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U.S ATLAS Computing Project Management Plan

<u>1</u>	ATLAS Objectives	6
1.1	Scientific Objectives	6
1.2	Technical Objectives	6
1.3	Cost Objectives	6
1.4	Schedule Objectives	6
<u>2</u>	ATLAS Organization	7
2.1	Introduction	7
2.2	International ATLAS and its Project Management	7
2.3	ATLAS Physics and Computing Organization	8
2.4	Membership of the U.S.ATLAS Collaboration	9
2.5	U.S. ATLAS Project Management Structure	10
2.5.1	U.S. ATLAS Project Manager	10
2.5.2	Institutional Board	11
2.5.3	Executive Committee	12
2.5.4	Associate Project Manager for Physics and Computing	12
2.5.5	Subsystem Managers	12
2.5.6	Brookhaven National Laboratory (BNL) and Columbia University	12
2.5.7	Project Advisory Panel	13
2.5.8	Physics and Computing Advisory Panel	13
2.6	Department of Energy (DOE) and National Science Foundation (NSF)	14
2.6.1	U.S. LHC Program Office	14
2.6.2	U.S. LHC Project Office	14
<u>3</u>	Physics and Computing Project	14
3.1	Physics and Computing Subproject Management	15
3.1.1	Physics	17
3.1.2	Software	17
3.2	Facilities Subproject	17
3.3	Upper level project management: description of responsibilities	18
3.3.1	Associate Project Manager	18
3.3.2	Project Engineer	18
3.3.3	Level 2 Managers: Generic Responsibilities	18
3.3.4	Physics subproject manager	19
3.3.5	Software subproject manager	19
3.3.6	Facilities subproject manager	20
3.4	Software Agreements	20
3.5	Memoranda of Understanding	20
3.6	Computing and Physics Policies	20
3.6.1	Local Computing Hardware Support	20
3.6.2	Physicist Support	21
3.7	Cost Estimates for Physics and Computing	21
3.7.1	Core Software	21
3.7.2	Detector Specific Simulation and Reconstruction Software	21
3.7.3	Facilities	22
3.7.4	Cost Escalation and Contingency	22
<u>4</u>	Management and Control System	22
4.1	Baseline Development	22
4.2	Project Performance	22
4.3	Reporting	23
4.4	Host Laboratory Oversight	27
4.5	Meetings with DOE and NSF	27
4.6	Periodic Reviews	27

5	WBS Dictionary for U.S. ATLAS Computing.....	28
	2.3.2.1.3Data storage	31
	2.3.2.1.4Information servers.....	31

List of Abbreviations

ACWP	Actual Cost of Work Performed
ALD	BNL Associate Laboratory Director
APM	Associate Project Manager for Physics and Computing
AY	At Year (referring to a dollar value)
BCP	Baseline Change Proposal
BCWP	Budgeted Cost of Work Performed
BCWS	Budgeted Cost of Work Schedules
BHG	Brookhaven Group
BNL	Brookhaven National Laboratory
CB	ATLAS Collaboration Board
CCB	Change Control Board
CERN	European Laboratory for Particle Physics
CH	Chicago Operations Office
DHEP	Division of High Energy Physics
DOE	Department of Energy
EDIA	Engineering Design, Inspection and Assembly
EDMS	Engineering Data Management System
ES&H	Environmental Safety and Health
HEP	DOE Headquarters Office of High Energy Physics
IB	Institutional Board
IMOU	Interim Memorandum of Understanding
JOG	Joint Oversight Group
LHC	Large Hadron Collider
LHCC	CERN LHC Committee
MOU	Memorandum of Understanding
MRE	Major Research Equipment
NSF	National Science Foundation
PAP	Project Advisory Panel
PBS	Product Breakdown Structure
PCAP	Physics and Computing Advisory Panel
PL	ATLAS Project Leader
PM	U.S. ATLAS Project Manager
PMCS	Project Management Control System
PMP	Project Management Plan
PO	U.S. ATLAS Project Office
QAP	Quality Assurance Plan
R&D	Research and Development
RRB	ATLAS Resource Review Board
SC	DOE Office of Science
SM	U.S. ATLAS Subsystem Manager
TDR	Technical Design Report
TRT	Transition Radiation Tracker
WBS	Work Breakdown Structure

1 ATLAS Objectives

1.1 Scientific Objectives

The fundamental unanswered problem of elementary particle physics relates to the understanding of the mechanism that generates the masses of the W and Z gauge bosons and of quarks and leptons. To attack this problem, one requires an experiment that can produce a large rate of particle collisions of very high energy. The LHC will collide protons against protons every 25 ns with a center-of-mass energy of 14 TeV and a design luminosity of $10^{34} \text{ cm}^{-2} \text{ s}^{-1}$. It will probably require a few years after turn-on to reach the full design luminosity.

The detector will have to be capable of reconstructing the interesting final states. It must be designed to fully utilize the high luminosity so that detailed studies of rare phenomena can be carried out. While the primary goal of the experiment is to determine the mechanism of electroweak symmetry breaking via the detection of Higgs bosons, supersymmetric particles or structure in the WW scattering amplitude, the new energy regime will also offer the opportunity to probe for quark substructure or discover new exotic particles. The detector must be sufficiently versatile to detect and identify the final state products of these processes. In particular, it must be capable of reconstructing the momenta and directions of quarks (hadronic jets, tagged by their flavors where possible), electrons, muons, taus, and photons, and be sensitive to energy carried off by weakly interacting particles such as neutrinos that cannot be directly detected. The ATLAS detector is designed to have all of these capabilities.

1.2 Technical Objectives

The ATLAS detector is designed to perform a comprehensive study of the source of electroweak symmetry breaking. It is expected to operate for twenty or more years at the CERN LHC, observing collisions of protons, and recording more than 10^7 events per year. The critical objectives to achieve these goals are:

- Excellent photon and electron identification capability, as well as energy and directional resolution.
- Efficient charged particle track reconstruction and good momentum resolution.
- Excellent muon identification capability and momentum resolution.
- Well-understood trigger system to go from 1 GHz raw interaction rate to ~100 Hz readout rate without loss of interesting signals.
- Hermetic calorimetry coverage to allow accurate measurement of direction and magnitude of energy flow, and excellent reconstruction of missing transverse momentum.
- Efficient tagging of b-decays and b-jets.

1.3 Cost Objectives

The current cost estimate is in Appendix 1.

1.4 Schedule Objectives

2 ATLAS Organization

2.1 Introduction

The U.S. ATLAS Construction Project operates within the context of the internationally funded ATLAS experiment located at CERN. The general responsibilities of the U.S. participants are described in Article VI of the Experiments Protocol signed between CERN, and DOE and NSF. In essence, they have responsibilities for R&D, engineering design, prototyping, fabrication, installation and normal maintenance and operation of detector systems and components as agreed to and described in the IMOU, the MOU, and their addenda. The responsibilities of the CERN management are described in Article VIII of the same Protocol.

The U.S. ATLAS Construction Project is managed by the U.S. ATLAS Project Office, located at Brookhaven National Laboratory (BNL), under the direction of the designated U.S. ATLAS Project Manager (hereafter referred to as the Project Manager or PM). The Project Manager has the principal authority for day-to-day management and administration of all project activities. The Director of BNL, or his/her designee, is responsible for management oversight of the project and DOE and NSF jointly provide requirements, objectives and funding.

