

TS Workshop

Report of Contributions

Contribution ID: 1

Type: **not specified**

THE ALICE DIPOLE MAGNET

Tuesday 4 May 2004 08:40 (20 minutes)

The design and construction of the ALICE dipole magnet has been co-ordinated within the LEA group. Several teams from collaborating institutes as well as design and engineering resources from CERN participated in the project. The construction of the different main components was entrusted to industry in several countries. The paper highlights some of the major design features and engineering solutions. The requirements for a full preassembly are explained and the assembly procedure as well as the status of the project is summarized

Author: SWOBODA, D.**Presenter:** SWOBODA, D.**Session Classification:** LHC & Experiments I

Contribution ID: 2

Type: **not specified**

LAYOUT DRAWINGS OF THE LHC COLLIDER

Tuesday 4 May 2004 11:20 (20 minutes)

The team in charge of the LHC integration largely uses 3D scenes combining functional positions of equipments and the 3D CAD model issued from the CERN Drawing Directory (CDD) repository. This is made possible through the Digital Mock-Up tool developed at CERN. Giving dimensions in 3D context is a challenge with the current 3D CAD tools used at CERN. Requirements from users groups have made clear a need for automatic production of 2D layout drawings. This paper presents the retained solution to create on-request dimensioned drawings, to publish them, while maintaining coherence and consistency with the 3D integration scenes. Reliability of the information, on-line availability of the latest layout changes on dimensions and positions of equipments, and the maintenance of the facility will also be described.

Author: VERGARA, A.**Presenter:** VERGARA, A.**Session Classification:** LHC & Experiments I

Contribution ID: 3

Type: **not specified**

LARGE SCALE DEPLOYMENT OF MTF AND LESSONS LEARNED

Tuesday 4 May 2004 11:40 (20 minutes)

The MTF system was developed to capture the design, manufacturing, test and installation data of equipment built for LHC. Today, more than 120.000 descriptions of LHC equipment are being managed with the MTF. The acquisition of the equipment data is both an organisational and a technical challenge. For expensive equipment such as the LHC dipoles a reliable and robust non-conformance methodology must be put in place, the MTF provides the required information technology support tools. The EDMS Service has developed methods, training processes and tools to cope with an extensive use of the system, a use which will grow during the next years until LHC is installed. This paper presents the experience acquired and the solutions put in place.

Author: MALLON, S., MANOLA-POGGIOLI, E.

Presenter: MALLON, S., MANOLA-POGGIOLI, E.

Session Classification: LHC & Experiments I

Contribution ID: 4

Type: **not specified**

INSTALLATION OF A PARTICLE ACCELERATOR: FROM THEORY TO PRACTICE

Tuesday 4 May 2004 12:00 (30 minutes)

The size and complexity of the LHC project at CERN calls for a strong co-ordination of all installation activities. The detailed installation planning has to take into account many constraints such as the component production rates, the installation contracts or the transport and handling requirements in a narrow tunnel with limited access points. The planning also needs to be flexible enough to cope with aleas that are unavoidable in such a large project that spans over many years. This paper describes the follow-up methodology, both in the field and in the office, adopted by the IC team to assist the groups involved in the installation of the LHC machine.

Author: FORAZ K., VITASSE, M., WEISZ, S.

Presenter: FORAZ K., VITASSE, M., WEISZ, S.

Session Classification: LHC & Experiments I

Contribution ID: 5

Type: **not specified**

Conclusions

Tuesday 4 May 2004 12:30 (10 minutes)

Author: POTTER, K.

Presenter: POTTER, K.

Session Classification: LHC & Experiments I

Contribution ID: 6

Type: **not specified**

Welcome

Tuesday 4 May 2004 08:30 (5 minutes)

Author: CIRIANI, P.

Presenter: CIRIANI, P.

Session Classification: LHC & Experiments I

Contribution ID: 7

Type: **not specified**

Introduction to the session

Tuesday 4 May 2004 08:35 (5 minutes)

Author: POTTER, K.

Presenter: POTTER, K.

Session Classification: LHC & Experiments I

Contribution ID: 8

Type: **not specified**

METROLOGIE DES EXPERIENCES : DEFIS ET RESULTATS

Tuesday 4 May 2004 09:00 (20 minutes)

La physique des particules a toujours exige une connaissance precise de la geometrie des equipements experimentaux et la metrologie des detecteurs a ete de concert avec celle des accelerateurs. Les premiers systemes de detection, de dimensions modestes, demandaient deja un positionnement le plus pres du 'theorique', les premieres mesures tridimensionnelles ont ete pratiquees pour la construction de BEBC, constituant les premiers defis geometriques. Les experiences LHC ne peuvent etre comparees a aucune autre precedente au CERN et leurs exigences ont amene les concepteurs et constructeurs a considerer le 'survey' bien plus tot que jamais auparavant : ce sont des dizaines de milliers de kilometres qui ont ete parcourus, theodolites et cameras digitales en guise de bagages, afin d'assurer les controles systematiques en usine ou en laboratoire. La metrologie des experiences occupe une place importante dans les procedures d'installation et exige toujours un degre eleve d'expertise avec un besoin continu d'adaptation et de developpement.

Author: LASSEUR, C. , GAYDE, J-C.**Presenter:** LASSEUR, C. , GAYDE, J-C.**Session Classification:** LHC & Experiments I

Contribution ID: 9

Type: **not specified**

SYSTEME DE PLC POUR LA SUPERVISION DE LA DISTRIBUTION BASSE TENSION DES EXPERIENCES ALICE ET LHCB

Tuesday 4 May 2004 09:20 (20 minutes)

Le groupe TS/EL étudie et réalise la distribution électrique basse tension pour alimenter les racks contenant l'électronique associée aux détecteurs dans les zones expérimentales du LHC.

La distribution basse tension utilisera des tableaux récupérés des expériences du LEP pour ALICE et LHCb et un système basé sur des gaines CANALIS pour ATLAS et CMS.

L'ensemble de la distribution électrique basse tension sera surveillée et contrôlée par l'intermédiaire de systèmes à base de PLC.

Ce papier décrit l'infrastructure de supervision proposée pour ALICE et LHCb et son intégration au CERN Electrical Network Supervisor (ENS) et au Detector Control System (DCS).

Author: BURDET , G.

Presenter: BURDET , G.

