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

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NINETY-SECOND SESSION OF THE COUNCIL  
QUATRE-VINGT-DOUZIEME SESSION DU CONSEIL

Geneva - 21 June 1991

PROGRESS REPORTS PRESENTED TO COUNCIL  
RAPPORTS D'ACTIVITE PRESENTES AU CONSEIL

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## PARTICLE PHYSICS EXPERIMENTS DIVISION (PPE)

### LEP EXPERIMENTS

The second half of 1990 and the first half of 1991 have been extremely productive for the four major LEP experiments as can be judged from the number of published physics papers which number about twenty for each of the experiments. The shut-down period from September 1990 until April 1991 was used to complete the detectors by installing certain "staged" items, to install the new (reduced diameter) vacuum pipes and to repair some malfunctions. At the same time, the superconducting quadrupoles which produce the low-beta insertion were modified by AT Division. The details for each experiment are summarized below.

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The *Obelix* detector is nearing completion, and by May 1991 the last of the four electromagnetic calorimeter modules will be installed. During the first physics run in 1990 approx. 1 million  $\bar{p}p$  annihilation events into charged final states have been recorded, and their analysis confirms the expected detector performance.

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#### **THE ISOLDE PROGRAMME**

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In a test of a new target and ion-source system one of the few elements which is difficult to produce on-line, Oxygen, was added to the list of beams available at ISOLDE.

Effort was spent on resolution and beam stability on ISOLDE-3 in order to perform the experiment (IS01-42). This experiment, which measures the Gamow-Teller strength in the beta delayed neutron decay of  $^{37}\text{Ca}$  (the mirror nucleus of the  $^{37}\text{Cl}$  used as neutrino detector), would only be possible if the  $^{37}\text{Ca}$  beam of about 10 atoms/sec could be separated from the  $\sim 10^6$  times higher isobaric mass  $^{37}\text{K}$  beam *only 8 MeV apart*. By tuning the resolving power ( $M/\Delta M$ ) of ISOLDE-3 to 10000 FWHM it was possible to perform the experiment and mark a new era of isobaric mass separation at ISOLDE.

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will increase in the future as the analysis of the experiments UA1 and UA2 comes to an end.

The R&D activities supported under the LAA project continue to be a vital activity for the future, and, following the restructuring, some eighteen staff supported by LAA are working in the Division. Much of this work will find application in the detectors of the LHC experiments.

### **SUPPORT & ADMINISTRATION**

The support in mechanical areas of detector development and construction for the approved experimental programme, including R&D projects, as well as mechanical support for the operation of the current large detectors, has been provided by the Detector Unit of the Division, the leadership of which passed from P. Lazeyras to H.-J. Hilke in March this year. The staffing levels of this unit are being strongly reduced by retirements and early departures. Some recruitment is urgently needed in this Unit.

The Division continues to support the large visitor programme both through the Users' Office and through the Administration and Secretariats group. This is also an area which suffers heavy staff depletion due to early departures and where some recruitment will be necessary in the near future.



**I RESEARCH DIVISIONS**

- Theoretical Physics Division (TH)
- Particle Physics Experiments Division (PPE)
- Electronics and Computing for Physics Division (ECP)
- Computing and Networks Division (CN)

## THEORETICAL PHYSICS DIVISION (TH)

The TH Division has 18 staff physicists, 10 of them with permanent contracts; about 30 Fellows and up to 100 visitors, most of them for short periods of time. We also enjoy the services of four faithful and overburdened secretaries. On average the production of the TH division is a preprint every day.

The scientific activity of the TH division is quite diverse, although the strongest component this year, as in the previous two years, centres upon phenomenology and LEP- and LHC-related studies. Work on lattice gauge theories is not very intense due in part to the little time available for theorists in CERN's mainframe computers. The activity in astroparticle physics and cosmology has maintained a level comparable to that of previous years, and LEP data have provided help in sharpening bounds on possible dark matter candidates.

A growing component of TH activities is the connection of Quantum Field Theory and Particle Physics with Statistical Mechanics and Condensed Matter Physics, in particular in areas related to the fractional Hall effect and high  $T_c$  superconductors. About 7% of this year's preprints are dedicated to these subjects.

The theoretical work not immediately related to experiments carried out in the laboratory has quite a broad spectrum of interests: construction of models beyond the standard model based on superstrings, technicolour theories and their possible experimental signatures, new symmetries in field theory (topological field theories,  $W$ -algebras), classification of conformal field theories (modular invariants, integrable systems, low dimensional systems, duality transformations, etc.). The sum total of these activities amounts to about a quarter of this year's production.

The work more directly connected with phenomenology is dominated by the analysis of LEP data and their use to either rule out or constrain possible extensions of the standard model. There is still a good deal of work on radiative corrections and precision tests of the standard model. There are also important contributions to the analysis of CP violation and neutrino masses, specially in view of the new experiments trying to verify whether there is a 17 keV neutrino.

As in the past we have continued steadily working on quark bound states and associated Schrödinger problems. As in previous years, there is a healthy community in our group studying problems related to the quark-gluon plasma and heavy ion collisions. The sum total of these activities is near 60% of our production. We have also had an increase in the study of baryon violating processes in the standard model with high multiplicity in the final state at LHC and SSC energies.

The rest of the work includes studies on astroparticle physics and quantum field theory on a lattice.

The large spectrum of topics studied in the TH Division speaks quite well about its health and it also reflects the growing symbiosis between fields apparently as different as condensed matter physics and low dimensional quantum gravity. The work of our division exhibits a well-balanced level of activity between subjects close to everyday experimentation at CERN and topics of a more speculative or fundamental nature.

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## ELECTRONICS AND COMPUTING FOR PHYSICS DIVISION (ECP)

ECP consists of a team of 120 computer scientists, technicians and support staff, working on computing related to experiments from on line data collection to analyses of physics results, and of a team of 150 designers and support staff (pcb layouts, workshops), working on all the aspects of electronics for experiments. In addition, a small team is taking care of the infrastructure of the LEP experiments area.

### COMPUTING

The three proposals submitted to the DRDC RD-11 (Embedded architectures for second-level triggering in LHC experiments), RD-12 (Readout system test benches) and RD-13 (A scalable data-taking system at a test beam for LHC) have been approved and the development and test of prototypes have been started. A full status report of the MPPC (Massively Parallel Processing Collaboration) project has been presented to the DRDC in January. More than a million NA36 events have been processed with PPCS (Parallel Processing Compute Server, a joint CERN - IBM study).

Improvements in the on-line systems of ALEPH, DELPHI and OPAL were successfully completed in time for the Spring re-start. The LEAR experiments CPLeaR and JetSet entered a period of stable data collection. Modifications to the Omega on-line system continued on schedule. Participation has started in the following new experiments and projects, either full- or part-time : NA48, P254 and the Heavy Ion study P259, the Scalable LHC Data Taking System RD-13, LHC studies for future high performance data transmission systems, the Scalable Coherent Interconnect SCI and the High Performance Parallel Interface HIPPI, and the CERN-ESPRIT Transputer project .

Offline support is continuing for ALEPH, DELPHI, JETSET, NA31, NA34/44, OMEGA, OPAL, UA1, and UA2 (final physics analyses). For the DRDC proposals, simulation, design work and preparation for test beam analysis is under way for the RD-2 (Silicon preshower) and RD-6 (TRD) detectors. Studies are advancing on possible detector setups for LHC, particularly in view of the pattern recognition

and background rejections. For Monte Carlo event generators, development work continues on EUROJET, EURODEC and PHOTOS, plus the interface to the Particle Data Group database and a standard interface to GEANT.

Amongst several new activities, GISMO, a short-term research project to investigate the applicability of object oriented programming techniques to event reconstruction and simulation has been concluded. A wide area hypertext joint project with CN, called WWW, has now produced for evaluation a line-mode browser for terminals and a hypertext editor for NeXT to look at various aspects of access to documentation of experiments. The Software Technology Interest Group STING, investigating on software development environments for future projects, has been set up and now has about 150 subscribers, of whom about two thirds are at CERN. Its role is to distribute news items, documents, reports on conferences and coordinate technical presentations. Several product evaluations are under way.

## ELECTRONICS

Several prototype chips have been designed for approved DRDC projects (RD-2, RD-9) by the Microelectronics Group and are now under test. The work on pixel detectors and associated electronics is advancing. Different circuit configurations are in the process of design and will soon be submitted for prototype fabrication. Investigations and measurements on radiation hardness of silicon detectors and electronics have already started, in particular on speed and leakage current under neutron and gamma radiation. A Fastbus master port chip set is in the process of design. This uses a complex 22K gate array which embeds all the functionality of a slave port and will substantially reduce the complexity of building Fastbus boards.

Support was provided to the electronics designers in their various activities. Different layouts for printed circuit boards in CAMAC, Fastbus, and nonstandard sizes were produced. Apart from cables and Fastbus boards, many prototype boards with surface mount devices were produced for PS, SPS and LEP experiments.

The Instrumentation Pool group has continued collaboration with European manufacturers to develop jointly electronics instruments for the Electronics Pool. The group is developing an automated test bench for the testing of Fastbus supplies. A similar development for VMEbus units is under study. Many VMEbus modules, particularly studied for high energy physics experiments, have been tested in view of standardization in the Electronics Pool. Some of the units have been developed by the manufacturers and some of them were developed by French laboratories in collaboration with OPAL and marketed by two European manufacturers respectively situated in Geneva (Switzerland) and Viareggio (Italy).

In addition to the on-going support work the Electronics Design and construction groups have participated actively in the upgrade of the LEP detectors. These include a front-end signal processing board for the ALEPH Silicon Calorimeter, a discriminator module for the DELPHI Forward RICH detector, readout systems for the ALEPH and OPAL silicon-strip Microvertex Detectors using Digital Signal Processors (originally developed for the DELPHI Microvertex Detector), analog front-end electronics for the DELPHI HPC, and an upgrade to the ALEPH slow control system.

Other developments include a fast CCD camera readout developed for NA35, the front-end electronics for the liquid argon detector in ICARUS, rejuvenation of the OMEGA electronics, and a substantial contribution for development and test of the magnetic field measuring systems for the prototypes of the ELETTRA synchrotron (Trieste), the design of these magnets being under CERN responsibility.

### **LEP Experimental Areas Infrastructure**

A lot of effort has been expended in order to have all the services ready in time for the four experiments at LEP, after the long winter shutdown. In particular the General Safety Surveillance System was accomplished and tested. Cabling support was given to LEP experiments and to other experiment programmes. The electronic and cabling laboratories have been redeployed. Mechanical support has been given for the construction of the handling system for magnets in the LEP low-beta insertion and wiggler magnets.

## COMPUTING AND NETWORKS DIVISION (CN)

### Introduction

During the first half of 1991, the Computer Operations and the Software Support groups were involved in major upgrades of the IBM system and the VAX cluster. On the IBM system an extra 50 Gigabytes of 3990 disks were installed during the Christmas shutdown, and an upgrade of the 3090 mainframe to a model J was done at Easter. Two weeks later, a major new operating system, VM/ESA, was successfully introduced after an intensive systems development period. All this work was completed just before the start of this year's long LEP run in order to minimize the impact on physics processing later on during the year.

In the DEC area, a new VAX 9000/410 mainframe was put successfully in production on January 24th. For this, VMS version 5.4 had to be tested and installed earlier in January. 15 Gigabytes of new technology RA92 disks were installed on February 23rd in replacement for old and unreliable RA8X disks. These upgrades resulted in a considerable improvement to the VMS service.

The SHIFT (Scalable Heterogeneous Integrated Facility Testbed) system was also made ready for LEP start-up. Apollo and Silicon Graphics CPU servers now offer a considerable CPU capacity to the OPAL experiment, and the disk servers will allow a large portion of their physics data to be kept on-line during analysis. Tape staging is done successfully through the Cray Ultranet connection.

