Memorandum of Understanding

for Collaboration in the Construction of the ATLAS Detector

between

The EUROPEAN ORGANISATION FOR NUCLEAR RESEARCH,

hereinafter referred to as CERN, Geneva, as the Host Laboratory

on the one hand

and

an Institution/Funding Agency of the ATLAS Collaboration

on the other hand.

Preamble

(a) A group of Institutes from CERN Member and non-Member States, and CERN, has agreed to collaborate to form the ATLAS Collaboration (**Annex 1**). This Collaboration has proposed to CERN an experiment to study particle interactions at the highest possible energies and luminosities to be reached with the Large Hadron Collider (LHC). These Institutes have secured the support of their Funding Agencies to enable them to participate in the ATLAS Collaboration.

(b) Agreement to this Collaboration is effected through identical Memoranda of Understanding (MoU) between each Funding Agency or Institute, as appropriate, in the Collaboration and CERN, as the Host Laboratory. These MoUs collectively define the Collaboration and its objectives, and the rights and obligations of the collaborating Institutes.

(c) On the basis of a Technical Proposal submitted in December 1994 (CERN/LHCC/94-43) and a detailed review of the scientific merits, the technological feasibility and estimates of the needed resources, the LHC Committee (LHCC) recommended approval of the experiment to the CERN Research Board, subject to a set of milestones to be met by the experiment in its initial phase (CERN/LHCC 95-76).

(d) Based on the recommendation by the LHCC and in agreement with the list of milestones, the Research Board recommended to the Director General of CERN to approve the project, together with plans, including milestones, leading to the sub-system/detector Technical Design Reports.

(e) The Director General accepted the Research Board recommendation and approved the project to build the detector for the ATLAS experiment within a cost ceiling not exceeding 475 MCHF (in 1995 prices).

(f) Before proceeding to the final construction phase each sub-detector/system will be subjected to a technical, financial, and manpower review (CERN/DG/RB 95-234) by the LHCC based on the Technical Design Reports. This process will be completed during 1997 and 1998 for most of the sub-systems/detectors.

(g) A Resources Review Board (RRB) has been constituted which comprises the representatives of all ATLAS Funding Agencies and the managements of CERN and the ATLAS Collaboration. It is chaired by the CERN Director of Research.

The role of the RRB includes :

- reaching agreement on the Memorandum of Understanding
- monitoring the Common Projects and the use of the Common Funds
- monitoring the general financial and manpower support
- reaching agreement on a maintenance and operation procedure and monitoring its functioning
- endorsing the annual construction and maintenance and operation budgets of the detector

The collaboration management reports regularly to the RRB on technical, managerial, financial and administrative matters, and on the composition of the Collaboration.

(h) These Memoranda of Understanding replace the existing Interim Memoranda of Understanding (IMoU) which were valid for the period 1 January 1995 to 31 December 1997.

(i) This MoU is not legally binding, but the Institutes and Funding Agencies recognize that the success of the Collaboration depends on all its members adhering to its provisions. Any default will be dealt with, in the first instance, by the Collaboration and if necessary then by the RRB.

Article 1 : Parties to this MoU

1.1 The Parties shall be all the Institutes of the Collaboration as listed in **Annex 1** and their Funding Agencies, and CERN as the host laboratory. **Annex 2** lists the Funding Agencies and their duly authorized representatives. The Funding Agency may be an Institute or an established institution acting on behalf of one or more funding agencies.

1.2 The collaborating Institute(s) and the ATLAS Collaboration will hereinafter be referred to as "Institute(s)" and "Collaboration", respectively.

Article 2 : Purpose of this MoU

2.1 This MoU defines the construction phase of the ATLAS detector. Its purpose is to define the programme of work to be carried out for this phase and the distribution of charges and responsibilities among the Parties for the execution of this work. It sets out organisational, managerial and financial guidelines to be followed by the Collaboration.

2.2 The construction phase comprises the engineering design, final prototyping, preproduction, construction, calibration, transportation, assembly, installation and commissioning of the elements which will be part of the ATLAS detector in the underground experimental area.

2.3 The ATLAS project is executed in the normal framework of the CERN scientific programme, approved by the CERN Council, and subject to the bilateral Agreements and Protocols between CERN and non-Member States.

2.4 In case of conflict between Agreements or Protocols and the present MoU, the former prevail.

Article 3 : Duration of this MoU and its Extension

3.1 This MoU is valid for the construction period of the ATLAS detector, from 1 January 1998 to a date not earlier than 31 December 2005. The actual termination date will be set by the RRB no later than 31 December 2003.

3.2 This MoU may be extended at any time by mutual agreement of the Parties.

3.3 Any Funding Agency may withdraw its support from the Collaboration by giving not less than eighteen months notice in writing to the Collaboration and the Director General of CERN. In such an event, reasonable compensation to the Collaboration will be negotiated through CERN and confirmed by the RRB.

3.4 Any Institute may withdraw from the Collaboration according to the procedures agreed by the Collaboration, the conditions as set out in the current document "General Conditions for Experiments Performed at CERN" and by giving notice in writing to its Funding Agency.

Article 4 : The ATLAS Detector and Collaboration

4.1 The detector for the ATLAS experiment has been described in detail in the Technical Proposal submitted to the LHCC in December 1994 and in the subsequent sub-system/detector Technical Design Reports. It consists of a number of sub-system/detector units as listed in **Annex 3.**

4.2 The names of the scientists presently participating in the Collaboration are listed in **Annex 4** by country and by Institute.

4.3 The current management structure of the Collaboration is described in the attached ATLAS documents (**Annex 5**).

4.4 The technical participation of the Institutes in detector construction is set out in **Annex 6**.

4.5 **Annex 7** gives an overview of the foreseen construction schedule.

4.6 Following the recommendations of the LHC Cost Review Committee (CORE) the manpower and financial resources needed for the ATLAS experiment are grouped into three headings:

4.6.1 R&D work on the various detector elements ;

4.6.2 costs for infrastructure in the Institutes, and costs for personnel, travel, etc. of the Institutes as arising from their participation in the Collaboration ;

4.6.3 engineering design, final prototyping, preproduction, construction, calibration, transportation, assembly, and installation costs for the complete detector.

The resources needed for work under the headings 4.6.1 and 4.6.2 are the responsibility of the Institutes supported by their respective Funding Agencies. These resources are neither accounted for in detector construction costs, nor monitored centrally by the Collaboration.

The resources needed for work under the heading 4.6.3 cover the costs of the detector construction. These costs have been evaluated by the Collaboration and verified by CORE. Only these costs are monitored centrally by the Collaboration.

4.7 Any Institute that wishes to join the Collaboration during the period of validity of this MoU will be expected to make an appropriate contribution to the funding of the detector construction including the Common Projects. This will be negotiated by the Collaboration and endorsed by the RRB. In the event that the detector construction is already fully funded, the new Institute will have to make a special contribution which will be negotiated by the Collaboration and endorsed by the RRB.

4.8 The individual sub-system/detector CORE costs, expressed in Swiss Francs, are contained in the ATLAS Cost Review Estimate, Version 7, dated 31 Jan. 1998.

4.9 Unless explicitly mentioned, all cost figures in this MoU are expressed in 1995 Swiss Francs based on estimates valid on 31 January 1998. The calculated CERN index for materials cost variations (investments) will be used for cost monitoring purposes throughout the lifetime of the project.

Article 5 : Programme of Work for the Construction Phase of the ATLAS Detector and Sharing of Responsibilities for its Execution

5.1 The total construction work for the detector, which includes the work executed under the terms of the IMoU, is divided into:

5.1.1 Sub-system/detector construction, which will be the responsibility of individual Institutes, or groups of Institutes, and

5.1.2 Common Projects comprising those elements of the detector construction which the Collaboration has agreed are to be provided at the common expense of the Collaboration; see Article 6.

5.2 **Annex 8** shows the value of the deliverables, by Funding Agency and system/sub-detector, to which the Funding Agencies are committed and for which they have foreseen the appropriate funding.

5.3 **Annexes 9.1 to 9.6** list, by system/sub-detector, the deliverables to be provided by the Institutes, the value of these deliverables, their delivery dates and the sharing among Institutes (Annexes 9.n.A). Annexes 9.n.B summarise the value of the deliverables for particular systems/sub-detectors by Funding Agency. Annexes 9.nC show the planned spending profiles.

5.4 The Institutes, supported by their Funding Agencies, will make their best efforts to design, produce final prototypes, preproduce, construct, calibrate, transport, assemble, install and commission all the deliverables listed in Annexes 9.1.A to 9.6.A, within the limits of their funding.

In the event of cost overruns, these will first be brought, by the Institute(s) concerned, to the attention of the Collaboration and then to the RRB if solutions have not been found. The Collaboration will propose ways of accommodating such overruns within the overall cost ceiling of the ATLAS detector, including descoping or staging if other ways cannot be found, and seek the endorsement of the RRB.

Article 6 : Common Projects

6.1 **Annex 10** lists the Common Projects, together with their estimated costs (Annex 10.A) and the contributions from each Funding Agency (Annex 10.B) to cover them. The planned spending profile is shown in Annex 10.C.

6.2 Contributions to the Common Projects will be made in two ways :

6.2.1 by taking responsibility to supply a Common Project item or parts of it, in agreement with the ATLAS Executive and Collaboration Boards and endorsed by the RRB. This option is referred to as "in-kind contribution".

6.2.2 by cash payments to a dedicated Common Fund which will be established for the Common Projects through a dedicated account at CERN. The Common Fund will be managed and operated by the ATLAS Resources Coordinator, taking advice from the ATLAS Management, together with the CERN Finance Division. All Common Fund operations will be monitored by the RRB.

6.3 Contributions to the Common Projects are due in proportion to contributions to the funding of the ATLAS detector construction, as set out in Annex 9.n.B, based on the ATLAS Cost Review Estimate, Version 7, of Article 4.8.

A minimum cash contribution of 100 kCHF is required from each and every Institute which has voting rights in the Collaboration Board. As the design and construction stage is expected to last eight years the minimum cash contribution to the Common Fund will be invoiced by the Collaboration Management at a rate of 12.5 kCHF per Institute and per year, starting in 1996 and terminating in 2003.

The ATLAS Management may also recommend to the RRB to update the level of contribution to the Common Projects, for example due to a major change in the level of participation of an Institute or due to an Institute joining or leaving the Collaboration.

6.4 Subscriptions by Institutes for "in-kind contributions" to Common Projects have been solicited by the ATLAS management. On the basis of the subscriptions offered, and aiming at a fair sharing among all Institutes/Funding Agencies, the ATLAS Management will propose such "in-kind contributions" to the ATLAS Collaboration Board and will submit their recommendations to the RRB for approval.

6.5 Contracts for Common Projects will be placed either by CERN in accordance with the document "Financial Guidelines for LHC Collaborations" (CERN/FC/3796), or by other Institutes, in accordance with their own purchasing rules and regulations.

6.6 The responsibilities for the maintenance and operation of the ATLAS detector will be laid down in a separate MoU on maintenance and operation procedures. This will be prepared by the Collaboration together with CERN, in consultation with the RRB and will be signed by all the Parties.

Article 7 : Obligations of CERN as the Host Laboratory, and of the Institutions

7.1 The general obligations of CERN as host laboratory and of the Institutions are contained in the current document "General Conditions for Experiments Performed at CERN". This document is regarded as an integral part of this MoU and is attached as **Annex 11**.

7.2 All equipment brought to the CERN site must comply with CERN's safety regulations. If relevant, the design, test criteria and testing of equipment should be discussed well in advance with CERN's safety officials. All equipment brought to CERN must be accessible for inspection by the Group Leader in Matters of Safety.

Article 8 : Rights and Benefits of Institutes

8.1 The Institutes participating in the Collaboration are entitled to join the operational phase of the project and to participate in the scientific exploitation of the data acquired. Further details are set out in the current document "General Conditions for Experiments Performed at CERN".

Article 9 : Administrative and Financial Provisions

9.1 General financial matters and purchasing rules and procedures for the LHC experiments, including the rules which apply for Common Fund operations, are dealt with in accordance with the "Financial Guidelines for the LHC Collaborations" (CERN/FC/3796).

9.2 Under the provisions of the CERN basic Convention dated 1st of July 1953, revised on 17 January 1971, any Institute's staff and property located at CERN shall be subject to the authority of the CERN Director General and shall comply with the CERN regulations.

Article 10 : Amendments

10.1 This MoU may be amended at any time with the agreement of its signatories or of their appointed successors. Any such amendments will be subject to the prior agreement of the RRB.

Article 11 : Disputes

11.1 Any dispute between Funding Agencies shall be resolved by negotiation or, failing that, by arbitration through the President of the CERN Council, who may, at his or her discretion, adopt any form of arbitration process. Any dispute between a Funding Agency and CERN will be resolved using standard CERN procedures for the resolution of such disputes. Any dispute between Institutes will be resolved according to Collaboration procedures.

Article 12 : Annexes

12.1 All the Annexes are an integral part of this MoU. They are understood to be the planning basis for the construction of the ATLAS detector.

ANNEXES

Annex 1 :

Institutes in the ATLAS Collaboration and Names of their Contact Persons

Annex 2 :

List of Funding Agencies and their Representatives

Annex 3 :

Sub-system/detector Structure of the ATLAS Detector

Annex 4 :

Present Participants in the ATLAS Collaboration by Country and Institute

Annex 5 :

Management Structure of the ATLAS Collaboration

Annex 6 :

Overview of the Technical Participation of Institutes in Detector Construction

Annex 7 :

Construction Schedule for 1997 to 2005

Annex 8 :

Summary Table of the value of the deliverables to which the Funding Agencies are committed and for which they have foreseen the appropriate funding

Annex 9.1 to 9.6 :

Deliverables to be provided by the Institutes for the individual Sub-systems/detectors (including their estimated values)

Annex 10 :

Common Projects, their estimated Costs and Funding

Annex 11 :

General Conditions for Experiments Performed at CERN.

The European Organization for Nuclear Research (CERN)

and

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declare that they agree on the present Memorandum of Understanding for the ATLAS Experiment.

Done in Geneva

on ______________________

For CERN

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Lorenzo Foà
Director of Research

Done in ______________________

on ______________________

For

____

ATLAS Institutions, their Contact Physicists and Representatives

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Australia

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University of Sydney (L. Peak, referred to as "Sydney")

Austria

Institut für Experimentalphysik der Leopold-Franzens-Universität Innsbruck, Innsbruck (D. Kuhn, referred to as "Innsbruck")

Azerbaijan Republic

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Republic of Belarus

Institute of Physics, National Academy of Science, Minsk, Belarus (Yu. Kulchitsky, referred to as "Minsk")

Brazil

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Canada

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Sub-detector structure of the ATLAS detector.

The ATLAS detector is structured into the following sub-detector units which will be used throughout this document:

- Inner Detector	Pixel Detector (PD) Semiconductor Tracker (SCT) Transition Radiation Tracker (TRT)
- Solenoid Magnet	
- Liquid Argon Calorimeter	
- Tile Calorimeter	
- Toroid Magnets	Barrel Toroid End-Cap Toroids
- Muon Detection System	Monitored Drift Tube Ch. (MDT) Cathode Strip Chambers (CSC) Resistive Plate Chambers (RPC) Thin Gap Chambers (TGC)
- Trigger, Data Acquisition and Detector Control System	Level 1 Trigger Level 2 Trigger DAQ and Event Filter Detector Control System (DCS)
- Detector Infrastructure	
- Off-line Data Handling	

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Management Structure of the ATLAS Collaboration

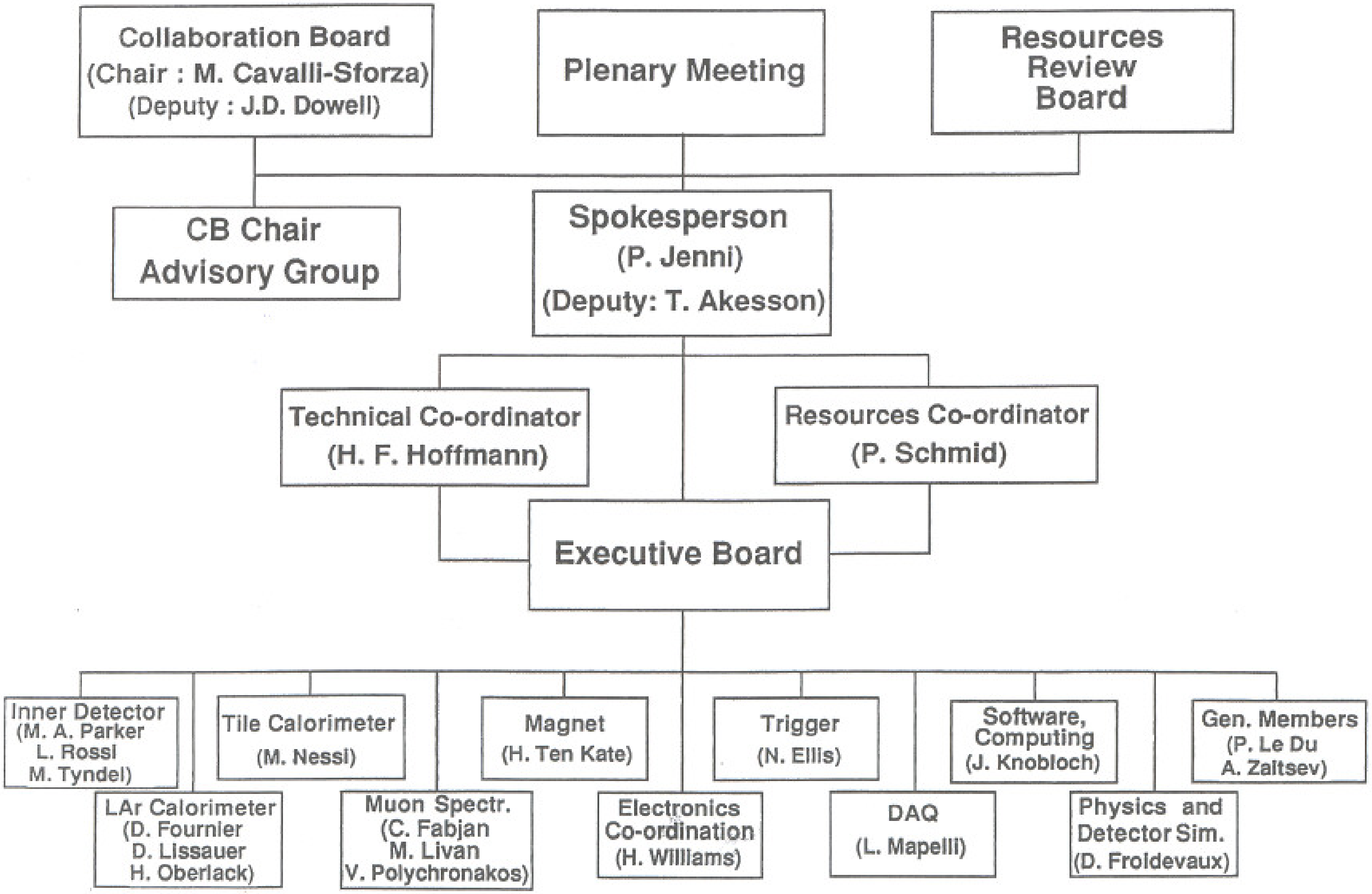
The organisation of ATLAS with present holders of central management positions, is shown in annex 5.1. It is described in annex 5.2 and is based on the two documents, annexes 5.3 and 5.4, approved by the Collaboration Board.

On 7 March 1997 the Collaboration Board approved three additions to this organisation: conditions for institutions joining after 1996 (annex 5.5), conditions for suspended membership (annex 5.6) and on the exclusion of institutions from ATLAS (annex 5.7).

Annex 5.8 describes the procedures for admission of new institutions.

The overall construction, installation and commissioning task of ATLAS is formalised in a system using a Product Breakdown Structures (P.B.S.) and a task list which together produce a Work Breakdown Structure (W.B.S.). The W.B.S. consists of work packages which together fully describe the complete project.

ATLAS ORGANIZATION



Annex 5.2

ATLAS Internal Note
Gen-No-016
16 December 1996

Description of the ATLAS Organisation

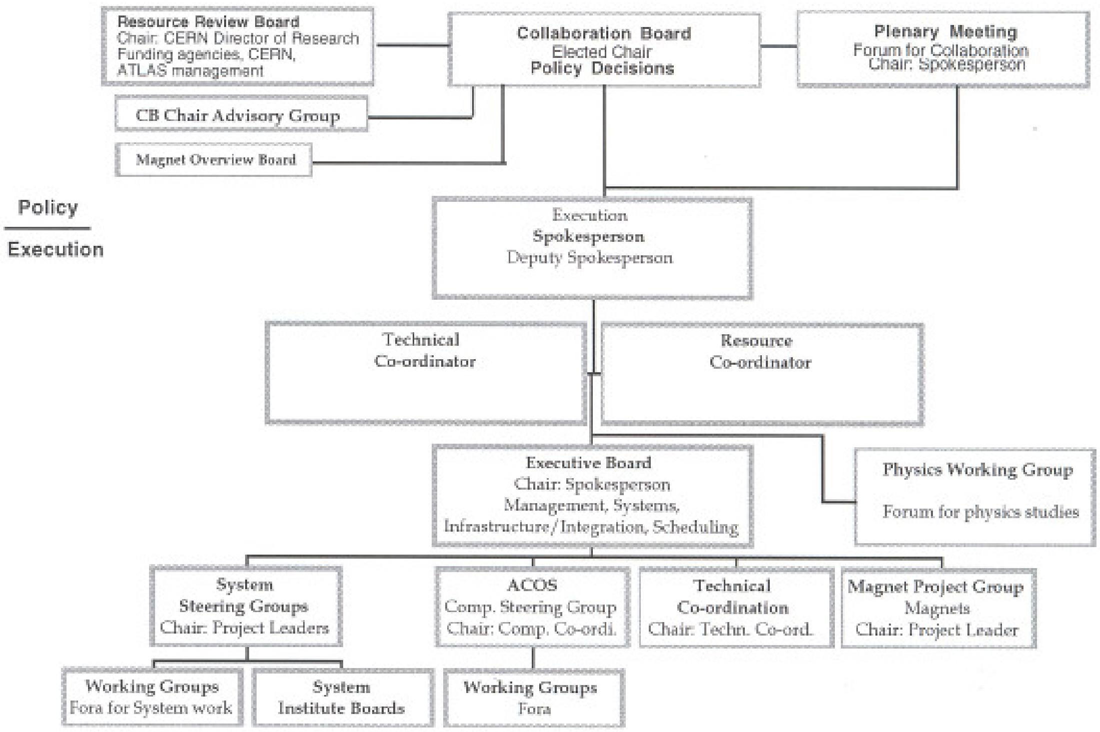
Torsten Åkesson

Introduction

This report gives an overview of the ATLAS organisation as decided by the Collaboration Board and defined in the ATLAS Internal Notes [1,2].