Session Classification: LHC & Experiments I

Contribution ID: 10

Type: **not specified**

THE RADIATION MONITORING SYSTEM FOR THE LHC EXPERIMENTS AND EXPERIMENTAL AREAS

Tuesday 4 May 2004 09:40 (20 minutes)

With the high energies stored in the beams of the LHC, special attention needs to be paid to accident scenarios involving beam losses which may have an impact on the installed experiments. Among others, an unsynchronized beam abort and a D1 magnet failure are considered serious cases. According to simulations, the CMS inner tracker in such accident scenarios can be damaged by instantaneous rates which are many orders of magnitude above normal conditions. Investigations of synthetic diamond as a beam condition monitor sensor, capable of generating a fast beam dump signal, will be presented. Furthermore, a system to monitor the radiation fields in the experimental areas is being developed. It must function in the radiation fields inside and around the experiments, over a large dynamic range. Several new active and passive sensors, such as RadFET, OSL (Optically Stimulated Luminescence) sensors, p-i-n diodes, Polymer-Alanine Dosimeters and TLDs (Thermoluminescent Dosimeters) are under investigation. Recent results obtained in test beams and in the laboratory, including a GEANT4 Monte Carlo simulation of the sensor housing, are presented.

Author: ILGNER, C.**Presenter:** ILGNER, C.**Session Classification:** LHC & Experiments I

Contribution ID: 11

Type: **not specified**

INTEGRATION OF FORWARD PHYSICS DETECTORS INTO THE LSS OF THE LHC

Tuesday 4 May 2004 10:00 (20 minutes)

Experimental detectors will be installed in the Long Straight Sections (LSS) of the LHC. The reasons why the experiments need to locate detectors in the machine tunnel will be explained. A detailed description of the TOTEM Roman Pot in the LSS5 and the ALICE Zero Degree Calorimeter (ZDC) in the LSS2 will be given. A few new proposals in the LSS1 and the LSS8 will also be mentioned. Integration issues will be discussed in detail including the foreseen radiation levels. Roman Pots need to be integrated in the primary vacuum of the machine while the ALICE ZDCs have to be integrated into the combined experimental and injection insertion at IR2. The AB/BDI group project that foresees the installation of luminosity monitors in the LSS will be mentioned in relation to the integration of the experimental detectors.

Author: MACINA, D.**Presenter:** MACINA, D.**Session Classification:** LHC & Experiments I

Contribution ID: **12**

Type: **not specified**

COFFEE BREAK

Tuesday 4 May 2004 10:20 (20 minutes)

Session Classification: LHC & Experiments I

Contribution ID: 13

Type: **not specified**

INSTALLATION OF THE LHC EXPERIMENTAL INSERTIONS

Tuesday 4 May 2004 10:40 (20 minutes)

The installation of the LHC experimental insertions, and particularly the installation of the low-beta quadrupoles, raises many technical challenges due to the stringent alignment specifications and to the difficulty of access in very confined areas. The compact layout with many lattice elements, vacuum components, beam control instrumentation and the presence of shielding does not allow for any improvisation in the installation procedure. This paper reviews all the constraints that need to be taken into account when installing the experimental insertions. It describes the chronological sequence of installation and discusses the technical solutions that have been adopted

Author: BARTOLOME-JIMENEZ, S.

Presenter: BARTOLOME-JIMENEZ, S.

Session Classification: LHC & Experiments I

Contribution ID: 14

Type: **not specified**

VACUUM CHAMBERS FOR LHC LSS

Tuesday 4 May 2004 11:00 (20 minutes)

The approximately 6 km total length of the Large Hadron Collider (LHC) warm sections consist of about 1000 chambers. Most of these chambers, of various length and cross sections, are made of copper, but different lengths in stainless steel, mumetal, aluminium and beryllium will also be used. All the chambers will be internally coated with a thin film of TiZrV, to reduce both the secondary electron yield and the photon and electron stimulated desorption, with the further advantage of providing a huge additional pumping speed. In order to cope with the tight production schedule, a new dedicated coating facility was created, which allows four chambers to be coated per working day. This coating facility and its operating mode are described, together with the TiZrV film characteristics (structure, morphology) and performance (pumping speed, ultimate pressure, discharge gas outgassing).

Author: COSTA PINTO, P.**Presenter:** COSTA PINTO, P.**Session Classification:** LHC & Experiments I

Contribution ID: 15

Type: **not specified**

Introduction to the session

Tuesday 4 May 2004 14:00 (10 minutes)

Author: HAUVILLER, C.

Presenter: HAUVILLER, C.

Session Classification: LHC & Experiments II

Contribution ID: 16

Type: **not specified**

LHC ACCESS SYSTEM: STATUS REPORT

Tuesday 4 May 2004 16:50 (20 minutes)

The LHC complex is divided into a number of areas with different levels of access authorizations. The LHC interlocked areas are the ones where access is restricted, and not allowed during beam operation or equipment tests. Inside those interlocked areas, the personnel protection is ensured by the LHC Access System. This system is made of two parts: the LHC Access Control System and the LHC Access Safety System. The LHC Access Control System regulates the access to the tunnels and experimental areas by identifying the users and checking their authorisations. It allows a remote or automatic operation of the access control equipment and restricts the number of users working simultaneously in the interlocked areas. On the other hand, the LHC Access Safety System ensures the safety functions of the LHC Access System by interlocking the LHC key safety elements. This paper summarises the project status, organisation and main milestones up to final acceptance before the LHC start up

Author: NININ, P.**Presenter:** NININ, P.**Session Classification:** LHC & Experiments II

Contribution ID: 17

Type: **not specified**

IMPROVING INDUSTRIAL PROCESS CONTROL SYSTEMS SECURITY

Tuesday 4 May 2004 17:10 (20 minutes)

System providers are today creating process control systems based on remote connectivity using internet technology, effectively exposing these systems to the same threats as corporate computers. It is becoming increasingly difficult and costly to patch/maintain the technical infrastructure monitoring and control systems to remove these vulnerabilities. A strategy including risk assessment, security policy issues, service level agreements between the IT department and the controls engineering groups must be defined. In addition an increased awareness of IT security in the controls system engineering domain is needed. As consequence of these new factors the control system architectures have to take into account security requirements, that often have an impact on both operational aspects as well as on the project and maintenance cost. Manufacturers of industrial control system equipment do however also propose progressively security related solutions that can be used for our active projects. The paper discusses the impact of these issues on the process control system for the air handling of the LHC tunnel and its underground areas. It describes a technical evaluation of different solutions and the associated costs.

Author: EPTING, U., MORODO, MC.