2.2 International ATLAS and its Project Management

The large general-purpose LHC experiments rank among the most ambitious and challenging technical undertakings ever proposed by the international scientific community. The inter-regional collaborations assembled to design, implement and execute these experiments face unprecedented sociological challenges in marshaling efficiently their enormous, yet highly decentralized, human and economic resources. The overall ATLAS approach to this challenge is to base most of the ATLAS governance on the collaborating institutions rather than on any national blocks. Thus the principal organizational entity in ATLAS is the Collaboration Board (CB), consisting of one voting representative from each collaborating institution, regardless of size or national origin.

The CB is the entity within ATLAS that must ratify all policy and technical decisions, and all appointments to official ATLAS positions. It is chaired by an elected Chairperson who serves for a non-renewable two-year term. The Deputy Chairperson, elected in the middle of the Chairperson's term, succeeds the Chairperson at the end of his/her term. The CB Chairperson has appointed (and the CB ratified) a smaller advisory group with whom he/she can readily consult between ATLAS collaboration meetings.

Executive responsibility within ATLAS is carried by the Spokesperson who is elected by the CB to a renewable three-year term. The Spokesperson is empowered to nominate one or two deputies (there is presently one) to serve for the duration of the Spokesperson's term in office. The Spokesperson represents the ATLAS Collaboration before all relevant bodies, and carries the overall responsibility for the ATLAS Detector Project.

The ATLAS central management team also includes Technical and Resource Coordinators, both CERN staff members whose appointments to their roles require CERN management approval. The Technical Coordinator has the overall responsibility for the technical aspects of the detector construction. This includes responsibility for the integration of the ATLAS subsystems and for coordinating the CERN infrastructure, including the installation of the experiment in the surface and underground areas. The Resource Coordinator is responsible for budget and manpower planning, including securing the Common Projects resources, and for negotiating the MOUs with the various funding agencies.

The ATLAS Spokesperson chairs an Executive Board (EB), consisting of high-level representatives of all the major detector subsystems plus the Technical and Resource Coordinators. The Executive Board directs the execution of the ATLAS project according to the policies established by the Collaboration Board.

Each ATLAS subsystem has a Project Leader directly and ultimately responsible for ensuring that the design and construction of the corresponding subsystem are carried out on schedule, within the cost ceiling, and in a way that guarantees the required performance and reliability. Each major ATLAS subsystem is overseen by a technically-oriented Steering Group, with expertise in all the relevant technical areas.

It is understood that the U.S.-ATLAS management must operate within the regulations imposed by the U.S. funding agencies, the funding appropriated by the U.S. Congress, and the terms of the U.S.-CERN Protocol on LHC Experiments. Subject to these limitations, it is expected that the U.S.-ATLAS management implements all decisions taken by the ATLAS Resource Review Board (RRB) and the Collaboration Board. The RRB comprises representatives from all ATLAS funding agencies and the managements of CERN and the ATLAS Collaboration. The U.S. has DOE and NSF representatives. The RRB meets twice per year, usually in April and October.

The role of the RRB includes:

- reaching agreement on the ATLAS 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

As far as project execution is concerned, decisions by the ATLAS Executive Board (EB) should also be adopted directly or, if not compatible with the U.S. operating procedures, adapted so as to match the EB decision as closely as possible. In the latter case ATLAS management should be consulted and informed about the detailed U.S. implementation.

ATLAS has adopted procedures for quality control and change requests valid for all Collaboration partners. For example, a Product Breakdown Structure (PBS/WBS) structure has been established and a global Engineering Data Management System (EDMS) is used to manage documents pertaining to ATLAS Technical Coordination, the ATLAS Detector, General Facilities, Assembly and Test Areas and Offline Computing. A CERN Drawing Directory (CDD) is used to manage all drawings. It is understood that the U.S. institutions use these management procedures and tools at the same level as all the other ATLAS institutions.

2.3 ATLAS Physics and Computing Organization

The ATLAS Physics and Computing Organization consists of two co-leaders, one is the Physics Coordinator, who is in charge of organizing efforts in the area of physics objects, event generators and benchmark studies. The other is the Computing Coordinator, in charge of coordinating core software activities and overall support functions. The Computer Steering Group (CSG) consists of the Computing Coordinator, who acts as chair, the Physics Coordinator, the Chair of the Quality Control Group, the Offline Coordinators representing each of the subsystems (Inner Detector, TRT, L Ar, Tile, Muon, Trigger/DAQ and Event Filter), and the chair of the National Computing Board (NCB).

The National Computing Board (NCB) consists of one representative from each country in the collaboration, and has an elected chair who serves for a two year term.

Software agreements are discussed between the relevant NCB representatives and in the CSG. This discussion focuses on the available resources from any given country and the needs of ATLAS. After discussion between

these two groups, a proposal for the Institutional Commitments for Computing deliverables is made to the Collaboration Board, which approves the Software Agreements. The Software Agreements are then reviewed by the RRB and are approved by the Research Director of CERN and codified as Memoranda of Understanding for Computing.

2.4 Membership of the U.S.ATLAS Collaboration

The U.S. ATLAS Collaboration consists of physicists and engineers from all U.S. institutions collaborating on the ATLAS experiment at the CERN LHC. Table 3-1 shows a list of the participating institutions. Individuals from these institutions share responsibility for the construction and execution of the experiment with collaborators from the international high-energy physics community outside the U.S.

Table 2-1: U.S. ATLAS Participating Institutions

(Agency support shown in parentheses)
Argonne National Laboratory (DOE)
University of Arizona (DOE)
Boston University (DOE)
Brandeis University (DOE/NSF)
Brookhaven National Laboratory (DOE)
University of California, Berkeley/Lawrence Berkeley National Laboratory (DOE)
University of California, Irvine (DOE/NSF)
University of California, Santa Cruz (DOE/NSF)
University of Chicago (NSF)
Columbia University (Nevis Laboratory) (NSF)
Duke University (DOE)
Hampton University (NSF)
Harvard University (DOE/NSF)
University of Illinois, Urbana-Champaign (DOE)
Indiana University (DOE)
Iowa State University (DOE)
Massachusetts Institute of Technology (DOE)
University of Michigan (DOE)
Michigan State University (NSF)
University of New Mexico (DOE)
State University of New York at Albany (DOE)
State University of New York at Stony Brook (DOE/NSF)
Northern Illinois University (NSF)
Ohio State University (DOE)
University of Oklahoma/Langston University (DOE)
University of Pennsylvania (DOE)
University of Pittsburgh (DOE/NSF)
University of Rochester (DOE/NSF)
Southern Methodist University (DOE)
University of Texas at Arlington (DOE/NSF)
Tufts University (DOE)
University of Washington (NSF)
University of Wisconsin, Madison (DOE)

2.5 U.S. ATLAS Project Management Structure

To facilitate interactions with the U.S. funding agencies and for effective management of U.S. ATLAS activities and resources, a project management structure has been established with the Project Office located at BNL. Appendix 2 shows the organization chart for U.S. ATLAS. This organization is headed by a U.S. ATLAS Project Manager supported by a Project Office along with U.S. Subsystem Managers for each of the major detector elements in which the U.S. is involved. The organization also includes an Institutional Board with representation from each collaborating institution, and an Executive Committee. The responsibilities of each will be described below. The U.S. ATLAS planning and management is being done in close cooperation with the overall ATLAS management. The U.S. Subsystem Managers interact closely with the corresponding overall ATLAS Subsystem Project Leaders, and the U.S. ATLAS Project Manager maintains close contact with the ATLAS Spokesperson, and the Technical and Resource Coordinators. U.S. ATLAS Project Manager