To allow for better support of Unix workstations, a separate systems software section was established that will initially support HP/Apollo systems, ULTRIX DECstations and VAXstations as well as SUN stations. With the growing number of workstations at CERN and the growing importance of UNIX, it is believed that this service will continue to expand as the demand increases.

Upgrades of several links brought CERN's total external network capacity above 11 Mbit/s, essentially meeting the targets set several years ago to cope with the first years of LEP data.

During the period under consideration, the Computer-Aided Detector Design (CADD) project was launched as an intergroup effort and in collaboration with a number of external institutes. The objective of this project is to allow a closer collaboration among engineers designing the mechanical structure and physicists designing the functional part of a detector, allowing the parameters to be exchanged in an efficient and reliable way between the CAD on the one hand and

detector simulation programs on the other. The division plays a coordinating role for the work in European institutes.

### **Computer Centre Operations.**

The beginning of 1991 showed an important expansion in the group with the very smooth transfer of the User Consultancy section into the in the CO group, renamed for the occasion Consultancy and Operations. The section concerned is responsible for the User Consultancy Office (UCO), documentation, resource management and accounting. The section is also starting an ambitious program in the area of CERN-wide workstation user support.

Considerable effort was spent on the upgrades of the central IBM and VAX systems, as mentioned above.

The CRAY configuration was not changed during this period, waiting for a decision on an upgrade. The Ultranet integration to CRAY is complete and running smoothly now. Performance of the CRAY configuration in the 4 months preceding Easter has been rather bad hardware-wise with more machine failures than average and especially with serious disk problems due to bad cooling fans. The problem has finally been resolved by changing all fan bearings on these disks a short time after the 5th incident.

The SMCF 3480 cartridge robot hardware and software have also been upgraded to their latest level (version 2.2) very successfully in February/March in a way invisible to the user community. It is believed that no further upgrade will be necessary in this generation of devices. The section was also heavily involved in the expansion of the self-service tape copy station (3480 to Exabyte and vice-versa, Exabyte to Exabyte, 3420 to 3480, etc). The service is now in place with twin systems available.

Finally, draft tenders for replacing the aging UPS in the centre as well as reviewing industrial support for all computer services have gone out to Finance Division with the objectives of replacing the UPS at Christmas 1991 and have the industrial support issue resolved by 1992.

### **Software Support.**

The first few months of 1991 were characterised by a relatively high level of activity in the Software Group, mainly in order to introduce new software and hardware solutions for the VXCERN and IBM services, prior to the LEP restart in April.

Thanks to the Tape Management System software (TMS) we have now introduced mandatory control of over 400,000 centrally registered tapes.

The CRAY X-MP continued to deliver valuable CPU cycles to the LEP experiments and the LHC study team. The latest version of the operating system, UNICOS 6, is being prepared for introduction later in the spring.

The overloaded central Unix service continued unchanged, but there is some hope that a plan to improve this important service will be agreed before the summer.

As far as databases are concerned, the efforts to move to Oracle v.6 continued both in the VM and VMS environment. Nevertheless, it is not expected that the conversion, which requires close cooperation by the database owners, will be completed before the end of the year.

#### **Data Communications.**

In the computer networking area, growth, upgrades, and support of services continued as usual. The operational use of the FDDI 100 Mbit/s network was expanded, including use of single-mode optical fibres. Additional buildings were equipped with Ethernet, and industrial collaboration on network monitoring tools continued. The use of terminal servers increased, and the only service to shrink was the obsolescent INDEX terminal switch.

Technical support for PC networking restarted, due to the filling of a long outstanding post. In the TCP/IP networking support we have migrated some basic services to UNIX workstations to offer a more reliable service than previously offered by the PCs, and a time service synchronised to external time sources. The TAG++ terminal gateway has undergone further enhancements offering connections to outside institutes and this very successful service has been expanded.

TCP/IP traffic continued to grow remarkably. Meanwhile preparations for the CHEOPS project for data transfer by satellite continued well.

#### **Applications Software Support.**

The CERN Library is now distributed to about 600 laboratories or universities in 50 countries in the world. The number of supported platforms has largely increased (mainly Unix workstations). The library distributed every 4 months exceeds now one million lines of code.



The main activity of the Simulation Section has been centred on the maintenance and development of the GEANT program. Designed in 1981-1982 for the needs of the LEP collaborations, GEANT has now become a standard for simulating HEP detectors. The current version 3.14 is the result of a fruitful collaboration with physicists modelling detectors for the LHC. It is a major step in the automatic computation of the parameters controlling the precision of the tracking, essential for the correct simulation of fine grain calorimeters. The simulation of electron beams is now in excellent agreement with experimental results (linearity and resolution). Work has been started to provide in the next version of GEANT an interface with the hadronic part of the FLUKA package, in collaboration with the University of Helsinki.

Together with the Serpukhov Institute of High Energy Physics (USSR), a project to upgrade the geometrical detector description has been launched. This is part of the CADD project.

The first half of 1991 saw the introduction of the FATMEN package. FATMEN is a file and tape management system that provides a distributed file catalogue with transparent access to data regardless of location, operating system or medium.

CSPACK is a new package aimed at the distributed computing environment. It provides a set of callable routines and standalone utilities which extend the standard physicists environment of PAW, CMZ, FATMEN etc. into a fully distributed one.

A major release of GKSGRAL was put in production. At the same time there was the first release of GRVIEW and GRCONV (general facilities for metafile viewing, editing and conversion). The corresponding user's guide for all these utilities was produced.

KUIP, the User Interface Management System developed in the context of PAW, is used by a growing number of application packages. KUIP is being developed in the direction of a menu-oriented Macintosh-like interface. An interface with OSF/MOTIF is in progress. A KUIP Interface Builder (KUIB) has been written, which permits the interactive design and editing of a KUIP-based application and a new KUIP manual has been prepared.

The high level graphics package HIGZ is used by PAW and GEANT and also by a very large number of other applications. HIGZ provides interfaces to a number of existing de-facto standards. An interface to the X/Windows system has been implemented.

The FIND system on VM can now cope with many more keywords (0.5-1 Mkeys) with good response. As a consequence synonym handling, multi-language versions and multiple FIND group search could be introduced. A procedure ensuring the flow of yellow page information from the divisional secretariats into a marked up file was implemented. A completely new NEWS system based on FIND was implemented as a test version. A project to integrate FIND into a hypertext system available on Unix systems, VMS and MacIntosh was launched.

### **Computing Support for Engineers.**

#### **Electronic CAE**

The support activities for analog and digital electronic CAE have been brought together in one workroom area and integration is expected to benefit in consequence. In digital electronics, ongoing system, application and library support was given for the RACAL REDAC, DAZIX and P-CAD CAE/CAD systems as well as for design with Programmable Logic Devices (PLD's). A new PLDmaster release supporting XILINX PLD's was installed and tested, the LOGIC AUTOMATION library for DAZIX was introduced, and 4 more SPARCstations and a SUN 4/470 compute- and file-server were added to the workstation cluster. Several packages were installed on the server: a DAZIX simulation engine, the LOGIC AUTOMATION simulator, ABEL 4 for PLD design and the publishing and documentation package FRAMEMAKER. A4 and A3 PostScript printers were installed along with the TRANSCRIPT software package. For the PC platform, the commercial terms for P-CAD were renegotiated, plans were made for a component model creation service and various options for simulation and PLD design were investigated. Presentations were given at the German and Swiss DAZIX user meetings. On the analog side, support for the I-SPICE (VAX-VMS), SABER (UNIX) and PSpice (PC) analog simulators continued. Networked licensing across UNIX-platforms was introduced for SABER, allowing freer access. For PSpice, new advantageous licence conditions were negotiated based on standardised packages. Basic training, as well as CERN-application-specific courses, were organised. A survey of packages for transmission line simulation was made and two different programs were purchased for evaluation.

### Mechanical CAE

System operation and user support was continued for the EUCLID-IS CAD system, now comprising some 40 seats. The central VAX is being upgraded to a single 6510 with one of the Database VAX's as fallback. Five leased VS3100 M76 stations arrived, at last offering on-line response judged adequate by users. This, along with a new high performance hidden line removal routine written in-house and the reception of a special bug-fix release, has permitted wider production use of EUCLID-IS 210. Evaluation of Pro-Engineer (DECstation/Ultrix) showed the interest for 3D design of this package, based on a-priori parametrisation of models. AutoCAD commercial terms were stabilised advantageously for workstations and PC's. More convenient procedures were introduced for running the supported structural analysis and field calculation code on the mainframes and viewing the results. Preparations were made for the installation of the newly acquired MAFIA package for RF cavity design. Following the launch of the Computer Aided Detector Design (CADD) initiative, specific investigations were made on data exchange and a prototype interface was written to the SET exchange standard from the GEANT event simulation code.

### Microprocessor Support

Work on the VICbus (VME Inter-Crate bus) standard in Working Group 8 of ISO-IEC/JTC1/SC26 progressed to the state of distribution of an official Committee Draft to the concerned National Bodies of the IEC. OS-9 related work concentrated on testing, installation, and distribution of new releases of OS-9 itself, its networking products, and new or improved tools for software production (gcc, f2c, Unibridge). The X11 port was updated to Release 4. First experience was gained with running OS-9 on Motorola's new MC68040 processor. Real-time Unix was added to the work program with first tests of LynxOS, chosen by the control groups of the accelerator divisions, and active participation in the IEEE P1003.4 (real-time extensions to POSIX) Working Group. The OS-9 port to the CHI Fastbus processor was completed, and testing of the Turbochannel-based interface from DECstations to VMEbus progressed to the state of executing programmed I/O and DMA transfers.

## **II TECHNICAL DIVISIONS**

- Accelerator Technologies Division (AT)
- Mechanical Technologies Division (MT)
- Proton Synchrotron Division (PS)
- SPS and LEP Division (SL)
- Technical Support Division (ST)
- Technical Inspection and Safety Commission (TIS)

## ACCELERATOR TECHNOLOGY DIVISION (AT)

The Accelerator Technology Division regroups all CERN activities in Cryogenics, Superconducting RF Cavities, Magnets, Vacuum, and Geodesy. It also includes activities on application software and software engineering, industrial controls, and lasers for CLIC R&D.

In their technological domains, the groups carry a CERN-wide responsibility for maintenance and operations support and are strongly involved in LEP200 and LHC R&D projects.

### 1. CRYOGENICS

- *Operation of existing cryoplants and cryogenic facilities*

Refrigeration of the existing cryoplants for LEP and SPS experiments and accelerator components (superconducting RF cavities and quadrupole magnets) continued. The central control system, introduced earlier for LEP, has been extended to most of the cryoplants in the North Area. Conversion by industry of the former RCBC hydrogen liquefier, to serve as a helium refrigerator for NA44, is nearing completion. A contract has been placed for industrial supply of the cryogenic control system of LEP200 and LHC.

- *Cryogenics for LEP-200*

Four cryoplants of an equivalent of 12 kW cooling capacity at 4.5 K, upgradable to 18 kW, have been ordered from industry for the cooling of LEP200 and later on LHC. Two smaller cryoplants (400 W/4.5 K) have been ordered for the cooling of superconducting cavities in the SPS and for tests of superconducting RF cavities. Civil engineering work for installation of LEP200 equipment has started.

- *Cryogenics for LHC*

Experiments with boiling or pressurized superfluid helium on flow and heat transfer, carried out in collaboration with CEA Grenoble, have given promising results. Consequences for the cooling scheme of LHC are being

studied. Detailed analysis of the cooling scheme for LHC has started. Helium will be supplied by the recently ordered 18 kW/4.5 K cryoplants, complemented by final 1.8 K stages. Preparatory work for the beam test of the LHC Twin Aperture Prototype (TAP) magnet in 1992 continues.