ATLAS organisation

The management operates under the constitution of the ATLAS collaboration [1] which specifies that the collaboration shall have a separation between policy-making and executive powers. This is implemented as shown in the block diagram below:



Policy

The full collaboration has week-long meetings (ATLAS Weeks) four times a year. The general forum, *the Plenary Meeting (PM),* and the policy deciding body, *Collaboration Board (CB)* assemble at these occasions. Systems give overview presentations at the PM and issues to be decided in the CB are presented and openly debated first in the PM before being brought up at the CB for decision. The decisions in the CB are taken by consensus or vote. All votes are open except those concerning persons, e.g. the Spokesperson or CB chair elections. Each institution of ATLAS is represented in the CB and has one vote. Larger institutions can at their discretion have two persons in the CB, but still with only one vote. The exact rules for CB decisions and elections can be found in [1]. The Executive Board (see below) members are ex-officio at the CB.

The CB chairperson can have an Advisory Group to help prepare the agenda. The Advisory Group is nominated by the CB-chair and elected by the CB for the duration the chairpersons office. The Advisory Group also prepares the Spokesperson elections and is the body where especially sensitive issues can be brought up, e.g. issues concerning persons in the executive organisation. The ATLAS Spokesperson, Deputy, Resource and Technical Co-ordinators are in attendance in the Advisory Group, but the CB-chair can decide to hold some meetings without these people present.

The CB can form *Overview Boards* to monitor the development of crucial items. Currently, the only example is the *Magnet Overview Board* monitoring the largest common project item in the experiment, the magnets.

The *Resource Review Board, RRB,* is the body where the ATLAS resources are approved upon proposals from the collaboration, and monitored. It is composed of representatives of the national funding agencies, the CERN management and the ATLAS management. It is chaired by the CERN Director of Research. The RRB discusses the different national contributions and the Memoranda of Understanding. In-kind contributions to the Common Projects have to be approved in the RRB.

The formal commitments to the ATLAS construction are made through the Memorandum of Understanding signed by the funding agencies and CERN.

Overall Execution

Having clearly defined System interfaces and guide-lines for organisation [2], performance and technical co-ordination allows Subsidiarity to be a governing principle for the execution of ATLAS; the decision making is done when possible at the System level. However, global directives, approvals and monitoring have to be done centrally to ensure overall physics performance, a synchronous time schedule, integratability, and uniform hardware and software quality in the project.

The Spokesperson is the highest level executive of ATLAS, and as such has the overall responsibility of the ATLAS execution. He or she organises the day-to-day execution of the project. He or she represents the ATLAS executive branch at the CB and is the ATLAS contact to the outside world and the CERN management. The Spokesperson may have one or two deputies. Technical co-ordination is delegated to a Technical Co-ordinator and resource co-ordination to a Resource Co-ordinator. Both are CERN staff. The Technical Co-ordinator monitors the technical aspects of the construction of the System, is responsible for the detector integration, for the overall construction of the detector and of the experimental area, and for common project issues. The Resource Co-ordinator monitors and manages the financial and human resources of the collaboration.

Appointments are done in consultation with the CERN management for the Spokesperson, and in agreement with the CERN management for the Technical and Resource Co-ordinators.

About once a month the *Executive Board (EB)* meets. The EB is the main body for directing the execution of the ATLAS project and for direct communication between the ATLAS management and the Systems. It monitors the execution of the individual Systems and discusses matters involving several Systems. The EB meetings are prepared by the Spokesperson who chairs them. The EB is composed of:

- The ATLAS management (Spokesperson, Deputy Spokesperson, Technical Co-ordinator and Resource Co-ordinator)
- The System Project Leaders and for some Systems additional representation depending on their size and complexity.
- The Magnet Project Leader
- Technical co-ordination staff (in attendence)
- Up to two additional individuals chosen to ensure an overall balance in the complete EB.
- The CB Chairperson and Deputy as ex-officio

The contact between the ATLAS management and the national funding agencies is maintained via an ancillary structure of *National Contact Physicists* relating to the Spokesperson and the Resource Co-ordinator.

In difficult cases, e.g. when major technology choices have to be made, a review panel can be appointed. Such a panel is chaired by an ATLAS physicist not directly involved in the issue.

System Interaction with the ATLAS Management

An ATLAS System roughly correspond to a performance task. It is a major activity involving a set of institutions which will produce hardware and software. A System is constrained by a performance specification and the integration requirements of the whole experiment, and has to work inside a geometrical envelope and a cost ceiling. This is specified in its Technical Design Report (TDR). The original version of the TDR is submitted to the LHCC for construction approval. It defines the design, production procedure including quality assurance, maintenance, commissioning and sharing of responsibilities. This includes the formal breakdown structures that are linked to the highest levels of the ATLAS breakdown structures, and the scheduling that is included in the overall ATLAS project planning.

The internal ATLAS TDR approval procedure is the guarantee that the System is coherent with the overall ATLAS organisation and quality. The TDRs are regularly revised to be consistent with the System being constructed. Depending on the level of changes the revision approvals are done at the System levels, by the technical co-ordination, the Spokesperson or the EB. Changes that could have a major impact on the experiment have to be approved by the CB.

The Project Leader regularly communicates the System status to the ATLAS management and technical co-ordination.

The ATLAS management regularly discuss with the Project Leader questions relevant to the System execution and resources.

System Execution

General Organisation

The large number of institutions and people involved necessitates a management structure. This management has to have the solid support in the System collaboration and an excellent working relationship with the central ATLAS management team. The day-to-day System execution is lead by the Project Leader who is usually a member of the ATLAS Executive Board. The System has a Steering Group and an Institute Board. If it is convenient for the System, these bodies can be combined in order to be able to carry out the steering and decision making in one group. The Project Leader is the System representative within the ATLAS organisation.

Steering Groups

Each System has a Steering Group reflecting the range of activities within itself and bringing together the people leading these efforts. The Steering Group takes decisions on technical execution matters and make recommendations to the Institute Board on major technical choices and on matters of sharing resources and responsibilities. The Steering Group is chaired by the Project Leader who prepares its agenda. Its members are nominated by the Project Leader based on broad consultation in the System community and approved by the Institute Board. The frequency of Steering Group meetings shall be sufficiently high to ensure the effective leadership of the System execution. The Project Leader shall routinely consult the Steering Group whenever significant issues arise. The ATLAS management members are ex-officio in all Steering Groups.

Institute Boards

Each System has an Institute Board. The Institute Board takes decisions on major technical choices and on sharing of resources and responsibilities. Major technology choices affecting the overall performance of ATLAS have to be brought forward to the collaboration as a whole for decision in the Collaboration Board [1]. The institutions are the source of money and manpower, and therefore all major questions involving sharing of responsibilities and contribution of resources have to be agreed upon by the Institute Board. The Institute Board also proposes the Project Leader candidate for approval by ATLAS, and approves the Steering Group composition. In major matters concerning resources the Institute Board shall invite the ATLAS Resource Co-ordinator.

Sub-System

Each System may be broken up into smaller organisations, Sub-Systems, which in some cases may more directly correspond to the direct detector construction tasks. These Sub-Systems may well have their internal organisations with Project Leaders, Steering Groups and Institute Boards as described in the System organisation. However, the formal lines of responsibilities go through the System Project Leader.

ATLAS Project Leaders

Appointment

The Project Leader candidate is nominated by the System participants, short-listed by the Steering Group, elected by the System Institute Board, proposed by the spokesperson to the Collaboration Board and approved by it. The appointment is for two years with the possible extension according to the ATLAS organisation rules[1].

Mandate

The Project Leader is the person directly and ultimately responsible to the ATLAS collaboration, for ensuring that the design and construction of the corresponding System are carried out on schedule, within the cost ceiling, and in a way that guarantees the required performance and reliability, within the framework of the ATLAS resource planning. He or she collaborate closely with the ATLAS technical and resource co-ordination. The Project Leader shall bring up to discussion, with the ATLAS management, incompatibilities between the requirered project development and the available resources.

While the responsibility to the ATLAS collaboration remains at all times with the Project Leader, he or she may choose to delegate some tasks, or to appoint people such as project engineer, electronics project engineer, s/w responsible, etc. to assist in managing the project. Such appointments must specify a clear set of responsibilities; they shall be approved by the Steering Group and confirmed by the Institute Board.

References

[1] *ATLAS Organisation*, ATLAS Internal Note GEN-NO-009, 16 September 1994

[2] *ATLAS System Organisation*, ATLAS Internal Note Gen-No-015, 29 November 1996

ATLAS Internal Note
Gen-No-009
16 September 1994

ATLAS Organization

(16 September 1994)

1 Preamble

The ATLAS Organization shall be guided by the following principles:

- democracy;
- separation of policy-making and executive powers;
- minimal formal organization;
- limited terms of office.

2 Plenary Meeting

The Plenary Meeting is the forum of the all-hands discussion. All major ATLAS decisions concerning

- physics objectives and results;
- hardware and software design;
- organizational matters

must be discussed in the Plenary Meeting and, if appropriate, in its subordinate Working Group Meetings.

3 Collaboration Board

The Collaboration Board is the policy- and decision-making body of the ATLAS Collaboration.

Typical tasks of the Collaboration Board will be:

- decisions on the global detector design;
- policy matters (guidelines for the interaction with the LHC Committee and the CERN Management, publications, presentations etc.);
- financial and human resources;
- elections;
- ATLAS organization;
- ATLAS membership.

The spokesperson(s) are elected *ad personam* by the Collaboration Board, after nomination of candidates by, and due consultation with, the Collaboration. The spokesperson(s) represent the Collaboration to the LHC Committee, to the CERN Management, and to the outside.

The term of office is three years, renewable with a 2/3 majority.

The spokesperson(s) may nominate one or two deputies, who will be elected by the Collaboration Board for the duration of the term of office of the spokesperson(s). The responsibilities of the deputy spokesperson(s) have to be clearly defined.

The spokesperson(s) and their deputies shall not represent any country, institution, or activity within ATLAS.

5 Executive Board

The Executive Board directs the execution of the ATLAS project, in line with policies set by the Collaboration Board. The Executive Board brings together the coordinators responsible for the design, construction, and operation of ATLAS within the available resources, with a view to the overall performance of the experiment.

Typical tasks will be:

- review of schedules;
- setting and review of milestones;
- review of financial and human resources;
- coordination between the subdetector work programmes;
- coordination of test beam activities;
- coordination of hardware and software.

The detailed composition of the Executive Board will be adapted to the current needs of the experiment. Its composition, as well as the description of the specific tasks for the Executive Board members, are given in a separate document which is subject to approval by the Collaboration Board.

The Executive Board is chaired by the spokesperson(s). The technical coordinator serves as deputy chairperson.

The members of the Executive Board are elected for a period of office of two years, renewable with a 2/3 majority.

The technical coordinator will typically deal with

- integration issues of the subdetectors;
- safety;
- ATLAS infrastructure at CERN;

- surface and experimental areas, services;
- installation;
- machine interface;
- test beams.

The technical coordinator chairs regular technical coordination meetings.

The resource coordinator is a member of the Executive Board. He or she oversees the resource planning of the ATLAS project, and will typically deal with

- budget planning;
- manpower planning;
- Memoranda of Understanding;
- Common Fund.

Annex 5.4

ATLAS Internal Note
Gen-No-015
29 November 1996

ATLAS System Organisation

Preamble

The optimisation and construction of ATLAS as one coherent scientific facility is a large task. The required resources are substantial and the ATLAS collaboration has a responsibility to ensure that these will efficiently produce a facility with the expected performance. This requires an organisation with clear lines of responsibilities. ATLAS is divided into different performance tasks (Systems) and we need one person with an overall responsibility for each of these, the Project Leader. This responsibility requires the full support from the System community which is ensured by the appointment procedure. This appointment procedure is executed with the Project Leader responsibilities open on the table, so that the participating institutes know exactly what they agree to when they select their candidate. The Project Leader is working with a Steering Group which shall be an active body in guiding the System execution.

The System organisation described in this document was approved by the Collaboration Board the 29'th of November 1996.

System Interaction with the ATLAS Management

An ATLAS System roughly corresponds to a performance task. It is a major activity involving a set of institutions which will produce hardware and software. A System is constrained by a performance specification, and has to work inside a geometrical envelope, schedule and a cost ceiling. This is specified in its Technical Design Report (TDR). The original version of the TDR is submitted to the LHCC for construction approval. It defines the design, production procedure including quality assurance, maintenance, commissioning and sharing of responsibilities. This includes the formal breakdown structures that are linked to the highest levels of the ATLAS breakdown structures, and the scheduling that is included in the overall ATLAS project planning. The internal ATLAS TDR approval procedure is the guarantee that the System is coherent with the overall ATLAS organisation and quality. The TDRs are regularly revised to be consistent with the System being constructed. Depending on the level of changes the revision approvals are done at the System levels, by the technical co-ordination, the Spokesperson or the EB. Changes that could have a major impact on the experiment have to be approved by the CB.

The Project Leader regularly communicates the System status to the ATLAS management and technical co-ordination. The ATLAS management regularly discuss with the Project Leader questions relevant to the System execution and resources.

General Organisation

The large number of institutions and people involved necessitates a management structure. This management has to have the solid support in the System collaboration and an excellent working relationship with the central ATLAS management team. The day-to-day System execution is lead by the Project Leader who is usually a member of the ATLAS Executive Board. The System has a Steering Group and an Institute Board. If it is convenient for the System, these bodies can be combined in order to be able to carry out the steering and decision making in one group. The Project Leader is the System representative within the ATLAS organisation.

Steering Groups

Each System shall have a Steering Group reflecting the range of activities within itself and bringing together the people leading these efforts. The Steering Group takes decisions on technical execution matters and make recommendations to the Institute Board on major technical choices and on matters of sharing resources and responsibilities. The Steering Group is chaired by the Project Leader who prepares its agenda. Its members are nominated by the Project Leader based on broad consultation in the System community and approved by the Institute Board. The frequency of Steering Group meetings shall be sufficiently high to ensure the effective leadership of the System execution. The Project Leader shall routinely consult the Steering Group whenever significant issues arise. The ATLAS management members are ex-officio in all Steering Groups.

Institute Boards

Each System shall have an Institute Board. The Institute Board takes decisions on major technical choices and on sharing of resources and responsibilities. Major technology choices affecting the overall performance of ATLAS have to be brought forward to the collaboration as a whole for decision in the Collaboration Board [1]. The institutions are the source of money and manpower, and therefore all major questions involving sharing of responsibilities and contribution of resources have to be agreed upon by the Institute Board. The Institute Board also proposes the Project Leader candidate for approval by ATLAS, and approves the Steering Group composition. In major matters concerning resources the Institute Board shall invite the ATLAS Resource Co-ordinator.

Sub-System

Each System may be broken up into smaller organisations, Sub-Systems, which in some cases may more directly correspond to the direct detector construction tasks. These Sub-Systems may well have their internal organisations with Project Leaders, Steering Groups and Institute Boards as described in the System organisation. However, the formal lines of responsibilities to the central ATLAS organisation go through the System Project Leader.

Work Definition of ATLAS Project Leaders

Appointment

At latest when entering the TDR phase the Systems shall start the process of appointing the Project Leader.

The Project Leader candidate is nominated by the System participants, short-listed by the Steering Group, elected by the System Institute Board, proposed by the spokesperson to the Collaboration Board and approved by it. The appointment is for two years with the possible extension according to the ATLAS organisation rules[1].

Mandate

The Project Leader is the person directly and ultimately responsible to the ATLAS collaboration, for ensuring that the design and construction of the corresponding System are carried out on schedule, within the cost ceiling, and in a way that guarantees the required performance and reliability, within the framework of the ATLAS resource planning. He or she collaborate closely with the ATLAS technical and resource co-ordination. The Project Leader shall bring up to discussion, with the ATLAS management, incompatibilities between the requirered project development and the available resources.

While the responsibility to the ATLAS collaboration remains at all times with the Project Leader, he or she may choose to delegate some tasks, or to appoint people such as project engineer, electronics project engineer, s/w responsible, etc. to assist in managing the project. Such appointments must specify a clear set of responsibilities; they shall be approved by the Steering Group and confirmed by the Institute Board.

The Project Leader chairs the System Steering Group. He or she shall maintain continuous communication with the Steering Group, keeping it up-dated on the development of the project and consulting it on questions of major importance.

In leading the System the Project Leader shall always consider the effect of any decisions taken within the System on the performance and functioning of the ATLAS experiment as a whole.

Typical tasks of the Project Leader include (but are not limited to):

- Preparing all decisions in the sub-detector community, by activating all the necessary studies and forums, thus making sure that everyone has the opportunity to express opinions well before the formal decision is taken by the Steering Group and the Institute Board.
- Maintaining up-to-date knowledge on all activities inside the System either directly or through people to whom co-ordination has been delegated.
- Keeping the System community informed on developments from the central ATLAS co-ordination relevant to the execution of the System.
- The production of the System TDR and its presentation to the LHCC.
- Ensuring a correct distribution and balance of responsibilities among the participating institutions.
- Keeping an updated project plan for the System, including the use of resources (resource loaded project plan), and communicating it to the general ATLAS project planning.
- Representing the System in the Executive Board (Project Leaders and the EB members are subject to endorsement by the CB).
- Organising System collaboration meetings and Steering Group meetings.
- Ensuring that clear work definitions are written for people to whom tasks are permanently delegated, such as the project engineer.
- Ensuring the efficiency of the System execution.
- Ensuring that the System status is regularly communicated to the ATLAS management.
- Bringing to the ATLAS management's attention changes that could affect the rest of the experiment.

References

[1] *ATLAS Organisation*, ATLAS Internal Note GEN-NO-009, 16 September 1994

Conditions for Institutions joining after 1996

New Institutions are expected to make significant contributions to the ATLAS project (detector construction, software) which will have to be negotiated case by case. These contributions will be laid down in an amendment to the IMoU or MoU.

New collaborators will have the same obligations towards the Common Projects as all other collaboration members. In particular the full minimum Common Fund cash contribution of 100 kCHF is requested. A definite payment plan has to be included in the request to join the ATLAS Collaboration.

Suspended Membership

ATLAS can create the status of 'Suspended Membership' in order to allow Institutions to temporarily interrupt their contributions to the experiment and to re-integrate without having to re-apply for membership.

Suspended Membership will be granted only in exceptional cases and for well justified circumstances which will have to be considered case by case by the Collaboration Board.

The following rules apply to the status of Suspended Membership:

- Suspension of membership shall in no case be possible beyond a duration of 3 years.
- The integrated minimal cash contribution to the Common Fund remains 100 kCHF; the standard annual dues of 12.5 kCHF not paid during the suspension period will have to be paid according to a plan to be agreed upon at the time of re-integration.
- Commitments taken by the Institutions and laid down in the IMoU and MoU will be redefined in an amendment.
- Suspended Membership of a period of less than 3 years can only be extended once to a total maximum period of 3 years.
- If the Institution does not re-integrate at the end of the suspension period it may declare withdrawal from the Collaboration, otherwise ATLAS will start an exclusion procedure.

Exclusions of Institutions from ATLAS

It is the duty of the ATLAS management to inform the Collaboration Board about Institutions which are not fulfilling their commitments and obligations as specified in the IMoU and MoU. The commitments are not only of material nature, but concern also the active participation in the experiment.

The ATLAS management shall also inform in writing the representative of the Institution and its Funding Agency that the expected commitments are not being honored.

After a delay of six months following the written notification, the Collaboration Board may ultimately decide to exclude an Institution from the Collaboration, after due verification of the facts and after considering all circumstances.

Contributions already made to ATLAS shall remain part of ATLAS until completion of the experiment as specified in the General Conditions for Experiments at CERN.

Procedures for Admission of New Institutions

The Collaboration Board (CB) decides on admission of new Institutions to ATLAS. A positive decision is then forwarded to the Resource Review Board for endorsement. The conditions for Institutions joining after 1996 are described in the Collaboration Board Minutes (7-Mar-97) and in Annex 5.5

An Institution that wishes to join the ATLAS Collaboration sends an Expression of Interest (EoI) to the spokesperson. This EoI should include:

Current Institution members who wish to join;

Name of the team leader;

Field of interest in ATLAS;

The expected contribution to the project;

Expected development of team size during the ATLAS project;

The associated funding agencies.

The spokesperson informs the CB about the EoI, and a decision can be taken earliest at the subsequent meeting.

The spokesperson discusses the EoI with the relevant national contact physicist, relevant system project leaders and Institutions in the area in which the candidate Institution has expressed interest.

The spokesperson brings the EoI to the CB for decision when the future ATLAS activities of the Institution are clarified. The CB is notified in advance in such a case.

If the Collaboration Board admits the new Institution, the Resource Review Board is informed and its endorsement is requested.