2.5.1 U.S. ATLAS Project Manager

U.S. ATLAS Project Manager (PM) has the responsibility of providing programmatic coordination and management for the U.S. ATLAS Construction Project. Responsibilities for the Research Program are addressed in separate documents. He/she represents the U.S. ATLAS Project in interactions with overall ATLAS management, CERN, DOE, NSF, the universities and national laboratories involved and BNL, the Host Laboratory. The PM is appointed by the Director of BNL and with concurrence of the DOE and NSF upon recommendation from the U.S. ATLAS Collaboration. The PM will serve as long as there is the continuing confidence of the Collaboration and the funding agencies. He/she reports to the BNL Director (or his/her appointed representative). The PM is advised in this role by an Executive Committee, which includes all U.S. Subsystem Managers, as described below. The PM may select a Deputy to assist him. With respect to technical, budgetary, and managerial issues, the U.S. Subsystem Managers, augmented by the Institutional Board Convener, act as a subcommittee of the Executive Committee to provide advice to the PM on a regular basis. Consultation with this subcommittee is part of the process by which the PM makes important technical and managerial decisions. An example of such a managerial decision would be a modification of institutional responsibilities.

1. Appointing, after consultation with the Collaboration, of U.S. Subsystem Managers (SMs) responsible for coordination and management within each detector subsystem. The SMs will serve with the PM's continuing concurrence.
2. Preparing the yearly funding requests to DOE and NSF for the anticipated U.S. ATLAS activities.
3. Recommending to DOE and NSF the institution-by-institution funding allocations to support the U.S. ATLAS efforts. These recommendations will be made with the advice of the SMs, and the U.S. ATLAS Executive Committee.
4. Approving budgets and allocating funds in consultation with the SMs and managing contingency budgets in accord with the Change Control Process in Section 7.
5. Establishing, with the support of BNL management, a U.S. ATLAS Project Office with appropriate support services.
6. Working with BNL management to set up and respond to whatever advisory or other mechanisms BNL management feels necessary to carry out its oversight responsibility.
7. Keeping the BNL Director or his chosen representative well informed on the progress of the U.S. ATLAS effort, and reporting promptly any problems whose solutions may benefit from the joint efforts of the PM and BNL management.
8. Interacting with CERN on issues affecting resource allocation and availability, preparation of the international MOUs defining U.S. deliverables and concurring in these MOUs.
9. Advising the DOE and NSF representatives at the ATLAS Resource Review Board meetings.
10. Negotiating and signing the U.S. Institutional MOUs representing agreements between the U.S. ATLAS Project Office and the U.S. ATLAS collaborating institutions specifying the deliverables to be provided and the resources available on an institution-by-institution basis.
11. Periodically reporting on project status and issues to the Joint Oversight Group.
12. Conducting, at least twice a year, meetings with the U.S. ATLAS Executive Committee to discuss budget planning, milestones, and other U.S. ATLAS management issues.
13. Making periodic reports to the U.S. ATLAS Institutional Board to ensure that the Collaboration is fully informed about important issues.

The channels for funding, reporting, and transmission of both types of MOUs are shown in Appendix 7-2. DOE funding will be a mixture of grants and Research Contracts through BNL. NSF funding will be through subcontracts through Columbia University. Further details on the identities and roles of the various participants in the U.S. ATLAS Collaboration governance are given below.

2.5.2 Institutional Board

The U.S. ATLAS Collaboration has an Institutional Board (IB) with one member from each collaborating institution and a Convener elected by the Board. The Convener serves for a two-year renewable term. The IB will normally meet several times per year. Under normal circumstances the meetings are open to the Collaboration, although closed meetings may be called by the Convener to discuss detailed or difficult issues. All voting is by IB members only, except in the case of the absence of a member when the missing member may appoint an alternate.

The IB members represent the interests of their institutions and serve as points of contact between the U.S. ATLAS management structure and the collaborators from their institutions. They are selected by the ATLAS participants from their institutions.

The Institutional Board deals with general policy issues affecting the U.S. ATLAS Collaboration. As chairman of this board the Convener will organize meetings on issues of general interest that arise and will speak for U.S. ATLAS on issues that affect the Collaboration. The Convener also will recommend for ratification to the Institutional Board the ad hoc committees charged with running the elections for the Convener and for the membership of the Executive Committee, as described in the next section. The Convener will recommend to the Institutional Board the establishment of any standing committees to deal with collaboration wide issues if the need arises. The Institutional Board also provides its recommendation on the appointment of the Project Manager to the BNL Director, and DOE and the NSF.

2.5.3 Executive Committee

The Executive Committee advises the Project Manager on global and policy issues affecting the U.S. ATLAS Collaboration or the U.S. ATLAS Construction Project. It also deals with issues external to the U.S. ATLAS Construction Project such as education, computing, physics analysis etc. The Executive Committee has meetings at least twice per year. Its membership is the following:

- The Deputy Project Manager,
- Associate Project Manager for Physics and Computing
- Subsystem Managers, including each level 2 manager from the Physics and Computing Project (PCP)
- The Subsystem Representatives from each subsystem in which U.S. groups are playing a major role, their number being given in parentheses:
 - Semiconductor tracker (1),
 - TRT (1),
 - Liquid argon calorimeter and forward calorimeter (2),
 - Tile calorimeter (1),
 - Muon spectrometer (2),
 - Trigger/DAQ subsystems (1),
- The Education Coordinator,
- The U.S. members of the overall ATLAS Executive Board,
- The Convener of the Institutional Board.

The Subsystem Representatives are elected for two-year renewable terms by the IB members whose institutions are associated with the given subsystem.

The Education Coordinator, also elected for a two-year renewable term by the IB, is expected to actively promote educational programs associated with ATLAS and with the U.S. member institutions, and to report to the Executive Committee on these issues. He/she will also act as liaison to DOE and NSF for educational activities. The intended audiences for these education activities are a) the general public, b) secondary school students, c) undergraduates, and d) primary and secondary school teachers.

2.5.4 Associate Project Manager for Physics and Computing

The Associate Project Manager for Physics and Computing (APM) is responsible for the technical, schedule and cost aspects of the U.S. ATLAS Computing Project. (The scope of the U.S. ATLAS Computing Project is part of the U.S. preparations for participation in the ATLAS research program and is not part of the U.S. ATLAS Construction Project.) The Computing Project will follow all the features of this Project Management Plan in terms of defining a WBS for the deliverables, a detailed cost estimate and resource loaded schedule, controls and reporting. The APM develops the budgets for the institutions participating. The U.S. ATLAS Project Manager appoints the APM with concurrence from the Executive Committee. The APM appoints Software, Facilities and Physics Subsystem Managers with the concurrence of the Executive Committee.