Presenter: EPTING, U., MORODO, MC.

Session Classification: LHC & Experiments II

Contribution ID: 18

Type: **not specified**

TIM (TECHNICAL INFRASTRUCTURE MONITORING) AND CCC

Tuesday 4 May 2004 17:30 (20 minutes)

The Technical Infrastructure Monitoring project (TIM) will implement the future control system for the TCR. The aim of the project is to replace the current TCR monitoring system with a modern system built on standard hardware and software components, taking advantage of existing services and license agreements. The TIM system will be put in operation in the TCR towards the end of 2004, but is already prepared to integrate the CERN Control Centre (CCC). This paper discusses hardware, software and availability aspects of TIM and gives details as for its integration in the CCC. In particular, similarities and differences with the accelerator and cryogenics controls are considered

Author: BATZ, M., SOLLANDER, P.

Presenter: BATZ, M., SOLLANDER, P.

Session Classification: LHC & Experiments II

Contribution ID: **19**

Type: **not specified**

Conclusion

Tuesday 4 May 2004 17:50 (10 minutes)

Author: HAUVILLER, C.

Presenter: HAUVILLER, C.

Session Classification: LHC & Experiments II

Contribution ID: 20

Type: **not specified**

LOGISTICS OF LHC CRYODIPOLES: FROM SIMULATION TO STORAGE MANAGEMENT

Tuesday 4 May 2004 14:10 (20 minutes)

The main families of LHC superconducting cryomagnets consist of approximately 1240 cryodipoles and 480 Short Straight Sections (SSS). The different contracts, which are constraining the production and installation of these cryomagnets, have been initially rated according to the baseline schedule, based on a “just in time” scheme. However the complexity of the construction and the time required to fully test the cryomagnets require that each contract is decoupled as much as possible from the others’ evolutions and impose temporary storage between different assembly and test activities. Therefore, a tool simulating the logistics over the whole duration of the project was created in order to determine the number of cryomagnets to be stored at the various stages of their production. In this paper the organization of cryomagnet flow and the main challenges of logistics are analyzed on the basis of the planning of each main step before installation in the LHC. Finally, the solutions implemented for storage, handling and transportation are presented and discussed.

Author: FORAZ, K. , NICQUEVERT, B.

Presenter: FORAZ, K. , NICQUEVERT, B.

Session Classification: LHC & Experiments II

Contribution ID: 21

Type: **not specified**

MECHANICAL DYNAMIC LOAD OF THE LHC ARC CRYO-MAGNETS DURING THE INSTALLATION

Tuesday 4 May 2004 14:30 (20 minutes)

About 1700 LHC main superconducting dipoles and quadrupoles will have to be transported and handled between the assembly, the magnet measurements and the storage that precedes the final installation in the LHC tunnel. To ensure the required mechanic and geometric integrity of the cryo-magnets, transport specifications and allowed acceleration loads were defined after detailed dynamic analysis. A large number of cryo-magnets are now arriving at CERN on a regular basis. The logistics for the handling and transport are monitored with tri-axial acceleration monitoring devices that are installed on each cryo-magnet. Measurements are made to commission new equipment like overhead cranes, tunnel transport and handling devices to guarantee that the defined acceleration limits are respected. The results from the acceleration monitoring that are stored in the same quality assurance system as the cryo-magnets allowed to give a first idea of the level of the mechanical dynamic load on each magnet throughout the logistics chain and were used to detect details such as out-of-specification accelerations that needed improvement.

Author: ARTOOS, K. , CAPATINA, O.

Presenter: ARTOOS, K. , CAPATINA, O.

Session Classification: LHC & Experiments II

Contribution ID: 22

Type: **not specified**

SECURITE DES OPERATIONS DE TRANSPORT - MANUTENTION

Tuesday 4 May 2004 14:50 (20 minutes)

Dans le cadre de la démarche sécurité au sein du groupe TS-IC, ce document décrit les mesures mises en œuvre afin de rationaliser l'organisation sécurité des opérations de transport –manutention. Le papier s'attachera tout d'abord à clarifier les responsabilités des différents intervenants au cours de chaque phase (préparation, planification, coordination, supervision). La stratégie envisagée sera ensuite détaillée et mise en perspective : formalisation de l'appréciation du niveau de risque, systématisation et coordination des actions préparatoires, mise en place d'inspections de sécurité, motivation financière du personnel du contractant, analyse des accidents. Un accent particulier sera porté sur le suivi du matériel CERN : maintenance, contrôle périodique de sécurité et retour d'information des utilisateurs. Enfin, compte tenu de la rigueur inhérente à la sécurité, le système qualité de suivi des non-conformités et des actions associées sera présenté

Author: PRODON, S.**Presenter:** PRODON, S.**Session Classification:** LHC & Experiments II

Contribution ID: 23

Type: **not specified**

SPS EXTRACTION KICKER MAGNET - THERMAL ANALYSIS

Tuesday 4 May 2004 15:10 (20 minutes)

As the SPS accelerator will be used for the CNGS project and as LHC injector, the proton beams passing through its extraction kickers will have a much higher intensity than in the past. The image currents generated by this beam may provoke a temperature increase in the magnet's ferrite core to temperatures above the Curie temperature, unless the heat produced is effectively removed. A further complication arises from the fact that a high voltage is applied to the ferrites. The solution adopted consists in transferring the heat via Aluminium Nitride insulators to a water cooling circuit. The heat transfer analysis and the calculated thermal distribution of the magnet are presented.

Author: TIMMINS, M.**Presenter:** TIMMINS, M.**Session Classification:** LHC & Experiments II

Contribution ID: 24

Type: **not specified**

BOITES DE DISTRIBUTION POUR L' ALIMENTATION ELECTRIQUE DU LHC

Tuesday 4 May 2004 15:30 (20 minutes)

En tant qu'unité d'engineering mécanique et matériaux, le groupe MME est en charge de la conception et des dossiers de spécification des DFBA, DFBL & DFBLM (Electrical Distribution Feed Boxes) du LHC. Ces équipements complexes ont pour fonction principale l'alimentation électrique de puissance des aimants de la machine. Au total 34 types de DFB différents seront nécessaires, comportant quelque 1200 amenées de courant supraconductrices et résistives de 120 A à 13000 A. Pour les besoins urgents du test dans le secteur 7-8 du LHC, le groupe a été également sollicité pour réaliser les dossiers des plans de fabrication, fabriquer et assembler 2 versions de DFBA (la DFBLAN et la DFBAO), ainsi que les amenées de courant correspondantes d'ici mai 2005. Cette opération requiert l'utilisation de nombreuses compétences du groupe. Plus de 500 plans de fabrication seront produits et plusieurs spécifications techniques seront établies. Une collaboration rapprochée entre le bureau d'étude et l'équipe de fabrication permet (pratiquement) en temps réel de choisir les techniques de production et d'assemblage les mieux appropriées. Des tests de faisabilité sont effectués, si nécessaire. La note décrit les enjeux techniques des DFB, mais aussi le processus multidisciplinaire menant de la conception à la réalisation sous la contrainte d'un calendrier très serré