Participation of Institutes in ATLAS Sub-systems

Country	Institute	Inner Det.	LAr Cal.	Tile Cal.	muon cham.	trigger /DAQ
Armenia	Yerevan			•		
Australia	Melbourne	•				
	Sydney U	•				
Austria	Innsbruck					•
Azerbaijan	Baku					
Belarus	Minsk			•		
Brazil	Rio			•		
Canada	Alberta		•			
	Carleton		•			
	Montreal		•			
	Toronto	•	•			
	TRIUMF		•			
	Vancouver		•			
	Victoria		•			
Czech Republic	Prague AS	•		•		•
	Prague CU	•		•		•
	Prague TU	•				
Denmark	Copenhagen	•				•
Finland	Helsinki					
France IN2P3	Annecy		•			
	Clermont			•		
	Grenoble		•			
	Marseille	•	•			•
	Orsay		•			
	Paris		•			
France CEA	Saclay		•		•	•
Georgia	Tbilisi AS + SU					
Germany BMBF	Bonn	•				
	Dortmund	•				
	Freiburg	•			•	
	Heidelberg					•
	Mainz		•			•
	Mannheim					•
	Munich LMU				•	
	Siegen	•				
	Wuppertal	•	•			
Germany MPI	Munich MPI	•	•		•	
Greece	Athens TU				•	
	Athens U				•	
	Thessaloniki				•	
Israel	Haifa				•	•
	Tel-Aviv				•	•
	Weizmann				•	•

Participation of Institutes in ATLAS Sub-systems

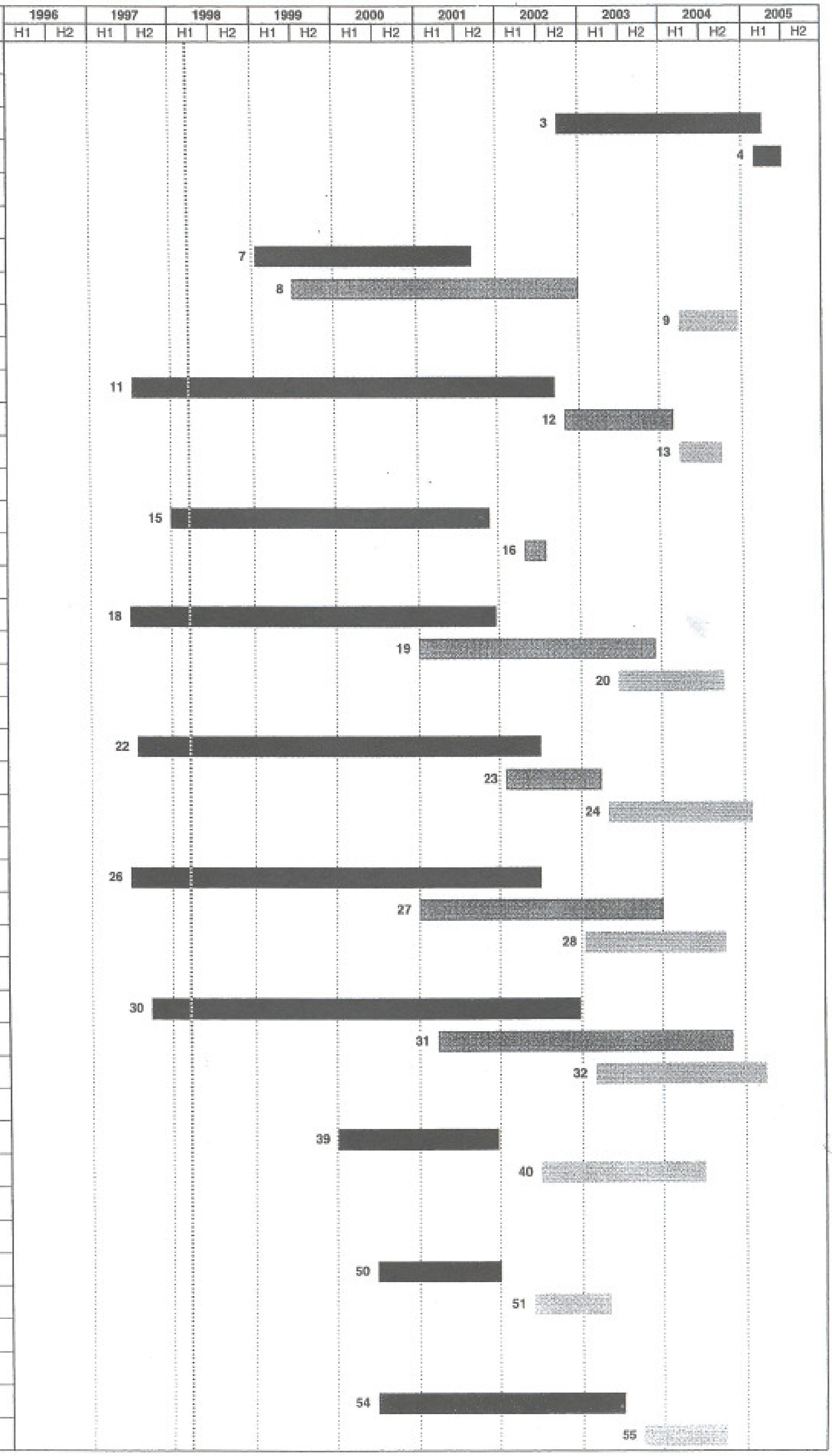
Country	Institute	Inner Det.	LAr Cal.	Tile Cal.	muon cham.	trigger /DAQ
Italy	Cosenza				•	
	Frascati				•	
	Genova	•				•
	Lecce				•	•
	Milano	•	•			
	Naples				•	•
	Pavia				•	•
	Pisa			•		
	Rome I				•	•
	Rome II				•	•
	Rome III				•	
	Udine	•				•
Japan	Fukui					
	Hiroshima IT					
	Hiroshima U	•				
	KEK	•			•	•
	Kobe				•	•
	Kyoto U					•
	Kyoto UE	•				
	Nagasaki					•
	Naruto					
	Shinshu				•	•
	Tokyo ICEPP				•	•
	Tokyo MU	•			•	•
	Tokyo UAT				•	
Morocco	Morocco		•			
Netherlands	NIKHEF	•			•	•
	Nijmegen				•	
Norway	Bergen	•				
	Oslo	•				
Poland	Cracow INP	•				•
	Cracow FPNT	•				•
Portugal	Portugal			•		•
Romania	Bucharest			•		•
Russia	Moscow ITEP		•			
	Moscow FIAN	•	•			
	Moscow MEPhI	•				
	Moscow SU	•				•
	Novosibirsk		•			•
	Protvino	•	•	•	•	•
	St Petersburg NPI	•			•	•
JINR	JINR	•	•	•	•	•
Slovak Republic	Slovakia		•	•		
Slovenia	Ljubljana	•				
Spain	Barcelona			•		
	Madrid		•			
	Valencia	•		•		
Sweden	Lund	•				
	Stockholm KTH		•			
	Stockholm U			•		•
	Uppsala	•				

Participation of Institutes in ATLAS Sub-systems

		Inner Det.	LAr Cal.	Tile Cal.	muon cham.	trigger /DAQ
Switzerland	Bern					•
	Geneva	•	•			•
Turkey	Ankara					•
	Istanbul					•
United Kingdom	Birmingham	•				•
	Cambridge	•				
	Edinburgh					•
	Glasgow	•				
	Lancaster	•				
	Liverpool	•				•
	London QMW	•				•
	London RHBNC					•
	London UC	•				•
	Manchester	•				•
	Oxford	•				
	RAL	•				•
	Sheffield	•				•
US DoE+NSF	Albany	•				
	Ann Arbor	•			•	
	Argonne			•		•
	Arizona		•			
	Arlington			•		
	Berkeley	•				
	Boston				•	
	Brandeis				•	
	Brookhaven		•		•	
	Chicago			•		
	Columbia		•			
	Duke	•				
	Hampton	•				
	Harvard				•	
	Indiana	•				
	UC Irvine	•				•
	MIT				•	
	Michigan SU			•		•
	New Mexico	•				
	Northern Illinois				•	
	Oklahoma	•				
	Philadelphia	•				
	Pittsburgh		•			
	Rochester		•			
	UC Santa Cruz	•				
	Dallas		•			
	Stony Brook		•		•	
	Tufts				•	
	Urbana			•		
	Seattle				•	
	Wisconsin	•				•
CERN		•	•	•	•	•

ATLAS PROJECT
MASTER SCHEDULE (abstract)

ID	Task Name
1	**ATLAS Detector**
2	
3	Detector Installation
4	Detector Global Commissionning
5	
6	**1. Vacuum**
7	Procurement & Production
8	Pre-assembly and Testing
9	Installation
10	**2. Inner Detector**
11	Procurement & Production
12	Pre-assembly and Testing
13	Installation
14	**3. Solenoid Magnet**
15	Manufacturing & Pre-tests
16	Assembly in Larg Barrel
17	**4. LAr Calorimeter**
18	Procurement & Production
19	Pre-assembly and Testing
20	Installation
21	**5. Tile Calorimeter**
22	Procurement & Production
23	Pre-assembly and Testing
24	Installation
25	**6. Toroids**
26	Procurement & Production
27	Pre-assembly and Testing
28	Installation
29	**7. Muon Spectrometer**
30	Procurement & Production
31	Pre-assembly and Testing
32	Installation
33	**8. Shielding**
39	Procurement & Production
40	Installation
41	
42	**9. Support Structures**
50	Procurement & Production
51	Installation
52	
53	**10. Trigger & DAQ**
54	Procurement & Production
55	Installation



Planning of Resources for the full ATLAS Detector

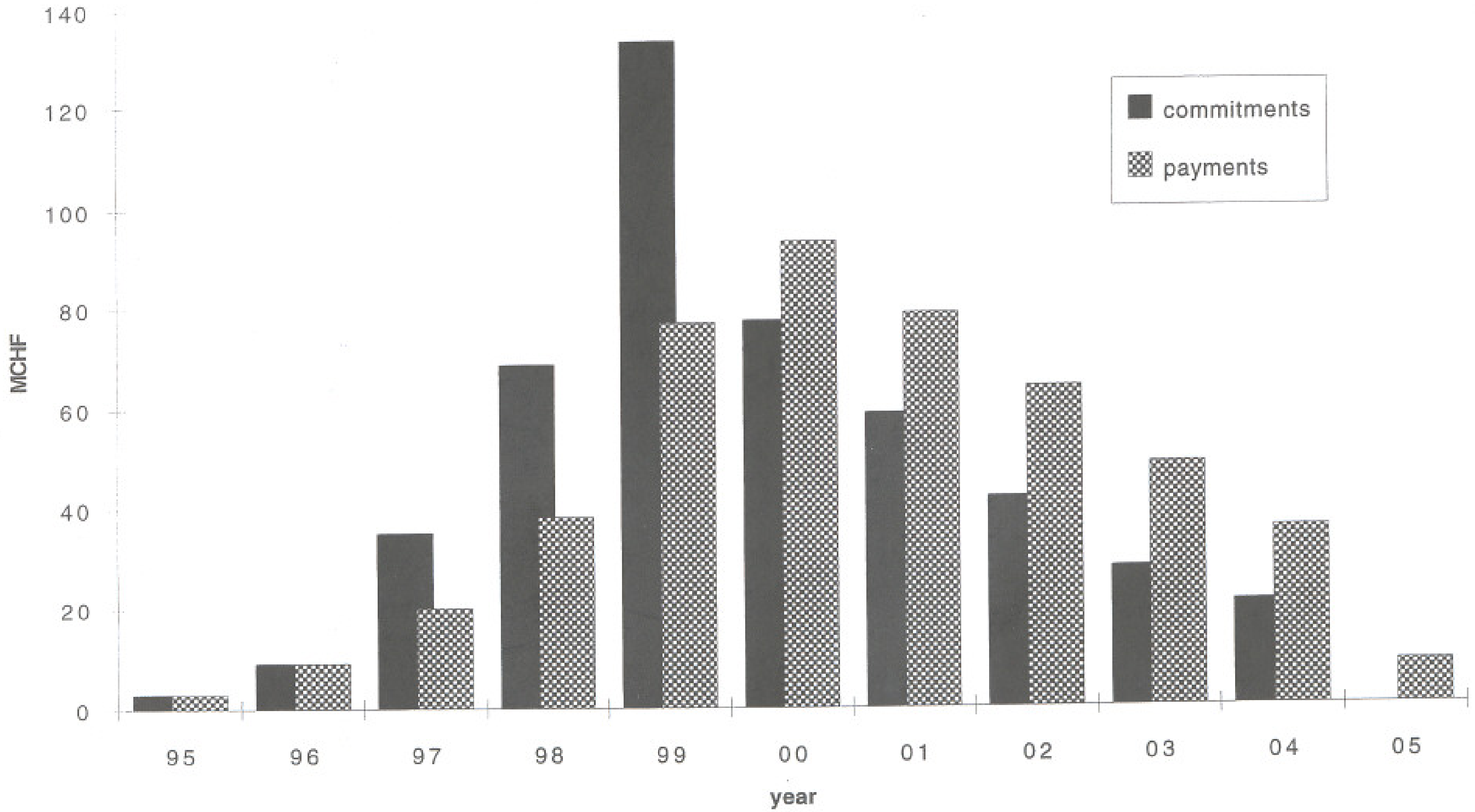
(value of deliverables in ATLAS 1995 MCHF)

	Inner Det.	LAr Cal.	Tile Cal.	muon cham.	trigger/ DAQ/con.	Common Projects	total
Armenia			0.1			0.1	**0.2**
Australia	1.4					1.1	**2.5**
Austria					0.3	0.3	**0.6**
Azerbaijan						0.1	**0.1**
Belarus						0.1	**0.1**
Brazil			0.1			0.1	**0.2**
Canada	0.1	8.4				6.6	**15.1**
Czech Republic	0.5		0.5			0.6	**1.6**
Denmark	0.9				1.0	1.4	**3.3**
Finland						0.1	**0.1**
France IN2P3	2.1	17.8	2.1			17.0	**39.0**
France CEA		5.7		2.2	3.9	8.6	**20.4** *
Georgia						0.1	**0.1**
Germany BMBF	7.9	3.2		2.5	4.7	14.2	**32.5**
Germany MPI	1.7	1.6		0.9		3.3	**7.5**
Greece				1.0		0.7	**1.7**
Israel				2.5	0.4	2.1	**5.0**
Italy	5.0	3.7	1.3	9.3	5.9	19.8	**45.0**
Japan	6.8			6.8	4.5	14.0	**32.1**
Morocco		0.2				0.1	**0.3**
Netherlands	1.8			3.0	0.9	6.7	**12.4**
Norway	2.4					1.8	**4.2**
Poland	0.4				0.2	0.4	**1.0**
Portugal			1.0		0.3	0.9	**2.2**
Romania			0.3			0.3	**0.6**
Russia	3.4	4.7	1.1	3.5		10.0	**22.7**
JINR	0.5	0.7	0.8	1.0	0.1	2.3	**5.4**
Slovak Republic		0.3				0.2	**0.5**
Slovenia	0.8					0.7	**1.5**
Spain	1.2	2.3	2.0			4.3	**9.8**
Sweden	3.1	1.5	0.9		0.6	4.7	**10.8**
Switzerland	4.9	1.1			4.0	8.5	**18.5**
Turkey					0.2	0.2	**0.4**
United Kingdom	13.1				5.9	15.0	**34.0**
US DoE + NSF	12.0	16.9	3.6	8.8	4.0	35.5	**80.8**
CERN	9.0	8.6	3.0	1.5	11.5	26.4	**60.0**
total	79.0	76.7	16.8	43.0	48.4	208.3	**472.2**
CORE detector cost	78.5	80.0	15.2	42.5	49.8	208.7	**474.7**
total - cost	0.5	-3.3	1.6	0.5	-1.4	-0.4	-2.5

comment: A number of Funding Agencies have indicated possible additional contributions to the Common Projects

* This contribution by CEA does not include a special contribution of 1 MCHF concerning engineering of the barrel toroid, to be considered as an advance on any possible future contributions

Planned Spending Profile for the ATLAS Detector



Inner Detector

The Inner Detector consists of the Pixel Detector (part A), the Semiconductor Tracker (SCT, part B), the Transition Radiation Tracker (TRT, part C) and Inner Detector General Items (part D).

A. Pixel Detector

Institutes participating:

Czech Republic:	Prague AS, CU & TU		
France/IN2P3:	Marseille		
Germany:	Bonn	Dortmund	Munich MPI
	Siegen	Wuppertal	
Italy:	Genova	Milano	Udine
Netherlands:	NIKHEF		
US:	Albany	Berkeley	UC Irvine
	UC Santa Cruz	New Mexico	Oklahoma
	Wisconsin		

Milestones:

Pixel TDR	April	1998
Radiation-hard module completed	January	1999
Select module baseline	November	1998
Start pixel sensor production	May	1999
Mechanical engineering baseline selected	June	1999
Pixel module-0 completed (stave+sector)	October	1999
25% module production completed	January	2001
Pixel detector complete	May	2003
Begin pixel detector test with full inner detector	September	2003
Start installation into ATLAS	March	2004
Begin commissioning	September	2004

Development work still to be completed:

Design, prototype production and tests of front-end rad-hard chips *(Berkeley, Bonn, Marseille)*	---->	1999
Design prototype production and tests of module and ladder/sector controller including data transmission *(Berkeley, Genova, NIKHEF, Siegen)*	---->	1999
Design prototype production and tests of sensors and their optimization for radiation resistence *(New Mexico, Dortmund, MPI Munich, Prague, Udine)*	---->	1999
Choice of local busses and design production and tests of prototype modules *(Albany, Bonn, Genova, Marseille, NIKHEF, Oklahoma, Siegen, Wuppertal)*	---->	1999
Optimization of bump bonding process *(Berkeley, Bonn, Dortmund, Genova, Marseille)*	---->	1999
Design of mechanical supports and mounting jigs *(Berkeley, Bonn, Genova, Marseille, Wuppertal)*	---->	2000
Optimization of cooling system *(Berkeley, Genova, Marseille, Prague)*	----->	2000
DCS and Power Supplies *(Marseille, Wuppertal)*	----->	2001
Off-detector electronics *(Irvine, Wisconsin)*	----->	2001

Distribution of commitments on detector construction:

The costs listed indicate the value of the commitment to deliverables in 1995 kCHF according to the ATLAS cost document, CORE version 7, dated 31 January, 1998; the dates indicate the time the delivery is requested according to the construction schedule.
The costs are indicated for groups of institutes belonging to a Funding Agency; subdivision at the institute level, whenever relevant, will be done when the TDR will be presented.

Mechanics

- Construction of barrel supports including cooling pipes (800 kCHF, May 2000 to January 2002)
  Marseille 40%, (Bonn, Dortmund, Wuppertal) (20%), Genova (40%)

- Construction of disk supports including cooling pipes (320 kCHF, May 2000 to January 2002)
  Berkeley (100%)

- Construction of support structure and tooling (400 kCHF, September 2000 to June 2002)
  (Bonn, Dortmund, Wuppertal) (37.5%), Genova (37.5%) Berkeley (25%)

Electronics and modules

- On-chip rad-hard electronics (Front-end matrix, Module Control Chip) (6620 kCHF, November 1999 to June 2001)
  Marseille (19%), NIKHEF (4.7%),
  (Bonn, Dortmund, Wuppertal, Siegen) (28.7%),
  (Genova, Milano) (27.1%), (Berkeley, Santa Cruz) (20.5%)

- Sensors (1140 kCHF, June 1999 to August 2001)
  (Prague AS, CU and TU) (10%), (Milano, Udine) (40%),
  (Bonn, Dortmund, Wuppertal, Siegen) (30%),
  (Albany, New Mexico,Oklahoma) (20%)

- Module Integration (wafer thinning, bump-bonding, flip-chip and hybrids) (3380 kCHF, January 2000 to October 2001)
  Marseille (9%), Genova, Milano, Udine) (46%),
  (Bonn, Dortmund, Wuppertal) (34%),
  (Albany, Berkeley, Oklahoma) (11%)

Off-module electronics and pixel services

- Cables, links, power supplies and Detector Control System (1740 kCHF, June 2001 to January 2003)
  (Prague AS, CU and TU) (4.8%), Marseille (7.9%),
  (Bonn, Dortmund, Wuppertal, Siegen) (35%),
  (Genova, Milano, Udine) (36%),
  (Albany, Berkeley, Irvine, New Mexico, Oklahoma, Santa Cruz, Wisconsin) (16.3%)

- RODs and crates (560 kCHF, January 2002 to April 2003)
  (Irvine, Wisconsin) (100%)

Module-0

(350 kCHF, January 1999 to October 1999)
Marseille (30%), (Bonn, Dortmund, Wuppertal, Siegen) (50%), (Genova, Milano, Udine) (10%), (Albany, Berkeley, Irvine, New Mexico, Oklahoma, Santa Cruz, Wisconsin) (10%)

B. Semiconductor Tracker (SCT)

Institutes participating:

Australia:	Melbourne	Sydney	
Czech Republic:	Prague AS, CU & TU		
Germany:	Freiburg	Munich MPI	
Japan:	Hiroshima	KEK	Kyoto UE
	Tokyo MU		
Netherlands:	NIKHEF		
Norway:	Bergen	Oslo	
Poland:	Cracow FPNT	Cracow INP	
Russia:	Moscow SU	Protvino	
Slovenia:	Ljubljana		
Spain:	Valencia		
Sweden:	Uppsala		
Switzerland:	Geneva		
United Kingdom:	Birmingham	Cambridge	Glasgow
	Lancaster	Liverpool	London QMW
	London UC	Manchester	Oxford
	RAL	Sheffield	
US:	Berkeley	UC Irvine	UC Santa Cruz
	Wisconsin		
CERN			

Milestones

TDR	April	1997
Final design reviews, tender for detectors and ASICS	March	1998
Module-0 (Barrel and Forward)	October	1998
Freeze support structure design	September	1998

Start ASIC, Detector production	January	1999
System tests (TSP; proto-barrels and disks)	July	1999
25% Modules assembled	September	2000
Complete ASIC production	March	2001
Complete detector production	March	2002
SCT at CERN	January	2003
Assemble ID	September	2003

Development still to be completed

Further irradiation of detectors to quantify strip failures
(Australia, CERN, Prague, Germany, Japan, Norway, Russia, Ljubljana, Geneva, UK, Valencia) ---> 1998

Prototype and irradiation of CAFE, ABC, ABCD chips
(CERN, Cracow, NIKHEF, Geneva, UK, Uppsala, USA, Valencia) ---> 1998

Prototype & irradiation of complete datalinks
(UK) ---> 1998

Prototype Power Supplies & Cables
(Cracow, Prague, Ljubljana, UK) ---> 1998

Demonstrate elements of DCS system
(Russia, Uppsala) ---> 1998

Irradiation of complete modules
(Australia, CERN, Cracow, Prague, Germany, Japan, Norway, Russia, Ljubljana, Geneva, UK, Uppsala, USA, Valencia) ---> 1998

Finalise assembly process and jigs, prepare and qualify module assembly sites
(Australia, CERN, Cracow, Prague, Germany, Japan, Norway, Russia, Ljubljana, Geneva, UK, Uppsala, USA, Valencia) ---> 1998

Deformation and Stability Measurements of Prototype Barrel Cylinder
(Geneva, UK, Uppsala) ---> 1998

Prototype Forward Disk Structure and Space-frame
(Australia, NIKHEF, Russia, UK) ---> 1998

Obtain data from TSP and reconstruct tracks
(Australia, CERN, Cracow, Prague, Germany, Japan, NIKHEF, Norway, Russia, Ljubljana, Geneva, UK, Uppsala, Valencia) ---> 1999

Prototype Off-detector Electronics
(Geneva, UK, USA) ---> 1999

Multi-module system tests
(Australia, CERN, Cracow, Prague, Germany, Japan, NIKHEF, Norway, Russia, Ljubljana, Geneva, UK, Uppsala, USA, Valencia) ---> 1999

Distribution of commitments to detector construction

The costs listed indicate the value of the commitment to deliverables in 1995 kCHF according to the ATLAS cost document, CORE version 7, dated 31 January, 1998; the dates indicate the time the delivery is requested according to the construction schedule.