2.5.5 Subsystem Managers

The Subsystem Managers are responsible for the technical, schedule, and cost aspects of their subsystems. They develop the budgets for the institutions participating in their subsystems. They are appointed by the U.S. ATLAS Project Manager upon recommendation of the IB members whose institutions are involved in that subsystem. The Subsystem Managers, augmented by the Institutional Board Convener, also act as a subcommittee of the Executive Committee advising the PM on technical, budgetary, and managerial issues relevant to the U.S. ATLAS Project. Prior to making important technical and managerial decisions, the PM will consult with this subcommittee.

2.5.6 Brookhaven National Laboratory (BNL) and Columbia University

The DOE and NSF have assigned BNL management oversight responsibility for the U.S. ATLAS Construction Project, as well as the U.S. ATLAS Research Program. The BNL Director has the responsibility to assure that the detector effort is being soundly managed, that technical progress is proceeding in a timely way, that technical or financial problems, if any, are being identified and properly addressed, and that an adequate

management organization is in place and functioning. The BNL Director has delegated certain responsibilities and authorities to the Associate Laboratory Director for High Energy and Nuclear Physics. The Associate Director is responsible for day-to-day management oversight of the Construction Project and the U.S. Acting on recommendations of the U.S. ATLAS Collaboration, appoint the U.S. ATLAS Project Manager, ATLAS Project Manager reports to him. Specific responsibilities of the BNL Directorate include:

1. Establish an advisory structure external to the U.S. ATLAS project for the purpose of monitoring both management and technical progress for all U.S. ATLAS activities;
2. Assure that the Project Manager has adequate staff and support, and that U.S. ATLAS management systems are matched to the needs of the project;
3. Consult regularly with the Project Manager to assure timely resolution of management challenges;
4. Concur with the International Memorandum of Understanding specifying U.S. deliverables for the U.S. ATLAS project funded by DOE and NSF.
5. Concur with the institutional Memoranda of Understanding for the U.S. ATLAS collaborating institutions that specify the deliverables to be provided and the resources available for each institution;
6. Ensure that accurate and complete project reporting to the DOE and NSF is provided in a timely manner.

The NSF Division of Physics has delegated financial accountability to Columbia University inclusive of line management authority, responsibility and accountability for overall project implementation, and contract administration. The Director of Nevis Laboratory is responsible for dispersal of NSF funds according to the allocations recommended by the U.S. ATLAS Project Manager and consistent with NSF Major Research Equipment (MRE) policies.

2.5.7 Project Advisory Panel

The Project Advisory Panel (PAP) is appointed by the Brookhaven Associate Laboratory Director, High Energy & Nuclear Physics. The role of the PAP in the U.S. ATLAS Detector Project is to provide oversight of the work performed in the Project plus advice to Laboratory management on the rate of progress in and adherence to the project plan as it relates to cost, schedule and technical performance. The primary mechanism for performing this oversight role is attendance at the Project Manager's periodic technical reviews of the U.S. ATLAS subsystems, followed by discussions among the attending PAP members with Project principals and Subsystem Managers. If necessary, additional other mechanisms may be employed as deemed necessary to exercise the oversight function. These may include special reviews or meetings and attendance at Department of Energy/National Science Foundation (DOE/NSF) reviews of the U.S. ATLAS Project. The PAP reports to Laboratory management by means of oral discussions plus a written report following each significant PAP review. PAP reports are transmitted to DOE and NSF.

2.5.8 Physics and Computing Advisory Panel

The Physics and Computing Advisory Panel (PCAP) is appointed by U.S. ATLAS Project Manager. The role of the PCAP in the U.S. ATLAS Detector Project will be to provide advice to the PM on the rate of progress in and adherence to the Computing project plan as it relates to cost, schedule and technical performance. The activities of the PCAP are described in more detail in the project management plan for U.S. ATLAS Software and Computing.

2.6 Department of Energy (DOE) and National Science Foundation (NSF)

The Department of Energy (DOE) and the National Science Foundation (NSF) are the funding agencies for the U.S. ATLAS Construction Project. As such they monitor technical, schedule, and cost progress for the program. The organizational structure is shown in Appendix 3.

The DOE has delegated responsibility for the U.S. ATLAS activities to the Office of Science, Division of High Energy Physics. The NSF has delegated responsibility for the U.S. ATLAS project to the Division of Physics, Elementary Particle Physics Programs.

The U.S. ATLAS Project receives substantial support from both DOE and NSF. Almost all the subsystems involve close collaboration between DOE and NSF supported groups. It is therefore essential that DOE and NSF oversight be closely coordinated. The DOE and NSF have agreed to establish a Joint Oversight Group (JOG) as the highest level of joint U.S. LHC Program management oversight. The JOG has responsibility to see that the U.S. LHC Program is effectively managed and executed so as to meet the commitments made to CERN under the International Agreement and its Protocols. The JOG provides programmatic guidance and direction for the U.S. LHC Construction Project and the U.S. LHC Research Program and coordinates DOE and NSF policy and procedures with respect to both. The JOG approves and oversees implementation of the U.S. LHC Project Execution Plan (PEP) and individual Project Management Plans which are incorporated into the PEP including the U.S. ATLAS Construction Project Management Plan.

All documents approved by JOG are subject to the rules and practices of each agency and the signed Agreements and Protocols.

The U.S. LHC Program Office and U.S. LHC Project Office are established to carry out the management functions described in the PEP. As the DOE has been designated lead agency for the U.S. LHC Program, the U.S. LHC Program Manager and the U.S. LHC Project Manager, who respectively head the program and project offices, will generally be DOE employees. The Associate U.S. LHC Program Manager will generally be an NSF employee.

2.6.1 U.S. LHC Program Office

The U.S. LHC Program Office has the overall responsibility for day-to-day program management of the U.S. LHC Program as described in the PEP. In this capacity, it reports directly to the JOG and acts as its executive arm. The office is jointly responsible with the U.S. LHC Project Office for preparation and maintenance of the PEP, and interfaces with the DOE Division of High Energy Physics and the NSF Division of Physics, which are the respective agency offices charged with responsibility to oversee the U.S. LHC Program. The Program Manager and Associate Program Manager are responsible for coordination between the agencies of the joint oversight activities described in the Memorandum of Understanding between DOE and NSF and in the PEP.

2.6.2 U.S. LHC Project Office

The U.S. LHC Project Office is responsible for day-to-day oversight of the U.S. LHC Projects as described in the PEP. In this capacity, the U.S. LHC Project Manager reports to the U.S. LHC Program Manager, and routinely interfaces with the Project Managers for each of the U.S. LHC Projects. These managers represent the contractors and grantees to DOE and NSF. These contractors and grantees have direct responsibility to design, fabricate, and provide to CERN the goods and services agreed in the International Agreement and Protocols.

3 Physics and Computing Project

There are two primary goals of the U.S. ATLAS Computing Project. The first is to provide the software, computing and support resources to enable collaborating U.S. physicists to fully participate

in, and make significant contributions to the physics program of ATLAS. The second primary goal is to contribute to the overall ATLAS Computing effort in a degree which is both commensurate with the proportionate scale of the U.S. contributions to the detector construction and well matched to the expertise of the U.S. physicists specializing in computing.

The computing effort for the ATLAS experiment far exceeds that of previous high energy physics experiments in the scale of data volume, CPU requirements, data distribution across a global network, complexity of the software environment, and a widespread geographic distribution of developers and users of software.

