Rotco (rotary capacitor) currently operational, the second Rotco was stripped down and given a thorough overhaul, while the SC continued running for physics experiments.

The access control system for the new ACOL machine has been completely renovated, and it is now possible to obtain access to certain sensitive machine systems without dumping the precious accumulated antiproton beam. New doors have been installed and a system using magnetic cards with a card reader at each door is now in use. The system, which has been developed in collaboration with the SPS division, has a micro-computer controlling each door. The micro-computers control the card reader, the distribution of keys, and communicate with the PS control system via a dedicated NORD 10. Eventually all of the PS access control system will be rebuilt in the same fashion.

SUPER PROTON SYNCHROTON DIVISION

During the long winter shutdown which ended at the beginning of June, all efforts were concentrated on the work necessary to prepare the SPS for e^+ and e^- acceleration in the coming months and for high luminosity ppbar collider operation with ACOL in the last two months of 1987. The main activities for $e^+ e^-$ were the following:

- i) Installation of the first 8 single cell cavity accelerating modules for e^+ and e^- operation. These cavities will produce more than enough voltage to accelerate leptons up to 10 GeV, one half of the nominal LEP injection energy and therefore will permit to carry out all lepton acceleration tests planned for 1987. Most of the remaining cavities will be installed in the 1988 winter shutdown, while the entire installation will be completed in the 1989 winter shutdown.
- ii) Installation in LSS6 of e^- injection, e^- extraction and e^+ extraction and the parts of the 20 GeV beam transfer lines TI12 and TI18 towards LEP which are located inside the SPS tunnel.
- iii) Installation of the shielding against synchrotron radiation in all medium straight sections, the regular arcs of sextants 1, 4, 5 and 6 and part of the long straight sections. The regular arcs of sextants 2 and 3 have already been done in the 1986 winter shutdown while the long straight sections will be completed in the 1988 winter shutdown.
- iv) Adaptation of the SPS computer controls system to multicycle operation with interleaved p, e^+ and e^- cycles. In 1987 the proton cycles, the services, vacuum, etc. will still be controlled from the existing SPS consoles dating from 1976 with the existing software. However, the lepton cycles will be controlled by a new timing system, new multicycle function generators, powerful commercial workstations as new operation consoles, a corresponding new software infrastructure for the Prévessin Control Room and new application programmes, all of which have been installed in the recent months.

The main activities to prepare high luminosity ppbar operation with ACOL were:

- i) Installation of all infrastructure and 4 out of the 5 single cell cavity accelerating modules for the new 100 MHz system, which increases the longitudinal acceptance at 26 GeV injection by a factor 2. The 5th cavity will be installed during one of the short shutdowns in the coming autumn.

- ii) Subdividing the existing 2 families of F sextupoles into 3 families of F sextupoles to double the range of momenta over which a good chromaticity correction can be obtained.

- iii) Completion of the system of electrostatic separators and the associated diagnostics for 6 bunch separation.

TECHNICAL SUPPORT DIVISION

The ST Division is now a year old and its organizational structure has been found to meet the needs of the Organization. Methods are still being adapted to deal with the diminution of the budget by a million francs in comparison with last year's budget and also with the loss of 5% in personnel strength from mid 1986 to mid 1987 (early retirements, retirements, deaths, transfers to LEP apart from the large general transfer of staff to LEP at the beginning of 1986).

Technical support for the laboratory, in particular for the machine and experimental divisions, is provided by the different Groups and their more outstanding features this half year are described below.

MECHANICAL SUPPORT GROUP

- Mechanical fabrication and mechanical welding work in particular prototypes and small-scale manufacture. Most of the work is for ACOL, LEP experiments and LEP Division.
- Handling and heavy transport. Here the work load for LEP installations is greatly increasing especially at points PM15, PM25, PM45 and, from the beginning of June, at points PM65 and PM85. A great deal of handling work for LEP experiments in the pre-assembly halls is being provided and at the same time, the group has to deal with the PS/SPS shut-down, the final assembly stage of the ACOL Project and the modifications being made to UA1 and UA2.
- Transportation of material and equipment between CERN and Vienna was carried out for the Exhibition there, and much similar help is being given to the Press and Visits Service, which is becoming very active in this field and the financial implications and their consequences on the division have to be reviewed in the near future.