- Procurement of Silicon Detectors including testing, monitoring radiation tolerance and delivery to module assembly centres (1/99 - 2/02)
  Barrel detector (8550 kCHF)
  Japan (57%), Norway (18%), UK (25%)
  Forward detector (7090 kCHF)
  Germany (41%), Geneva (29%), UK (26%), Valencia (7%)

- Procurement of Frontend ASICs, including testing, monitoring radiation tolerance and delivery to module assembly centres
  (5890 kCHF; 1/99 - 2/01)
  CERN (5.9%), Norway (2.8%), Geneva (4.5%), UK (25.7%), Uppsala (6.6%), USA (50.0%), Valencia (4.5%)

- Supply of Frontend system components and testing (385 kCHF; 1/99 - 2/01)
  CERN (24.5%), Norway (11.5%), Geneva (18.5%), Uppsala (27.0%), Valencia (18.5%)

- Supply of bridging and digital circuits (1195 kCHF; 1/99 - 4/01)
  UK (100%)

- Procurement of Hybrids including population with SMD components, assembly of ASICs to Hybrids including wirebonding, testing and 'burn-in' (1/99 - 2/02)
  Barrel detector (2080 kCHF)
  Japan (27%), Uppsala (18%), UK (25%), USA (30%)
  Forward detector (1860 kCHF)
  CERN (9%), Germany (30%), Geneva (22%), NIKHEF (4%), Russia (4%), UK (27%), Valencia (9%)

- Supply of module components and testing (3/99 - 4/02)
  Barrel detector (1110 kCHF)
  Japan (27%), Norway (9%), Uppsala (9%), UK (25%), USA (30%)
  Forward detector (1070 kCHF)
  Australia (5%), Germany (34%), NIKHEF (5%), Geneva (25%), UK(27%), Valencia (9%)

- Assembly of Modules at cluster sites and testing prior to delivery to the pre-assembly sites:

barrel module 1:	*Norway, Uppsala (9%)*
barrel module 2:	*UK (13%)*
barrel module 3:	*Japan (14%)*
barrel module 4:	*USA (15%)*
forward module 1:	*Australia, CERN, Cracow, Prague, Ljubljana, Geneva, Moscow (15%)*
forward module 2:	*Prague, Germany, NIKHEF, Protvino (17%)*
forward module 3:	*UK, Valencia (17%)*

- Assembly of Data-links (optohybrids, optical links, off-detector driver/receiver) including testing and delivering to pre-assembly sites
  (2620 kCHF; 3/99 - 3/01)
  CERN (15.8%), Japan (17.6%), Norway (4.5%), Ljubljana (7.7%), UK (45.6%), Uppsala (4.5%), Valencia (4.4%)

- Supply of low mass cables and patchpanels and connectors including testing and delivering to pre-assembly/final assembly sites
  (1455 kCHF; 3/99 - 3/01)
  Germany (19.8%), Ljubljana (43.7%), Geneva (11.5%), UK (25.0%)

- Supply of Off-detector Electronics including crates, power supplies
  (1510 kCHF; 10/99 - 3/04)
  UK (25.0%), USA (75.0%)

- Supply of Low Voltage Power supplies
  (1470 kCHF; 10/99 - 3/04)
  Australia (31.0%), Prague (20.4%), Geneva (28.6%), UK (20.0%)

- Supply of Detector Bias
  (1005 kCHF; 10/99 - 3/04)
  CERN (13.8%), Cracow (19.9%), Germany (46.3%), UK (20.0%)

- Supply of External Cables
  (2015 kCHF; 10/99 - 3/04)
  Australia (31.0%), CERN (16.7%), Germany (23.9%), Geneva (12.8%), not covered (15.6%)

- Provide the temperature, coolant and current monitoring devices and the SCT specific DCS hardware and software
  (415 kCHF; 1/99 - 2/01)
  Uppsala (100%), Russia

- Provide CF cylinder structure, mechanical fixtures, brackets, local cooling, cable harnesses and assemble modules to cylinders
  (2590 kCHF; 9/99 - 12/02)
  CERN (1.3%), Japan (25.0%), Norway (3.7%), Geneva (40.0%), UK (30%)

- Provide Space Frame, CF disks, mechanical fixtures, local cooling cable harnesses, and assemble modules to disks
  (2485 kCHF; 9/99 - 12/02)
  Australia (10.4%), CERN (0.4%), NIKHEF (47.3%), Russia (4.2%), UK (37.7%)

C. Transition Radiation Tracker (TRT)

Institutes participating:

Denmark:	Copenhagen		
Poland:	Cracow		
Russia:	Moscow FIAN	Moscow MEPhI	Moscow SU
	Petersburg NPI		
JINR			
Sweden:	Lund		
US:	Ann Arbor	Duke	Hampton
	Indiana	Philadelphia	
CERN			

Milestones:

Barrel module 0	December	1998
End-cap module 0	December	1998
Initial production milestone (1/8 of barrel modules, at least 2 end-cap wheels and pre-production electronics ready)	June	2000
Start procurement of front-end ASICs	June	2000
Barrel construction complete	December	2002
End-cap construction complete	February	2003

Test complete Inner Detector on surface	September	2003
Start installation of Inner Detector into ATLAS	March	2004
Start final commissioning	September	2004

Development work still to be completed:

-Finalise barrel module design and tooling and prepare assembly sites
(Duke, Hampton, Indiana) ---> 1998

-Finalise end-cap wheel design and tooling and prepare assembly sites
(CERN, JINR, Petersburg NPI) ---> 1998

-Define and implement quality assurance procedures
(All institutes) ---> 1998

-Perform radiation-hardness and large-scale ageing tests of complete pre-production prototypes
(All institutes) ---> 1998

-Develop and validate full rad-hard front-end electronics
(Ann Arbor, CERN, Cracow, Lund, Moscow MEPhI, Philadelphia, Petersburg NPI) ---> 2000

-Finalise readout and protocols including off-detector electronics
(Ann Arbor, CERN, Copenhagen, Lund, Philadelphia) ---> 1998

-Specify and qualify all services to and from detector
(CERN, Cracow, Lund, Philadelphia) ---> 1998

-Finalise design and implementation of high-voltage system
(CERN, Moscow MEPhI, Philadelphia) ---> 2000

-Develop and validate low-voltage system and power supplies
(Cracow, Philadelphia) ---> 2000

-Finalise design of read-out drivers and timing, control modules
(CERN, Copenhagen) ---> 2000

-Develop and finalise design of ionisation gas system
(CERN, Cracow, Moscow FIAN/MEPhI/SU) ---> 2000

-Develop and finalise design of cooling and ventilation gas system
(CERN) ---> 2001

-Develop and finalise design of cooling system
(Petersburg NPI) ---> 2001

Distribution of Commitments to Detector Construction

The costs listed indicate the value of the commitment to deliverables in 1995 kCHF according to the ATLAS cost document, CORE version 7, dated 31 January, 1998; the dates indicate the time the delivery is requested according to the construction schedule.

Mechanics

- Procurement of coated polyimide film for straws (340 kCHF, December 1998):
  CERN (38%), Moscow FIAN/MEPhI/SU (32%), Lund (30%)

- Procurement of reinforced straws, including reinforcement tooling (710 kCHF, August 2000):
  CERN (44%), Duke/Hampton/Indiana (49%), Petersburg NPI (7%)

- Procurement of barrel materials and tooling, and assembly/testing of barrel modules (890 kCHF, February 2002):
  Duke/Hampton/Indiana (94%), Lund (6%)

- Procurement of end-cap support rings (2720 kCHF, December 2001):
  CERN (90%), Petersburg NPI (10%)

- Procurement of end-cap materials and tooling and assembly/testing of end-cap wheels (3950 kCHF, August 2002):
  CERN (42%), JINR (22%), Moscow FIAN/MEPhI/SU (2%), Petersburg NPI (34%)

On-detector electronics

- Procurement of front-end ASICs (2970 kCHF, December 2001):
  Lund (43%), Philadelphia (57%)

- Procurement of test electronics (80 kCHF, December 1999):
  Petersburg NPI (100%)

- Manufacturing and testing of barrel front-end boards (150 kCHF, December 2001):
  Lund (100%)

- Manufacturing and testing of end-cap front-end boards (320 kCHF, December 2001):
  CERN (62%), Ann Arbor/Philadelphia (38%)

Cables and off-detector electronics

- Cables (1500 kCHF, June 2003):
  CERN (81%), Duke/Hampton/Indiana (6%), Philadelphia (13%)

- Back-end electronics and links to DAQ (1450 kCHF, December 2003):
  CERN (38%), Copenhagen (62%)

Infrastructure items

- Cooling system (100 kCHF, June 2003):
  Petersburg NPI (100%)

- Slow controls (100 kCHF, December 2003):
  Cracow (100%)

- Gas system and power supplies (1040 kCHF, June 2003):
  CERN (21%), Cracow (10%), Duke/Hampton/Indiana (43%), Moscow FIAN/MEPhI/SU (26%)

Assembly & commissioning at CERN

- Barrel module and end-cap wheel testing and commissioning at CERN:
  All institutes

- Final commissioning of assembled detector (on the surface and in the experiment):
  All institutes

D. Inner Detector General Items

Institutes participating:

Canada:	Toronto		
Czech Republic:	Prague AS, CU & TU		
France/IN2P3:	Marseille		
Germany:	Bonn	Dortmund	Munich MPI
	Siegen	Wuppertal	
Italy:	Genova	Milano	Udine
Netherlands:	NIKHEF		
Norway:	Oslo		
Russia:	Protvino		
Switzerland:	Geneva		
United Kingdom:	Birmingham	Cambridge	Glasgow
	Lancaster	Liverpool	London QMW
	London UC	Manchester	Oxford
	RAL	Sheffield	
US:	Albany	Berkeley	UC Irvine
	UC Santa Cruz	New Mexico	Oklahoma
	Wisconsin		
CERN			

Development work still to be completed:

Final design of cooling system
(CERN, Norway, UK, Genova) ---> 1998

Final design of alignment system
(CERN, NIKHEF, UK) ---> 1998

Final design of SCT/TRT barrel support structure ---> 1999
(CERN, UK, Protvino)

Final design of forward services supports ---> 1999
(CERN)

Final design of installation tooling ---> 2001
(CERN)

Distribution of Commitments to Detector Construction

The costs listed indicate the value of the commitment to deliverables in 1995 kCHF according to the ATLAS cost document, CORE version 7, dated 31 January, 1998; the dates indicate the time the delivery is requested according to the construction schedule.

Cooling system (SCT and Pixels)

- Procurement of cooling plant, interface to DCS, pipework
  (710 kCHF, 10/99-3/04)
  CERN (29%), Genova (14%), Norway (37%), UK (21%)

Alignment system (SCT and Pixels)

- Provide equipment necessary for survey during assembly and for in-situ alignment, carrying out the surveys and setup database for use by trigger and offline
  (750 kCHF, 2/99-1/03)
  CERN (25%), NIKHEF (30%), UK (26%), Toronto (13%), not covered (6%)

- Procurement of second laser
  (250 kCHF, 1/01)
  UK (100%)

Barrel support structure (SCT and TRT)

- Procurement of barrel support structure
  (600 kCHF, 10/01)
  CERN (25%), UK (25%), Protvino (50%)

Installation equipment

- Provide supports for forward ID services, assembly and installation tooling, transport cradle for complete ID
  (450 kCHF, 10/01)
  CERN (44%), Russia (56%)

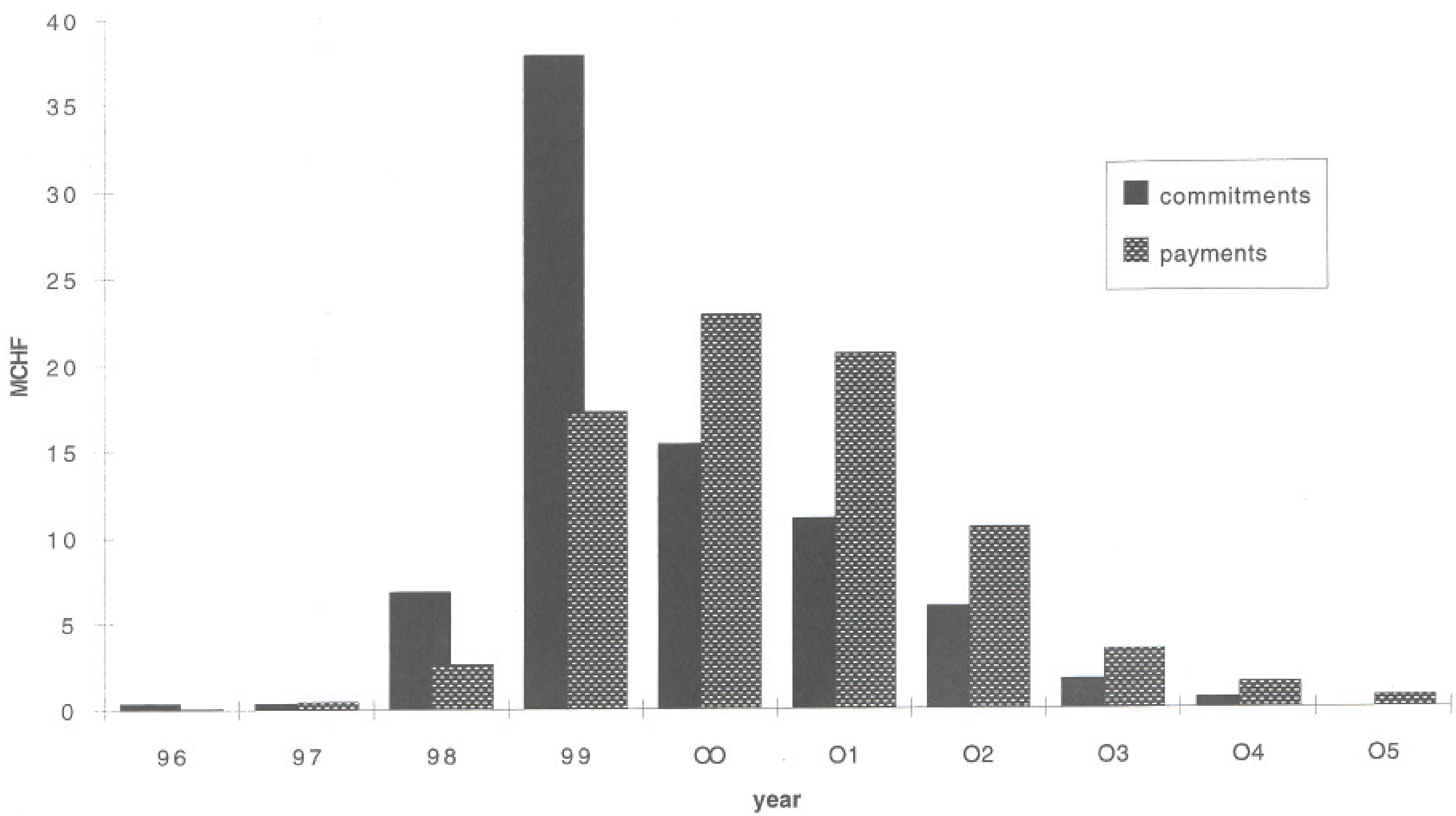
- Cable extensions (pixels)
  (100 kCHF, 1/03)
  (Prague AS, CU and TU) (5%), Marseille (8%),
  (Bonn, Dortmund, Wuppertal, Siegen) (35%),
  (Genova, Milano, Udine) (36%),
  (Albany, Berkeley, Irvine, New Mexico, Oklahoma, Santa Cruz, Wisconsin) (16%)

Planning of Resources for the Inner Detector

(value of deliverables in ATLAS 1995 kCHF)

	pixel detector	SCT detector	TRT	General Items	total
Armenia					0
Australia		1395			1395
Austria					0
Azerbaijan					0
Belarus					0
Brazil					0
Canada				100	100
Czech Republic	200	300		5	505
Denmark			900		900
Finland					0
France IN2P3	2125			10	2135
FRANCE CEA					0
Georgia					0
Germany BMBF+MPI	4485	5065		35	9585
Greece					0
Israel					0
Italy	4935			135	5070
Japan		6845			6845
Kazakhstan					0
Morocco					0
Netherlands	310	1305		225	1840
Norway		2060		260	2320
Poland		200	205		405
Portugal					0
Romania					0
Russia + JINR		180	3170	550	3900
Slovak Republic					0
Slovenia		840			840
Spain		1210			1210
Sweden		1500	1580		3080
Switzerland		4950			4950
Turkey					0
United Kingdom		12425		745	13170
US DoE + NSF	3255	5040	3730	15	12040
CERN		1540	6730	740	9010
total	15310	44855	16315	2820	79300

Spending Profile for Inner Detector



Annex 9.2.A

Liquid Argon Calorimeter

The Liquid Argon Calorimeter consists of

an Electromagnetic Barrel Calorimeter (EMB) including a pre-sampler (PS)

and two End-Cap Calorimeters (EC), each containing in a single cryostat:
- an Electromagnetic End-Cap Calorimeter (EMEC)
- a Hadron Calorimeter (HCAL) and
- a Forward Calorimeter (FCAL)

The cryostats for the barrel and end-cap calorimeters are part of the Common Projects (c.f. annex 10) and are not covered in this annex.

Institutes participating

Canada:	Alberta	Carleton	Montreal
	Toronto	TRIUMF	Vancouver
	Victoria		
France/IN2P3:	Annecy	Grenoble	Marseille
	Orsay	Paris	
France/CEA:	Saclay		
Germany:	Mainz	Munich MPI	Wuppertal
Italy:	Milano		
Morocco			
Russia:	Moscow FIAN	Moscow ITEP	Novosibirsk
	Protvino		
JINR			
Slovak Republic:	Kosice		
Spain:	Madrid		
Sweden:	Stockholm KTH		
Switzerland:	Geneva		
US:	Arizona	Brookhaven	Columbia
	Dallas	Pittsburgh	Rochester
	Stony Brook		
CERN			

Milestones:

EM barrel module-0 ready for beam test (with PS)	August	1998
EM endcap module-0 ready for beam test	July	1998

Hadronic endcap module-0 ready for beam test	April	1998
Forward Cal module-0 ready for beam test	May	1998
Start procurement of material for series		1998
Confirm cold preamplifiers for hadronic EC	December	1997
Confirm analog readout electronics	November	1998
Build warm readout electronics	1999 to	2002
Calibration of modules at SPS	1999 to	2002
Order cryostats		1998
Start assembly work in west area		2001
Cold test of EM barrel and solenoid	October	2002
Cold test of End-caps C	January	2002
Cold test of End-caps A	July	2003
Start installation in ATLAS pit	October	2002
Start final detector commissioning	July	2004

Development work still to be completed:

finish development of front-end readout	---> 1999
develop Read-Out Drivers (RODs)	---> 2000
select optical links	---> 2000
design and order cryogenic system	---> 1999

Distribution of Commitments to Detector Construction

The costs listed indicate the value of the commitment to deliverables in 1995 kCHF according to the ATLAS cost document, CORE version 7, dated 31 January 1998; the dates indicate the time the delivery is requested according to the construction schedule.

The LAr calorimeter is presently not completely funded. For items which are not fully covered by commitments the missing fraction is indicated as "not covered" (NC).

Barrel Presampler

- shells and support bars
  (190 kCHF, 1998 to 2000)
  Grenoble (100%)

- support rails
  (15 kCHF, 1998 to 2000)
  Grenoble (100%)

Sectors

- test cryostats and test of sectors in home institutes
  (75 kCHF, 1997–1998 to 2000)
  Grenoble (50%), Stockholm (50%)

- test benches
  (75 kCHF, 1997-1998)
  Grenoble (50%), Stockholm (50%)

- assembly tools
  (45 kCHF, 1997-2000)
  Morocco (50%), Stockholm (50%)

- storage vessels
  (50 kCHF, 1998 to 2000)
  Stockholm (100%)

Modules

- electrodes (FR4)
  (470 kCHF, 1997 to 2001)
  Morocco (15%), Stockholm (85%)

- jigs and shims
  (205 kCHF, 1997 to 1998)
  Grenoble (100%)

- production of modules
  (410 kCHF, 1997 to 2001)
  Grenoble (100%)

Cold electronics

- mother boards
  (85 kCHF, 1997 to 2001)
  Grenoble (100%)

- signal and high voltage cables
  (110 kCHF, 1997 to 1999)
  IN2P3 (100%)

Assembly tools

- integration and insertion tools
  (25 kCHF, 1997 to 2001)
  Grenoble (20%), Morocco (60%), Stockholm (20%)

<u>*Barrel Electromagnetic Calorimeter*</u>

Tooling

- tooling for sandwich assembly and bending of lead-stainless steel absorbers
  (400 kCHF, 1997)
  CERN (100%)

- curing moulds and other tools for lead-stainless steel absorbers
  (600 kCHF, 1997)
  Orsay (100%)

- metrology for lead-stainless steel absorbers
  (220 kCHF, 1997)
  Paris (100%)

- tooling for honeycomb spacers
  (120 kCHF, 1997)
  Saclay (100%)

- tooling for bending of kapton electrodes
  (250 kCHF, 1997)
  Annecy (100%)

- electrical test systems for kapton electrodes
  (400 kCHF, 1997)
  Milan (50%), Paris (50%)

- backbones for module assembly
  (450 kCHF, 1997 to 1998)
  Saclay (100%)

- module assembly tools
  (1050 kCHF, 1997)
  Annecy (43%), CERN (33%), Saclay (24%)

- cold tests stations
  (1000 kCHF,1997 to 1998)
  Annecy (50%), Saclay (50%)

- half barrel assembly equipment
  (180 kCHF, 1999)
  CERN (50%), Saclay (50%)

Procurement

- precision G10 bars, for absorber fabrication
  (2330 kCHF, 1997 to 2000)
  CERN (100%)

- lead, stainless steel, prepreg for absorber fabrication
  (1510 kCHF, 1997 to 1999)
  CERN (5%), Saclay (95%)

- fabrication of absorbers in home institute
  (400 kCHF, 1998 to 2001)
  Orsay (100%)

- procurement of kapton electrodes from industry
  (6250 kCHF, 1997 to 2000)
  CERN (25%), Milano (26.5%), IN2P3 (11%), US-labs (32%), Saclay (5.5%)– with a limitation, barrel and endcap (see next section) of 3000 kCHF for the US and 500 kCHF for Saclay

- ground springs
  (150 kCHF, 1997 to 2000)
  Milano (100%)

- logistics
  (200 kCHF, 1997 to 2000)
  Annecy (62.5%), CERN (12.5%), Milano (25%)

- bending of kapton electrodes in home institute
  (1998 to 2000)
  Annecy (100%)