- *Cryogenic support for physics experiments*

Cryogenic support is provided for experiments NA35, NA44, NA45 and NA47. Work on particle calorimeters using liquid xenon and liquid krypton continues, the krypton calorimeter will find an application in the new kaon experiment NA48. As ever, liquid helium and nitrogen was regularly supplied to various users. Preparation for the resiting of the central helium liquefaction facilities have started.

## 2. MAGNETS

In the sector of maintenance and development of the existing accelerators the activities of the AT-MA Group have been concentrated on the shut down and start up of the machines.

- *PS*

The annual shut down work was completed on time. The work on magnets for ISOLDE and CLIC was continued. The measurements of ISOLDE magnets, which will be delivered in July, are being prepared.

- *SPS*

The low- $\beta$  insertion in LSS4 has been transformed in a high- $\beta$  insertion and the usual maintenance on SPS magnets has been performed. The repair and modification work on beam line and machine magnets was continued.

- *LEP*

During this shutdown the group accomplished four major tasks, namely: the dismantling and reinstallation of four half-cells in octant 4, the assembly, measurement and installation of the polarization wigglers at points 3 and 7, the completion of demagnetization of all vacuum chambers

between points 2 and 3 and the removal and reinstallation of the low- $\beta$  quadrupoles for minor repairs. No difficulties were encountered during the start up. The group also participated in the updating of files, the introduction of data for the newly installed equipment and in machine performance tests, including energy calibration and beam test of the new polarization wigglers. The work on the system to demagnetize in situ the LEP vacuum chambers has continued and a prototype device will be operational in June.

The work on magnets for LEP2 is progressing satisfactorily; the study of requirements for additional magnets to satisfy LEP2 optics has been pursued.

- *LHC*

The work on magnets for LHC was continued and the major effort was dedicated to the preparation of the 100 m long test cell. The manufacture of NbTi cable is advancing and first results indicate that wires with 5 m filaments can be made. The firms entrusted with the supply of eight prototype dipoles are finalizing the design of the tooling and have ordered the main components. The cryostats for these prototypes have been ordered; the supply is shared among three major European manufacturers of cryogenic equipment.

Work is progressing as foreseen on the lattice quadrupoles and correction magnets, and tests have begun on dipole-sextupole correctors.

Twin-aperture dipole magnet models have been tested, field level and errors and their behaviour during transition at 1.8 K and 4.2 K assessed.

The twin-aperture prototype magnet (TAP) with HERA type coils has been installed at the CEA 1.8 K Test Station at Saclay and cryogenic and magnetic tests are in progress.

The study of the test station is continuing, as well as the design of the measuring benches and their implementation and connection to the cryogenic plant. The equipment with the longest delivery time is ordered, and effort is now concentrated on the design of the measuring equipment and instrumentation.

### 3. VACUUM

The main activities during the first quarter were linked to the annual shutdowns of all the accelerators and involved the normal maintenance, modifications and upgrading of many machine elements which normally also require vacuum work. Only a few can be mentioned here :

- new vacuum chambers for the LEP experiments of smaller diameter and the central part made of Beryllium;
- new polarization wigglers and horizontal separators for LEP;
- reinstallation of the Jura part after the end of the civil engineering work;
- replacement of 30% of the SPS vacuum valves;
- removal of the low  $\beta$  system in LSS4 of the SPS and return to the initial (pre ppbar) configuration;
- new slow ejection in the PS;
- new roughing stations in the PS transfer lines;
- new collector of the electron cooling system in LEAR and new monitor tanks.

Machines running under ultra-high vacuum, in particular LEAR and LEP, required an excessive work load for bakeout during the final weeks of the shutdowns.

Upgrading of the controls for PS and SPS involved new power supplies and interlocks for about one third of the PS and new controls in one sextant of the SPS.

No vacuum problems disturbed the restart of the machines in March/April and their subsequent operation. The low outgassing in LEP is particularly worth mentioning because it proves that a careful procedure for interventions at atmospheric pressure prevents loss of the previous beam cleaning.



Development activities are actively pursued for various projects:

- LEP 200 : installation of a second module in LEP, follow-up of the cavity manufacture in industry and preparation of the infrastructure at CERN required for testing and commissioning.
- ISOLDE : design of new vacuum systems for the two ISOLDE separators, based largely on equipment recovered from the SC and the old ISOLDES.
- LHC : first operation of a synchrotron radiation beam line at EPA which will allow dynamic desorption tests with a spectrum of synchrotron light identical to LHC.
- CLIC : installation and commissioning of the vacuum system for the test facility ("CTF").

#### 4. RF

The second superconducting cryo-module, not with bulk Nb but with Nb/Cu sputter cavities, was installed in LEP and is actually under test in collaboration with SL-RFL and AT-CR and has seen its first beam. The two modules together have obtained 50 MV up till now.

A third module with Nb/Cu sputter cavities is assembled now and will be tested soon for installation in LEP. It was delayed due to the low performance of one of its cavities after installation in the single cryostat, which could be reestablished with simple rinsing.

The fabrication for at least 160 Nb/Cu sputter cavities and their couplers is in its initial phase at all three manufacturers and permanent contact is necessary, asking often for the presence of different group members at the factories. Since it was decided that the material considered of 'strategic importance' was ordered under the responsibility of CERN, also these orders have to be prepared and followed up. The prototype cavity with the latest modifications on cryostat and coupling ports (increased LHC compatibility) has been finished recently and is under test.

In parallel the test area in SM18 is under preparation in collaboration with other groups and a large number of the instrumentation has been received now.

Since the first cavities will arrive before SM18 is operational, the old test set-ups in hall 163 and 180 are upgraded to serve as intermediate solution.

The contract for a measurement team was attributed by the Finance Committee and first contacts have taken place.

The production of the 20 bulk niobium cavities ordered in industry continues and it is hoped that the first 4-module can be assembled in the near future.

## 5. COOLING & VENTILATION

The main activities of the AT-CV group for beginning of 1991 have been :

- An extensive overhaul and maintenance work on all the cooling, air treatment and fire detection systems which have been on permanent operation for eighteen months.
- Achievement of the design and tender documents for upgrading and new cooling facilities for LEP200.

Work on service facilities in hall SM18 has progressed : most of the fluid distribution network has been installed, cooling towers have been ordered together with their electrical and control equipment.

In view of the vertical tests of the RF superconducting cavities in LHe, the following items have been ordered :

- Set of cryostats with their ancillary equipment.
- High purity water and demineralized cooling water installations.
- Clean room.
- Handling equipment for cavities.

In parallel, the hardware and software for test data acquisition is being developed.

## 6. SURVEY

- Maintenance survey -checking and correction- of many sections of LEP, SPS, EPA, LIL, LEAR, ACOL and TT20; alignment of LEP200 components; various surveys relating to unstable areas, to the infrastructure of LEP and SPS tunnels or to the Low Beta sections).
- Comparative measurements of the (unstable) control networks around LEP experiments; metrological and geodetic measurements associated with the heavy programme of works in these four experiments; maintenance/routine survey of the evolution of fixed target experiments, secondary beams, etc.
- Completion of the SITE database, on a Land Information System
  - Successful developments in micrometric systems
  - Collaborations (and services) with several connected fields, requesting expertise in high-accuracy measurements/metrology of large objects.

## 7. CONTROLS

CO members have devoted quite a lot of effort to evaluate the proposals made by several European firms, for the adjudication of the LEP200 cryogenics control system.

Several projects of interconnecting AT groups equipments to the LEP control system were achieved: clinometers for the Survey group, L3 platform for the Magnet group, cryogenics control in LEP point 2 for supra RF cavities.

CO group has taken the responsibility of the cryogenics control contract with ABB and is currently involved in the definition of the different constituents.

A laboratory for the group has been set up with connections to the LEP machine control system.

## 8. CLIC

For the CLIC Test Facility an ultra-fast 7 ps laser system is on order and will be delivered by September 1991. To permit tests on various optical components, photocathode materials and to study the RF cavity behaviour a non-synchronisable Nd:YAG laser with an 8 ns pulse length has been ordered and is now in service. The important and particularly interesting feature of this system is its 5th harmonic generator, which creates 213 nm UV radiation. First tests using this laser light with the standard CsI photocathode material in the RF cavity showed highly efficient generation of electron bunches. Consequently the Synchro-laser system now on order has been upgraded by the addition of an appropriate 5th harmonic generator crystal.

## MECHANICAL TECHNOLOGIES DIVISION (MT)

Following the completion of LEP phase 1 and thanks to the restructuration of the mechanical activities in the accelerator sector, more human resources could be found for the design support of the CERN large projects. The manpower of the MT-ES and MT-DO groups involved in LEP200, LHC and CLIC activities is now larger than that occupied with the maintenance and upgrading of existing accelerators. Studies undertaken last year to rationalize, homogenize and boost again the activities of the MT-MF and MT-SM groups have been concluded in the form of two projects MINOS and SUMER, whose first steps are being completed.

### 1. MT-ES (Engineering Support)

10 out of the 16 engineers of the group are working full time on LHC and/or LEP200 studies (see description below).

Among the activities linked to machine maintenance and upgrading worth mentioning are : the PS slow ejection (design and construction of 10 new vacuum chambers and 3 septa) layouts for the Booster-Isolde line, completion of the AAC plasma lens, continuation of the mechanical studies for CTF, design of 2 magnets for Linac 1 and LPI. The group is also engaged in new studies for the LEP beam dump, improvement of the cooling of the LEP separators, construction of horizontal LEP separators. The special studies section of the group has re-designed the 4 LEP experimental transparent chambers and is working on stress-strain measurements for LHC magnets while the remote handling section is engaged in consolidation work of Mantis 2 and operates the AAC target zone.

### 2. MT-DO (Design Office)

45000 design office hours were supplied to various mechanical projects by the MT-DO staff of 50 CERN plus 15 industrial support personnel during the first half of 1991. Some 150 jobs are at present underway.

The distribution of the MT-DO manpower to date has been :

- **LEP200 - 12 people** - for superconducting cavities, layouts, waveguides, couplers, cryogenic lines, injection magnets, layout of SM1 and test facilities.
- **LHC - 17 people** - for dipole, quadrupole and sextupole magnets, support frames, cryostats, beam dumps, beam monitors and test benches.

- **Existing accelerators - 23 people** - for continuing maintenance and upgrading.
- **Other projects - 3 people** - for CLIC studies.

An important effort is also being made for training staff on new design techniques, such as 2D and 3D CAD Systems with the aim of performing all design work on computerised systems in one to two years time. At the beginning of 1991, 80% of the staff of the Design Office group was equipped with workstations or personnel computers. Finally, considerable effort is being devoted to introducing new processes for updating documentation, reproducing and recording drawings.

### 3. MT-MF (Manufacturing Facilities)

Maintenance and improvement programs of the accelerators complex has absorbed 80 % of the workshops resources, during the second semester of 1990 and the beginning of 1991.

The most notable examples of successfully completed jobs were :

- two prototype cryostats for LEP200 superconducting RF cavities;
- 5 laminated yokes for pulsed magnets to be installed along the new line of slow ejection 62;
- 2 RF cavities for LIPS out of the eight programmed till the end 1991;
- the special corrugated, thin wall vacuum chamber for the JETSET experiment on LEAR;
- a small set of hydrogen jet target nozzles whose manufacturing (output diameter  $\leq 20 \mu$ ) remains an unequalled specialty of the CERN fine mechanics section;
- an on-line, continuous monitoring, quality test bench for superconducting cables for LHC.