There are three components of the Computing Project.

- Facilities: Hardware, networking and software support of U.S. Collaborators in data analysis and in computing contributions to the ATLAS Collaboration.
- Physics: Support of event generators, physics simulation, specification of physics aspects of facilities support.
- Software: Development and maintenance of software deliverables to the International ATLAS project, as specified in software agreements and memoranda of understanding between either CERN, the International ATLAS Collaboration and the U.S. ATLAS Computing Project.

The Computing Project covers the period from 1999 through the duration of the experiment. For expediency, the Project is delineated into two phases: the initial phase of the development of software, and support facilities prior to data taking, expected to be 2005, and the maintenance phase, where the Project must stay current with changes in computing technology, and provide ongoing support and development functions.

3.1 Physics and Computing Subproject Management

The project organization is presented in Figure 3- 1. The structure of the project organization reflects the three main components of the Computing Project: physics, facilities and software deliverables. These three components have specific level 2 WBS specifications and corresponding level 2 managers. The management structure is designed to reflect a natural flow of deliverables between U.S. ATLAS and International ATLAS, specifications and responsibilities for deliverables.

- Facilities: specifications of platform needs of U.S. ATLAS are negotiated with International ATLAS in the formulation of policies. Data and software releases are delivered from International ATLAS to U.S. ATLAS, where local support functions are provided for both.
- Software: specifications of software deliverables are designated by International ATLAS to U.S. ATLAS. Software deliverables are made from U.S. ATLAS to International ATLAS, where they are incorporated into the overall software package.

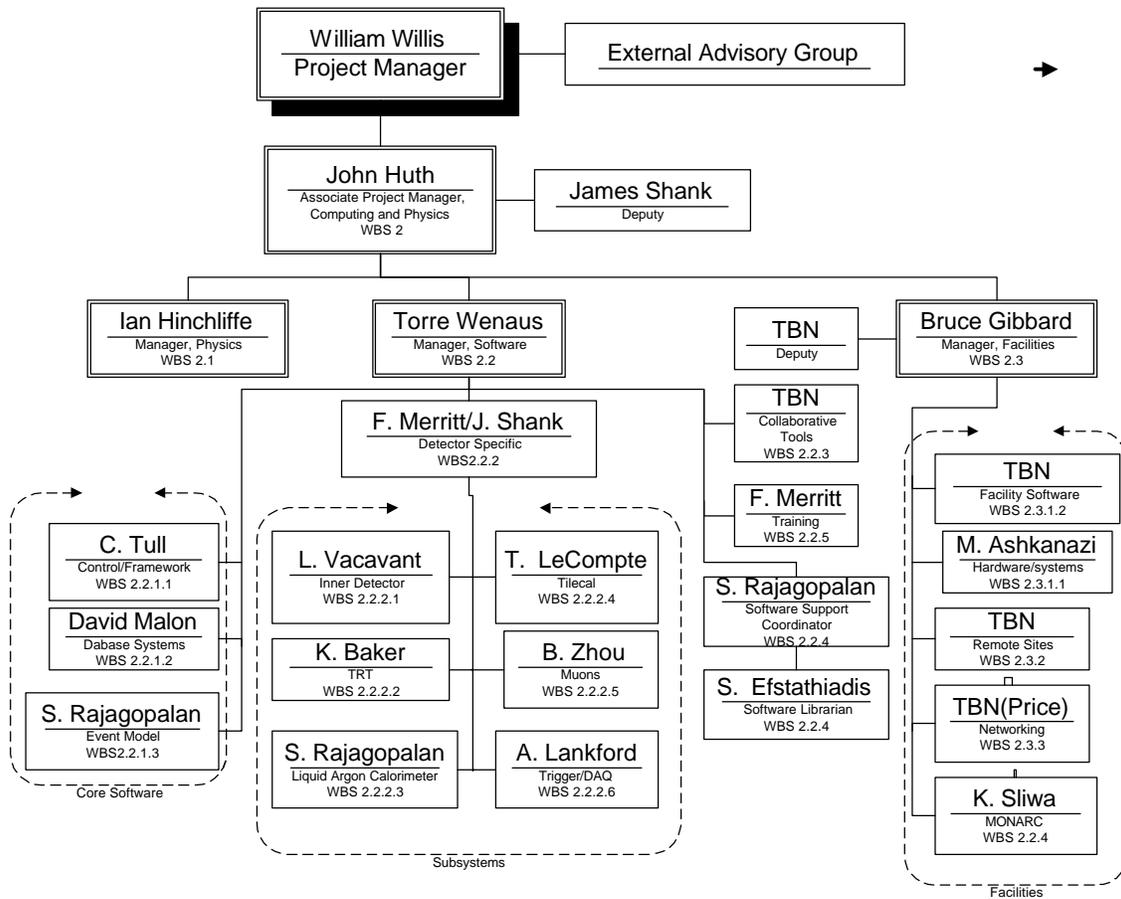


Figure 3-1 Management Structure of U.S. ATLAS Physics and Computing Project

3.1.1 Physics

The goal of the physics subproject is to provide support functions for physics related tasks both for the U.S. ATLAS Collaboration and specific responsibilities as negotiated with International ATLAS, such as support of certain event generators. The physics subproject deals with the development and maintenance of certain classes of physics objects (e.g. jets, missing energy). The physics subproject role also involves the establishment of crucial benchmark studies to measure the performance of software and facilities systems, in particular the coordination of mock data challenges for U.S. Facilities. There will be a substantial independence of all collaborators, U.S. and Internationally, in the area of data analysis, with the principle of democratic access to the data. This aspect is explicitly not included in the Physics Subproject.

3.1.2 Software

The goal of the software subproject is to provide a set of deliverable software packages to U.S. ATLAS, the International ATLAS Collaboration, CERN and the general high energy physics community, as negotiated with these organizations and specified in the form of software agreements and memoranda of understanding. Within

1. Core: General purpose software that is not specific to a given detector subsystem
2. Detector specific simulation and reconstruction
3. Training
4. Collaborative tools

the project, software is divided into the following categories:

Note that traditionally, detector specific simulation and reconstruction activities have been carried out by physicists and in the past have not involved the use of Project funds for their support. With modern software methodology, and with the increased complexity associated with the scale of the project, it is necessary to have a more systematic approach to this, including the use of some software professionals to support the activities of physicists and assist in the maintenance of reconstruction and simulation packages. Much of the specifications of reconstruction algorithms are based on decisions made by the International ATLAS Collaboration, and duties associated with the project include the implementation, documentation and maintenance of the associated software packages.

3.2 Facilities Subproject

The goals of the facilities subproject is to provide the basis for the support of U.S. ATLAS physicists in the analysis of data from the ATLAS experiment, and to carry out specific computing tasks for the International ATLAS experiment as per agreement between the two. The facilities subproject consists of the following major pieces:

1. Regional (Tier 1) computing center at Brookhaven National Laboratory
2. Software support of a code repository at BNL and support of U.S. Physicists in the use of ATLAS software.
3. Tier 2 centers. There will be roughly 5 tier 2 centers for U.S. ATLAS. These are to be linked together and with the Tier 1 center to form a coherent computing grid environment. Software hardware support functions are also carried out at these locations.
4. Participation in the construction of grid software
5. Modeling tasks to optimize resource usage.