- electrical test of kapton electrodes in home institute
  (1998 to 2000)
  Milano (50%), Paris (50%)

- spacer honeycomb strips
  (270 kCHF, 1997 to 1998)
  Saclay (100%)

- stainless steel (external) and composite (internal) support rings
  (980 kCHF, 1997 to 1999)
  Annecy (100%)

- cooling loops in modules
  (10 kCHF, 1997 to 1999)
  Saclay (100%)

- assembly of rings and backbones
  (450 kCHF, 1997 to 1999)
  Saclay (100%)

- stacking of modules
  (1998 to 2001)
  Annecy (30%), CERN (30%), Saclay (40%)

- cold tests of modules
  (1998 to 2001)
  Annecy (50%), Saclay (50%)

Cold electronics

- summing boards and mother boards
  (1230 kCHF, 1998 to 2000)
  Brookhaven (100%)

- cold cables
  (1250 kCHF, 1998 to 2000)
  IN2P3 (100%)

- patch panels
  (50 kCHF, 1997 to 2000)
  Annecy (100%)

__End Cap Presampler__

Tooling

- assembly tools, test bench, test cryostat, storage vessel, transport
  (70 kCHF, 1999 to 2002)
  Novosibirsk (100%)

Modules

- electrodes, G10 bars, assembly of modules
  (70 kCHF, 1999 to 2002)
  Novosibirsk (100%)

- honeycomb spacers
  (5 kCHF, 1999)
  Stockholm (100%)

Cold electronics

- cold cables
  (35 kCHF, 1999)
  IN2P3 (100%)

<u>*End-Cap Electromagnetic Calorimeter*</u>

Tooling

- tooling for sandwich assembly bending and curing of lead-stainless steel absorbers (including metrology)
  (1600 kCHF, 1997)
  Madrid (100%)

- tooling for bending of kapton electrodes
  (300 kCHF, 1997)
  Marseille (55%), NC (45%)

- electrical test systems for kapton electrodes
  (150 kCHF, 1997)
  Orsay and Paris (100%)

- structure for EM wheel assembly
  (200 kCHF, 1997 to 1999)
  Novosibirsk (66%), NC (34%)

- contribution to overturning tool (in common with HEC)
  (250 kCHF, 1997 to 1999)
  Novosibirsk (52%), NC (48%)

Procurement

- precision G10 bars
  (805 kCHF 1998 to 2001)
  Marseille (100%)

- lead for absorber fabrication (including tooling for controls)
  (325 kCHF, 1997 to 2000)
  Madrid (70%), Paris(7%), NC (23%)

- stainless steel for absorber fabrication
  (360 kCHF, 1997 to 2000)
  Novosibirsk (27.8%), Madrid (19.5%), Marseille (42%), NC (10.7%)

- kapton electrodes from industry
  (3050 kCHF, 1997 to 2000)
  CERN (25%), Milano (26.5%), IN2P3 (11%), US-labs (32%), Saclay (5.5%) – with a limitation, barrel and endcap (see preceding section) of 3000 kCHF for the US and 500 kCHF for Saclay

- ground springs
  (150 kCHF, 1998 to 2001)
  CERN (100%)

- logistics
  (100 kCHF, 1998 to 2001)
  CERN (25%), Marseille (75%)

- electrical test of kapton electrodes in home institute
  (1998 to 2001)
  Orsay (100%)

- honeycomb spacers
  (700 kCHF, 1998 to 2000)
  Marseille (100%)

- miscellaneous for spacers
  (400 kCHF, 1998 to 2000)
  Madrid (25%), NC (75%)

- precision structure (aluminium and G10)
  (860 kCHF 1997 to 2000)
  Marseille (57%), Novosibirsk (43%)

- tools for stacking and control of modules
  (435 kCHF, 1997 to 2001)
  Madrid (19%), Marseille (76%), NC (5%)

- overturning tool for modules
  (20 kCHF, 1998)
  Madrid (100%)

- transport of modules
  (25 kCHF, 1998)
  Marseille (100%)

- stacking of modules
  (1998 to 2001)
  Madrid (50%), Marseille (50%)

- cold tests of modules at CERN
  (1998 to 2002)
  Madrid, Marseille, Novosibirsk

Cold electronics

- summing boards and mother boards
  (560 kCHF, 1997 to 2001)
  Madrid (35%), Marseille (54%), NC (11%)

- cold cables
  (970 kCHF, 1997 to 2000)
  IN2P3 (100%)

- patch panels
  (50 kCHF, 1997 to 2000)
  Marseille (50%), NC (50%)

End-Cap Hadronic Calorimeter

absorbers

- precision machined copper plates and module support (1998 to 2001)
  hadronic wheel 1 (25 mm thick plates) (2580 kCHF)
  Canada (50%), Munich MPI (10%), JINR (38%), NC(2%)
  hadronic wheel 2 (50 mm thick plates) (2860 kCHF)
  Canada (50%), Munich MPI (10%), Protvino (36%), NC (4%)

- inter-module clamps
  hadronic wheel 1 (280 kCHF)
  Canada (50%), Munich MPI (12%), JINR (38%)
  hadronic wheel 2 (265 kCHF)
  Canada (50%), Munich MPI (14%), Protvino (36%)

Readout kapton electrodes

- pad boards
  (1275 kCHF, 1998 to 2001)
  Canada (37%), Mainz (53%), Moscow/FIAN (10%)

- EST boards
  (845 kCHF, 1998 to 2001)
  Canada (47%), Moscow/FIAN (53%)

- honeycomb spacers
  (160 kCHF 1998 to 2001)
  Canada (100%)

Assembly and tests

- module assembly in home institutes, transport and test at CERN
  (1310 kCHF 1998 to 2002)
  Canada (50%), Munich MPI (15%), JINR (16.5%),
  Moscow/FIAN (2%), Protvino (16.5%)

- wheel assembly table and rotation device (50%) for assembly at CERN
  (340 kCHF, 2000 to 2002)
  Canada (100%)

Cold electronics

- cold preamplifiers
  (955 kCHF, 1998 to 2000)
  Munich MPI (100%)

- signal distribution
  (455 kCHF, 1998 to 2000)
  Canada (50%), Munich MPI (50%)

- low voltage distribution
  (85 kCHF, 1998 to 2000)
  Munich MPI (100%)

- high voltage distribution
  (115 kCHF, 1998 to 2000)
  Kosice (50%), Munich MPI (50%)

- calibration distribution
  (75 kCHF, 1998 to 2000)
  Kosice (100%)

Module 0

- mechanics and cold electronics
  (510 kCHF, 1997)
  Canada (50%), Mainz (5%), Munich MPI (10%), JINR (12.5%),
  Moscow/FIAN (10%), Protvino (12.5%)

Special Module

- module for combined test with FCAL (see below)
  (150 kCHF, 1999)
  Canada (40%), Munich MPI (60%)

Forward Calorimeter

Detector Modules

- FCAL1 copper matrix, rods, interconnects and tooling
  (465 kCHF, 1999 to 2000)
  Arizona (100%)

- FCAL2 and FCAL3 -Tungsten matrix, electrodes, interconnects and tooling
  (1645 kCHF, 1999 to 2000)
  Canada (100%)

- Tungsten rods for FCAL2 and FCAL3
  (900 kCHF, 2000)
  Moscow ITEP (100%)

Cold electronics

- mother boards, cold cables, transformers, blocking capacitances
  (310 kCHF, 1999 to 2001)
  Arizona (100%)

Assembly, transport and tests

- transport of modules to CERN
  (120 kCHF, 2000 to 2001)
  Arizona (25%), Canada (75%)

- tools for assembly at CERN
  (35 kCHF, 2000 to 2001)
  Arizona (100%)

Warm electronics

High Voltage supply system

- power supplies and cables up to feedthroughs
  (920 kCHF, 2000 to 2002)
  CERN (28%), Wuppertal (19%), Stockholm KTH (47%), NC (6%)

Front-End crates and power supplies

- front end crate system
  (2820 kCHF, 2000 to 2003)
  Brookhaven (59%), Canada (14%), NC (27%)

- low voltage power supplies
  (2430 kCHF, 2000 to 2003)
  Brookhaven (59%), CERN (20%), Kosice (5%), Morocco (4%), NC (12%)

- low voltage power supplies for HEC pre-amplifiers
  (335 kCHF, 2000 to 2003)
  Munich MPI (100%)

Calibration system

- calibration pulser boards for EM and FCAL
  (1125 kCHF, 2000 to 2003)
  Annecy (50%), Orsay (50%)

- calibration pulser boards for HEC
  (120 kCHF, 2000 to 2003)
  Kosice (33%), Mainz (67%)

Front End boards

- warm preamplifiers for EM and FCAL
  (1665 kCHF, 1999 to 2000)
  Brookhaven (50%), Milano (50%)

- multigain shaping amplifiers
  (915 kCHF, 1999 to 2000)
  Grenoble (30%), Orsay (70%)

- pole-zero adapters for HEC
  (55 kCHF, 1999 to 2000)
  JINR (100%)

- layer sum « personality cards »
  (350 kCHF, 2000 to 2002)
  Pittsburgh (100%)

- analog pipelines « SCA » chips
  (2115 kCHF, 1999 to 2000)
  Columbia (59%), Orsay (18%), Saclay (24%)

- address generator chips
  (500 kCHF, 1999 to 2000)
  Canada (100%)

- ADCs
  (980 kCHF, 2000 to 2001)
  Columbia (59%), CERN (41%)

- other components on FE boards
  (2165 kCHF, 2000 to 2001)
  Canada (3%), Columbia (59%), NC (38%)

- FE boards, cabling and integration
  (1850 kCHF, 2000 to 2001)
  Canada (2.5%), CERN (29%), Columbia (59%), NC (9.5%)

- bench tests of FE boards in home institutes
  (500 kCHF, 1998 to 2003)
  Columbia (59%), Orsay (41%)

LVL1 analog summing

- tower builder boards
  (690 kCHF, 1999 to 2002)
  Saclay (87%), Munich MPI (13%)

- LVL1 receiving station
  (490 kCHF, 1999 to 2000)
  Brookhaven, Pittsburgh (100%)

- LVL1 links
  (135 kCHF, 1999 to 2000)
  Saclay (69%), Munich MPI (26%), NC (5%)

TTC and crate controllers

- FE crate controllers
  (560 kCHF, 1999 to 2002)
  Paris (100%)

- TTC distribution
  (taken care of by LVL1 team)

Links and Read Out Drivers (RODs)

- links from FEB to RODs
  (1130 kCHF, 2000 to 2003)
  Grenoble (10%), Marseille (11%), Stockholm KTH (44%), Dallas (35%)

- ROD crate and power supplies
  (610 kCHF, 2000 to 2003)
  CERN (23%), Geneva (36%), IN2P3 (26%), Munich MPI (15%)

- ROD modules
  (3215 kCHF, 2000 to 2003)
  Annecy-Marseille (37.5%), Geneva (20%), Munich MPI (12.5%), US (30%)

- serial control link
  (90 kCHF, 1999 to 2000)
  Paris (100%)

- controls and CPUs
  (730 kCHF, 2000 to 2002)
  CERN (16%), Geneva (26%), Munich MPI (25%), Paris (33%)

<u>*Cryostats, cryogenics and mechanics for test beam*</u>

Central cryogenics system

- tanks, purity system, controls
  (275 kCHF, 1997)
  CERN (65%), Saclay (35%)

Equipment for H8 testbeam line (EM barrel)

- moving platform
  (100 kCHF, 1997)
  CERN (50%), JINR (50%)

- cryostat
  (550 kCHF, 1997)
  CERN (9%), Orsay (91%)

- cryogenics
  (135 kCHF, 1997)
  CERN (35%), Saclay (65%)

- cold cables and feedthroughs
  (245 kCHF, 1997)
  Brookhaven (50%), IN2P3 (50%)

- clean assembly area
  (60 kCHF, 1997)
  CERN (50%), IN2P3 (50%)

Equipment for H6 testbeam line (End-Cap detectors)

- moving platform, adaptation of reused cryostat for EM modules
  (125 kCHF, 1997)
  CERN (68%), Novosibirsk (32%)

- cryogenics for EM
  (115 kCHF, 1997)
  CERN (36%), Novosibirsk (9%), Saclay (55%)

- cold cables and feedthroughs for EM
  (60 kCHF, 1997)
  IN2P3 (50%), Brookhaven (50%)

- adaptation of reused cryostat for HEC and FCAL
  (50 kCHF, 1997 to 1998)
  Munich MPI (100%)

- cryogenics for HEC
  (105 kCHF, 1997)
  CERN (45%), Saclay (55%)

- feedthroughs for FCAL
  (20 kCHF, 1998 to 1999)
  US (100%)

- clean assembly area
  (25 kCHF, 1997)
  CERN (60%), Munich MPI (40%)

<u>Test beam electronics</u>

High Voltage supply system

- power supplies, control, cables up to feedthroughs
  (60 kCHF, 1997 to 1998)
  CERN (30%), Stockholm KTH (50%), Wuppertal (20%)

Front-End crates and power supplies

- front end crate system
  (545 kCHF, 1997 to 1998)
  Brookhaven (100%)

- low voltage power supplies
  (150 kCHF, 1997 to 1998
  NC (100%)

Calibration system

- calibration pulser boards for EM, HEC and FCAL
  (95 kCHF, 1997 to 1998)
  Annecy (43%), Kosice (11%), Moscow ITEP (3%), Orsay (43%)

Front End boards

- components, multilayer boards and cabling
  (590 kCHF, 1998)
  Canada (9%), IN2P3 (17%), JINR (1%), Milano (5%), US (68%)

LVL1 analog summing

- tower builder boards
  (85 kCHF, 1998)
  Saclay (74%), NC (26%)

- monitoring station
  (30 kCHF, 1998 to 1999)
  US (100%)

TTC and crate controllers

- FE crate controllers
  (90 kCHF, 1998)
  Paris (100%)

- TTC distribution
  (50 kCHF, 1998)
  Saclay (100%)

Links and Read Out Drivers (RODs)

- links from FEB to RODs, incl. LVL1 links
  (40 kCHF, 1998 to 1999)
  Marseille (47%), Saclay (20%), Stockholm KTH (33%)

- ROD system
  (215 kCHF, 1998 to 1999)
  Annecy-Marseille (55%), Munich MPI (10%), US (20%), CERN (15%)

Monitoring, Slow control, irradiation tests

Irradiations

- Irradiation of materials and electronics, including checks of pollution
  (230 kCHF, 1997 to 2000)
  Canada (10%), Grenoble (67%), JINR (13%), NC (10%)

Monitoring

- purity probes and associated electronics
  (215 kCHF, 1999 to 2002)
  Mainz (100%)

- temperature probes and associated electronics
  (290 kCHF, 1999 to 2002)
  CERN (79%), JINR (21%)

- position and stress probes and associated electronics
  (110 kCHF, 1999 to 2002)
  CERN (50%), IN2P3 (50%)

- slow controls
  (150 kCHF, 1999 to 2002)
  CERN (13%), Mainz (74%), IN2P3 (13%)

commissioning

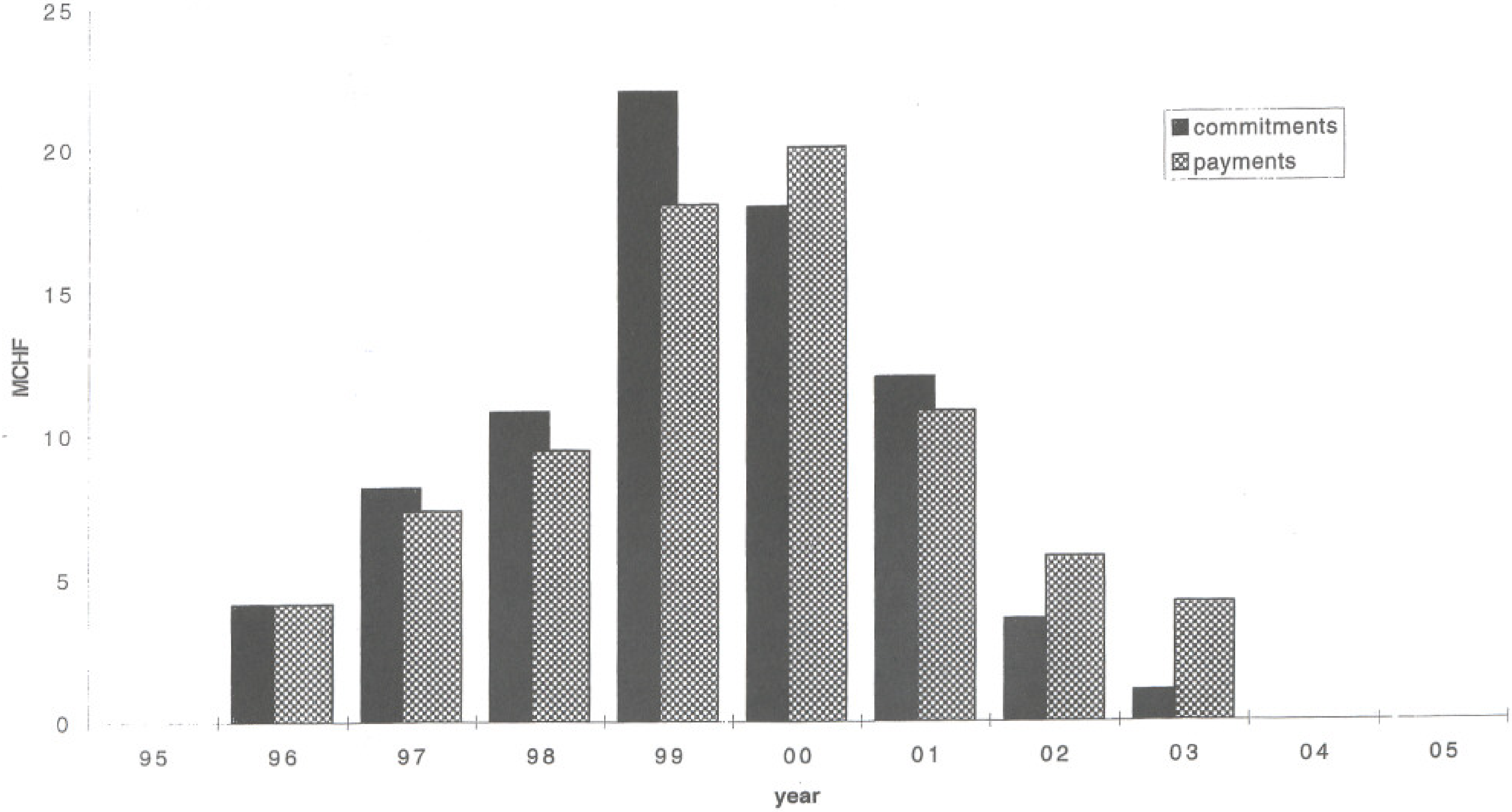
- final detector commissioning:
  (2003 to 2004)
  all institutions participating in the construction of the LAr detector

Planning of Resources for the LAr Calorimeter

(value of deliverables in ATLAS 1995 kCHF)

	barrel presh.	barrel elm.	end-cap presh.	end-cap elm.	hadron end-cap	forward cal.	electr.	test beam &misc.	total
Armenia									**0**
Australia									**0**
Austria									**0**
Azerbaijan									**0**
Belarus									**0**
Brazil									**0**
Canada					5560	1735	1005	75	**8375**
Czech Republic									**0**
Denmark									**0**
Finland									**0**
France IN2P3	1095	5715	35	4550			5120	1320	**17835**
France CEA		3910		170			1200	425	**5705**
Georgia									**0**
Germany BMBF+MPI					2980		1395	420	**4795**
Greece									**0**
Israel									**0**
Italy		2055		810			830	30	**3725**
Japan									**0**
Morocco	110						95		**205**
Netherlands									**0**
Norway									**0**
Poland									**0**
Portugal									**0**
Romania									**0**
Russia + JINR			140	730	3420	900	55	200	**5445**
Slovak Republic					135		160	10	**305**
Slovenia									**0**
Spain				2300					**2300**
Sweden	555		5				925	45	**1530**
Switzerland							1055		**1055**
Turkey									**0**
United Kingdom									**0**
US DoE + NSF		3230		975		840	10625	1190	**16860**
CERN		4830		940			1985	850	**8605**
total	1760	19740	180	10475	12095	3475	24450	4565	**76740**

Spending Profile for the LAr Calorimeter



Tile Calorimeter

Institutes participating:

Armenia:	Yerevan		
Belarus:	Minsk		
Brazil:	Rio		
Czech Republic:	Prague AS	Prague CU	
France:	Clermont		
Italy:	Pisa		
Portugal			
Romania:	Bucharest		
Russia:	Protvino		
JINR			
Slovak Republic:	Bratislava		
Spain:	Barcelona	Valencia	
Sweden:	Stockholm U		
US:	Argonne	Arlington	Chicago
	Urbana	Michigan SU	
CERN			

Milestones:

barrel module-0 ready for beam tests	September	1996
start procurement of absorber material	September	1997
final choice of fibre type	September	1998
final choice of the PMT device	March	1999
finish prototype work on the pipeline system	April	1999
first module calibration at the SPS test beam	July	2000
start pre-assembly work in the surface area	April	2002
start installation in the ATLAS experimental area	May	2003
start final detector commissioning	July	2004

Development work still to be completed:

Choice of the technology to drive the source system, including source design (full scale prototypes for module-0)
(Barcelona, CERN, JINR, Protvino) ---> 1998

Final design of the laser system
(Clermont, Portugal) ---> 1998

Final choice of the PMT device and associated electronics, including test benches and prototypes ---> 1999

- PMT tests and optimisation
  (Clermont, Pisa, Valencia, Urbana)
- PMT blocks design, assembly and tests
  (Arlington, Bratislava, Clermont, JINR, Portugal, Pisa, Valencia, Urbana)

Final design of the readout electronics, ---> 1999
prototyping and test benches

- Integrator on 3-in-1 card and associated read-out *(Barcelona)*
- Design of 3-in-1 card, pulse shaper and calibration, signal and low voltage bussing in drawer *(Chicago)*
- PMT high voltage divider *(Clermont)*
- High voltage supplies and HV bussing in drawers *(Clermont, Prague AS)*
- Level1 trigger sum and low voltage supplies *(Rio)*
- Digitising electronics in drawers *(Chicago, Stockholm U)*
- Signal extraction, patch panels *(Clermont, CERN)*
- Drawer design, test bench, cooling, safety and manipulation *(Clermont)*

R&D on injection moulded scintillator and mass production techniques, including tile wrapping
(CERN, Portugal, Michigan, Protvino) ---> 1998

R&D on wave length shifting fibres and fibre preparation, including ageing and radiation tests.
(Portugal, Michigan, Pisa) ---> 2000

Development and design of methods and tools to polish and aluminise fibres and fibre bundles
(CERN, Portugal, Yerevan) ---> 1998

Automation of the fibre routing and fibre insertion
(Portugal, CERN) ---> 1998

R&D on the interface between the tile calorimeter read-out system and the central level-1&2 trigger and DAQ system
(Valencia) ---> 1999

R&D and design of the gap scintillator detector
(Arlington, Michigan) ---> 1999

R&D on the slow control (including test beam aspects)
(Barcelona, Bucharest, CERN, Clermont, Chicago, JINR, Minsk, Prague AS, Protvino) ---> 2000

Distribution of Commitments to Detector Construction

The costs listed indicate the value of the commitment to deliverables in 1995 kCHF according to the ATLAS cost document, CORE version 7, dated 31 January 1998; the dates indicate the time the delivery is requested according to the construction schedule.