Some new interesting jobs have also started, such as :

- construction of a new RFQ for the LINAC pre-injector;
- construction of a laminated septum for the new slow ejection 62, together with the associated special vacuum chambers;
- construction of two special thin wall vacuum chambers for the CELSIUS experiment on the Uppsala Ring.

The Main Workshop reorganization is well under way and civil engineering work is being performed, for the time being, on schedule. Great effort is put on minimizing the interferences with normal workshop activity. The

machines Maintenance Section is under stress, but still successfully facing the overload represented by the large number of machine-tools to be moved, checked and repaired if necessary, and re-implanted at their new locations. The restructuring project foresees this operation for  $\approx 120$  machines within the end of the year.

#### 4. MT-SM (Surfaces and Materials)

A high level Advisory Panel has largely confirmed the conclusions of the 1990 SUMER plan, namely that the MT/SM group should focus effort to provide expert advice and specialised services for surface and material studies at CERN.

The groups capacity to contribute significantly to projects involving new materials and applications will be considerably reinforced before the end of the year with the installation of an infra-red spectrometer, a scanning electron microscope, an X-ray diffractometer and a vacuum thermal balance. Work has started on reorganising the photomechanical technologies and surface treatment workshops and on reinstalling the chemistry laboratory and the metallurgy and material analysis laboratories in order to regroup personnel and to improve working conditions. However the main activity of the group has, as in the past, been to provide the required technical services to users from both the accelerator and physics sectors.

#### 5. MT-CAE (Computer Aided Engineering)

During this period, the group MT-CAE has been involved in the following main activities :

- The adjudication for a new system for archiving and visualising drawings.
- The pilot project "Workshop machine tools management and maintenance", using PANORAMA and RAPIER software.
- The evaluation and use of the new CAD software PRO/ENGINEER is now finished.
- Analysis of a cross-charging system for MT.
- General informatics support for the division : hardware and software.

## 6. MT-IN (Installation)

The MT-IN group has carried out the assembly of the machine elements located in octant 3-4 of LEP which were dismantled in view of the injection of additional concrete. It has successfully contributed to the punctual start up of the machine, in close collaboration with the SL Division. Two elements of the superconducting cavities have been assembled and installed. The assembly of the third element is presently underway and its installation should be effected in June. The preparation work for equipping the klystron galleries for LEP200 has started. The first stage of the installation work for the ISOLDE project is completed and the second one which should start in June is in preparation. A lot of work has been prepared, coordinated, supervised and performed within the frame of the MINOS project. The preparation of the call for tenders for the mechanical industrial support concerning both installation and workshops in collaboration with the MT-MF group is almost completed.

## 7. MT ACTIVITIES FOR LEP200

MT division has been involved in the following activities :

### **Design Work**

- Installation layouts and design of associated equipment (insertions, beam instrumentation, dumps, vacuum system, RF components).
- Thermal calculations for beam instrumentation in view of the LEP energy increase.

### **Installation Work**

- Installation of the two first 10m cryomodules in the LEP tunnel.
- Preparation installations for underground site works in LEP points 4 and 8.
- Installation of new RF "Bunkers" (fire-safe transformers protections).
- Coordination work in SM18 building.

### **Project follow-up**

- Follow-up of manufacture of the LEP200 pilot project in LEP point 2.
- Technical assistance for contract following of the 3 coated cavities contracts.



### **Workshop Realizations**

- Production in CERN workshops of 8 RF superconducting cavities.
- Production of vacuum chambers and vacuum components for LEP point 2.
- Production of new beam instrumentation prototypes.

## **8. MT ACTIVITIES FOR LHC**

MT has continued to be deeply involved in the following mechanical engineering activities :

- design support for the 10m long superconducting dipoles prototypes and for the 1 m long models;
- detailed design of the dipole cryostats, of the magnet cold supports and of the magnet interconnections, with preliminary inquiries on possible welding robots and on-line controls of the welding as well as on bellows;
- design study of the LHC short straight section cryostat, which will house the lattice quadrupoles, correction magnets and beam monitors;
- study of supporting structures for installing the LHC magnets in the LEP tunnel, in order to minimize interference between the two machines;
- design support for other parts of the project, such as beam dumping kickers, RF septum cavities, experimental underground halls and handling of heavy components for the experiments;
- preliminary study of the installation of the 100m LHC test cell in SM18;
- studies on safety of cryomagnets, especially during quenching : definition of maximum helium pressure in the different working conditions, the cryomagnet as a pressure vessel, etc.

These problems require extensive mechanical calculations, mainly with finite elements methods. Because of the limited manpower available at CERN, several collaborations with external institutes in the Member States are being set up, to alleviate CERN work load.

## PROTON SYNCHROTRON DIVISION (PS)

The PS Complex had its customary long winter shut-down for the substantial maintenance and installation activities which are usually scheduled for this period. Highlights of these and the subsequent start-up, operation and performance of the different accelerators of the Complex are summarized below. The PS Division has seen its staff numbers decline continuously. This has led to the formation of a Beam Diagnostics group in which the beam diagnostics activities, until now dispersed over several groups, will be concentrated. With the closure of the Synchrocyclotron (SC) after 33 years of faithful service, recuperation work has started with small items of equipment to be re-used for the future ISOLDE facility, the aim being that the whole of the old SC zone is recuperated where possible, renovated and finally, re-used for other purposes.

For the hadron linacs, a series of tests were carried out on the proton ion source to find a new operating point which would make it easier to manage. The new working point also lowered the required gas consumption. Preparation of the ECR sulphur source for the summer physics run have already started with the aim of testing a new extraction geometry and verifying the reliability of power supplies. For Linac2, a new record intensity was reached with 190 mA at the exit of the Linac and 175 mA in the old measurement beam line. This intensity approaches the level needed for LHC operation and will be useful for further tests in conjunction with the Booster. For Linac1, work has progressed with a rather precise calibration of the O8+/S16+ ratio measurement for the next sulphur run; in addition, beam optics have been defined with the aim of satisfying the PSB and separating the different ion species. It has been decided to replace the Cockroft-Walton generator (750 KeV) and the LEPT of Linac2 with a radiofrequency quadrupole (RFQ2) in 1993. This RFQ2 is now under test in its experimental area, delivering about 220 mA at 750keV and with a relatively low breakdown rate. A second, spare RFQ2 is under construction.

Extensive civil engineering and installation activities have continued on schedule for the displacement of ISOLDE to the vicinity of PS Booster. In the area where the new line towards the ISOLDE building branches off, civil engineering and infrastructure work has been completed. Furthermore, some new magnets have been installed or rearranged, including the vertical switching magnet

deflecting the 1 GeV beam by 200 mrad. The four-fold increase in the proton flux required by ISOLDE will make beam losses an important issue and considerable effort has gone into the PSB hardware modifications so as to avoid these; modifications include (i) the reduction of coupling impedances by installation of RF by-passes and other measures (ii) adjustments and increase of voltage on  $h=5$  cavities and (iii) improvements of the longitudinal low-level feedback loops. Despite these major changes, the Booster started on schedule and without any serious difficulties.

The PS Main Ring saw some important renovation work in the 2nd octant together with the refurbishing of half of the demineralised water circuits. Installation work was also carried out for the new slow extraction channel. The PS commenced its beam run on 4th March and protons and leptons were delivered to SPS as planned later in the month. High intensity performance tests have been carried out for both protons and electrons in the PS;  $2E13$  protons per pulse were accelerated at 14 GeV/c with minimal injection losses while for the latter,  $4E10$  electrons per bunch were accelerated to 3.5 GeV/c in anticipation of the higher intensities foreseen for LEP. For the leptons, the PS restrictions are related to ion induced phenomena affecting electrons rather than positrons.

In order to improve the reliability and maintainability of the LEP Preinjector (LPI), a new front end of the linac (LIL) has been designed and installed, taking advantage of the LEP shut-down since September '90. It consists of a new electron gun pulser, a bunching system and a beam matching line bringing the beam up to the first LIL accelerating section. During commissioning in late '90 and routine operation since March '91, the front-end has shown excellent performance and reliability. In the framework of LPI consolidation, a spare of the electron gun and its modulator have been built and installed on a test stand for precise beam measurements; a spare of the bunching system is being made in collaboration with LAL, Orsay (France). Since the start-up in March, the LPI has served as an injector for SPS and LEP and from April 20, provides leptons for LEP physics. The main problem in operation comes from the aging of LIL klystrons; these are being progressively replaced after a working life of over 18000 hours. A test area is being set up for the irradiation of sample vacuum chambers with the synchrotron radiation produced in the Electron Positron Accumulator (EPA). This is within the scope of the development work for the LHC because it has been shown that the synchrotron radiation spectrum of electrons in EPA at 350 MeV is very close

to the one expected for protons at 8 TeV in the LHC. An experimental area used for the calibration of the LEP L3 detector two years ago has been re-activated for preliminary 500 MeV electron irradiation trials. This is to evaluate possible radiation damage to optical fibres in the novel detectors for the LHC.

The AAC commenced with tests of a prototype plasma lens to collect the antiprotons from the production target. This resulted in some very encouraging results with yields of over  $60E-7$  antiprotons per incident proton, as seen on the injection orbit of the Collector Ring AC. It should be recalled that the project to study and develop this prototype plasma lens was launched with the financial support from the German government and in collaboration with the University of Erlangen, Germany. For the physics debut after a period of machine experiments, the AAC commenced with the classical 20 mm Li lens as the collector lens; however, a serious fault after the first few days of running meant that a back-up solution using a 400 KA Magnetic Horn had to be brought into operation, with reduced yields.

LEAR commenced its physics run on schedule after the long shutdown, providing two successful beam periods to the JETSET experiment at 1500 and 2000 MeV/c. Similarly, a successful week of physics was accomplished at 72 MeV/c with slow extraction spills of 20 minutes as well as fast extraction of 30 to 40 pulses of 100 nsec duration for the anticyclotron experiment P118T. Shutdown activities saw the capability of the stochastic cooling system augmented to function in the full range from 61.2 to 2000 MeV/c. Similarly, tests and improvements have continued for the electron cooling system and a new collector has been installed.

Computational and experimental (Machine Development) studies with a view to generate the very high brightness beams requested by the proposed LHC are being actively pursued. Furthermore, several scenarios to produce these dense proton beams have been worked out in collaboration with the other machines of the LHC injector chain and hardware implications have been analysed.

The Controls system has seen the introduction of some 25 new workstations and 3 servers. These have been successfully applied for various major applications including the control of the 1 GeV injection process for the PS, control of the hadron linac as well as the interactive control interface for the Programme Line Sequencer. The joint PS/SL project for the controls system consolidation and

upgrade has been finalized, culminating in the publication of a report for technical and budget approval. Substantial work has continued in related issues to this project. In particular, progress has been made in certain fundamental directions including the choice of a real-time Unix operating system for front-end processors, the implementation of a powerful server for the real-time Oracle (vs. 6) database and some of the definitions for the PS/SL timing and process synchronization needs.

For the Lead Ion Accelerating Facility, design studies on possible accelerating structures for the Lead Linac between 0.25 MeV/u and 4.2 MeV/u have concentrated mainly on the Quasi-Alvarez structure. This variant adapts the principles used previously in the design of the CERN 50 MeV proton linac to a novel structure well-adapted to accelerate heavy ions with the charge-to-mass ratio only a ninth to that of the proton. Detailed computations and model measurements have confirmed the initial analytical predictions. Based on these design computations, a complete conceptual study of the mechanical features has shown that the structure can be realized using modern technology. Extensive effort has also gone into the study of the beam transport and measurement line at the exit of Linac which will be used to filter out the desired charge state for further acceleration in the Booster. Collaboration with several laboratories in different (member and non-member) states is well advancing. The first formal agreement has been signed with IN2P3 (France) and others are expected to follow in the near future. For the laser ion source studies, experiments have commenced with the Lumonics carbon dioxide pulsed laser. A copper target and ion-extraction system have been mounted in the target chamber. Using a pulse energy of about 5 Joule (about 10% of maximum), an ion current varying between 1 and 2 A has been observed for 5 microseconds prior to the onset of an electrical breakdown. The nature of this breakdown is under investigation. A magnetic analyser capable of measuring currents from different charge states is under construction.