3.3 Upper level project management: description of responsibilities

3.3.1 Associate Project Manager

1. Develop a project plan, conforming to the technical and scientific needs and policies of ATLAS and U.S. ATLAS.
2. Execute the approved project plan.
3. Establish and maintain the project organization and tracking, with the resources of BNL. This includes the management of procurements, schedules, reporting, etc.
4. Develop the annual budget request to the DOE and NSF. The requests are reviewed by the level 2 project managers and are approved by the Project Manager.
5. Act as a liaison between the project and the ATLAS Computing management.
6. Appoint the L2 managers, with the advice and concurrence of the EC and Project Manager.
7. Provide coordination and oversight to the subprojects, by requiring appropriate reporting and tracking, and the results of technical review.
8. Review and approve memoranda of understanding (MOU) between CERN and the Project, and between the Project and U.S. ATLAS Collaborating institutions.
9. Allocate money and resources within the project.
10. Exercise change control authority.
11. Establish advisory committees where appropriate.
12. Provide reports and organize reviews in conjunction with the funding agencies.

3.3.2 Project Engineer

1. Provide technical input to the development of the baseline project plan, especially with respect to budget and personnel requirements, deliverables, milestones and contingency.
2. Develop an integrated cost and schedule plan.
3. Reporting variances from the scope, schedule or cost estimates to the APM.

3.3.3 Level 2 Managers: Generic Responsibilities

The level 2 managers share a common set of responsibilities in their relation to the project. These are to:

1. Develop, in collaboration with the APM the definition of the milestones and deliverables of the subproject.
2. Develop, subject to review by the APM, the technical specifications of each component and deliverable of the sub-project.
3. Define, in consultation with the APM the organizational substructure of the subproject.
4. Develop, with the guidance of the APM, the annual budget proposal for the subproject.
5. Identify resource imbalances within their subprojects and recommend adjustments within the limits of the allocated resources.
6. Deliver the scope of the subproject on schedule, within budget and in conformance with the technical specifications of the project.
7. Be accountable for all funds allocated to the subproject.
8. Maintain the cost and schedule plan for the subproject.
9. Provide reports as required to the APM, PM.

3.3.4 Physics subproject manager

1. Provide support for physics generators, as per agreement with International ATLAS
2. Support for physics objects
3. Creation of benchmark studies to assess software and facilities readiness
4. Management of the user side of the mock data challenges
5. Provide requirements for the U.S. ATLAS computing facilities and relevant software packages

3.3.5 Software subproject manager

1. Provide oversight to agreed simulation/reconstruction activities undertaken by U.S. ATLAS groups.
2. Provide oversight and input to the U.S. ATLAS Training Coordinator in relevant software technologies.
3. Appoint level 3 and 4 managers in the software subproject, with the advice and concurrence of the APM.
4. Assist the APM in the development of software MOU's between the Computing Project and CERN
5. Assist the APM in the development of software MOU's between the U.S. ATLAS Project and participating institutions. Assess the resource requirements of proposed U.S. ATLAS software deliverables to ensure a proper matching between resources and deliverables.
6. Assess the needs of U.S. Physicists for support of ATLAS software packages, develop and implement a support plan.
7. Assess the technical risks of implementation strategies being proposed by participating U.S. Institutions and advise the APM and International ATLAS any unacceptable risks
8. Oversee core software deliverables from the U.S.

3.3.6 Facilities subproject manager

1. Assess the resource requirements of proposed U.S. ATLAS facilities and develop a plan to meet these requirements at the regional center
2. Implement the plan for the U.S. ATLAS computing facilities
3. Represent the U.S. ATLAS Computing Project on matters related to computing at regional centers
4. Develop a plan to address the U.S. contributions to the computational needs of the ATLAS experiment, including data analysis and simulation.
5. Appoint level 3 and 4 managers in the Facilities subproject, with the advice and concurrence of the APM.
6. Assist the APM in the development of facilities MOU's between the Computing Project and CERN
7. Assist the APM in the development of facilities MOU's between the U.S. ATLAS Project and participating institutions.

3.4 Software Agreements

A software agreement is established between the International ATLAS Collaboration and the U.S. ATLAS Computing and Physics Project, specifying the nature of the deliverables and/or level of effort associated the deliverables and their maintenance. Out of the overall software agreement established between International ATLAS and the U.S. ATLAS Computing and Physics Project, relevant software agreements are established between the U.S. ATLAS Computing and Physics Project and participating U.S. ATLAS Institutions. The principal software agreement is signed by the APM, appropriate representatives of the funding agencies and the Spokespersons of the ATLAS Experiment. The software agreements between the U.S. ATLAS Computing and Physics Project are signed by the APM and the relevant representatives of the participating institutions.

3.5 Memoranda of Understanding

An MOU's is established between the International ATLAS Collaboration and the U.S. ATLAS Computing and Physics Project, specifying the nature of the deliverables and/or level of effort associated the deliverables and their maintenance. Out of the overall MOU established between International ATLAS and the U.S. ATLAS Computing and Physics Project, relevant software agreements are established between the U.S. ATLAS Computing and Physics Project and participating U.S. ATLAS Institutions.

3.6 Computing and Physics Policies

A number of policy issues must be spelled out. These include local platform support, and the use of physicists within the project.

3.6.1 Local Computing Hardware Support

Until the establishment of Tier 2 centers, most of the CPU and I/O intensive computing jobs are to be performed at the Tier 1 regional center. It is recognized that there is a need for modest platform support locally

at institutions for the purposes of development. Modest support will be provided for software development at institutions that have taken on a significant responsibility, providing a working arrangement can be made such that there is an coordination in the purchase of U.S. supported platforms, and the understanding that the majority of the computation is to be carried out at the Tier 1 center. As Tier 2 centers are established, there will be a net migration of some effort to these areas.

3.6.2 Physicist Support

It is recognized that there will be a substantial amount of physicist support required. This is estimated to be at the level of roughly 50 post-doctoral scientists at the start of active data taking. As a matter of policy, it is noted that physicists are not to be included in the project funding, yet this is a substantial amount of manpower which much exist in order for the U.S. ATLAS Physics and Computing Goals to be met. These must come from the base program. Ideally a large fraction of this may be incremental or may be the result of redirection of effort.

We note that there is an additional category of support staff, which is considered to be on project. This is in the category of applications physicist. An applications physicist is typically a computer professional who has a strong background in physics and computing, and is not on an academic track. In the areas of detector specific simulation and reconstruction, we expect that there will be roughly two applications physicists per subsystem contributing to the development and maintenance of software deliverables.

3.7 Cost Estimates for Physics and Computing

In Appendix 1, we list a preliminary cost profile for the PCP, from 1999 through 2006. The asymptote of level funding may not occur until the year 2008, however. The cost tables are still in the process of being updated. In particular, the facilities subproject is in the process of revision. The core software and detector specific simulation and reconstruction activities should be relatively stable.

3.7.1 Core Software

Core software estimates were derived from comparisons with the effort required at existing experiments (BaBar, CDF and D0). The data management effort includes roughly one half of the overall effort to be devoted to data management systems, where it is expected that other collaborators would take up the additional effort. The control/framework effort is self-contained as a U.S. responsibility. Note that some sharing with other experiments may reduce the overall cost burden.