SPECIAL TECHNOLOGIES GROUP

Support provided by the special technologies group is very varied and is particularly oriented towards the LEP experiments, the LEP machine (RF cavities) and the ACOL programme (these technologies include surface treatment, printed circuits, vacuum coatings, chemistry, special welding, brazing, chemical analyses, metallurgy, sheet metal spinning, thermal treatment, etc.). Development is also being carried out in the frame of the high field superconducting magnet programme for the Large Hadron Collider.

ELECTRICAL INSTALLATIONS AND ALARM SYSTEMS GROUP

This group has been carrying out maintenance work and studies on the distribution networks, control systems for the technical infrastructure, fire-detection systems, telephone networks, generators and computer control rooms, much of it connected to the ongoing extension of the CERN sites.

An active part is played in studies on saving energy costs to CERN and some projects have been carried out already. The group is also involved in the Technical Committee on Electricity.

COOLING, HEATING, AIR CONDITIONING AND VENTILATION GROUP

Apart from the maintenance of existing installations, the Group provides much technical support at present in the following fields:

- Conception and commissioning of piping and air-conditioning systems for the LEP surface and SR buildings, as well as studies for the call for tender for the LEP Pump House.
- Research and commissioning work for electronics cooling installations and air-conditioning of counting rooms for LEP experiments.
- Installation of cryogenics components for tests of the RF superconducting cavities in SPS.
- Large equipments for ACOL, cooling systems for the machine, target tunnels and connecting buildings are being terminated at the present moment.

SITE MANAGEMENT GROUP

- Apart from the everyday work of maintaining buildings and roads on the site, the Group also deals with divisional work requests in the civil engineering field. This can range from small repair work on buildings to important civil engineering orders for ACOL.

At the moment, the group is having to concentrate its efforts in the direction of:

- Creation and exploitation of a sophisticated tool (on CAD) to have on record a complete inventory of all CERN buildings and the use made of possible storage space.
- Clearing up the storage areas on the site used by outside firms and the removal of these firms to the local area.
- Revision of service contracts, in particular for Cleaning work, aiming at better results.

The Group will see to all urgent repairs of buildings and roads for the next two years, but a move is being made to work out a programme of consolidation for all CERN installations.

LOGISTICS GROUP

This group is responsible for the distribution of goods and also for the stocking of goods and their management. A study is under way to rationalize and modernize our system of management and distribution.

ST DIVISION - TIS COMMISSION

A number of organizational changes have been made in the TIS Commission, in order to try to meet the growing demands of LEP machine and experiments within severe limitations of personnel and budgets.

A change in the shift system of the Fire and Ambulance Service was made, in order to increase the emergency standby team from 12 to 14 within the same total staff. A new Leader of the General Safety Group is giving high priority to improving the effectiveness of safety inspections and the analysis and follow-up of accident statistics, all with reduced personnel. The Medical Service, whose workload also increases with site expansion and an ageing CERN staff, have benefited from a new computer data-base for their medical records.

A completely new code for the safe handling and control of depleted uranium (DU) has been prepared and a "Uranium Controller" named. Detailed studies of the safety implications of the use of DU by specific experiments continue. The Mechanical Engineering Group have revised the safety code for pressure vessels, in addition to participating in reception tests of LEP installations, notably in the control of pipework, cranes and lifts. They also participate in a number of studies for superconducting magnets as part of the long-term development programme.