The experimental programme in the CLIC Test Facility is in full swing. An S-band gun with a photocathode, a laser system and a spectrometer have been installed. The 4 MeV electron beam from the gun will soon be accelerated to about 55 MeV. With a laser synchronized to the rf and delivering picosecond long pulses, production of short electron bunches is foreseen in autumn and tests on the CLIC structures will follow. Work on the gun and photocathodes

continues in order to approach the required beam performance. A system for introducing and removing cathodes under vacuum from the gun is under development.

## SPS AND LEP DIVISION (SL)

After its first year of operation the beginning of 1991 saw some minor restructuring of the division in order to streamline services in the light of experience gained during 1990. In particular the operation of the LEP services was moved from the accelerator control room (PCR) to the technical control room (TCR) of the ST Division. This allows some saving in manpower as well as a 24 hour coverage 365 days per year.

The section responsible for the controlled access systems of SPS and LEP was also transferred to ST to facilitate the unification of all CERN access systems, both accelerator and site.

The year started with the customary winter shutdown and hectic activity on both machines. On the SPS the main activity was the removal of the low-beta insertion in LSS4 and the installation of the equipment needed for the small-angle scattering experiment UA4-2 scheduled for the end of the year. Other activities included the replacement of more than 100 km of radiation damaged cable in LSS6 which required the dismantling and reinstallation of all extraction elements.

A complete vertical realignment of the SPS was performed by the AT Division survey group and proved to be of immense value. When the machine was switched on the beam circulated on the injection plateau without any corrections. This had not been seen for many years and greatly facilitated recommissioning.

The SPS started for physics on April 9th as foreseen and has been performing satisfactorily since then. A new discharge circuit for the pulsed quadrupole used for the fast resonant extraction has resulted in an improved spill to the neutrino area. The recommissioning of the lepton cycles went smoothly and the SPS was ready to inject into LEP on time.

In the SPS experimental areas, setting-up of the beams for fixed-target physics and tests could start prior to April 9th and the scheduled programme is now under way. Three novelties are worth special mention: In the West Area, a new set of collimator inserts for the magnets of the hyperon beam have led to

improved background conditions for experiment WA89. In the North Area, the muon beam transport, including the momentum station has undergone a major upgrade to match the needs of the Spin Muon Collaboration experiment NA47 and commissioning has already resulted in a smaller beam spot and improved halo. The project to convert three magnets of target station T2 to provide an additional splitter for ion beams has been completed and the changes shown to be 'transparent' to proton operation. Design studies, including preparations for further bent crystal tests, have gone ahead for the project to provide simultaneous  $K_{0L}$  and  $K_{0S}$  beams to the new CP-violation experiment.

At the end of August 1990 LEP was shut down for maintenance and for the first step in the LEP200 upgrade programme.

At point 8 the civil engineering of the additional klystron gallery was started and at point 2 the construction of the surface building for the new LEP200 cryogenics installation is being completed. Another site of intense civil engineering activity was in the region of the difficult geological structure ("the renard") under the Jura between points 3 and 4. Attempts to make the tunnel leak-tight by injecting mortar into the surrounding rock met with only limited success.

All four 156 mm diameter vacuum chambers in the experiments were changed for chambers of 106 mm diameter made of beryllium and carbonfibre composites. This in turn required that 8 collimators be moved closer to the experiments in order to keep the backgrounds to an acceptable level.

The eight superconducting quadrupoles in the low-beta insertions were removed and a fault with their internal supports was corrected.

Four more sectors of the vacuum chamber were demagnetized bringing the total demagnetized region to approximately three kilometres.

Twelve polarization wigglers were installed in points 3 and 7. These wigglers should reduce the polarization time by about a factor of ten.

One more twelve metre module consisting of four 4-cell superconducting cavities was installed in point 2, bringing the number of installed cavities up to eight.



In October last year the so-called "crash pretzel" programme was started. Four horizontal separators recuperated from the SPS collider were installed in the four even points of LEP to allow experiments with a half pretzel to be performed in 1991 with a view to installing a full pretzel and doubling the number of bunches per beam in 1992. First machine development results are encouraging.

LEP started up somewhat later than last year due to the high volume of shutdown work. Recommissioning started on April 10th. After quickly obtaining circulating beam under the conditions of 1990 the machine was moved to a new working point free of systematic resonances. Initial experience is good although the machine has yet to be tuned to high luminosity. Physics data taking started on April 19th as foreseen.

Apart from the activity around the two machines several groups were involved in future development work.

Both the power converter (PC) and LEP radiofrequency (RFL) groups are heavily involved in the LEP200 programme. In addition the RFL group forms the nucleus of the CERN linear collider (CLIC) effort.

The controls group has been heavily involved in the consolidation of the LEP control system and the preparation of a project to modernize the control system of the SPS in the framework of the CERN-wide controls upgrade project.

Both the SPS radiofrequency (RFS) and beam transfer groups have been involved in studies and prototype work for the LHC project. The effort in the accelerator physics (AP) group was mainly divided between LHC and LEP studies (the latter including LEP 200, pretzel and polarization) with some contribution to B-factory, Tau-charm and CLIC studies.

The beam instrumentation group (BI), apart from the operation and maintenance of the vast amount of instrumentation in the machines and experimental areas, has been involved in development work on the SPS and LEP. The work on the SPS was mainly concerned with preparation for the up-coming ion run where much more sensitive instrumentation is required in the machine

and external beam lines. On LEP a major upgrade of the closed orbit measurement system is in progress. In addition the development of some of the more exotic instrumentation is continuing.

## TECHNICAL SUPPORT DIVISION (ST)

### Introduction

The last months of 1990 were used to shape the definitive mandate of the Division. In fact last touches were made to reorganize into one Group the task of entrance control, be it to the sites on the surface or the underground accelerator and experimental areas. Also the telephone service finally settled down together with its new telephone exchange system. The new installation has a considerable technical potential which now ought to be exploited to the benefit of its customers and providing reduced operating costs.

All Groups have now actively contributed to the Operation programmes, LEP 200 and LHC preparations. Special efforts were devoted to the consolidation of the Civil Engineering domain. The special contributions of the Swiss Confederation and the Canton of Geneva have been most welcome to refurbish a number of installations, the maintenance of which had unfortunately fallen behind. An attempt has been launched to rehabilitate certain blocks of buildings and for a start efforts will be concentrated on the SC area and the block 104 at Entrance B. There is the aim to gain considerable amounts of office and laboratory space by the utilization of existing space and skilful expansion.

The rather dramatic number of staff departures in the near and medium-term future have again put strong emphasis on the transfer of activities from CERN staff to industry. Based on the past good experience of ST Division to share more of the work load with industry, the Division is optimistic to continue successfully in this direction providing that the necessary budgetary support will be granted by the Management.

### **Groupe Manutention lourde, Transport et Maintenance d'Equipements de Levage**

Suite aux départs négociés d'une part et aux réductions des effectifs des contrats de prestations de services dans les activités de la Manutention et du Transport d'autre part, le groupe HM a pu supporter l'accroissement de charges grâce à une meilleure organisation.

Le Groupe a assuré le transport de personnes lors de séances officielles au CERN, conférences, visites et déplacements à l'extérieur du domaine, les mouvements de matériels sur les sites, de ou vers l'extérieur sur de courtes et longues distances, ainsi que les services généraux : nombreux déménagements dus aux transferts de personnes vers les Divisions nouvellement créées, et l'ensemble des mouvements de matériel effectués dans tous les halls de montage et d'expérimentation, ainsi que dans les tunnels de machines.

Dans le domaine de la Manutention sur le Site, les travaux particuliers suivants ont eu lieu :

- manutentions pendant les arrêts de la machine en janvier, février, mars,
- le programme normal concernant les modifications des faisceaux,
- le démontage du SC.

Une enquête préliminaire concernant les interventions de transport de personnes et de matériels, ainsi que les interventions de manutention lourde pour les besoins de programmes de physique de l'Organisation a été lancée fin avril 1991.

La maintenance des installations techniques (ponts-roulants, ascenseurs...) sous-traitée à la firme METAREG dans le cadre d'un contrat de type A s'est déroulée selon les programmes prévus. A noter la vétusté de certaines installations qui devront être remplacées dans un très proche avenir.

### **Groupe Installations Electriques**

Le début du 1er semestre a été consacré aux travaux du shut-down des machines (changement des câbles irradiés au SPS, travaux de démontage et de remontage d'équipements dans l'arc 3-4 du LEP pour permettre les injections pour étanchéifier le tunnel, travaux de préparation pour ISOLDE au PS). Dans le même temps, les travaux d'installation électrique pour le projet LEP 200 ont débuté (câblage pour la RF supra, installation pour les essais des cavités en SM 18).

Les derniers contrats importants pour le projet LEP 200 ont été notifiés (liaisons 66 kV vers les points 4 et 8, postes 66 kV, compensateurs et filtres, tableaux et protections HT, tableaux BT, contrôle de qualité).

La politique de recherche d'un partenaire industriel compétent pour des opérations couvrant globalement les études, l'installation et la maintenance pour les cinq prochaines années et fondée sur une politique de règlement d'après travaux réalisés, a été concrétisée par la mise en application du contrat le 1er janvier 1991. Cela a nécessité de gros efforts d'unification des bases de données de câblage et d'exploitation pour l'ensemble du CERN, et la mise au point de logiciels communs de gestion des travaux et de la maintenance.

### **Groupe Contrôles et Communications**

Après la restructuration de 1990, une des tâches principales du Groupe a été de définir les différentes lignes politiques et techniques à suivre dans les divers secteurs.

#### **Contrôle des accès :**

Un projet a été présenté dans le domaine du contrôle d'accès pour une gestion globale des accès des Sites, et une étude réalisée qui propose un accès contrôlé, unique pour toutes les zones expérimentales.

#### **Téléphone :**

L'année 1991 est surtout employée à réaliser et mettre en service les différents programmes qui permettent d'utiliser les grandes potentialités du système digital du nouveau central téléphonique

Une campagne de renouvellement des appareils téléphoniques a été entreprise après appel d'offres ; à noter que certains appareils dataient de plus de 30 ans.

#### **Salle de contrôle :**

Un très grand effort est fait pour mettre au point le système de supervision qui permettra de gérer d'une façon optimale les divers équipements techniques des différentes machines. Cette tâche est difficile en raison des origines diverses des installations et des solutions techniques adoptées.

**Appui industriel :**

Une attention particulière a été portée à l'établissement de spécifications techniques pour le nouveau contrat d'entretien et la gestion de la maintenance assistée par ordinateur. Compte tenu de la diminution du personnel CERN et de l'augmentation des équipements en charge, ces deux points sont prioritaires.

**Projets en cours :**

- Réalisation d'un réseau fibres optiques intersites.
- Renouvellement d'anciens systèmes d'interphonie.
- Renouvellement de l'ancien système de contrôle de l'infrastructure technique et son intégration dans les systèmes de contrôle des machines.
- Divers travaux de consolidation et participation aux nouveaux projets ISOLDE et LEP200.

**Cooling, Ventilation and Air-Conditioning Group**

The Cooling, Ventilation and Air-Conditioning Group has the complex task to operate all of the large cooling and ventilation equipment at CERN, with the exception of the LEP machine and to design and build new installations.