Mechanics

- Procurement of absorber material, including transport to the cutting plants and module-0 (2320 kCHF, August 1998)
  Argonne (29.3%), Barcelona (15.0%), CERN (34.1%), Pisa (9.0%), Prague AS and CU (12.6%)

- Cutting of plates and delivery to the submodule assembly plants, including the initial surface treatment (June 1999) :
  barrel master and spacer plates (440 KCHF): *JINR (66%), CERN(34%)*
  ext. barrel master plates (210 kCHF): *Argonne (100%)*
  ext. barrel spacer plates (240 kCHF): *Barcelona (100%)*
  special spacers (50 kCHF): *CERN (100%)*

- Procurement of girders and transport to module assembly plants (May 2000):
  barrel modules (900 kCHF): *Bucharest (33.5%), CERN (66.5%)*
  ext. barrel modules (925 kCHF): *Argonne (50%), Barcelona (50%)*

- Construction of assembly tools for modules and submodules, including submodules welding bars and transports (500 kCHF, July 1999):
  Argonne (18.2%), Arlington (4.1%), Barcelona (15.2%), JINR (23.1%), Pisa (12.6%), Prague AS and CU (12.6%), Protvino (7.1%), Valencia (7.1%)

- Assembly of submodules and transport to the module assembly plants :
  standard submodules (2210 submodules, February 2001):
  Argonne (130 sub.), Barcelona (228 sub.), Chicago(195 sub.), JINR (243 sub.), Pisa (309 sub.), Prague AS and CU (309 sub.), Protvino (309 sub.), Urbana (195 sub.), Valencia (292 sub.)
  special submodules (195 sub., February 2001):
  Argonne (65 sub.), Barcelona (65 sub.), JINR (65 sub.)
  ITC submodules (130 sub., February 2001): *Arlington (130 sub.)*

- Modules assembly, including the procurement of front and end plates and transport to CERN (November 2001):
  barrel modules (280 kCHF): *JINR (100%)*
  extended barrel A (210 kCHF): *Argonne (100%)*
  extended barrel B (140 kCHF): *Barcelona (100%)*
  ITC end plates (60 KCHF): *Arlington (100%)*

- Procurement and distribution of small items for the assembly (glue, elastic pins, bolts, rods and tubes) (145 kCHF, July 1998):
  Argonne (14.2%), Barcelona (14.2%), CERN (64.2%), JINR (7.4%)

- Installation and manipulation tools, support structures for the final assembly (500 kCHF, September 2001):
  CERN (54%), JINR (6%), Pisa (20%), Protvino (20%)

- Mechanical preassembly and final assembly inside the full detector (March 2004):
  Argonne, Barcelona, Bratislava, CERN, JINR, Minsk, Pisa, Prague, Protvino

Optics

- Procurement of fibres, including testing, preparation and module-0 (585 kCHF, December 2000):
  Portugal (77.2%), Pisa (22.8%)

- Fibres aluminization, profiles and automates for fibres insertion (180 kCHF, July 2001):
  Portugal (100%)

- Final fibre preparation and delivery to the instrumentation plants (August 2001):
  Portugal (50%), Pisa (50%)

- Material for scintillator construction, including moulds (360 kCHF, May 1998):
  CERN (40%), Portugal (8%), Protvino (52%)

- Scintillator construction and transport to the instrumentation plants (November 2001):
  Protvino (100%)

- Scintillator wrapping and masking (100 kCHF, November 2001):
  Michigan (100%)

- Fibre bundle polishing tools (20 kCHF, March 1999):
  Yerevan (100%)

- External ITC scintillator construction and installation (December 2002):
  Arlington (50%), Michigan (50%)

Electronics

- Construction, assembly and test of drawers, including installation, manipulation tooling, girder rings systems and tooling for girder rings installation (385 kCHF, November 1999):
  Clermont (94%), Portugal (6%)

- PMT procurement, testing and PMT block assembly (2790 kCHF, December 2001):
  Arlington (7%), Bratislava, CERN (14%), Clermont (30%), Portugal (3%), JINR, Pisa (10%), Valencia (10%), Urbana (26%)

- Procurement and testing of PMTs for Module-0 (35 KCHF, September 1996):
  Clermont (25%), Pisa (25%), Urbana (25%), Valencia (25%)

- Procurement of mechanical and optical parts for PMT blocks (340 kCHF, June 2000):

light guides:	*Portugal (12.2%), Prague CU (12.2%)*
metal shielding:	*CERN (22.3%), Yerevan (22.3%)*
moulded support:	*Portugal (28.8%)*
small items:	*Clermont (2.2%)*

- PMT block 3-in-1 cards (680 kCHF, December 1999):
  Barcelona (12%), Chicago (44%), Stockholm (44%)

- Procurement and testing of PMT high voltage dividers (150 kCHF, December 1999):
  Clermont (100%)

- High voltage source and distribution system (680 kCHF, May 2000):
  Clermont (85%), Prague AS (15%)

- Digital pipeline system, including signal, TTC connection and low voltage distribution cards (1030 kCHF, December 2001):
  Chicago (50%), Stockholm (50%)

- Integrators readout system (60 kCHF, December 2001):
  Barcelona (100%)

- LVL1 trigger analog adder and trigger links (170 kCHF, December 2001):
  Rio (24%), CERN (76%)

- Read Out Driver system, including connections to the readout buffers and TCC connections (205 kCHF, December 2003):
  Valencia (100%)

- Low voltage power system and connection to the drawer system (90 kCHF, January 2003):
  CERN (50%), Rio (50%)

- Patch panels, drawer connectics, cooling, safety aspects and slow controls (70 kCHF, December 2001):
  Clermont (100%)

- Laser system, including clear fibres and connectors (135 kCHF, January 2000):
  Clermont (70%), Portugal (30%)

- Caesium source calibration system (165 kCHF, October 1999):
  Barcelona (5%), CERN (30%), JINR (10%), Protvino (55%)

Instrumentation & commissioning

- Detector mechanics infrastructure (795 KCHF, December 2003)
  CERN (21.8%), JINR (44.7%), Pisa (33.5%)

- Infrastructure for optics instrumentation (635 KCHF, December 2002)
  Pisa (37.5%), Protvino (62.5%)

- Detector electronics infrastructure (130 KCHF, December 2003)
  Portugal (39.5%), Stockholm (60.5%)

- Modules instrumentation in 4 regional plants (Argonne & Michigan, Barcelona, CERN) (May 2002)
  all institutions

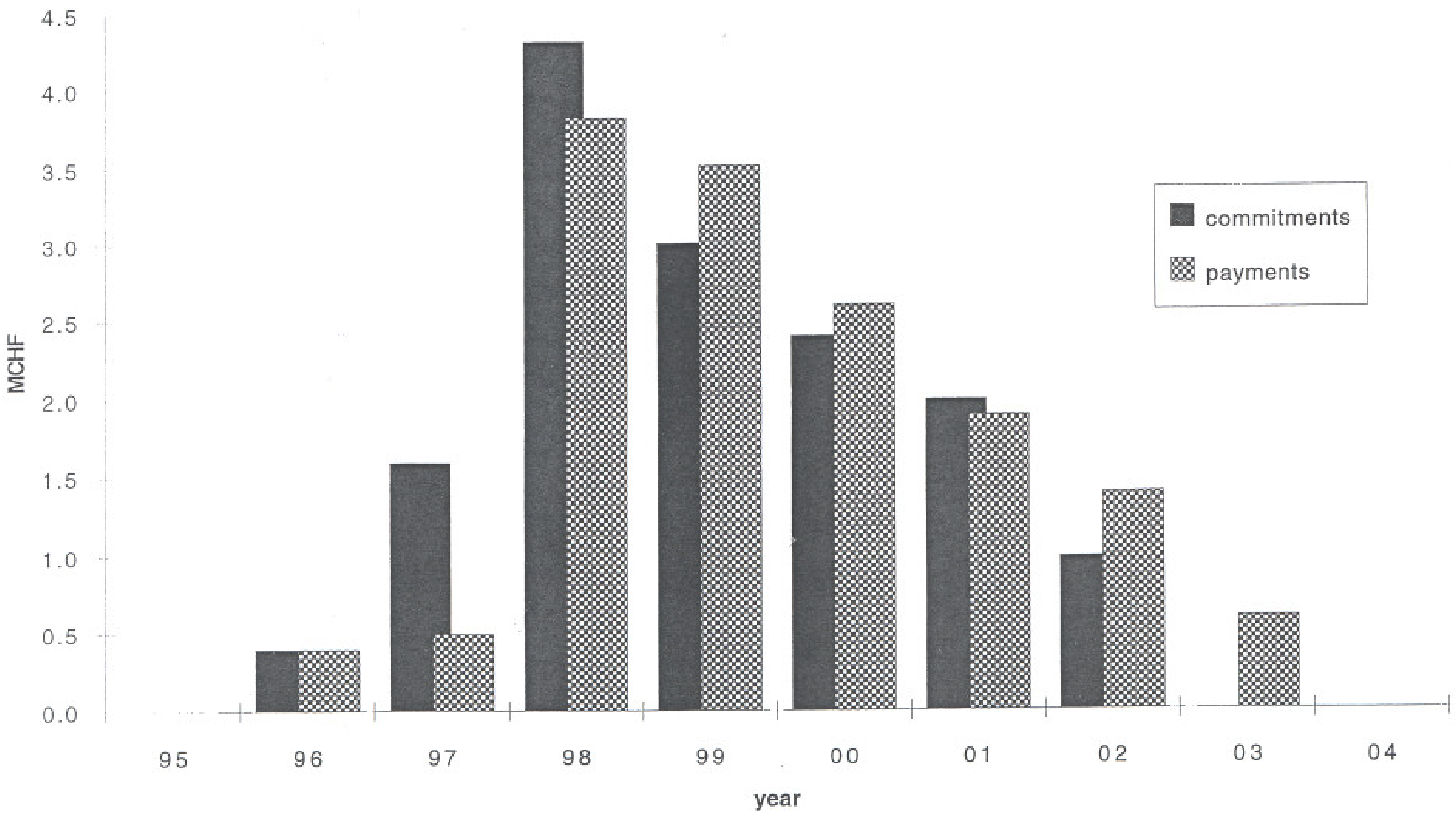
- Final detector instrumentation and commissioning at CERN :
  all institutions

Planning of Resources for the Tile Calorimeter

(value of deliverables in ATLAS 1995 kCHF)

	mechanics	optics	electronics	total
Armenia		20	75	95
Australia				0
Austria				0
Azerbaijan				0
Belarus				0
Brazil			85	85
Canada				0
Czech Republic	355		145	500
Denmark				0
Finland				0
France IN2P3			2110	2110
FRANCE CEA				0
Georgia				0
Germany BMBF+MPI				0
Greece				0
Israel				0
Italy	675	335	290	1300
Japan				0
Morocco				0
Netherlands				0
Norway				0
Poland				0
Portugal		660	340	1000
Romania	300			300
Russia + JINR	1265	520	105	1890
Slovak Republic				0
Slovenia				0
Spain	1325		640	1965
Sweden			895	895
Switzerland				0
Turkey				0
United Kingdom				0
US DoE + NSF	1755	100	1745	3600
CERN	2145	145	690	2980
total	7820	1780	7120	16720

Spending Profile for the Tile Calorimeter



Muon Instrumentation

The Muon Instrumentation System consists of

- Monitored Drift Tube Chambers (MDT)
- Cathode Strip Chambers (CSC)
- Resistive Plate Chambers (RPC)
- Thin Gap Chambers (TGC)

Alignment, magnetic field and temperature monitoring systems and general support structures are grouped into the separate heading "Muon Systems Instrumentation"

Institutes participating:

France CEA:	Saclay		
Germany:	Freiburg	Munich LMU	Munich MPI
Greece:	Athens NTU	Athens U	Thessaloniki
Italy:	Cosenza	Frascati	Lecce
	Napoli	Pavia	Roma I
	Roma II	Roma III	
Israel:	Haifa	Tel-Aviv	Weizmann
Japan:	KEK	Kobe	Shinshu
	Tokyo ICEPP	Tokyo MU	Tokyo UAT
Netherlands:	Nijmegen	NIKHEF	
Russia:	Protvino	Petersburg NPI	
JINR			
US:	Ann Arbor	Boston	Brandeis
	Brookhaven	Harvard	MIT
	Northern Illinois	Seattle	Stony Brook
	Tufts		
CERN			

Milestones:

Monitored Drift Tubes Chambers (MDT)

design review and approval	June	1998
test results from module-0	1st Q	1999
production of on-chamber eletronics finished	4th Q	2000

production of MDT chambers finished	4th Q	2003
start of installation in ATLAS experimental area	4th Q	2003

Cathode Strip Chambers (CSC)

test results from module-0	1st Q	1999
production of on-chamber electronics finished	4th Q	2001
production of CSCs finished	4th Q	2002
start of installation in ATLAS experimental area	4th Q	2004

Resistive Plate Chambers (RPC)

design review and approval	September	1998
test results from module-0	1st Q	1999
production of RPCs finished	3rd Q	2003
start of installation in ATLAS experimental area	4th Q	2003

Thin Gap Chambers (TGC)

design review and approval	March	1998
test results from module-0	3rd Q	1998
production of TGCs finished	3rd Q	2003
start of installation in ATLAS experimental area	1st Q	2004

Alignment Systems

demonstration of end cap chamber alignment	4th Q	1998

Development work still to be completed:

Operation of MDT chambers under high radiation dose	March	1998
End cap chamber alignment	--->	1998
On-chamber electronics		
MDT	--->	1999
CSC	--->	1999
RPC	--->	1998
TGC	--->	mid-1999

Sharing of Commitments to Detector Construction

The costs listed indicate the value of the commitment to deliverables in 1995 kCHF according to the ATLAS cost document, CORE version 7, dated 31 January, 1998. The dates indicate the time the fully operational item has to be available for installation.

A. Monitored Drift Tube Chambers (MDT)

The MDT project is being carried out in a close collaboration between the MDT institutes. The project requires many components (mechanical parts, electronics, alignment, auxiliary components and instruments). In many cases these components will be procured by one or a few institutes for the full quantity necessary to build all chambers. In exchange, these institutes will receive from other MDT institutes other components to complete their MDT construction commitments: this procedure provides the project with the benefit of large-quantity pricing, with the additional aim to achieve a fair sharing of industrial contracts in the participating countries. The construction of the MDT chambers is scheduled to start in the first quarter of 1999 and to be finished in the fourth quarter of 2003.

Barrel chamber system (B)
Inner (I), Middle (M), Outer (O) Layer,
Small (S), Large (L) Chambers

BIS: - mechanics, hedgehog boards, patch panels, transport (985 kCHF)
Athens NTU (34%); Athens U (33%), Thessaloniki (33%)

BIL: - mechanics, hedgehog boards, patch panels, transport (950 kCHF)
(Cosenza, Pavia, Roma I, Roma III) (100%)

BIR: - mechanics, hedgehog boards, patch panels, transport (295 kCHF)
(Cosenza, Pavia, Roma I, Roma III) (100%)

BMS: - mechanics, transport (730 kCHF)
JINR (100%)

- hedgehog boards (55 kCHF)
(Freiburg, Munich LMU, Munich MPI) (100%)

- patch panels (25 kCHF)
JINR (100%)

BMF (foot sector):

- mechanics, transport (140 kCHF)
  JINR (100%)

- hedgehog boards (10 kCHF)
  (Freiburg, Munich LMU, Munich MPI) (100%)

- patch panels (5 kCHF)
  JINR (100%)

BML: - mechanics, hedgehog boards, patch panels, transport (1125 kCHF)
Frascati (100%)

BOS: - mechanics, hedgehog boards, patch panels, transport (1130 kCHF)
(Freiburg, Munich LMU, Munich MPI) (100%)

BOF (foot sector); BOG (special foot 1); BOH (special foot 2):

- mechanics, hedgehog boards, patch panels, transport (590 kCHF)
  (Freiburg, Munich LMU, Munich MPI) (100%)

BOL: - mechanics, hedgehog boards, patch panels, transport (1620 kCHF)
NIKHEF (100%)

End cap chamber system (E)

Inner (I), Middle (M), Outer (O) Layer
Small (S), Large (L) Chambers

EIS: - mechanics, hedgehog boards, patch panels, transport (365 kCHF)
Boston Muon Consortium (Boston, Brandeis, Harvard, MIT, Tufts), Ann Arbor, Northern Illinois, Seattle (100%)

EIL: - mechanics, hedgehog boards, patch panels, transport (650 kCHF)
Boston Muon Consortium (100%)

EMS: - mechanics, hedgehog boards, patch panels, transport (920 kCHF)
Boston Muon Consortium (100%)

EML: - mechanics, hedgehog boards, patch panels, transport (1070 kCHF)
Boston Muon Consortium (100%)

EES (extra small):

- mechanics, hedgehog boards, patch panel, transport (300 kCHF)
  Boston Muon Consortium (100%)

EEL (extra large):

- mechanics, hedgehog boards, patch panels, transport (325 kCHF)
  Boston Muon Consortium (100%)

EOS: - mechanics, tranport (965 kCHF)
Protvino (100%)

- hedgehog boards (80 kCHF)
  (Freiburg, Munich LMU, Munich MPI) (100%)

- patch panels (30 kCHF)
  JINR (100%)

EOL:
- mechanics, transport (1020 kCHF)
  Protvino (100%)

- hedgehog boards (80 kCHF)
  (Freiburg, Munich LMU, Munich MPI) (100%)

- patch panels (35 kCHF)
  JINR (100%)

MDT electronics and gas system

The dates (month/year) indicate the completion of the production of the subsystems.

- On-chamber electronics and R/O cards; 9/00 (2435 kCHF)
  (Boston, Harvard) (100%)

- TDCs for drift time readout; 9/00 (1415 kCHF)
  (KEK, Tokyo UAT) (100%)

- Off-chamber readout electronics (RODs); 6/03 (1680 kCHF)
  (Freiburg, Munich LMU, Munich MPI) (20%), Nijmegen (41%), Saclay (33%), JINR (6%)

- High voltage power supply system; 1/03 (1850 kCHF)
  (Frascati, Pavia, Roma I) (84%),
  (Freiburg, Munich LMU, Munich MPI) (16%)

- Low voltage power supply system; 1/03 (170 kCHF)
  (Frascati, Pavia, Roma I) (100%)

- MDT gas system; 6/03 (900 kCHF)
  CERN (78%), (Freiburg, Munich LMU, Munich MPI) (22%)

B. Cathode Strip Chambers (CSC)

The construction of the CSCs is scheduled to start in the second quarter of 1999 and to be finished in the fourth quarter of 2002.

- mechanics materials, construction and transport; 12/02 (280 kCHF)
  (Brookhaven, Stony Brook) (46%), Petersburg NPI (54%)

- chamber electronics; 12/01 (1370 kCHF)
  Brookhaven (97%), Petersburg NPI (3%)

- LV and HV system; 12/02 (70 kCHF)
  Brookhaven (100%)

CSC gas system

- conceptual design
  Brookhaven

- technical design
  CERN

- gas system fabrication; 6/03 (70 kCHF)
  Petersburg NPI (100%)

C. Resistive Plate Chambers (RPC)

The construction of the RPCs is scheduled to start in the second quarter of 1999 and to be finished in the third quarter of 2003.

Chamber construction (mechanics): Station 1, 2, 3
Small (S), Large (L) Chamber

- Chambers mechanics and readout strip panels (2165 kCHF)
  B1S, B2S, 1/3 of B3S: *Lecce (30%)*
  B1L, B2L, 1/3 of B3S: *Napoli (36%)*
  B3L, 1/3 of B3S: *Roma II (34%)*

- Mechanical support frames for RPC chambers (610 kCHF)
  Protvino (69%), Roma II (31%)

- High voltage and low voltage (760 kCHF)
  Lecce (34%), Napoli (33%), Roma II (33%)

- Frontend electronics (1320 kCHF)
  Lecce (30%), Napoli (30%), Roma II (40%)

RPC gas system
- conceptual design
  Lecce, Roma II (100%)

- technical design
  CERN, Lecce

- gas system fabrication; 6/03 (350 kCHF)
  Italian RPC Groups (100%)

D. Thin Gap Chambers (TGC)

The construction of the TGCs is scheduled to start in the first quarter of 1999 and to be finished in the third quarter of 2003.