Important modifications at AA-ACOL, the PS and SPS, and for linking the SPS to LEP, required radiation protection services. The Radiation Protection Group was also involved in the commissioning of LIL and EPA, which are the only accelerators in operation at CERN besides the SC where ISOLDE III is nearing completion. Theoretical work and estimations for new projects continued.

A large amount of radioactive waste mainly originating from the transformation of the PS installations (e.g. vacuum chamber, AA target area) was delivered to the central RP radioactive storage area. A new automatic reader for thermoluminescence dosimeters will be used for environmental monitoring on all CERN sites, including LEP.

In all Groups, routine work such as environmental and personnel monitoring, medical examinations, fire prevention, mechanical and electrical inspections and control of chemicals continues.

III ADMINISTRATION

- **Direction of Administration**
- **Finance Division**
- **Personnel Division**

DIRECTION DE L'ADMINISTRATION

Bureau du Directeur de l'Administration

L'Administration a poursuivi sa mission de représentation de l'Organisation auprès des Services publics français et suisses, au niveau local, départemental et cantonal, national et fédéral. Elle a également assuré une liaison permanente avec les élus français et suisses à tous les niveaux ainsi qu'avec de nombreuses organisations représentatives et professionnelles.

L'Administration, en liaison avec les Services concernés, a élaboré ou actualisé plusieurs procédures : accès au domaine, conduite et stationnement des véhicules.

Outre la gestion financière des différentes unités de l'Administration, le bureau a été également chargé d'études factuelles pour le Directeur de l'Administration au titre desquelles on peut notamment citer l'amélioration de l'enregistrement des décisions divisionnaires en matière contractuelle.

General Services Group

This new Group took over the work of Reception Group, Personnel Division, on 1 January 1987.

It has since added to its Housing activities, the management of 70 new flats in nearby France, and to its Registration activities the issue of a new type of access card aimed at the progressive automation of access control to the CERN sites, including LEP.

The Group has recently taken over responsibility for operating the CERN signature rights procedures.

Composition and Printing Group

The plans to upgrade the NOTIS Office Support system used by the various services of the DG were approved and the installation of a ND 560CX computer, increased disk storage and a high-speed magnetic tape for backup started in January. However, the decision was then taken to transfer all the NOTIS support functions, apart from those directly used by the Group, to the newly created MIS unit in DD division.

The text processing section has started the changeover to a completely rewritten version of the ND COMTEC NORTEXT typesetting system. Amongst the large number of documents typeset, pride of place must be given to the prestigious 600 page Volume 1 of the HISTORY OF CERN printed by NORTH HOLLAND directly from camera-ready pages.

The print load for the first half 1987 has increased by 15% over that of the corresponding period in 1986. The increase is for jobs with a limited number of copies and rapid turnaround produced on the Kodak duplicators, and for large jobs with long print-runs such as yellow reports. The policy of replacing departing CERN staff by contract staff has been successfully continued.

DIVISION DES FINANCES

SITUATION FINANCIERE

La baisse des taux d'intérêt s'est poursuivie depuis le début de l'année et tend actuellement à se stabiliser.

Vu que certains Etats membres n'ont pas encore payé le premier ou les deux premiers tiers des contributions de l'année, et étant donné la baisse généralisée des taux d'intérêt et le rythme très élevé des paiements pour le projet LEP, il sera difficile d'atteindre les recettes réelles prévues au budget de cette année.

Il est à noter qu'au début du mois de mai, une somme d'environ 74 millions de francs suisses pour le premier et le deuxième tiers des contributions de certains Etats membres n'a pas encore été reçue.

SERVICES FINANCIER ET COMPTABLES

Durant cette période, une bonne partie de l'activité a été consacrée aux opérations de clôture et à la préparation des comptes annuels de 1986.

Si on compare les dépenses au 30 avril de cette année avec les dépenses au 30 avril 1986, on constate une augmentation de quelque 28 millions de francs suisses.

Les provisions pour engagements non échus encore ouvertes à fin avril ne sont plus que de 11,9 millions de francs suisses.