Author: FOLCH, R., TRILHE, P.**Presenter:** FOLCH, R., TRILHE, P.**Session Classification:** LHC & Experiments II

Contribution ID: 25

Type: **not specified**

COFFEE BREAK

Tuesday 4 May 2004 15:50 (20 minutes)

Session Classification: LHC & Experiments II

Contribution ID: 26

Type: **not specified**

THE LHC COLLIMATORS

Tuesday 4 May 2004 16:10 (20 minutes)

In the framework of the LHC Collimator project, TS department has been assigned the task to design the series collimators and to manufacture prototypes to be tested in summer 2004. Their concept must comply with a very demanding specification, entailing a temperature on the collimating jaws not exceeding 50°C in steady conditions and an unparalleled overall geometrical stability of 25 μm on a 1200 mm span, meeting, at the same time, the challenging deadlines required by the project schedule.

To respond to these tough and sometimes conflicting constraints, the chosen design appeals to a mixture of traditional and innovative technologies, largely drawing from LEP collimator experience. The specification imposes a low-Z material for the collimator jaws, directing the design towards graphite or such novel materials as 2-D and 3-D Carbon/Carbon composites. An accurate mechanical design has allowed to considerably reduce the mechanical play and to optimize the geometrical stability. The mechanical lay-out and a summary of the in-depth thermo-mechanical calculations concerning cooling efficiency, temperature distribution, mechanical strength and deformations are presented.

Author: BERTARELLI, A.**Presenter:** BERTARELLI, A.**Session Classification:** LHC & Experiments II

Contribution ID: 27

Type: **not specified**

INTEGRATION OF TRANSPORT AND HANDLING EQUIPMENT AT CERN –CRITERIA TO SATISFY OPERATIONAL NEEDS AND SAFETY ASPECTS

Tuesday 4 May 2004 16:30 (20 minutes)

Within the last 4 years TS-IC-HM (former ST-HM group) integrated about 150 transport and handling supplies including 29 cranes, 20 fork lift trucks, 60 tunnel vehicles. Most of these are standardised supplies, but very often special functionality has been implemented and the complexity of the equipment has been increased. With the Rocla cryo-dipol transporters even prototype equipment was integrated that had been specially designed for CERN. This paper discusses the differences regarding the actions that have to be performed when the different kind of equipment have to be integrated.

Author: BERTONE,C. , BOETTCHER, O.

Presenter: BERTONE,C. , BOETTCHER, O.

Session Classification: LHC & Experiments II

Contribution ID: **28**

Type: **not specified**

Introduction to the session

Wednesday 5 May 2004 08:30 (10 minutes)

Author: BALDY, J.L.

Presenter: BALDY, J.L.

Session Classification: Contracts

Contribution ID: 29

Type: **not specified**

MANAGING THE DETECTOR FIXED GAS DISTRIBUTION CONTRACTS

Wednesday 5 May 2004 11:20 (20 minutes)

This presentation will explain what is involved in managing the two contracts that are in place for the detector fixed gas distribution networks. The work under Contract F-447 involves the supply and installation of two completely new fixed gas distribution systems located at point 1 and point 5. These systems start in the gas buildings located on the surface and finish at the proximity of the detector in the experimental cavern. The work under contract E-070 involves the modifications to the pre-existing LEP fixed gas systems located at points 2 and 8 which will be re-used for the ALICE and LHCb experiments. This contract also operates and maintains the SPS, PS and experimental hall gas systems that are located all over CERN.

Author: MCFARLANE, D.**Presenter:** MCFARLANE, D.**Session Classification:** Contracts

Contribution ID: 30

Type: **not specified**

MANAGING THE LHC EXPERIMENTAL AREAS

Wednesday 5 May 2004 11:40 (30 minutes)

Following handover by the civil engineering contractors the new LHC experimental areas must be fitted-out with appropriate infrastructure and technical services. An installation schedule taking into account all the activities involved must be developed and kept up-to-date. Integration of this installation planning with that of the LHC Machine and detectors of the experiment are vital elements. Once installation starts an Experimental Area Management (EAM) team must be set-up to co-ordinate all area activities. This process will be illustrated for the new areas at Point 1 and Point 5 and the EAM of the existing areas at Point 2 and 8, custom built and inherited from LEP, will also be compared. The status of installation in all areas will be briefly presented. The important tasks of EAM will be explained, and the organization used to achieve the goals will be detailed, with an emphasis on safety aspects. The successes and difficulties encountered so far will be reviewed and the conclusions that have been drawn from this experience will be discussed.

Author: BUTIN, F., EVRARD, S., GASTAL, M.**Presenter:** BUTIN, F., EVRARD, S., GASTAL, M.**Session Classification:** Contracts

Contribution ID: **31**

Type: **not specified**

Conclusions

Wednesday 5 May 2004 12:10 (10 minutes)

Author: BALDY, J-L.

Presenter: BALDY, J-L.

Session Classification: Contracts

Contribution ID: 32

Type: **not specified**

CIVIL ENGINEERING STATUS REPORT FOR THE CMS WORKSITE

Wednesday 5 May 2004 08:40 (20 minutes)

Civil engineering construction started at Point 5 in 1998 using a contract based upon the standard FIDIC model (Fédération Internationale des Ingénieurs Conseils). The new surface buildings and underground structures are necessary to accommodate the CMS detector for the LHC Project. The principal underground works at Point 5 consist of two new shafts, two caverns along with a number of small connection tunnels and galleries. At Point 5, the works are now 90% complete. Three surface buildings are due to be completed in 2004, namely the SX extension over the PX56 shaft, including the 'Bouchon', and also the SCX and SDX buildings. Underground, the USC55 cavern secondary lining is now complete and the UXC55 cavern lining due for completion in the summer of 2004. The aim of this paper is to present the status of the civil engineering on this worksite and in particular the challenges encountered during construction and experience gained using a FIDIC based contract.