In addition, the equipment of LEP surface buildings has been successfully commissioned and is now in operation, as, for example, the pumping system evacuating the seepage water collected on the LEP tunnel floor at PM32. Special attention and help are also given to the LEP experiments. The complementary installations for LEP 200 have been designed and the consequent call for tenders are in preparation.

A significant task is the design and realization of the cooling and air conditioning station for ISOLDE and of the cooling stations and the demineralized water piping for the overhaul of the PS main ring cooling system and experimental area.

## Groupe Génie Civil

A la fin de 1990, deux programmes de construction importants étaient engagés: le déplacement de l'expérience Isolde, depuis le SC, dans sa future zone, aux abords du Booster et la phase 2 du LEP.

La construction du nouveau complexe Isolde se poursuit selon le planning malgré les intempéries de l'hiver 1990/1991. Les travaux du béton armé, du hall de 700 m<sup>2</sup> et de ses ouvrages annexes sont avancés et, prochainement, les ouvrages en charpente métallique et bardage vont débiter.

Quant aux travaux liés à la phase 2 du LEP, deux volets sont à considérer: le premier est l'exécution des galeries pour installer les klystrons aux Points 8 et 4. La première de ces galeries (UA 87), de 24 m<sup>2</sup> de section finie et de 212 m de longueur, est partiellement excavée au Point 8 et les travaux continuent conformément au programme.

Le second volet du LEP 200 se rapporte aux bâtiments de surface qui, au nombre de 19, intéressent les sites aux Points 18, 2, 4, 6 et 8. S'agissant principalement d'extension de bâtiments existants et de réalisation de bâtiments destinés à abriter des compresseurs d'hélium, leur insertion dans les sites se déroule sans soulever de problèmes majeurs. A la fin du premier semestre 1991, le programme est respecté.

Le Groupe Génie civil a conduit en outre les travaux de confortement par injections d'un tronçon du Tunnel LEP en piémont du Jura.

Parallèlement à la réalisation de ces projets, les activités de réhabilitation de zones et un programme de consolidation sont suivis avec, entre autre, la réhabilitation de la zone du bâtiment 104 (ateliers d'entretien à l'entrée principale du site de Meyrin) de même que celle de la zone SC, qui font l'objet d'études à différents niveaux. Ces projets ont débuté au mois de mai de cette année.

Un projet de bâtiment de bureaux, sur le site de Prévessin, également approuvé est en cours d'étude pour une réalisation dans des délais très restreints.

De plus, les activités dans les domaines du dépannage, de l'entretien ainsi que de la mise en oeuvre de multiples ouvrages de génie civil à la demande des

divisions du CERN se poursuivent fort activement. Mais vu l'âge avancé de certaines installations, il restera à résoudre le problème du manque de budgets consacrés à ce domaine.

### **Maintenance du Site**

Les travaux de nettoyage ont été importants dans les tunnels et zones d'expérience du SPS et du LEP, à cause des activités liées au grand arrêt des machines, en plus des chantiers du LEP 200. La préparation de spécifications adaptées se poursuit en vue du renouvellement des contrats actuels ou nouveaux (par ex. la récupération des métaux). Les départs de personnel sont ressentis de façon aigüe dans ces secteurs.

Outre l'entretien des espaces verts, on peut citer entre autre de nouvelles plantations, pour l'embellissement des points du LEP et en forme de clôtures, pour protéger l'accès autour du SPS.



## **TECHNICAL INSPECTION AND SAFETY COMMISSION (TIS)**

### **1 Radiation Protection Group**

As usual, the long annual shutdown of the CERN accelerators dominated the activities of the Group at the beginning of the year. This period was also used to extend ARCON, the new radiation monitoring system which is now operational around LEP, into the North Experimental Area of the SPS.

The problem of radioactive waste has taken on a new dimension with the requirement for the dismantling of the SC and Isolde installations. Discussions with the relevant Swiss authorities to find solutions for the disposal of the radioactive material have started.

### **2 General and Electrical Safety Group**

The General and electrical safety inspections concentrated on areas which are only accessible during the annual shutdown. All alarm systems of the LEP experiments have been thoroughly tested.

A programme to check the conformity of all CERN machine-tools with the new safety regulations of the CERN Host-States has started. The measurements of the noise levels around all LEP sites were repeated to ascertain that these installations continue to have no impact on the environment. As the 1990 CERN accident statistics showed a high rate of serious road accidents, a special safety campaign for the prevention of such accidents is being prepared.

### **3 Service Secours et Feu**

Le projet d'adaptation du central d'alarme se poursuit: les travaux de génie civil s'achèvent, ainsi que la conception du synoptique réduit et l'étude de rationalisation de la répartition des divers tableaux de détection. Dans l'achat de matériel une priorité a été donnée aux équipements d'informatique de gestion et au matériel didactique pour les cours de sécurité.

Depuis un an les comptes rendus des rapports d'intervention sont mis à disposition des autres services concernés du CERN sur un serveur informatique. Ce type de consultation s'est montré très efficace.

#### **4 Service Médical**

Dans le cadre des tâches qui lui sont dévolues, le Service Médical a organisé des examens spécialisés (électrocardiogrammes à l'effort) pour le groupe des pompiers-ambulanciers dont l'âge moyen augmente, comme celui du reste du personnel, et pour lesquels il est impératif de vérifier le mieux possible l'aptitude professionnelle.

#### **5 Groupe Chimie, Prévention Feu et Matériaux**

Dans la Section Chimie et Gaz, les activités ont été concentrées sur le réaménagement du stockage de produits chimiques après les modifications imposées par le déménagement du local existant. Deux modules de détecteurs d'une expérience de physique contenant du lithium ont été démontés et 40 kg de lithium ont été éliminés par le service compétent de Genève.

La Section Prévention a surtout travaillé sur la préparation de l'installation d'un dispositif fixe d'extinction à mousse à haut foisonnement dans le hall d'expérience DELPHI. Une spécification a été écrite et des installations existantes similaires ont été visitées. En parallèle, des essais d'étanchéité des installations à extinction feu au Halon ont été effectués avec succès dans les zones souterraines du LEP.

Des mesures des doses et du flux de neutrons ont été effectuées dans le puits d'irradiation pour les matériaux, au-dessus de la cible d'ACOL. Les études sur des tests de radiation pour les détecteurs du LHC continuent. L'analyse des publications parues au sujet des effets des radiations sur les scintillateurs a été terminée et un rapport sur les résultats des essais de radiation sur des composants électroniques est en préparation.

## 6 Groupe Ingénierie Mécanique

Les inspections périodiques réglementaires de l'équipement se sont poursuivies régulièrement selon le planning. Les visites annuelles des expériences, en collaboration avec les DSO et les autres groupes du TIS, ont permis d'importantes mises au point dans les différents aspects de sécurité.

De nombreuses visites ont été effectuées chez les fabricants pour le contrôle du respect des codes, des normes et des spécifications ainsi que pour la réception de l'équipement. L'effort consacré aux calculs de sécurité, aux visites et réunions et à la réception du prototype concernant la commande de fabrication en URSS des 46 réservoirs de stockage à Hélium (80 m<sup>3</sup>, 20 bars), pour les installations cryogéniques du LEP 200, mérite d'être mentionné.

### **III ADMINISTRATION**

- Director-General Unit (DG)
- General Administration Division (AG)
- CERN Pension Fund
- Administrative Support Division (AS)
- Finance Division (FI)
- Personnel Division (PE)

## DIRECTOR-GENERAL UNIT (DG)

### EXTERNAL RELATIONS OF THE DIRECTOR-GENERAL

The present heading regroups various activities conducted under the direct authority of the Director-General in the field of the external relations of the Organization (mainly diplomacy and public image).

#### 1. Relations with Non-Member States

The first half of the year has seen an increase in the number of Non-Member States that are interested in establishing contacts with CERN, especially in Latin America. The Organization was represented at a recent Conference in Colombia which brought together scientists from the Andinos countries. It is likely that Cooperation Agreements with Argentina, Chile (already agreed by both parties), Colombia, Peru and hopefully Mexico, will be signed later in 1991. The scientific potential in Central and South America is considerable and already the Agreement signed with Brazil in 1990 has led to a marked increase in their involvement in the CERN research programme.

In North America the future of particle physics in Canada still awaits a decision on the proposed Kaon Factory. In the meantime active discussions on the future involvement of Canada in the CERN programmes and on contribution to CERN overheads are in progress with the Canadian authorities. Discussions with the Department of Energy in the United States concerning the signature of a bilateral agreement with CERN and the charging of Non-Member States, led to disappointing results thus far. However a memorandum of understanding has been signed in April with the SSC Laboratory in order to formalize exchanges at technical and scientific level between the SSC Laboratory and CERN as a scientific institution.

In Europe, following the admission of Poland, informal discussions have been continued with Czechoslovakia, Hungary (whose President visited CERN on 2 May) and Yugoslavia on the possible terms and conditions for membership of the Organization and preliminary proposals for Czechoslovakia

will be presented to the June Committee of Council. Good contacts have been established with the small but active nuclear physics community in Albania, where there is great eagerness to grasp the new opportunities to join the rest of Europe.

The Cooperation Agreement and Protocols with the Soviet Union have now reached their final stage and the latter, which will detail the future collaboration on LEP 200 and UNK, will be presented to Committee of Council for approval in June. A draft Protocol for the participation of the USSR to the realization of the LHC project has been prepared which details the specific equipment which could be contributed by the USSR. It is expected that this Protocol will be finalized by the end of 1991.

The Protocol to the Cooperation Agreement which was already signed with Israel specifying their contribution to CERN (the elements of which were presented to Council in December 1990) is now established and ready for signature. CERN awaits a final letter from the Israeli Ministry of Finance specifying details on the modalities of payments.

In Turkey a High Energy Physics Research Centre (YEFAM) has now been established in Ankara and groups from Universities in Adana, Ankara and Istanbul are now participating in the CHARM II experiment at CERN. With assistance from CERN the first Balkan School of Physics intended for students from Albania, Bulgaria, Greece, Romania, Turkey and Yugoslavia, will be held in Istanbul in September 1991.

The Australian Government has announced its intention to sign the Cooperation Agreement and the Australian Ambassador in Berne is expected to visit CERN for this purpose imminently. Two Australian Universities will participate in the programme of R&D for LHC known as RD-2.

With respect to the Asian region, the usual Cooperation Agreement was signed in March with India, which has expressed its interest in participating in the lead-ion facility and later in the LHC. The Chinese Academy of Sciences has also expressed their desire to sign a Cooperation Agreement to replace the

previous Protocol. The Director-General visited Japan in April to establish contacts with the new Government officials in charge of science policy.

are very active, and a strong effort is made to inform the general public (visits at from Eastern Europe has proved to be very successful and more than 50 appointments have been made to date. The last appointments will be made in the Autumn of this year, when the special budget will then be exhausted.

## 2. The public Image of CERN

The public image of CERN is a topic gaining in importance and the Director-General has decided that the various activities that shape CERN's public relations should be the object of continuing attention. Relations with the medias ~~are very active, with a strong~~ CERN, exhibitions in the Member States, publications, etc); special attention is also given to industry, with which CERN not only entertains technical and business contacts, but develops more and more joint ventures in various fields of R & D.

### 2.1 Press

1990 brought the first year of research using CERN's new accelerator LEP and the world's press continued to show great interest in the activities of the Laboratory. This can be seen from the large number of journalists, television and film crews and photographers which visited CERN in 1990. Three hundred and seventy-seven media representatives from twenty-two different countries were received by the Media Service. It is worth noticing that, amongst that number, there were forty-eight television and film crews which illustrates a marked trend towards an increase of interest in CERN amongst the visual media.

To respond to this trend the Media Service made a special effort to prepare high-quality video material to illustrate the exciting and spectacular nature of high-energy physics research so as to enable television crews to project a vital and up-to-date image of the Organization.