Le prêt de 62 millions de francs suisses au consortium EUROLEP, qui est financé par une banque, a été reconduit jusqu'au 31 octobre 1987.

En ce qui concerne les équipes de visiteurs, le nombre de comptes atteint actuellement 500.

BUREAU PLANIFICATION ET BUDGETS

Les activités du Bureau sont essentiellement centrées sur la préparation et l'édition des documents budgétaires de l'Organisation: budgets annuels et à long terme, variation des coûts et barème des contributions des Etats membres.

Le Bureau apporte son soutien logistique au Groupe de Planification du Budget (BPG) chargé, entre autre, d'étudier et de préparer des hypothèses de planification en vue des décisions du Directoire et du Comité de Management.

Le Bureau a également été largement impliqué dans la préparation d'analyses et d'études sur les coûts du matériel et du personnel pour le Comité d'évaluation du CERN.

SERVICE DES ACHATS

Section des Contrats

Pendant les premières 20 semaines de cette année, 872 extensions et 258 avenants à des contrats existants ainsi que 58 nouveaux contrats ont été établis; 12 appels d'offres ont été lancés.

La nouvelle Section des Contrats, créée fin 1986, est ainsi devenue opérationnelle, bien qu'une étape d'informatisation par du matériel bureautique reste encore à franchir.

Section des Commandes

Compared with the same period last year, the first three months of this year have been marked by an overall increase of 27% in the number of purchase orders placed. Although this upsurge in activity caused considerable strains on the resources of several divisional Purchasing Offices, the challenge was met without increasing the personnel.

Expositions

L'exposition de la Suède au CERN, du 17 au 20 mars 1987, a vu la participation de 19 firmes. Le Portugal, nouveau membre du CERN depuis janvier 1986, a organisé sa première exposition au CERN du 19 au 22 mai 1987.

En outre, 28 présentations techniques, limitées à un jour, ont eu lieu depuis le début de l'année.

SERVICE ASSISTANCE ADMINISTRATIVE ET TECHNIQUE

Durant les quatre premiers mois de l'année 1987, la section des factures a traité 24 000 documents, chiffre dépassant de près de 15% celui des périodes correspondantes des années antérieures.

Le Bureau de Travail temporaire a aussi été très fortement sollicité en ce début d'année: la cause principale en étant la longue période d'arrêt des machines du PS.

D'autre part, le suivi des décisions divisionnaires d'achat est en cours de réalisation dans COPICS. En particulier, l'application "Appels d'offres" a été modifiée pour prendre en compte les prévisions d'appels d'offres et les relier, le moment venu, aux marchés correspondants.

PERSONNEL DIVISION

REORGANIZATION OF PERSONNEL DIVISION

Arrangements were made for the personnel officers to be re-assigned to specialised units where they provide divisions with a full range of services based on modern human resource management techniques.

Training will be given to supervisors in the divisions to enable them to exercise direct authority and accept responsibility for the application of decisions affecting their personnel.

Recruitment action was started for the appointment of the new Personnel Division Leader, who is expected to take up his post by the end of the year.

MEETINGS OF CONSULTATIVE COMMITTEE ON EMPLOYMENT CONDITION

Two sessions of this tripartite body, in which the Member States, the CERN Management and the Staff Association are represented, were held in February and April. They were entirely devoted to technical aspects of the implementation of the Council decision to introduce reduction factors for the pensions of new recruits who retire between the ages of 60 and 65. It was decided to address a report to Council, via the Finance Committee, explaining the options and leaving it to them to take the policy decision.

CHANGE OF RESTAURANTS CONCESSIONS

In accordance with a recommendation of the external auditors, a call for offers for the three CERN restaurants was conducted. The concession conditions were updated and improved, from the clients' viewpoint, and new firms were selected for two of the restaurants, on the basis of proposals made by a working group in which the Staff Association and the Restaurants Supervisory Committee participated.