Author: OSBORNE, J.**Presenter:** OSBORNE, J.**Session Classification:** Contracts

Contribution ID: 33

Type: **not specified**

TS-CV CONTRACTS FOR THE LHC : CASE STUDY FOR THE TS WORKSHOP 2004

Wednesday 5 May 2004 09:00 (20 minutes)

The cooling and ventilation group deals with a great number of supplies and installation contracts, as well as some service ones, in relation to the LHC project. In the course of the last years the group has increased its experience in the handling of these contracts in particular as a consequence of the difficult situations sometimes faced, which have been trying but enriching. This paper reviews some statistics on the performance of the CV contracts and draws some conclusions from a set of key cases. These cases can be helpful in identifying possible weak points during the different project phases (engineering, tendering and contracting, installation, etc.) and can provide a basis for the discussion of potential solutions.

Author: INIGO GOLFIN, J. , PRINCIPE, R.

Presenter: INIGO GOLFIN, J. , PRINCIPE, R.

Session Classification: Contracts

Contribution ID: 34

Type: **not specified**

CONTRAT D'INSTALLATION DES CABLES C171: METHODOLOGIE ET EXPERIENCES

Wednesday 5 May 2004 09:20 (20 minutes)

Depuis l'été 2001, le contrat C171 intervient dans tous les accélérateurs du CERN pour le tirage des câbles, le montage des connecteurs et le test des liaisons installées. Les interventions sur le terrain se font principalement sous la forme de campagnes de tirage, ce qui permet de limiter les interventions dans le temps et dans l'espace.

Après avoir rappelé les caractéristiques principales de ce contrat, la méthodologie utilisée, le rôle des différents protagonistes et le travail effectué en 2003, on abordera les problèmes rencontrés durant les premières campagnes du LHC. Afin d'apporter des solutions et d'augmenter la qualité de la prestation, le Plan Qualité, déjà en place depuis 2002, a été enrichi de procédures et modes opératoires supplémentaires.

Author: GUILLAUME, J-C.

Presenter: GUILLAUME, J-C.

Session Classification: Contracts

Contribution ID: 35

Type: **not specified**

THE DIFFERENT APPROACHES TO THE FM CONTRACT

Wednesday 5 May 2004 09:40 (20 minutes)

In July 2002 a new strategy for the maintenance and operation of the surface installations and buildings and for the provision of services has been implemented with the start up of the “Facilities Management” contract. After almost 2 years, the first main contractor has been replaced, the scope of the contract has been slightly modified and CERN responsible has modified the way the contract is managed in order to better adapt to the existing situation and to face and solve several strategic issues. During the same time, the boundary conditions, in particular the legal ones, have forced other modifications in the general strategy. This paper, after a general and brief introduction on the Facilities Management and its objectives, focuses on the differences among the original strategy, the experience with the first contractor and the present status with the actual one. Specific examples will also be mentioned to show the modifications and the adaptation to the new conditions. Finally, an overview on the possible future evolutions in the short and medium term shall be mentioned

Author: NONIS, M.**Presenter:** NONIS, M.**Session Classification:** Contracts

Contribution ID: 36

Type: **not specified**

MANAGEMENT OF TRANSPORT AND HANDLING CONTRACTS

Wednesday 5 May 2004 10:00 (20 minutes)

This paper shall outline the content, application and management strategies for the various contracts related to transport and handling activities. In total, the two sections Logistics and Handling Maintenance are in charge of 27 (!) contracts ranging from small supply contracts to big industrial support contracts. The activities as well as the contracts can generally be divided into four main topics –‘Vehicle Fleet Management’; ‘Supply, Installation and Commissioning of Lifting and Hoisting Equipment’; ‘Equipment Maintenance’ and ‘Industrial Support for Transport and Handling’. Each activity and contract requires different approaches and permanent adaptation to the often changing CERN’s requirements. In particular, the management and the difficulties experienced with the contracts E072 ‘Maintenance of lifting and hoisting equipment’, F420 ‘Supply of seven overhead traveling cranes for LHC’ and S090/S103 ‘Industrial support for transport and handling’ will be explained in detail.

Author: RUEHL, I**Presenter:** RUEHL, I**Session Classification:** Contracts

Contribution ID: 37

Type: **not specified**

COFFEE BREAK

Wednesday 5 May 2004 10:20 (20 minutes)

Session Classification: Contracts

Contribution ID: 38

Type: **not specified**

ELECTRONICS DEVELOPMENT SUPPORT: HOW IS IT ORGANISED

Wednesday 5 May 2004 10:40 (20 minutes)

The group TS-DEM offers a global service for the development and production of electronics modules for several hundreds of electronics engineers at CERN and its collaborating institutes. To have a reliable and complete service that provides the layout, production and assembly of printed circuit boards and associated mechanics a professional organisation is needed. DEM uses industrial service contracts to do a major part of the work on the CERN site, while core technologies are performed by CERN staff. Furthermore we use several small supply contracts for the fabrication of circuit boards and associated mechanics.

Author: VAN DER BIJ, E.**Presenter:** VAN DER BIJ, E.**Session Classification:** Contracts

Contribution ID: 39

Type: **not specified**

L' ALIGNEMENT DES ACCELERATEURS DU CERN: DANS QUEL CONTEXTE CONTRACTUEL?

Wednesday 5 May 2004 11:00 (20 minutes)

L'alignement des quelques 10000 éléments répartis sur près de 60km de lignes de faisceaux met en œuvre des techniques spécialement développées pour atteindre les précisions requises de positionnement dans des temps d'intervention les plus courts possibles. Pour palier l'accroissement considérable de travail lié à la construction du LHC, le groupe SU (« Métrologie des Grandes Dimensions ») a été poussé à négocier deux contrats de services, l'un pour assurer la métrologie interne des cryo-aimants, l'autre pour assurer les travaux de géométrie liés au positionnement. L'analyse du travail à réaliser et l'écriture des spécifications seront présentées, ainsi que les limites du système qui apparaissent après une année de fonctionnement des contrats

Author: MISSIAEN, D. , QUESNEL, J-P.

Presenter: MISSIAEN, D. , QUESNEL, J-P.

Session Classification: Contracts

Contribution ID: 40

Type: **not specified**

Introduction to the session

Wednesday 5 May 2004 14:00 (10 minutes)

Author: BENVENUTI, C.

Presenter: BENVENUTI, C.