3.7.2 Detector Specific Simulation and Reconstruction Software

Here it is expected that the majority of the effort comes from physicists supported on the base program. It is noted that some level of support in the area of software integration, particularly in the areas of distributed computing environments, and code management will require some effort from software professionals. We have included an asymptote of two software professionals per subsystem, with the activity profile indicated in the spread sheet. It should be noted that one expects an effort of roughly 50 postdoctoral scientists in this area,

who are to be funded on the base program, and hence do not appear on project. We assume a roughly linear ramp from the present to the asymptote in 2006 of 50 postdoctoral scientists.

3.7.3 Facilities

The estimates are based on the scale of the computing required for Tier 1 and Tier 2 regional facilities. There is a cost sharing associated with the use of the RHIC Computing Facility (RCF). This will be updated with new information.

3.7.4 Cost Escalation and Contingency

The spread sheet is costed in FY 00 dollars. At the bottom of spread sheet are a set of cost escalation figures, based on standard government guidance for the out-years. A contingency of 40% has been applied for all items. The contingency will be updated.

4 Management and Control System

1. Baseline Development - Defining project scope and establishing the necessary cost and schedule baselines and work execution plans.
2. Project Performance - Project status monitoring, reporting and performance analysis.
3. Change Control - Management of project baselines and contingency funds.

The U.S. ATLAS project management control system (PMCS) incorporates three primary elements:

4.1 Baseline Development

The cost and schedule baseline and the hierarchical relationships are defined in a Work Breakdown Structure. Detailed cost estimates have been developed using appropriate standard estimating methodologies, and integrated with the work scope definition. Schedules and plans have been developed using a disciplined approach that integrates the work scope with the cost estimate. Resources defined in the detailed estimate are applied to the tasks established in the schedule to generate a time-phased budget. These resource-loaded schedules are then aligned to the budget profile and this establishes the schedule and cost baseline. This baseline establishes the Budgeted Cost of Work Scheduled (BCWS) which is used to formulate the overall funding profile.

4.2 Project Performance

Project performance integrates the work authorization with the funds management and accounting processes to provide a performance analysis capability that is used for reporting to both management and the DOE/NSF.

Funds management is based on funds authorized by both the DOE and NSF that are allocated to the individual institutions in accordance with the baseline estimate and the needs of the project. Funding is planned to occur twice each year. Work authorization is provided for each institution through the U.S. Institutional MOU process which defines the full work scope, including deliverables, and establishes the fiscal year funding. A yearly amendment to the Institutional MOU specifies the funding ceiling to each institution for each subsystem. Standard accounting processes are used to collect actual costs for completed work and to define the funds available for the remainder of the fiscal year. Performance analysis is provided through processing the schedules where comparisons are made between Budgeted Cost of Work Performed (BCWP) and (BCWS) as well as between BCWP and Actual Cost of Work Performed (ACWP). These comparisons provide a determination of project status, and help identify potential problems that cause schedule and cost variances.

The rudiments of performance analysis are embedded in the PCMS. The resource-loaded schedules generated during baseline development are statused on a quarterly basis and a comparison of BCWP and BCWS will yield a Schedule Variance (SV) that can be isolated to the specific task or tasks causing the variance. Also a comparison of BCWP and ACWP will yield a Cost Variance that can be attributed to the specific task or tasks causing the variance. This information can be used to establish work-arounds that will hopefully mitigate the problems.

A status report is issued each quarter that contains the following information:

1. U.S. ATLAS Project Managers overview and assessment of the project
2. A narrative describing the status of technical work, significant project accomplishments, problems and corrective action if applicable
3. A milestone schedule and status report at WBS level 2, identifying completed milestones, slippage and the percentage planned and completed based on cost performance data
4. Milestone Log
5. Critical path items will be identified for each WBS level 2 Subsystem
6. A Cost Schedule Status Report (CSSR) at WBS level 2 identifying BCWS, BCWP, ACWP, SV, CV, Budget at Completion (BAC), Estimate at Completion (EAC) and Variance at Completion
7. Variance analysis and corrective action plans where applicable

4.3 Reporting

I. Technical Progress

The responsible person in each institution responsible for effort on the PCP writes the progress by Level 3 WBS on a quarterly basis. Each item should refer to the appropriate Level 5 WBS element and any relevant milestones which are completed. This is due on a quarterly basis and is sent to the Subsystem Manager(s). Each Subsystem Manager(s) collates the input and sends it to the Project Manager by the 15th of the month after the end of each quarter. The APM for PCP reviews the reports and collates them into a single report, which is made available to the collaboration. Reports are to be logged centrally at a location associated with the U.S. ATLAS Project Office.

II. Costs

Each institution reports on each Level 5 item which is active in the following categories: The reports are placed on Atlas2 in: /pub/Incoming/Project_Management/Reporting/ Financial_Reporting. This is due on the 15th of the month following the end of the quarter in the Project Office. Reports are provided to the Subsystem Managers.

III. Performance

Each Subsystem Manager provides an estimate of the progress of each WBS Level 5 item by percentage by the 15th of the month after the end of the quarter. This is accomplished by updating EXCEL spreadsheets located on Atlas2 in /Project_Office/Reporting/Status. These reports of schedule and cost variance can be rolled up to any higher level.

IV. There are schedule status and turn-around documents. These are standardized for schedules and performance measurements at Level 5 of the WBS.

Reporting processes are employed to provide timely, accurate periodic progress reports which enable analysis, evaluation, and corrective action of work scope, schedule, and cost performance against the approved baseline.

Change Management

The Change Control Process outlined in Figure 4-1 is used to control changes to the Technical, Cost and Schedule Baselines. The membership of the Change Control Board (CCB) consists of the following:

Chair –Associate Project Manager for Physics and Computing

Project Manager

Deputy Project Manager for Physics and Computing

Subsystem Managers

Facilities Manager

Software Manager

Physics Manager

Project Office

Computing Project Engineer

Project Planning Manager

Baseline Change Proposals (BCP) for changes to the detector Technical, Cost and Schedule baselines are referred to the CCB. The following changes are required to be submitted for consideration by the Physics and Computing CCB:

1. Any change that affects the interaction between various detector systems, the interaction region, the hall safety issues. Such changes also require the concurrence of the ATLAS Change Control Board.
2. Any change that impacts the performance, the cost or schedule baselines within established thresholds, of the U.S. deliverables.
3. Any change to the project contingency budget.

The CCB considers the change and its impact, consulting, when necessary, with appropriate outside technical experts. Thresholds for the approval of changes to the detector configuration, cost and schedule are summarized in Table 4-2 along with those responsible for each level of change. After the CCB recommends action on the BCP, the PM approves or rejects the BCP. The BNL Associate Laboratory Director is also required to approve all BCPs involving a cost or schedule change. Upon approval, the change is incorporated into the baseline. An audit trail is provided for each change.

Contingency funds are held by the U.S. ATLAS Project Manager. Contingency funds may be allocated in response to requests for funds required in excess of the base cost. Such requests are reviewed and approved in accordance with the change control procedures.