- TGC chamber construction, assembly and transport (3390 kCHF)
  Israel (63%), Japan (37%)

- TGC chamber installation (170 kCHF)
  Japan (100%)

- Front-end electronics (1500 kCHF)
  Japan (100%)

- Low voltage (100 kCHF)
  Israel (5%), Japan (95%)

- High voltage (400 kCHF)
  Israel (5%), Japan (95%)

- TGC gas system; 6/03 (500 kCHF)
  Israel (15%), Japan (85%)

E. Muon Systems Instrumentation

Alignment

Barrel chamber alignment, 9/98–9/03
- in-plane alignment, RASNIK read-out (390 kCHF)
  NIKHEF (100%)
- axial-praxial alignment, bar system (665 kCHF)
  Saclay (100%)
- projective alignment (55 kCHF)
  NIKHEF (65%), Saclay (35%)

End-cap chamber alignment, 9/98–9/03

- in-plane alignment (210 kCHF)
  Boston Muon Consortium (100%)
- bar-chamber connections (270 kCHF)
  Saclay (100%)
- alignment sensors (580 kCHF)
  Boston Muon Consortium (28%),
  (Freiburg, Munich LMU, Munich MPI) (31%), Saclay (41%)
- bar system (120 kCHF)
  Boston Muon Consortium (50%),
  (Freiburg, Munich LMU, Munich MPI) (50%)
- RASNIK read-out (240 kCHF)
  Boston Muon Consortium (46%), NIKHEF (12%), Saclay (42%)

General Infrastructure Items

- B-field and temperature measurement system construction; 9/98–9/03 (600 kCHF)
  NIKHEF (45%), Saclay (55%)

- Installation tools; 6/03 (400 kCHF)
  CERN (100%)

- Supports for MDT chambers; 3/03 (2400 kCHF)
  Brookhaven (25%), CERN (12%), JINR (29%), Frascati (17%),
  (Freiburg, Munich LMU, Munich MPI) (17%)

- Support for CSC chambers; 6/03 (80 kCHF)
  Brookhaven (41%), Petersburg NPI (59%)

- TGC support frames (440 kCHF)
  Israel (20%), Japan (80%)

- Support structure for TGCs; 3/03 (500 kCHF)
  Israel (26%), Japan (74%)

- MDT infrastructure (110 kCHF)
  CERN (100%)

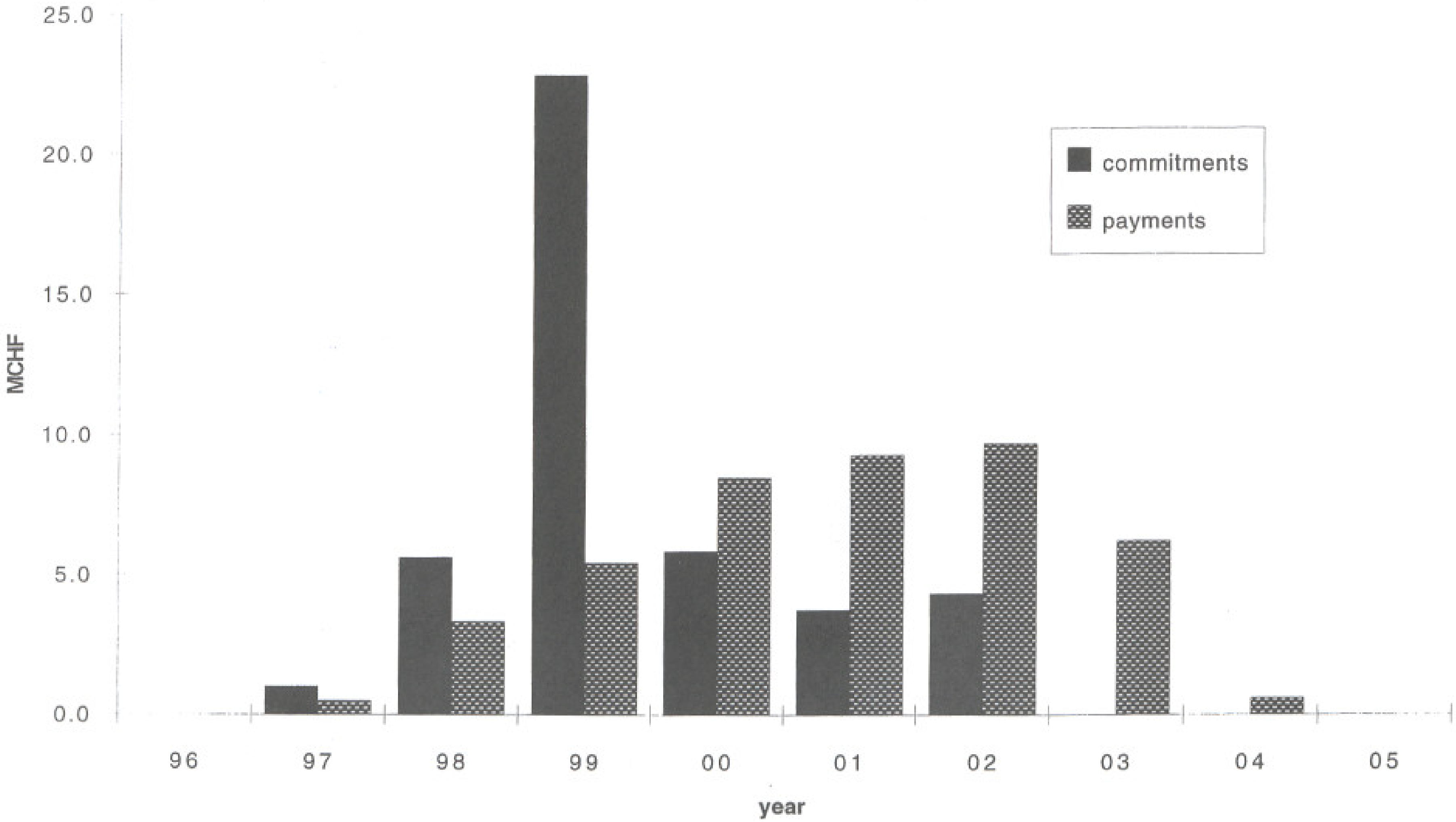
- TGC infrastructure (945 kCHF)
  Israel (11%), Japan (89%)

Planning of Resources for the Muon Instrumentation

(value of deliverables in ATLAS 1995 kCHF)

	MDT	CSC	RPC	TGC	System Instrum.	total
Armenia						0
Australia						0
Austria						0
Azerbaijan						0
Belarus						0
Brazil						0
Canada						0
Czech Republic						0
Denmark						0
Finland						0
France IN2P3						0
FRANCE CEA	555				1625	**2180**
Georgia						0
Germany BMBF+MPI	2770				650	**3420**
Greece	985					**985**
Israel				2235	325	**2560**
Italy	4095		4785		410	**9290**
Japan	1415			3825	1565	**6805**
Morocco						0
Netherlands	2310				725	**3035**
Norway						0
Poland						0
Portugal						0
Romania						0
Russia + JINR	3050	265	420		745	**4480**
Slovak Republic						0
Slovenia						0
Spain						0
Sweden						0
Switzerland						0
Turkey						0
United Kingdom						0
US DoE + NSF	6065	1530			1175	**8770**
CERN	700				800	**1500**
total	21945	1795	5205	6060	8020	**43025**

Spending Profile for the Muon Detector System



Trigger, Data Acquisition and Detector Control System

Introduction

In the case of the level-1 trigger, including the Trigger Timing and Control (TTC) distribution backbone, a Technical Design Report will be submitted in June 1998, and the sharing of responsibilities is the final one.

For Data Acquisition (DAQ) and High Level Trigger (HLT) systems, studies are still being made of a range of architectural and technology options. The sharing of responsibilities presented here is based on a model which was also used in making the cost estimates. Depending on the final architectural and technology choices, which will be presented in future documents to be submitted to the LHCC, there may be a redistribution of responsibilities. The final sharing of responsibilities in the areas of DAQ and HLT systems will be presented for approval by the RRB in a future addendum to the MoU. However, in the meantime, the institutes/funding agencies involved commit themselves to reserve funds for the overall DAQ and HLT systems at the indicated levels.

Concerning the Detector Control System (DCS), the requirements are defined. The detailed distribution of work will depend on the choice of a commercial product.

The deliverable items include both the hardware and the associated software. The percentages shown relate to the financial contributions, mainly for hardware. The percentage contributions for manpower for software development are generally different to these. The manpower contributions to the project, in particular those for software development, are documented elsewhere.

Milestones:

Level-1 Trigger Technical Design Report	June	1998
Technical Progress Report and Work Plan for DAQ, Event Filter, LVL2 Trigger and DCS	June	1998
Technical Proposal on DAQ and High Level Triggers	December	1999
Technical Design Report on DAQ and High Level Triggers	June	2001
Level-1 trigger construction completed (excluding on-detector electronics)	December	2002
Stand-alone DCS system completed	January	2003

DAQ and HLT construction completed
(reduced processing power) December 2003

Integration of detectors with trigger/DAQ/DCS system completed
December 2004

A. Level-1 Trigger

Institutes participating:

Germany:	Heidelberg	Mainz	
Italy:	Lecce	Naples	Rome I
	Rome II		
Israel:	Haifa	Tel Aviv	Weizmann
Japan:	KEK	Kobe	Kyoto U
	Shinshu	Tokyo ICEPP	Tokyo MU
Sweden:	Stockholm U		
United Kingdom:	Birmingham	London QMW	RAL
CERN			

Development work still to be completed:

Detailed specification of the calorimeter trigger processor
(Birmingham, Heidelberg, London QMW, Mainz, RAL, Stockholm U)
--> Dec 1998

Detailed specification of the muon trigger processor
(CERN, Haifa, KEK, Kobe, Kyoto, Lecce, Naples, Rome I, Rome II, Shinshu, Tel Aviv, Tokyo ICEPP, Tokyo MU, Weizmann) *--> Dec 1998*

Detailed specification of the central trigger processor
(CERN) *--> Dec 1998*

Detailed specification of the TTC backbone
(CERN) *--> Dec 1998*

Distribution of Commitments to System Construction

The costs listed indicate the value of the commitment to deliverables in 1995 kCHF according to the ATLAS cost document, CORE version 7, dated 31 January 1998; the dates indicate the time the delivery is requested according to the construction schedule.

Detailed design, prototyping and construction

- Calorimeter trigger processor (7640 kCHF, Dec. 2002)
  Birmingham, London QMW, RAL (48.7%); Heidelberg, Mainz (38.1%); Stockholm U (7.8%), not covered (5.4%)
- Muon trigger processor for RPC system (2605 kCHF, Dec. 2002)
  Lecce, Naples, Rome I, Rome II (100%)
- Muon trigger processor for TGC system (3340 kCHF, Dec. 2002)
  KEK, Kobe, Kyoto, Shinshu, Tokyo ICEPP, Tokyo MU (90.5%); Haifa, Tel Aviv, Weizmann (9.5%)
- Muon central trigger processor (675 kCHF, Dec. 2002)
  CERN (100%)
- Central trigger processor (535 kCHF, Dec. 2002)
  CERN (100%)
- TTC distribution backbone (1310 kCHF, Dec. 2002)
  CERN (100%)

B. Level-2 Trigger

Institutes participating:

Austria:	Innsbruck		
Czech Republic:	Prague AS & CU		
Denmark:	Copenhagen		
France/CEA:	Saclay		
Germany:	Mannheim		
Italy:	Genova	Lecce	Rome I
Israel:	Haifa	Tel Aviv	Weizmann
Netherlands:	NIKHEF		
Poland:	Cracow		
Russia:	Moscow SU		
United Kingdom:	Edinburgh	Liverpool	London RHBNC
	London UCL	Manchester	RAL
US:	Argonne	UC Irvine	Michigan SU
	Wisconsin		
CERN			

Development work still to be completed:

Pilot project to study level-2 trigger architecture and technology options ---> *Dec. 2000*

Study of integration of level-2 trigger with DAQ/EF ---> *Dec. 2000*

Detailed specification of level-2 trigger system ---> *Dec. 2001*

Distribution of Commitments to System Construction

The costs listed indicate the value of the commitment to deliverables in 1995 kCHF according to the ATLAS cost document, CORE version 7, dated 31 January 1998; the dates indicate the time the delivery is requested according to the construction schedule.

Design, prototyping and construction

- Level-2 calorimeter trigger (1870 kCHF, Dec. 2003)
  Argonne, Michigan SU (45.5%); Mannheim (10.7%); Saclay (45.5%)
- Level-2 muon trigger (1290 kCHF, Dec. 2003)
  CERN (15.5%); Genova, Lecce, Rome I, Rome II (52.7%); Mannheim (27.9%); Haifa, Tel Aviv, Weizmann (4.6%)
- Level-2 tracking trigger (4595 kCHF, Dec. 2003)
  CERN (21.7%); Copenhagen NBI (10.9%); Cracow (3.2%); Mannheim (10.1%); London RHBNC, London UCL, Manchester, RAL (18.5%); NIKHEF (7.1%); Prague AS and CU (0.9%); UC Irvine, Wisconsin (28.4%)
- Level-2 global trigger (1590 kCHF, Dec. 2003)
  Argonne, Michigan SU (18.2%); CERN (18.9%); Genova, Lecce, Rome I (13.8%); Liverpool, Manchester, RAL (18.9%); Saclay (31.4%)
- Level-2 supervisor and ROI builder (845 kCHF, Dec. 2003)
  Argonne, Michigan SU (100%)

C. Data Acquisition and Event Filter

Institutes participating:

Austria:	Innsbruck		
Denmark:	Copenhagen		
France IN2P3:	Marseille		
France CEA:	Saclay		
Germany:	Mainz		
Italy:	Pavia	Udine	
Japan:	KEK	Nagasaki	
Netherlands:	NIKHEF		
Portugal			
Romania:	Bucharest		
Russia:	Novosibirsk	Protvino	Petersburg NPI
JINR			
Switzerland:	Bern	Geneva	
Turkey:	Ankara	Istanbul	
United Kingdom:	Edinburgh	Liverpool	London RHBNC
	London UC	Manchester	RAL
	Sheffield		
US:	Argonne	UC Irvine	Michigan SU
	Wisconsin		
CERN			

Development work still to be completed:

Completion of DAQ / Event Filter prototype "-1", a system which provides the full functionality from the readout link to data recording --> *Dec 1998*

Assessment of the DAQ / Event Filter prototype "-1" system, including real-life utilisation --> *Dec 1999*

Integration studies of DAQ / Event Filter and LVL2 --> *Dec 2000*

Detailed specification of final system integrated with LVL2 --> *Dec 2001*

Distribution of Commitments to System Construction

The costs listed indicate the value of the commitment to deliverables in 1995 kCHF according to the ATLAS cost document, CORE version 7, dated 31 January 1998; the dates indicate the time the delivery is requested according to the construction schedule.

Detailed design, prototyping and construction

- DAQ Readout (including readout buffers, local DAQ and interfaces to other systems) (9275 kCHF excluding Common Project items, Dec 2003)
  Argonne, Michigan SU, UC Irvine, Wisconsin (7.3%);
  Bern, Geneva (18.3%); CERN (21.5%); Copenhagen NBI (5.4%);
  Edinburgh, Liverpool, London RHBNC, London UCL, Manchester, RAL, Sheffield (11.5%); Pavia, Udine (11.9%); Ankara, Istanbul (1.3%);
  NIKHEF (2.7%); Saclay (20.5%)

- Event Builder (3710 kCHF, Dec 2003)
  Bern, Geneva (32.3%); CERN (27%); KEK, Nagasaki (27%); Saclay (17.5%)

- Event Filter and Back-End DAQ (5675 kCHF excluding Common Project items, Dec 2003)
  Bern, Geneva (19.4%); CERN (24.6%); Pavia, Udine (22.9%);
  Innsbruck (5.3%); Ankara, Istanbul (0.5%); JINR (1.8%);
  KEK, Nagasaki (8.8%); Lisbon (5.3%); Mainz (13.6%); NIKHEF (1.3%)

System Integration (manpower only, Dec 2003)

D. Detector Control System

Institutes participating:

Netherlands: NIKHEF
Russia: Petersburg NPI
CERN

Development work still to be completed:

Detailed specification of the DCS system and selection of hardware and software components
(CERN, NIKHEF, Petersburg NPI) --> *Jan 2000*

Distribution of Commitments to System Construction

The costs listed indicate the value of the commitment to deliverables in 1995 kCHF according to the ATLAS cost document, CORE version 7, dated 31 January 1998; the dates indicate the time the delivery is requested according to the construction schedule.

Detailed design, prototyping and construction

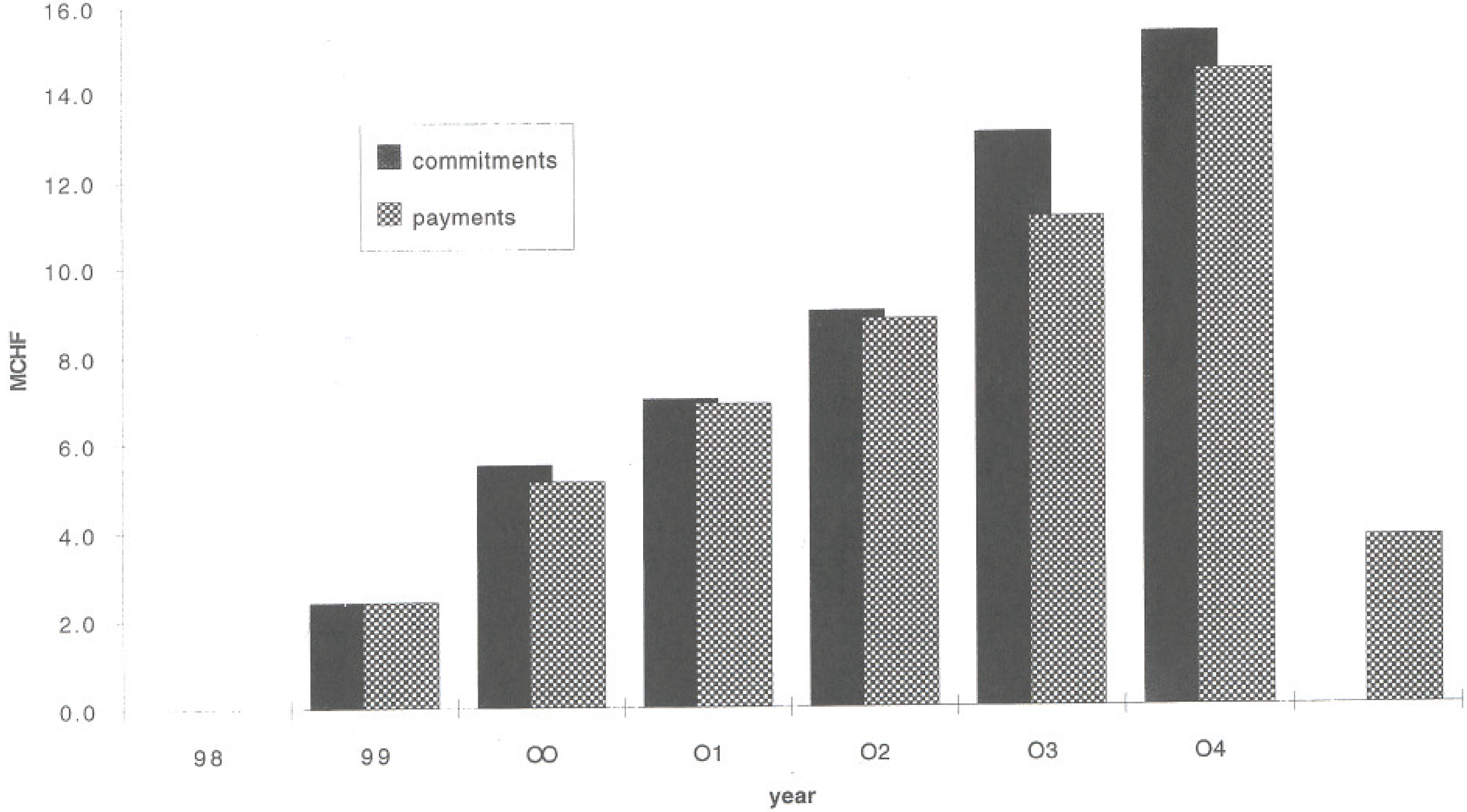
- Detector Control System
  (1800 kCHF excluding Common Project items, Jan 2003)
  CERN (89%); NIKHEF (11%);
  Petersburg NPI (manpower contribution only)

Planning of Resources for the Trigger/DAQ/DCS System

(value of deliverables in ATLAS 1995 kCHF)

	LVL 1 trigger	LVL 2 trigger	DAQ / evt. filter	DCS	total
Armenia					0
Australia					0
Austria			300		300
Azerbaijan					0
Belarus					0
Brazil					0
Canada					0
Czech Republic		40			40
Denmark		500	500		1000
Finland					0
France IN2P3					0
France CEA		1350	2550		3900
Georgia					0
Germany BMBF	2910	1025	770		4705
Greece					0
Israel	315	60			375
Italy	2600	900	2400		5900
Japan	3025		1500		4525
Morocco					0
Netherlands		325	325	200	850
Norway					0
Poland		150			150
Portugal			300		300
Romania					0
Russia + JINR			100		100
Slovak Republic					0
Slovenia					0
Spain					0
Sweden	600				600
Switzerland			4000		4000
Turkey			150		150
United Kingdom	3720	1150	1070		5940
US DoE + NSF		3290	675		3965
CERN	2500	1500	4400	1600	10000
total	15670	10290	19040	1800	46800

Spending Profile for the Trigger/DAQ/DCS System



Offline Computing

Institutes participating:

ATLAS offline computing is a communal task of all Collaborating Institutes. The detector specific software will mostly be developed by the institutes participating in the detector construction. CERN, as collaborating institute, will play a central role in coordinating the computing activities.

Introduction

Only computing hardware necessary at the experimental area for immediate data storage and for linking the data acquisition system to the CERN computer centre is included in the construction cost for the detector and, therefore, covered by the present MoU. Details about the hardware are given below.

The ATLAS computing strategy is laid down in the Computing Technical Proposal (CTP) (CERN/LHCC/96-43). The ATLAS software will be developed in a defined process involving requirements, design and coding - each being reviewed for quality assurance. The ATLAS data will be stored in an object-oriented database. First estimates of the cost of the computing infrastructure necessary for data storage, reduction and analysis are also contained in the CTP. These costs are not included in the present MoU.

A more precise description of the computing infrastructure, a strategy of how and where to deploy it and detailed commitments by collaborating institutes both for software developments and hardware installations will be defined and laid down in an addendum to the MoU. This addendum will also specify CERN's contributions as the host laboratory for central data storage, networking, software development tools, licences, etc.. The addendum is planned to be submitted by the end of 1999.

Milestones:

A detailed list of milestones has been defined in the Computing Technical Proposal. In the following, the major milestones are summarized:

Demonstrate ~1 Tbyte working prototype of event database	December	1998
First release of ATLAS OO software	End	1999
Functional software for simulation, reconstruction and analysis	End	2001
1% prototype of event-processing farm	December	2002
100% event database (disks + robots, not necessarily all tapes)	December	2004
Provide ~40% of final event processing and analysis farms	December	2004
Provide full event processing and analysis farms	April	2005

Development work still to be completed:

Development of an object-oriented simulation toolkit GEANT4 (RD44)
(Annecy, Berkeley, Brookhaven, CERN, Fukui, Hiroshima IT, KEK, Kobe, Kyoto U, Moskow FIAN, Naruto, Orsay, Protvino, Shinshu, Tokyo UAT, Vancouver, Valencia)

---> 1999

Study and development of event storage in an object-oriented database (RD45)
(Argonne, CERN, Hiroshima IT, KEK, Orsay, Portugal, NIKHEF, Protvino, Tufts)

---> 1999

Distribution of Commitments

The costs listed indicate the value of the commitment to deliverables in 1995 kCHF according to the ATLAS cost document, CORE version 7, dated 31 January, 1998.

Event buffer and link to the computer centre

All equipment needs to be installed at the experimental area by the end of 2004.