Session Classification: Technology

Contribution ID: 41

Type: **not specified**

MICROMETRIC ALIGNMENT METROLOGY: MEANS, DEVELOPMENTS AND APPLICATIONS

Wednesday 5 May 2004 16:50 (20 minutes)

PIn order to meet the ever-increasing drastic alignment tolerances concerning the future particle accelerators, a new generation of sensors has been developed. Whether they are based on ultrasonic, optical or capacitive technology, these sensors, of micrometric resolution, allow continuous measurements in an often hostile environment (strong radiations, strong electro-magnetic fields) and thereby revolutionize alignment possibilities. After a brief presentation of the different sensors tested, used and indeed developed by our group, we present the past, present and future applications linked to the particle accelerators –in the short term concerning micrometric alignment of the low-beta quadrupoles of the LHC, and in the long term concerning the prealignment of the CLIC –or linked to other applications.

Author: MAINAUD DURAND, H.**Presenter:** MAINAUD DURAND, H.**Session Classification:** Technology

Contribution ID: 42

Type: **not specified**

Conclusions

Wednesday 5 May 2004 17:10 (20 minutes)

Author: BENVENUTI, C.

Presenter: BENVENUTI, C.

Session Classification: Technology

Contribution ID: 43

Type: **not specified**

FABRICATION DES CIRCUITS HAUTE DENSITE ET AUTRES CIRCUITS SPECIAUX

Wednesday 5 May 2004 14:10 (20 minutes)

En marge de la fabrication standard de circuits imprimés, nous avons réalisé durant l'année 2003, en collaboration avec différents groupes de recherche, certains composants spécifiques à l'étude de la physique des particules des hautes énergies (détecteurs de particules et circuits électroniques exposés à de très forts taux de radiations). Pour comprendre la particularité de ces composants, les trois réalisations suivantes seront décrites en détail : circuits multicouches flexibles "low mass" tout aluminium pour l'expérience Alice, détecteurs à base de GEM (Gas Electron Multiplier) pour LHCb et détecteurs pixels mixtes (silicium, GEM).

Author: DE OLIVEIRA, R.**Presenter:** DE OLIVEIRA, R.**Session Classification:** Technology

Contribution ID: 44

Type: **not specified**

DISTURBANCES AND POWER QUALITY OF CERN'S ELECTRICAL NETWORK

Wednesday 5 May 2004 14:30 (20 minutes)

This paper gives an overview of most the common disturbances and power quality problems in CERN's electrical network and explains their consequences for accelerator operation. Based on detailed statistics, the quantitative parameters of network disturbances at CERN are presented and immunity levels for user's electrical equipment proposed in order to minimise the number of accelerator problems due to network disturbances. Several typical network disturbances recorded in 2003 are modelled in computer simulations, and their results are presented. Finally, the paper summarises the main parameters of CERN's low voltage distribution systems, their variations and power quality issues. Reference is made to the LHC Engineering Specification "Main Parameters of the LHC 400/230 V Distribution System" as a base for the specification of electrical equipment.

Author: KAHLE, K.**Presenter:** KAHLE, K.**Session Classification:** Technology

Contribution ID: 45

Type: **not specified**

SPECIAL COATINGS FOR THE LHC

Wednesday 5 May 2004 14:50 (20 minutes)

Several LHC components require a thin film coating. These coatings fall in two main categories, namely NEG coatings to improve the vacuum behaviour of chambers or conductive coatings to decrease the surface impedance of components. Examples of the first category are the intersection vacuum chambers of the different experiments, where the required vacuum can be obtained only with a NEG coating because of the large distance of the nearest pumping station. The graphite jaws of collimators are an example of the second category. In this case the high impedance of graphite must be decreased by a thin copper coating. These and other cases will be illustrated both with respect to the machine requirements and to the production programme.

Author: CALATRONI, S.**Presenter:** CALATRONI, S.**Session Classification:** Technology

Contribution ID: 46

Type: **not specified**

TECHNIQUES DE CONTRÔLES NON DESTRUCTIFS

Wednesday 5 May 2004 15:10 (20 minutes)

La construction du LHC et des expériences nécessite un contrôle permanent de la qualité de la matière première utilisée et des assemblages par soudage, brasage ou collage des divers composants. Pour la vérification des matériaux et des assemblages de fabrication, il est souvent hors de question de recourir à des méthodes qui altéreraient les parties à contrôler. Les techniques de Contrôles Non Destructifs (CND), dont celles les plus employées au CERN font intervenir la transmission d'ondes sonores (contrôle par ultrasons) ou de rayons pénétrants (radiographie X ou gamma), représentent un moyen de détection souvent quantitatif de défauts applicable au contrôle qualité de production. Ces deux techniques complémentaires nous permettent de déceler des discontinuités (dans la matière de base, fissuration ou dédoublement, manque de compacité...; dans les assemblages, présence d'inclusions, manque de brasure ou de fusion dans les joints soudés, cavités...). Après un bref aperçu des principes physiques régissant les deux techniques, des exemples récents de contrôles appliqués au LHC et aux expériences seront exposés

Author: DALIN, J.M.**Presenter:** DALIN, J.M.**Session Classification:** Technology

Contribution ID: 47

Type: **not specified**

COFFEE BREAK

Wednesday 5 May 2004 15:30 (20 minutes)

Session Classification: Technology

Contribution ID: 48

Type: **not specified**

TECHNIQUES DE FORMAGE ET D'ASSEMBLAGE

Wednesday 5 May 2004 15:50 (20 minutes)

Les sections Techniques d'Assemblage du groupe EST/MF et Brasage du groupe EST/SM ont été groupées en un seul service dans un but de rationalisation accrue des ressources et méthodes. Ce service dispose de nombreux moyens : soudure et découpe LASER (YAG, 350 W), soudure par faisceau d'électrons (deux installations, 35 et 7.5 kW), équipements TIG orbital, jet line, MIG, soudure plasma, boîte à gants, portique de soudage trois axes multiprocédés, presses plieuses, rouleuses, moyens de repoussage, alimentation à induction 12 kW et divers fours sous vide et à air. Le service est composé de 17 personnes dont la polyvalence est encouragée. Les activités de la section seront décrites à travers quelques exemples significatifs récents, notamment : l'assemblage des amenées de courant HTS, la réalisation des chambres LSS, des tubes HET, d'enveloppes céramiques pour détecteurs PET-HPD, le brasage de RFQ, la soudure du Barrel d'ATLAS ou encore le soudage des lignes de thermalisation du toroïde d'ATLAS.