PERIODIC REVIEW PROGRAMME

The training of supervisors for the Periodic Review interview was completed and a progress review was organized for the continuation of the scheme into the second pilot year. The Division established its planning for the study and formulation of a proposal for a future appraisal scheme.

IV DIRECTOR-GENERAL

- **Services of the Director General**
- **CERN Pension Fund**

SERVICES DU DIRECTEUR GENERAL

Les activités du Service d'Audit interne ont été orientées principalement sur la vérification des comptes 1986 de l'Organisation et de la Caisse de Pensions. Dans le cadre de cette vérification, quelques problèmes particuliers ont été examinés plus en détails à la demande des Commissaires aux Comptes. D'autre part des contrôles habituels ou non ont été effectués ainsi que des travaux liés au programme annuel du Service.

Ces tâches ont été accomplies avec la participation d'un nouveau membre de l'équipe arrivé au début de l'année en remplacement d'un auditeur parti.

Le Secrétariat du Conseil a continué d'assurer ses tâches habituelles (préparation des réunions et des documents du Conseil et de ses comités, ainsi que de l'ECFA).

Les tâches du Service des Relations publiques sont largement conditionnées par le vif intérêt que suscitent les activités du CERN et la réalisation du projet LEP: affluence réjouissante des visiteurs en semaine et le samedi.

De leur côté, les médias se sont intéressés eux aussi à la réalisation du Projet LEP (génie civil et installation technique de la machine); aux résultats scientifiques récents (ions lourds, anti-protons, etc.); et à l'avenir à long-terme du CERN et de ses programmes.

Le Service juridique a assuré sa fonction de conseil de l'Organisation; il a pris part à l'élaboration des documents et arrangements concernant le projet LEP, à l'étude des problèmes de transferts de technologies dans le cadre des relations de l'Organisation avec les industries, à la préparation et à la mise en oeuvre du programme d'activités LAA.

Il a contribué à la mise en place du régime juridique concernant l'importation et l'exportation d'uranium sur le territoire de ses Etats-hôtes, traité les questions relatives à l'affiliation en Suisse, à l'AVS, des membres du personnel de l'Organisation de nationalité suisse et celles se rapportant à la fiscalité immobilière en Suisse des fonctionnaires du CERN.

Il a pris part à divers comités (notamment le Comité pour la Politique de Sécurité, Groupe des Pensions, Comité des Relations avec les Etats-hôtes, Structure de Concertation), groupes de travail et enquêtes.

Il a participé activement aux travaux concernant la Caisse d'Assurances de l'Organisation, notamment pour ce qui concerne la garantie des pensions en cas de dissolution de l'Organisation et la gestion financière du patrimoine affecté à la Caisse.

Au plan du contentieux, il a défendu les intérêts de l'Organisation, notamment à l'occasion de l'arbitrage en cours entre le CERN et le Groupement EUROLEP.

The Publications and Exhibitions Group continued production of CERN's regular publications - CERN COURIER, Annual Report, Weekly Bulletin, CERN Images and visitor literature - as well as assisting in the production of LEPNEWS. The reputation of the COURIER continues to grow and the production figure for the two language versions topped 20 000 in March. The exhibition team have participated in preparations for five exhibitions, the biggest being a large CERN stand, in collaboration with the high-Energy Physics institute of the Austrian Academy of Science, at the inauguration of the new "Austria Centre" in Vienna.

The Translation and Minutes Service continued carrying out its usual tasks including preparation of minutes for the SPC, CC, FC, CCEC, SCC, etc., and the translation of texts for the Courier, the Bulletin and the Annual Report. Some members of the Service also acted as interpreters at various meetings. Further progress was made with automation, and it is expected that all members of the Service will be equipped with terminals by the end of 1987. In due course this should lead to improved productivity.

CERN PENSION FUND

The Annual Report of the CERN Pension Fund is submitted separately to the Council (CERN/1653 - CERN/FC/3064).

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