- Disk buffer holding the raw data accumulated in 24 hours (600 kCHF)
  CERN (25%), not covered (75%)
- Database server system including software (1800 kCHF)
  CERN (50%), not covered (50%)
- Networking hardware connecting to the computer centre (450 kCHF)
  CERN (100%)
- Monitoring equipment (150 kCHF)
  not covered (100%)

Common Projects

The ATLAS Collaboration Board has decided to execute the following parts of the detector (at a total estimated cost of 208.7 MCHF) as Common Projects:

	item	estimated cost (in MCHF)
A1	Barrel Toroid Magnet	111.7
A2	End-cap Toroid Magnets (2)	
A3	Solenoid	10.9
A4	Common Magnet Infrastructure	14.2
B1	LAr Barrel Cryostat	12.3
B2	LAr End-cap cryostats (2)	10.1
B3	Common LAr Cryogenic Plant	14.1
C	Trigger/DAQ/Controls Processors	7.2
D1	Radiation Shielding	4.9
D2	Detector Infrastructure	23.3

A MAGNETS

A1 Barrel Toroid

Milestones:

Completion of winding machine for B0	July	1998
Delivery of conductor for B0	August	1998
Completion of B0 test station at CERN	July	1999
Delivery of B0 to CERN	September	1999
Start coil winding of first BT coil	October	1999
50% of conductor delivered	January	2000
Start testing first BT coil at CERN	March	2001
Complete winding of 8th BT coil	September	2001
Complete delivery of warm structure	July	2002
Start installation of BT in cavern	January	2003

Work to be executed :

design, specifications, market surveys and preparation of tendering documents under contract with CEA/Saclay

8m prototype coil executed as in-kind contribution by CEA/Saclay and INFN/LASA

A2 End-cap Toroids

Milestones:

Complete cryostat scale model	June	1998
Delivery of first conductor batch	April	2000
Complete first vacuum vessel	April	2001
Finish coil winding	October	2002
Start tests of ECTs on surface	April	2003
Start installation of ECTs in cavern	November	2004

Work to be executed :

design, specifications, market surveys and preparation of tendering documents under contract with RAL

A3 Solenoid

Milestones:

Complete delivery of conductor	October	1998
Complete coil winding	March	1999
Test of solenoid	December	2000
Delivery of solenoid to CERN	January	2002
Test of solenoid in cryostat at CERN	July	2003

Work to be executed :

design, specifications, market surveys and preparation of tendering documents and construction executed by KEK as Japanese in-kind contribution

A4 Magnet Cryogenic Plant

Milestones:

Cryogenic plant installed	August	2003
Magnet power systems installed	August	2003

Work to be executed :

design and specifications executed by CERN

B LAr CRYOSTATS AND CRYOPLANT

B1 LAr Barrel Cryostat

Work to be executed :

design, specifications, market surveys and preparation of tendering documents and construction of cryostat and feed-throughs executed by BNL as in-kind contribution by US

B2 LAr End-cap Cryostats

Work to be executed :

design, specifications, market surveys and preparation of tendering documents and construction of cryostat executed by Orsay as in-kind contribution by IN2P3 France, BMBF and MPI Germany and Russia; feed-throughs constructed as in-kind contribution by Canada

B3 LAr Cryogenic Plant

Work to be executed :

design and specifications executed by CERN

C TRIGGER/DAQ/CONTROLS PROCESSORS

to be provided as in-kind contributions by various Funding Agencies

D SHIELDING AND INFRASTRUCTURE

design and specifications executed by CERN

Funding:

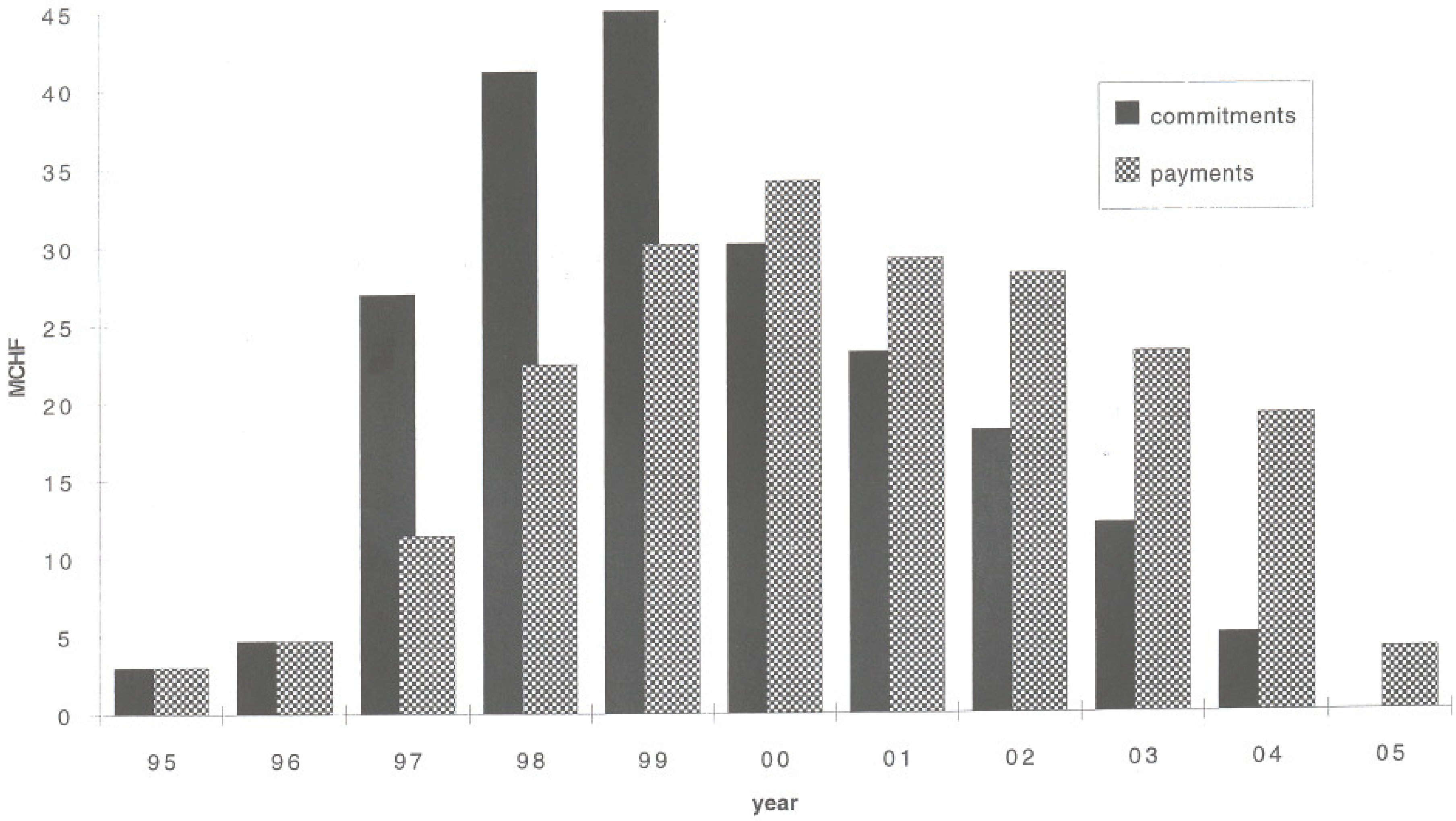
As set out in art. 6.2 of this document, the obligations of the institutes for the execution of the Common Projects are proportional to their investments into the detector sub-systems. A considerable fraction of these obligations are expected to be met by institutes providing Common Project items.

Planning of Resources for the Common Projects

(in ATLAS 1995 MCHF)

	cash or in-kind	membership contrib.	total
Armenia		0.1	**0.1**
Australia	0.9	0.2	**1.1**
Austria	0.2	0.1	**0.3**
Azerbaijan		0.1	**0.1**
Belarus		0.1	**0.1**
Brazil		0.1	**0.1**
Canada	5.9	0.7	**6.6**
Czech Republic	0.3	0.3	**0.6**
Denmark	1.3	0.1	**1.4**
Finland		0.1	**0.1**
France IN2P3	16.4	0.6	**17.0**
FRANCE CEA	8.5	0.1	**8.6**
Georgia		0.1	**0.1**
Germany BMBF	13.3	0.9	**14.2**
Germany MPI	3.2	0.1	**3.3**
Greece	0.4	0.3	**0.7**
Israel	1.8	0.3	**2.1**
Italy	18.6	1.2	**19.8**
Japan	12.7	1.3	**14.0**
Morocco		0.1	**0.1**
Netherlands	6.5	0.2	**6.7**
Norway	1.6	0.2	**1.8**
Poland	0.2	0.2	**0.4**
Portugal	0.8	0.1	**0.9**
Romania	0.2	0.1	**0.3**
Russia	9.3	0.7	**10.0**
JINR	2.2	0.1	**2.3**
Slovak Republic	0.1	0.1	**0.2**
Slovenia	0.6	0.1	**0.7**
Spain	4.0	0.3	**4.3**
Sweden	4.3	0.4	**4.7**
Switzerland	8.3	0.2	**8.5**
Turkey		0.2	**0.2**
United Kingdom	13.7	1.3	**15.0**
US DoE + NSF	32.4	3.1	**35.5**
CERN	26.3	0.1	**26.4**
total	194.0	14.3	**208.3**

Spending Profile for the ATLAS Common Projects



ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE

CERN EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

GENERAL CONDITIONS

FOR EXPERIMENTS PERFORMED AT CERN

25 April, 1989

GENERAL CONDITIONS

for experiments performed at CERN

The mission of the European Organization for Nuclear Research (CERN) is to sponsor international scientific research in high-energy physics. When running an experiment at CERN, the Universities and Research Institutions need to be informed of the rules and procedures concerning organizational, managerial and fmancial matters.

The role of CERN as that of a Host Laboratory, to be distinguished from the scientific responsibility in an experiment which lies with the collaboration, is addressed in the present document.

1. SCOPE OF APPLICATION

1.1. The General Conditions apply to experiments that are carried out at CERN by the combined efforts of several Universities and Research Institutions.

1.2. These experiments have to be approved by the CERN Research Board after consideration of written proposals submitted to the appropriate experiments committees; both scientific interest and the constraints imposed by available resources are taken into account.

2. PARTIES AND THEIR REPRESENTATION

2.1. The Parties concerned include:

- CERN, in its role as Host Laboratory, hereinafter referred to as ***"CERN as Host"*** (or simply "CERN"),
- the Institutions responsible for the research teams taking part in the experiments and forming ***the Collaboration,*** hereinafter collectively referred to as the Collaborating Institutions,
- where CERN research teams take part in the experiments, CERN like any other ***Collaborating Institution.***

2.2. Each Party shall have a Representative:

- CERN as Host shall be represented by a ***Director of Research,*** acting on behalf of the Director-General.
- The Collaboration shall be represented by a ***Spokesperson*** duly appointed, who is also empowered to co-ordinate its work. Where the Spokesperson is not permanently staying at CERN, the Collaboration appoints in addition a ***Contactperson*** at CERN.
- In its relations with CERN, each Collaborating Institution taking part in the experiment shall be represented by an appointed ***team member*** and/or a ***member*** of the relevant Funding Agency.

2.3. All Parties make an obligation of their own to ensure compliance of the General Conditions by their staff.

3. CONSTITUTIVE DOCUMENTS

3.1. The following documents shall constitute the formal basis for the experiments performed at CERN:

3.1.1. the ***EXPERIMENTAL PROPOSAL,*** after its approval by the CERN Research Board;

3.1.2. A ***MEMORANDUM OF UNDERSTANDING,*** which sets out the detailed arrangements and provisions specific to the experiment and which must be agreed and signed by CERN as Host and the Collaborating Institutions; special agreements or protocols of relevance may be appended to the Memorandum of Understanding;

3.1.3. the present ***GENERAL CONDITIONS,*** which the Parties accept by signing the Memorandum of Understanding, unless they agree on derogations therefrom, specified in the Memorandum of Understanding.

Contents of the Memorandum of Understanding

3.2. As a guidance, the essential parts of the Memorandum of Understanding are the following:

a) a list of the Collaborating Institutions and/or the Funding Agencies, responsible for the teams in the Collaboration;

b) a mention of the persons carrying specific responsibilities for the experiment;

c) - the definition of the obligations of the Parties with respect to the construction of the detector and the auxiliary equipment;

- a breakdown of the approximate requirements for manpower and money for the main items of the detector and of the auxiliary equipment, together with the contributions of the Parties;

- a timetable for the construction of the equipment to be provided for the eperiment;

d) the obligations of the Parties concerning the installation, operation and maintenance of the detector and auxiliary equipment;

e) an explicit reference to the General Conditions which the Parties accept, unless otherwise specified in the Memorandum of Understanding; moreover, explicit references must be made to the special agreements and protocols relevant to the experiment.

4. ORGANIZATION OF THE COLLABORATION

Internal autonomy and coordination with CERN

4.1. In its internal relations, the Collaboration is free to take such organizational decisions as deemed necessary. However, in preparing and realizing the experiment, the Collaboration shall take into account the rules in force on the sites of CERN.

Co-ordination in matters of safety

4.2. The Spokesperson of the Collaboration shall appoint, with the agreement of CERN, a Group Leader in Matters of Safety (GLIMOS). The rights and obligations of the GLIMOS are defined in the document "*Safety Policy at CERN - SAPOCO/42*". For practical reasons, a GLIMOS must normally be present at CERN.

Finance Review Committee

- *Initial Decision*

4.3. For experiments involving large capital investments, a Finance Review Committee (FRC) may be set up in agreement with all the Parties concerned.

- *Membership*

4.4. The FRC will be chaired by the appropriate Director of Research and will also include as members one representative of each Funding Agency or of the Collaborating Institution duly entitled, together with the Spokesperson of the Collaboration.

- *Terms of Reference*

4.5. The task of the FRC will be to monitor the financial aspects of the experiment as detailed in the Memorandum of Understanding. It is recalled that financial arrangements between CERN and the Collaboration are subject to the rules currently in force for visiting teams at CERN.

5. CERN'S OBLIGATIONS AS HOST LABORATORY

5.1. CERN is the Host Laboratory for the Collaboration. The provisions of this Section concern its obligations as host.

PRINCIPLES

Installation

5.2. CERN agrees to the installation of the detector, its auxiliary equipment and counting rooms in the appropriate experimental area, provided they satisfy CERN safety standards.

Duration

5.3. CERN agrees to keep the detector on site at least until the data taking for the experimental programme approved by its Research Board has been completed.

Network Connections

5.4. CERN agrees that computers and peripherals belonging to the Collaboration which are needed for the operation of the detector and its auxiliary equipment may be connected to the CERN Computer network, provided they conform with its compatibility standards.

Insurances

- *concerning property*

5.5. The items belonging to the Collaboration and the Collaborating Institutions, once they have been officially accepted on the CERN sites, will be insured at CERN's expense against the risks of fire, explosion, elemental power and water damage.

- *in case of civil liability*

5.6. The civil liability of the Collaboration, the Collaborating Institutions and their staff on the CERN sites will be covered, in case of damage caused to third persons and property, by the CERN operational risk insurance scheme.

- *and their limits*

5.7. However, the CERN insurance coverage is effective only above certain franchise sums which, in case of damage, will be charged to the Collaboration.

Social insurance

5.8. Independently of the foregoing provisions, the social insurance for the experimental teams remains normally the responsibility of the employer institutions concerned.

SERVICES

User Support Services and Users Office

5.9. CERN will provide access to its services, as described in the document "*User Support Services at CERN*" and under the conditions stated therein.

The Users Office will provide assistance, if required, on questions concerning access to the services provided by CERN.

Standard Services

5.10. CERN will generally provide, for the duration of the experiment, free of charge and within the limits and general constraints imposed by the available resources and schedules of accelerators, the standard services and facilities listed below:

- ***Particle beams and equipment***

a) particle beams and related shielding, monitoring equipment and standard communication with the accelerator control rooms;

b) beam time allocation and scheduling, following the recommendations of the relevant Experiment Committee;

c) test beam time for testing prototypes and calibrating final detector elements, subject to the normal scheduling and allocation procedures;

- ***Space***

d) floor space in the experimental area(s) for the experimental detector, its auxiliary equipment and the counting and control rooms;

e) laboratory and hall space for construction, testing and assembly of equipment;

f) storage place for spare parts, handling and assembly tools, detector and auxiliary equipment awaiting installation or removal;

g) office space, equipped with standard furniture and infrastructure facilities like terminal lines, telephones and electricity;

- ***Supplies and installations at the experiment***

h) help with the installation and removal of the detector and its auxiliary equipment, including the provision of crane and rigging services, geometrical survey and alignment, transport of equipment on and between the Laboratory sites, as well as inside the experimental areas;

i) basic infrastructure, such as counting houses, local air conditioning and cryogenics in amounts to be specified in the Memorandum of Understanding;

j) local supply of electricity, water, compressed air and standard terminal lines connected to the CERN communication network;

- ***Computing***

k) central computing resources for the Collaboration for the duration of the experiment in amounts to be decided by the normal CERN allocation procedures;

- *Transport of persons*

l) basic transportation for personnel between CERN sites;

- *Safety services*

m) access to its safety services for advice, inspection and control and first aid or other emergency help;

- *Administrative services*

n) access to its administrative services to help the Collaboration to purchase the necessary items for the experimental programme, in accordance with the CERN Financial Rules.

Special Services

5.11. A variety of services other than those specified above may be provided to the Collaborating Institutions on request, subject to the availability of resources. Such services will be charged to the Collaborating Institutions according to the rules currently in force at CERN.

Special Equipment

5.12. Any additional infrastructure equipment to be provided by CERN shall be explicitly mentioned in the Memorandum of Understanding. The respective obligations of CERN and of the Collaborating Institutions as to its construction, operation and maintenance shall be specified therein.

6. OBLIGATIONS OF THE COLLABORATING INSTITUTIONS

Basic Obligations

6.1. Any staff and property of Collaborating Institutions located at CERN will, while retaining their status in respect to their home institution, come under the authority of the Director-General of CERN and shall comply with the relevant regulations in force on the sites of the Organization.

Medical surveillance and certificates

6.2. Each Collaborating Institution sending staff to CERN remains responsible as employer for the medical surveillance of its staff and, in the case of staff who will work in places which are considered as presenting special risk conditions (e.g. radiation controlled areas), shall supply a certificate of medical aptitude on first arrival at CERN.

Safety briefings and inspections

6.3. For safety reasons, Collaborating Institutions shall participate in safety meetings and studies of their experiment and accept the right of the CERN services to carry out safety inspections as well as other safety measures set out in the document "*Safety Policy at CERN - SAPOCO/42*".

Supply of equipment

6.4. The Collaborating Institutions shall make available on the CERN sites, according to an agreed time table and in working order, the equipment which they have undertaken to supply and to commission. The Spokesperson shall inform the appropriate Director of Research of any significant failure to meet the agreed schedule.

Ownership status

6.6. The delivery of items to the CERN site, or the handling of such items there, will not affect rights of property relevant to those items, unless otherwise formally agreed with the owner. On the other hand, the ownership of equipment no longer required by the Collaboration can, under formal mutual agreement, be transferred to CERN, should it be mutually advantageous to do so.

Ownership inventory

6.7. As condition of application of the CERN insurances, each Collaborating Institution must provide CERN with a list of the property which it installs on the CERN site. It shall keep the said list up to date and, where necessary, inform CERN of any modifications to it.

Installation and dismantling of equipment

6.8. The Collaboration is collectively responsible for the installation and dismantling of the equipment supplied by the Collaborating Institutions, the contribution of CERN as host being limited in principle to the assistance detailed in paragraph 5.10 i) above.

Operation, maintenance and costs of equipment

6.9. The Collaboration is collectively responsible for the operation and maintenance of the equipment supplied by the Collaborating Institutions, and for providing the resources necessary to carry out the experimental programme. The resources needed to operate and maintain the infrastructure and other equipment supplied by CERN as host will be provided by CERN.

Assignment of equipment

6.10. In order not to affect adversely CERN's experimental programme and schedules, any Party providing equipment undertakes to leave it at CERN at the disposal of the Collaboration until the experiment is officially declared complete (see 8.2 below).

Early removal of equipment

6.11. On the other hand, if equipment provided by a Collaborating Institution is, in the opinion of the Collaboration, no longer required, the Parties may agree to and request its removal from the CERN sites under the responsibility of the said Institution and with the assistance of CERN.

Release of space

6.12. As soon as the experiment is declared complete (see 8.2 below), the space used by the Collaboration, including office and laboratory space and the space used for testing and running the experiment, will be made available to CERN for reallocation.

Removal and storage of equipment

6.13. If requested by CERN, equipment associated with the experiment shall be removed from the CERN sites within a maximum of two years after completion of the experiment. Storage for such period must be approved by the Division Leader concerned.

7. INTELLECTUAL PROPERTY

Free use of knowledge and data

7.1. In the context of the experimental programme, each Party shall be entitled to use for its own purposes any acquired knowledge, whether patentable or not, as well as any expertise developed during the manufacture of the components. All data obtained from experimental runs are made accessible to all Collaborating Institutions.

Matters for prior agreement

7.2. If a patentable invention or a new virtually profitable technique is developed by one of the Parties in the context of the experiment, the others shall be informed thereof as soon as possible in order to decide on the appropriate ownership, before further steps are taken; it is understood that every Party shall be entitled to a free utilization license as provided for under paragraph 7.1. above. Pending such decision, the Parties will refrain from action that would prejudice patent-taking or licensing.

8. FINAL PROVISIONS

Modifications and formal amendments

8.1. The Collaboration will settle and duly announce to CERN any modification or addition to the experiment which affects the terms of the Memorandum of Understanding. Major modifications shall be approved as formal amendments to the Memorandum of Understanding and consequently be accepted and signed by the representatives of the Parties.

Duration of the applicability of the Memorandum of Understanding

8.2. The terms and conditions of the Memorandum of Understanding will apply until the experiment is declared complete by the appropriate CERN Research Director in agreement with the Spokesperson.

Observance of the Memorandum of Understanding

8.3. The Memorandum of Understanding formalizes the agreement reached between all the Parties on the experiment and constitutes therefore the code of conduct which the Parties have accepted to follow with their best efforts.

Relevant documents

8.4. The following basic documents should be known by the members of the Collaboration taking part in experiments at CERN:

- the CERN Users' Guide,
- the User Support Services at CERN,
- the Safety Guide for CERN experiments,
- the Safety Policy at CERN - SAPOCO/42.

ACCU

8.5. The Advisory Committee of CERN Users (ACCU), promotes links between CERN Management and the User Community and advises on the working conditions and the arrangements for technical support to the CERN Users.