Author: FAVRE, G. , MATHOT, S.**Presenter:** FAVRE, G. , MATHOT, S.**Session Classification:** Technology

Contribution ID: 49

Type: **not specified**

AN APPLICATION OF POWDER METALLURGY FOR THE LHC

Wednesday 5 May 2004 16:10 (20 minutes)

The cold mass of the 1232 superconducting dipole magnets of LHC, operating at 1.9 K, is enclosed by a shrinking cylinder and two end covers at its extremities. The covers are structural components that must retain high strength and toughness at cryogenic temperature. They are manufactured by Metso Oy /FI in AISI 316 LN steel by Powder Metallurgy (PM) and Hot Isostatic Pressing. PM represents an attractive near net shaping technique for these components of complex geometry for which dimension tolerances, dimensional stability, weldability are key issues for magnet fabrication, and mechanical properties, ductility and leak tightness have to be guaranteed during operation. The material of the covers and its welds have been fully characterized and mechanically tested down to 4.2 K at CERN. The fine grained structure, the absence of residual stresses, the full isotropy of mechanical properties associated to the low level of Prior Particle Boundaries oxides result in superior mechanical properties and high ductility down to liquid helium temperature

Author: SGOBBA, S.**Presenter:** SGOBBA, S.**Session Classification:** Technology

Contribution ID: 50

Type: **not specified**

MATERIAL STUDIES FOR CLIC RF CAVITIES

Wednesday 5 May 2004 16:30 (20 minutes)

Following the EST/SM suggestion of replacing copper by molybdenum or tungsten for the construction of the RF cavity irises, different CLIC main beam accelerating structures were produced, extensively operated and disassembled for iris surface inspection.

The observed surface modifications were found to be very similar to those obtained by sparking in a dedicated laboratory set-up, showing the superior behaviour of both Mo and W with respect to Cu, in terms of surface erosion and conditioning.

The iris thermomechanical fatigue due to RF heating was simulated by high power pulsed laser irradiation. A CuZr alloy was found to be much more resistant than pure Cu. Measurements at higher pulse number will be performed on CuZr in order to extrapolate its fatigue behaviour up to the nominal CLIC duration.

Finally a possible future development of a hybrid probe beam acceleration structure will be presented

Author: TABORELLI, M.

Presenter: TABORELLI, M.

Session Classification: Technology

Contribution ID: 51

Type: **not specified**

Introduction to the session

Thursday 6 May 2004 08:30 (10 minutes)

Author: KURTYKA, T.

Presenter: KURTYKA, T.

Session Classification: Design Offices

Contribution ID: 52

Type: **not specified**

Discussion design office

Thursday 6 May 2004 11:40 (45 minutes)

Author: KURTYKA, T

Presenter: KURTYKA, T

Session Classification: Design Offices

Contribution ID: 53

Type: **not specified**

REORIENTATION DU BUREAU D'ETUDES GENIE CIVIL

Thursday 6 May 2004 08:40 (20 minutes)

Durant ces 7 dernières années, le bureau d'études génie civil a été entièrement tourné vers le projet LHC, sa tâche principale consistant à mettre en place les maquettes des nouveaux ouvrages LHC et des structures LEP, pour l'intégration de la machine et de ses différents services. Depuis 2002, le cahier des charges du bureau d'études CE a été recentré sur des activités plus traditionnelles, entre deux phases de grands projets. Ses activités sont actuellement orientées vers les 3 domaines suivants : support aux services généraux pour toutes les études de structure et d'aménagements extérieurs, assistance à la conception de projets tels le Globe de l'Innovation ou le CERN Control Centre et études préliminaires de projets du futur, tels le CLIC ou le SPL. Pour y parvenir, le bureau d'études s'appuie d'une part sur son propre staff, 1 ingénieur à temps partiel et 4 projeteurs, et d'autre part sur des consultants extérieurs, du type contrat cadre, mandats ponctuels ou mandats d'expertise.

Author: POEHLER, M.**Presenter:** POEHLER, M.**Session Classification:** Design Offices

Contribution ID: 54

Type: **not specified**

rojet LHCLE BUREAU D'ETUDES TS/CV/BE POUR LES BESOINS DU PROJET LHC

Thursday 6 May 2004 09:00 (20 minutes)

Le bureau d'études TS/CV/BE propose un appui technique personnalisé aux différentes sections du groupe TS/CV, responsables des projets liés aussi bien à la machine LHC, ses zones expérimentales, que d'autres projets associés. L'équipe, constituée historiquement et exclusivement de personnel d'entreprise extérieure, dispose d'un effectif variable, adapté à des besoins planifiés. Le choix d'utiliser les mêmes logiciels de CAO que la communauté du CERN, a limité la proportion de spécialistes au sein de l'équipe. Une méthodologie particulière a donc été mise en place pour satisfaire les demandes, tout en faisant face à l'étendue et à la complexité des installations de ventilation et de refroidissement. Des compétences externes spécialisées sont également sollicitées, au cas par cas, pour optimiser les coûts de fonctionnement.

Author: MARTEL, C.**Presenter:** MARTEL, C.**Session Classification:** Design Offices

Contribution ID: 55

Type: **not specified**

ELECTRONICS DESIGN OFFICE ORGANIZATION, METHODS AND TOOLS

Thursday 6 May 2004 10:00 (20 minutes)

The group TS-DEM offers a global service for the design, manufacturing and assembly of electronics modules for several hundreds of electronics engineers at CERN and its collaborating institutes. The Design Office in DEM determines and controls an overall planning, defines the resources required, solves the technical aspects and invoices the whole project. This involves technical resources provided by service contracts and supply contracts, but also negotiations with clients to be able to provide realistic plannings while still being able to handle urgent cases and high-workload periods.

Author: VAN DER BIJ, E.

Presenter: VAN DER BIJ, E.