Improving the archiving of press cuttings has been a project for the Media Service during the year 1990/1991. A new system will come into operation

by the end of 1991 whereby press articles are scanned directly onto an optical disk thus retaining details of typeface and photographs. Using a specially designed database, articles are retrieved, normally on a workstation, and displayed on video screens. During the first stage the number of users who will have direct access to this press scanning service will be limited but it will eventually be possible for all staff members to consult this press database thus providing a full and up to date press review for the staff.

## 2.2 Public Visit

The interest of the general public for CERN activities continues to increase steadily. In 1990, more than 25'000 visitors came to visit its facilities (two thirds of them under 25 years of age), - a 30% increase over the previous year. The first months of 1991 indicate that the total figure for the current year may well reach 30'000. In anticipation for this increase, the logistics of the CERN "public visit" is being reconsidered and will have to be adjusted, so as to keep pace with its growing success. The conferences given at CERN once a month for the lay public on various topics of scientific actuality also attract large audiences.

## 2.3 MICROCOSM

The MICROCOSM Project, approved by the Council of CERN in December 1988, has started operations on a provisional basis, pending its completion. It presents particle physics and CERN's activities to the layman as a freely accessible exhibition and constitutes a welcome addition to CERN's visit system. Thanks to the generous contributions from external donors (both public and private), the Project will be completed well in time for 1992, - the Year of Europe.

Some of MICROCOSM's space is reserved for temporary exhibitions: in 1990, MICROCOSM hosted from March until September an ESO Exhibition (Discoveries in the Southern Skies), followed by an Exhibition of the supraconducting Magnets for the HERA machine in DESY, from September 1990 until February 1991. An exhibition of ESA, the European Space Agency, will follow and present until October 1991 its scientific space research programme



under the title "From Giotto to Ulysses". Later on, MICROCOSM will present exhibits of non-accelerator research in particle physics from underground installations such as Gran Sasso, etc.

Further improvements of MICROCOSM layout, both from the didactical and esthetical points of view are in progress and should be completed by the autumn of 1991. A formal inauguration of MICROCOSM is foreseen for the end of this year.

## 2.4 CERN Exhibitions

The CERN travelling exhibition is visiting Denmark for the first time, installed in the Tycho Brahe Planetarium in Copenhagen. Further exhibitions are under preparation to coincide with the July Particle Physics Conference in Geneva and the Meeting of the British Association for the Advancement of Science in Plymouth. Meanwhile, to all the extent possible, CERN tries to respond to the numerous local demands for putting up small exhibitions in the region. The CERN exhibition team is also heavily involved with the CERN participation in a Science Pavilion at the 1992 World Fair in Sevilla.

## 2.5 Participation to Sevilla 1992 Universal Exposition

Sevilla '92 is projected to attract some 150'000 persons per day during its six months of existence from April to October 1992. CERN has been invited by the organizers to contribute to an exhibition on "The Universe" situated in the "Pavilion of the Future". This ambitious effort has been made possible, despite the budgetary restrictions at CERN by seeking the sponsoring support of major European industrial groups. In recognition, the organizers have offered CERN to hold a "Day of Honour", which is planned on 30 September 1992. The programme of this high visibility event is presently being discussed.

## 2.6 Publications

Production of CERN's main general publications - Annual Report, CERN COURIER, Weekly Bulletin and visitor literature - continued on schedule and a new brochure on the Large Hadron Collider project is ready for printing. A Publications Advisory Board has been set up to advise on the range and appropriateness of CERN's publications destined for the general public. The budget situation will also make it necessary for the Board to examine the possibility, instead of freely distributing CERN literature to the public, to charge moderate prices so as to cover production costs.

## 3. Relations du CERN avec l'industrie

Les activités du Bureau se sont poursuivies dans les domaines suivants :

- Contacts avec des entreprises et des organisations professionnelles régionales et nationales intéressées par les activités techniques du CERN, à la fois sur le plan purement commercial (fourniture d'équipements) et technologique. Les expositions industrielles au CERN constituent une occasion particulièrement propice.
- Initiation et poursuite de collaborations avec des instituts et des entreprises industrielles en vue de développements techniques communs.
- Transfert de technologie par octroi de licence pour l'utilisation commerciale d'appareils développés au CERN et initialement construits par l'industrie pour les besoins du CERN.
- Prise de brevet en vue de faciliter la valorisation de développements techniques susceptibles d'intéresser l'industrie.

Ces différents sujets rencontrent un vif intérêt dans beaucoup d'Etats Membres et certains ont organisé des réunions avec des industriels pour leur présenter cet aspect des activités de l'Organisation.

Les effectifs du Bureau étant très réduits, ces diverses activités se font en étroite collaboration et avec l'assistance des spécialistes des différentes Divisions et des Services centraux, en particulier la Division des Finances, le Service des Approvisionnements et les Services juridiques, mais aussi les Services des Médias, des Publications et des Visites.

Le Bureau coordonne les relations entre le CERN et la Commission des Communautés Européennes. Ces relations sont en développement rapide, en particulier en ce qui concerne les programmes de bourses et la participation à des programmes technologiques tels que Esprit. L'approfondissement de cette collaboration, dans le cadre de l'application de l'Acte Unique Européen, est un objectif majeur qui rencontre une attitude extrêmement ouverte et positive dans les Services de la Commission à tous les niveaux. Toutefois la situation juridique du CERN, dont le siège officiel est dans un pays extérieur à la Communauté, reste une source de difficultés que l'on espère voir résolues en 1991.

Les retombées technologiques et les applications des techniques développées pour la recherche fondamentale en physique des particules continuent d'être l'objet d'un très vif intérêt de la part d'un nombre croissant de milieux très divers. Le Bureau continue à rassembler, publier et présenter des informations et des exposés de synthèse sur ces sujets.

Il est également amené à jouer un rôle non négligeable dans les relations publiques de l'Organisation (visites spécialisées, interviews par la presse, brochures, expositions,...).

## **GENERAL ADMINISTRATION DIVISION (AG)**

### **BUREAU DU CHEF DE L'ADMINISTRATION**

Le bureau, chargé de missions factuelles pour le Chef de l'Administration, a également pris une part active aux travaux de divers comités tout en poursuivant ses activités de gestion financières des différentes unités composant l'Administration centrale du Laboratoire et géré de grands contrats à caractère administratif.

### **SERVICE D'AUDIT INTERNE**

Au cours du premier semestre de l'année le Service d'Audit interne a concentré ses efforts sur la révision de Comptes 1990 de l'Organisation et de la Caisse de Pensions. Ces travaux ont été entamés dès que les éléments significatifs des Comptes étaient disponibles au début de l'année et se sont déroulés selon un programme établi de contrôles et vérifications.

Se sont poursuivis, d'autre part, des travaux et vérifications dans différents domaines, à la demande du Chef de l'Administration ou d'autres responsables. L'Audit Interne s'est aussi attaché à apporter sa contribution aux activités de développement du nouveau système comptable et financier appelé à prendre le relais du système actuel.

### **SECRETARIAT DU CONSEIL**

Le Secrétariat du Conseil a continué d'assurer ses tâches habituelles: préparation des réunions et des documents du Conseil, de ses Comités et de ses groupes de travail, en particulier du groupe de travail concernant les procédures de vote et le statut, ainsi que de l'ECFA. Il a également assuré la liaison avec les Présidents des différents Comités.

Le Secrétariat a participé à la préparation de la réunion du Comité d'Evaluation du LHC ( 27-31 mai 1991) et à celle de la "Joint International Lepton-Photon Symposium and Europhysics Conference on High Energy Physics" qui se tiendra à Genève du 25 juillet au 1er août 1991.

Le Secrétariat du Conseil continue à assurer le secrétariat du MICROCOSM.

## SERVICE JURIDIQUE

Le Service juridique a assuré sa fonction de conseil de l'Organisation. Il a pris part aux travaux de la "Task Force" relative à la participation d'Etats non Membres aux activités du CERN.

Il a participé à l'étude des problèmes de transferts de technologies dans le cadre des relations de l'Organisation avec les industries, aux travaux concernant la prise de brevets et contribué à l'élaboration d'accords de coopération avec d'autres laboratoires.

Il a pris part aux travaux de la Caisse de Pensions de l'Organisation, notamment en ce qui concerne la garantie des pensions en cas de dissolution, la révision de son statut, les questions juridiques liées à la gestion de ses biens.

Il a participé aux discussions relatives aux contributions de certains Etats Membres, au Groupe de travail sur les procédures de vote et le statut.

Il a participé à divers Comités (notamment le Comité pour la Politique de Sécurité, le Groupe des Pensions) et groupes de travail.

Sur le plan du contentieux, il a défendu les intérêts de l'Organisation, notamment en matière de recours de membres du personnel devant le Tribunal administratif de l'OIT, et a poursuivi sa tâche dans le domaine des assurances. Il a conduit le dossier de l'arbitrage EUROLEP/CERN et celui de l'arbitrage SGIS/CERN.

## RELATIONS AVEC LES ETATS-HOTES

Au titre des relations avec les Etats-hôtes, l'Administration a poursuivi sa mission de représentation de l'Organisation auprès des autorités administratives françaises et suisses à tous les niveaux. Elle s'est occupée plus particulièrement des questions suivantes: séjour et emploi des conjoints et enfants des membres du personnel, passage par le tunnel intersites et par la frontière, arrangements douaniers, protection des biens et des personnes, transport et circulation, statut des entreprises contractantes et de leur personnel.

## **CERN PENSION FUND**

The Annual Report of the CERN Pension Fund is submitted separately to the Council (CERN/1857-CERN/FC/3432).

## ADMINISTRATIVE SUPPORT DIVISION (AS)

### Management Information Services (AS-MI)

The main activity in this period, other than normal service operation, has been in the Advanced Informatics for Support (AIS) project. Detailed analyses of the Foundation, Accounting and Purchasing areas have been carried out permitting completion of the data and function models. Following a market study and extensive evaluation, in close collaboration with Finance Division, an accounting package has been selected and implementation development has started.

A purchasing package has been tested and a final decision on this will be made following discussions with the supplier on required modifications.

The Automated Preprint Handling (APH) project has now installed and tested the necessary hardware and software, and compatibility tests have shown that most CERN microcomputers will be able to preview preprints. The library data base (ALICE) is being modified to communicate directly to the optical disk system and a room is being prepared to install the system (AS-SI). The software to interface the optical disk system with ALICE is now ready to be integrated. In June the system will be tested in real life, with SI staff starting a systematic scanning of preprints. At the same it is planned to give a reduced number of users access to the system to test their reactions.

A price review of IBM compatible personal computers has been carried out and a tender for high quality graphic screens has been prepared.

Two Desk Top Publishing centres are now in operation and making good progress with modern techniques in the field.

### Scientific Information Services (AS-SI)

In the Scientific Information Service, the automation programme continues. A major event was the successful testing, and linking to the ALICE retrieval system,

of the Optical Disk System for storage, transmission and display of preprints. The selection and realization of the set-up and the user interface was done by AS-MI, and the link to ALICE by AS-SI. The objective of creating an international clearing house for preprints can now be met.

The QALICE system for retrieval and output transfer by e-mail has been so successful that an extension of its capacity is needed. The related Selective Diffusion of Information (SDI) service for current awareness in HEP is now running more than 150 profiles.

An expert team has confirmed that the host computer requires upgrading to cope with the increasing load. A VAX 4300 will be installed about mid-1991, to handle operation for the coming 3-4 years.

The staff situation has been consolidated by recruiting a systems librarian from the Danish National Technology Library, who is expert on the ALICE system. This was made possible by internal staff movements. The loss of a part-time librarian by transfer had to be met by the reduction of the purchase service to CERN Groups (so-called "Long Term Loans") leaving the library services intact.