Session Classification: Design Offices

Contribution ID: 56

Type: **not specified**

BUREAU DE DOCUMENTATION TS/EL/DO

Thursday 6 May 2004 09:20 (20 minutes)

Le bureau de documentation a comme responsabilité de fournir et manager toute la documentation nécessaire au groupe TS-EL. Ce travail utilise des outils CAO (EUCLID- AUTOCAD) et de gestion de base de données ORACLE (GESMAR,EDMS) largement utilisé dans le département TS mais aussi des applications métiers tel que le transfert des données CAO vers les bases de données, le cheminement automatique ou la schématique électrique. La section se concentre sur des études de grands ensembles et l'intégration 3D des équipements électriques. Les études de services généraux sont généralement sous-traitées. Le projet LHC occupe actuellement la quasi totalité de nos ressources. Pour mener à bien les études électriques du LHC, caractérisées par une définition tardive des besoins et de nombreuses modifications, une structure souple et réactive a été mis en place : Une cellule CAO 3D EUCLID, en charge des layouts d'équipements et des cheminements, en relation avec l'intégration, et une cellule d'études des Services Généraux, FSU, modulable en fonction de la charge de travail. Les flux d'information entre ces deux cellules, les Project Managers TS-EL et notre contractant ont été optimisés dans le respect du plan Qualité LHC.

Author: DUJARDIN, M.**Presenter:** DUJARDIN, M.**Session Classification:** Design Offices

Contribution ID: 57

Type: **not specified**

LE BUREAU D'ETUDES MECANQUES DU GROUPE TS-MME

Thursday 6 May 2004 09:40 (20 minutes)

Le bureau d'études du groupe MME représente le principal support d'ingénierie mécanique pour le LHC et quelques projets autres. Il est constitué de trois sections au mandat distinct. Ses activités couvrent le design des divers équipements : des aimants supraconducteurs du LHC et leur alimentation électrique, le design pour le système vide et de l'instrumentation et calibration de faisceau. Le groupe a aussi en charge le design de tout système se rapportant aux complexes PS et SPS. Les principaux sujets présentés dans ce rapport concernent la structure du bureau d'études et son effectif, les ressources à disposition, son domaine d'activité, son mode de fonctionnement, les outils et les méthodologies développés. La coordination entre sections du groupe, qui apportent chacune son expertise, sera mise en évidence. Une vision du futur avec les besoins en ressources liés aux activités vitales pour le CERN est abordée en conclusion.

Author: MENOT, C.**Presenter:** MENOT, C.**Session Classification:** Design Offices

Contribution ID: 58

Type: **not specified**

LE SYSTEME D'INFORMATION GEOGRAPHIQUE ET SES UTILISATEURS

Thursday 6 May 2004 10:40 (20 minutes)

Le CERN est assimilable à un site de type industriel ou à une petite ville, à qui se pose le problème de la diffusion de l'information cartographique. Longtemps la distribution de plans papier fut le seul moyen de diffuser cette information. Après avoir fourni des extraits sur support informatique pour les besoins des projets nécessitant un fond de plan, nous pouvons désormais, par l'utilisation du Système d'Information Géographique (SIG), offrir un moyen de consulter directement les données saisies et de superposer toutes les informations souhaitées. Dans le SIG, les informations graphiques peuvent être liées à des informations alphanumériques permettant une recherche d'objet (par exemple un bâtiment) ou de croiser des informations pour réaliser des études statistiques ou thématiques. La présentation a pour objet de faire le point sur les informations disponibles actuellement et des applications utilisant le SIG. Il sera aussi montré les divers types d'informations existant actuellement au CERN et la possibilité de les utiliser avec le SIG. Ceci permettra de montrer comment, à partir d'un fond de plan commun, plusieurs applications peuvent travailler ensemble dans le SIG et échanger leurs informations.

Author: GUYOT, B.**Presenter:** GUYOT, B.**Session Classification:** Design Offices

Contribution ID: 59

Type: **not specified**

COFFEE BREAK

Thursday 6 May 2004 10:20 (20 minutes)

Session Classification: Design Offices

Contribution ID: 60

Type: **not specified**

ETUDES D'INTEGRATION POUR L'ACCELERATEUR LHC

Thursday 6 May 2004 11:00 (20 minutes)

Dans tous les projets de recherche ou industriels, l'intégration est une phase préalable et indispensable à l'installation de services ou d'équipements. Dans une première partie, il est montré comment et suivant quelle méthode ont été conduites les études d'intégration de la machine LHC. Puis dans une deuxième partie, sera présenté le site WEB de l'ICL (Intégration Cellule LHC), l'outil de diffusion des informations générées par les études d'intégration. Enfin, la gestion des documents de non-conformités d'installation, via le système MTF sera décrite

Author: MUTTONI, Y.**Presenter:** MUTTONI, Y.**Session Classification:** Design Offices

Contribution ID: 61

Type: **not specified**

CAD SUPPORT SECTION: TASKS AND PROJECTS

Thursday 6 May 2004 11:20 (20 minutes)

The CAE section is well known for its daily support of CAD usage at CERN but, in fact, a large part of the section's activity is dedicated to anticipating future needs and dealing with operating systems issues and evolution of CAD software. The section supports more than 200 professional CAD users located all around the site, and it helps many other users at CERN and outside with CAD data exchange. The section is in charge of developing tools to fulfil the specific needs of the design offices and adapting these tools to the changing hardware and software environment. As an example, the section, in collaboration with the MME design office and the survey group, has developed the DMU application, which is used extensively for the LHC integration studies. In the coming years, the big challenge for the section as well as for the design offices will be the introduction of Catia. This project, started last year, is going on to adapt Catia and its data manager SmarTeam to the tools and practices in use today. Catia offers the possibility to federate many of the engineering fields needed in accelerator and detector construction. However, extending the scope of the project to cover these new fields will require commitment from specialists in each discipline.

Author: FRIMAN, P., VAN UTYVINCK, E.

Presenter: FRIMAN, P., VAN UTYVINCK, E.

Session Classification: Design Offices

Contribution ID: **62**

Type: **not specified**

Discussion Design office II

Thursday 6 May 2004 14:00 (45 minutes)

Author: KURTYKA, T.

Presenter: KURTYKA, T.

Session Classification: Discussions

Contribution ID: **63**

Type: **not specified**

Contracts

Thursday 6 May 2004 14:45 (1 hour)

Author: BALDY, J-L.

Presenter: BALDY, J-L.

Session Classification: Discussions

Contribution ID: **64**

Type: **not specified**

COFFEE BREAK

Thursday 6 May 2004 15:45 (20 minutes)

Session Classification: Discussions

Contribution ID: 65

Type: **not specified**

Technology

Thursday 6 May 2004 16:05 (45 minutes)

Author: BENVENUTI, C.

Presenter: BENVENUTI, C.

Session Classification: Discussions

Contribution ID: **66**

Type: **not specified**

Conclusions

Thursday 6 May 2004 16:50 (10 minutes)

Author: CIRIANI, P.

Presenter: CIRIANI, P.

Session Classification: Discussions