The policy of free self-service photocopying of library material and free data base searches on external hosts has been maintained.

Cooperation with other HEP information centres, in particular SLAC and DESY, continues, inter alia, by weekly transmission of complete new CERN preprint records. The semi-automated merging of imported files, a key element in eliminating multiple entries now imposed by the requirement of timeliness, will be operational by the end of the year.

#### Logistics Group (AS-LO)

The illustrated Stores catalogue has been made accessible to users in electronic form (AppleShare file). In the same context, a project of electronic transmission of the Stores Material Request form has been elaborated and successfully put into operation.



The first Electronic Data Interchange (EDI) pilot project with IBM/Fabrimex was completed and negotiations are under way with other potential partners (e.g. integration of outside distributors into the Stores distribution system, starting next autumn).

The Group participated actively in the Purchasing/Logistics Detailed Area Analysis as part of the AIS project.

As consequences of the general economy measures, one of the two Self Service Stores on the Meyrin site was closed and the project of putting the Central Store under Industrial Support was initiated.

### **General Services (AS-GS)**

#### **Welcome Service**

The designation of a successor to the retiring head of this Section is expected soon. He will organize and supervise four activities:

- The Reception desk, the principle of which has just received the approval of the CERN Management, will be based on a permanent team composed of well-trained "stagiaires" at CERN, selected from different specialised schools in our Member States.
- The "Gardiennage Service", mainly handled by an outside firm, has been re-examined in depth and relations between the contractor and CERN have been improved. New procedures were studied and will come into operation by the second half of 1991 (an important project for the improvement of the necessary hardware has not yet been approved but is under consideration by the responsible Director).
- The restructuration of the Registration Office has started in spite of the loss of two staff members. A great effort was made in 1990 to include all the necessary information into one central data base.
- As soon as the policy concerning the Visits Service and Microcosm is reviewed by the Management, services will be rendered by Welcome Service in close collaboration with the Public Relations Services.

### **Mail Office**

Following the departure of the head of the service, the technical level of the post is being increased. The service is now largely computerised and needs more expertise in this field. An internal candidate has been selected.

Early in 1991, all internal delivery points were registered in a central data base and will become part of the AIS project. The management of these is now the responsibility of the service.

For the messengers and addressing tasks, a new specification for a tender, expected to be sent out during the second half of 1991, was written and approved. With the new proposed contract, a better service is expected in spite of an important decrease in the number of staff members.

### **Housing**

Major changes have taken place in the Housing Service, following the appointment of a new head of the service. His first task is to unify all the activities previously managed by separate persons. Contacts with outside partners are now improving.

The hostels and dormitories will be soon entrusted to a contractor, who will have to deal with reservations, room management, cleaning and maintenance, leaving only a few CERN staff for coordination and relation with users.

### **Space**

A general space management policy was presented and approved by the Management. Both the Administrative Liaison Committee and Site Committee have approved this programme and promised to give their strong support to its achievement.

The ORACLE based computer programme GESLOC, elaborated in close collaboration with AIS, is now operational for space management, and an extensive inventory of all office space has been completed in close collaboration with the Fire Brigade. An inventory of all locking systems is now being prepared using GESLOC.

## Office of the Division Leader (AS-DI)

### **Translation & Minutes Section**

The Translation and Minutes Service experienced its usual peak in the number of documents handled, owing to the translation of the Annual Report and the large number of documents to be translated for the June meetings of the Council and its Committees. An increase in editing and revision of draft documents was also noted. Eight out of eleven translators are now equipped with Macintoshes, and a particular effort is being made to set up an electronic filing system to improve reference facilities particularly regarding the translation of technical specifications and standard documents. It is unclear whether the Laboratory will be able to maintain the present number of translators.

### **Organization & Methods Section**

The section has been charged with the secretariat of a re-constituted Administrative Liaison Committee (CLA). At the request of the CLA, and in liaison with the AIS project, a study of administrative procedures was launched in the purchasing/logistics and financial areas. A new system for handling signature delegation information was implemented and a proposal was presented to and endorsed by the CLA to create a comprehensive document data base for procedures and official instructions. The Section Leader continues to be detached for 50% of his working time to the AIS project (User interface team).

## FINANCE DIVISION (FI)

### 1.— INTRODUCTION

In 1990, the Finance Division's activities were characterized by innovation despite continuing pressure from its other traditional tasks. Daily problems continue to demand immediate solutions even at a time of budget and accounting procedure reform. Thus, although work on the introduction of a computerized management data processing system has reached an advanced stage, it is business as usual using traditional methods until such time as the new procedures become operational and the associated equipment becomes available.

Despite the increased work-load, considerable progress has been made and it is expected that most of the set objectives will have been achieved by the end of 1991.

The Finance Division now has constant access to updated information on the Organization's cash position, thus making it considerably easier to mobilize its ever limited resources.

In addition to the increased activity generated by the Organization's major projects, especially LEP 200, there was continued intense activity associated with the reorganization of the supply services and particularly of purchasing. After a period of trial and error owing to staff changes, it is expected that activities can be centralized in the course of 1991. This will ensure greater rationalization of manpower and skills with a concomitant saving of resources in accordance with the policy of staff reductions laid down by the CERN Council.

However, it must be borne in mind that staff resources are already insufficient to cope with the major work-load looming ahead and that imaginative solutions will have to be found soon if requirements are to be met.

## 2.— FINANCIAL AND ACCOUNTING SERVICES

- 2.1 The main activities over this period have been the closing of the accounts and preparation of the 1990 Annual Accounts.
- 2.2 A study was conducted in the framework of the AIS Project (Advanced Information Systems for administration and management) which resulted in the definition of a high-level information systems model. One of the areas proposed for detailed analysis was the financial area with a view to implementing a new financial system.

The result of this in-depth area analysis for the Finance Division is a detailed information and function model, which specifies the information system that will cover the needs of the finance area. Transition issues, fall-back, security, audit, back-up and recovery are also addressed in the analysis.

The purpose of the in-depth study was to permit detailed assessment of and define the specifications for a package solution, with a view to finding a supplier who could provide a new financial software package suited to CERN's precise requirements.

Shortly, the package and supplier will be selected and implementation of the new financial system for CERN (General Ledger, Accounts Payable, Accounts Receivable) will begin.

- 2.3 Since the beginning of 1991, the Finance Division has successfully implemented the first phase of a new cash management system. Using a modem connected to a PC and/or Macintosh workstation, the user in the Finance Division can access the Account Report System (ARS) application. ARS allows the user to display information on account balances and transactions of the main CERN bank accounts in Switzerland and elsewhere. Up-to-date information can thus be obtained on the cash position of the Organization without having to wait for the daily status reports from the various banks. Furthermore, through selection masks, the user can easily track any type of financial transaction at any of the main banks where CERN has one or more accounts.

The next phase will include automatic reconciliation of the CERN financial accounts as well as electronic transfer of payments to banks with which CERN has dealings.

- 2.4 A new powerful workstation is being installed in the Finance Division to act as central server machine for the transmission of data from the Division to other Divisions. This server will allow IBM compatible workstations as well as Macintoshes to share data, text and files without the need to perform cumbersome conversions from PC to Mac and vice versa.

Furthermore, all access to the mainframe computers is being standardized, a development which will definitely facilitate the implementation of the new financial system.

- 2.5 The LEP debts had been reduced by 100.83 MCHF by the date on which the 1990 Accounts were closed and an amount of 78.5 MCHF has also been charged to the 1991 Budget. As a result, as at 30 April 1991, the overall LEP debts have been reduced by some 179.33 MCHF since 1 January 1989.
- 2.6 In accordance with document CERN/FC/3344, 20 MCHF were reimbursed to Switzerland in 1991. The balance of advances from Switzerland now amounts to 20 MCHF and it will be reimbursed by 1992 as planned.
- 2.7 For the first quarter of 1991, the Invoice Office handled about 13 800 invoices, a similar amount to the same period last year.

In the commitments field, a detailed follow-up procedure has been introduced for large contracts. This should allow more detailed monitoring of the financial aspects of contracts, whether subject to revision or not, extending over several years.

### 3.— PROCUREMENT SERVICE

The Service has been particularly heavily involved in acquiring the necessary materials and services for the LEP 200 project. By mid-April, 65 contracts were ready or were in the final stages of preparation. The peak of the work on calls for tenders for LEP 200, however, has now been passed and 24 calls for tenders were

issued over the same period. About 8000 orders were placed. Norway held a national exhibition at CERN in March and there were about ten one-day separate technical exhibitions.

Considerable attention was paid to the upgrading of the database for potential suppliers. This work, involving cooperation with authorities in several Member States will, of course, gradually be expanded to embrace all the Member States.

Work on the much needed modernisation of the informatics tools for the Procurement Service is being actively pursued within the framework of the Advanced Information System (AIS) project.

#### 4.— PLANNING AND BUDGET SERVICE

This service mainly prepares and publishes the Organization's Planning and Budget documents as well as the official documents on the contributions of the Member States and on the cost-variation index for Personnel and Materials.

In addition, the service provides the financial part of manpower planning and project authorization. It also regularly prepares various internal planning and control documents for the Management.

During the reporting period, additional documents for the Finance Committee and the Council regarding contributions and the re-scheduling of the debt to the Pension Fund have been prepared. A study on simulating different scenarios of contributions is still under way. On the Personnel side, the simulation model for the Personnel Budget is being revised and prepared for adaptation for the eventual introduction of career paths.

## PERSONNEL DIVISION (PE)

### Remuneration and career policy

Personnel Division co-ordinated an internal Working Group study of a merit-oriented advancement policy which was presented to Management and discussed with the Staff Association in the context of the Standing Concertation Committee. It prepared the final proposal document for Finance Committee and the Committee of Council.

### Early departures

In an attempt to bring the 1988 Early Departure arrangements to a close, it was decided that the 284 staff members whose applications for departure had been refused should be assisted to leave, if they could not be satisfactorily redeployed and remotivated. Arrangements have now been made for the majority of them, and the remainder should be resolved shortly; the last day of contract for the people concerned is 31 December 1993 at the latest.

Other staff wishing to leave before compulsory retirement are allowed to do so, subject to the needs of the Organization, on conditions which fall within the discretionary powers conferred on the Director-General by the Staff Rules and Regulations.

### Training

The development of the various CERN staff training programmes continued. There were further new initiatives in Technical and Management Training. In Academic Training, the introduction of several series of lectures at post-graduate level proved very successful. The CERN apprentice programme was reviewed, the outcome being the continuation of the technical apprentice programme at its present level and the introduction of secretarial apprentices.

### Fellows, Associates and Students

Personnel Division participated in discussions aimed at fostering the collaboration with the European Communities with a view to increasing the number of Fellows at the Laboratory.

In collaboration with the CERN Users' Office, efforts were made to improve the system for recording information about users, and to offer them appropriate insurance coverage, where this was missing.



Arrangements were made to improve the publicity about the CERN Student Programmes in the Member States.

### **Health insurance**

Arrangements to control the increases in costs were continued through communications with the staff and negotiations with the suppliers of medical services in the Geneva area.

Discussions took place on the conditions for an extension of the contract with "Austria Assurances S.A.", which expires on 31 December 1991.

### **Informatics**

A project to upgrade and extend the computing infrastructure in PE Division was authorized at the beginning of the year. The 1991 phase is being implemented: a local area network is now available with server and electronic mail facilities; the transfer of NOTIS files to the Macintoshes on a Word format should be completed by the end of the summer. Specific studies have been carried out for an analysis of school fees and fellowship stipends. A major effort has also been made for the evaluation of the costs of the proposed merit-oriented advancement scheme.

### **Staff Survey**

The annual staff survey, co-ordinated by Personnel Division, took place on the same basis as in 1990.

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