Table 4-1: U.S. ATLAS Change Control Process

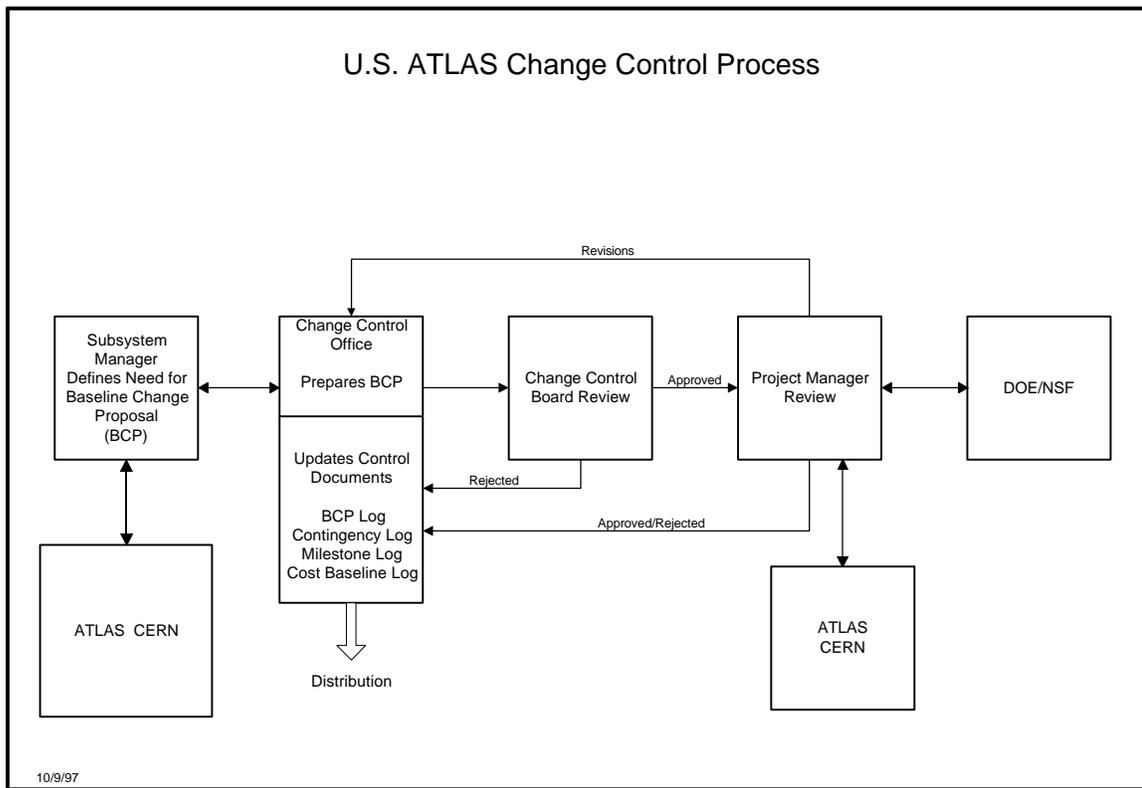


Table 4-2: U.S. ATLAS Change Control Thresholds

	Level 1 DOE/NSF Joint Oversight Group	Level 2 DOE/NSF Project Manager	Level 3 U.S. ATLAS Project Manager and BNL Associate Laboratory Director
Technical	Changes to the project purpose or goals.	Changes to the baseline list of deliverables	Changes that do not affect the Level 1 and Level 2 control items.
Cost	Changes to the Total Project Cost	Changes to the Level 2 Cost Baseline.	Changes to the cost baseline at WBS Level 3.
Schedule	Greater than 6-month change in a Level 1	Greater than 3-month change in a Level 2 milestone	Any change in a Level 3 milestone

4.4 Host Laboratory Oversight

As discussed earlier, the BNL Director has been charged by DOE and NSF with management oversight responsibility for the U.S. ATLAS activities, and he may delegate this responsibility to the BNL Associate Laboratory Director, High Energy and Nuclear Physics. The Associate Laboratory Director (ALD) has appointed a Project Advisory Panel (PAP) consisting of individuals outside of the U.S. ATLAS Collaboration with expertise in the technical areas relevant to the Project and the management of large projects, to assist him in carrying out his oversight responsibility. The PAP meets at least once per year, or more frequently if required, and its report to the ALD is also transmitted to the DOE/NSF Joint Oversight Group and to the U.S. ATLAS Project Manager. The ALD works with the PM to address any significant problems uncovered in a PAP review.

4.5 Meetings with DOE and NSF

There are regular coordination meetings between the DOE/NSF Project Manager, the Joint Oversight Group, the ALD, and U.S. ATLAS project management personnel for problem identification, discussion of issues, and development of solutions. Written reports on the status of the U.S. ATLAS Construction Project are submitted regularly, as specified in Table 4-3.

Table 4-3: Periodic Reports to DOE and NSF

REPORT	FREQUENCY	SOURCE	RECIPIENTS
Project Status	Quarterly	U.S. ATLAS Collaboration	DOE/NSF Program/Project Staff, BNL Associate Laboratory Director, PAP, Executive Committee, Institutional Representatives

4.6 Periodic Reviews

Peer reviews, both internal and external to the Collaboration, provide a critical perspective and important means of validating designs, plans, concepts, and progress. The Project Advisory Panel, appointed by the BNL Associate Laboratory Director provides a major mechanism for project review. The DOE and NSF will set up their own Technical, Management, Cost and Schedule Review Panels to review the research, development, fabrication, assembly and management of the project. In addition, the PM sets up internal review committees to provide technical assessments of various U.S. ATLAS activities, as he/she considers appropriate. Normally, all review reports are made available to members of the U.S. ATLAS Collaboration. However, if a particular report contains some material that, in the opinion of the authority to which the report is addressed, is too sensitive for general dissemination, that material may be deleted and replaced by a summary for the benefit of the Collaboration.

5 WBS Dictionary for U.S. ATLAS Computing

2.1 Physics

Covers “project” aspects of physics. This includes evaluation and creation of benchmarks for the performance of software, preparation for mock data challenges, and the support of event generators and their ATLAS interfaces that the U.S. takes on as responsibilities.

2.1.1 Physics Benchmarks

Project based effort devoted to establishing physics benchmarks to track the performance of software releases.

2.1.1 Mock Data Challenges

Effort, including software, directed at the preparation for and evaluation of mock data challenges within the U.S. and any global ATLAS effort.

2.1.2 Event Generation

Support of event generators and interfaces to ATLAS software.

2.1.3 Physics object software

Software for the creation and manipulation of physics objects (e.g. jets, electrons, missing energy)

2.2 Software Projects

Software projects that are part of the overall ATLAS (also LHC) effort. This work includes contributions to projects that the U.S. takes on as part of an overall MOU with ATLAS for software deliverables. In distinction, there is software effort associated with the regional center effort, which is mainly targeted as support for U.S. users.

2.2.1 Core Software

Non detector specific software efforts in the U.S. as part of the general computing infrastructure.

2.2.1.1 Control/Framework Software

Steering code to provide overall framework for ATLAS software

2.2.1.2 Database Management Systems

Database systems, including interfaces to commercial products.

2.2.1.3 Event Model

Description of the event as seen from the viewpoint of the physicist and how it maps into the datastore.

2.2.1.4 User Analysis Tools

Includes event visualization, histogramming and fitting packages

2.2.1.5 General Simulation and Reconstruction Software

Covers general (i.e. not detector specific) aspects of simulation and reconstruction. Examples include general detector description.

2.2.2 Detector specific simulation and reconstruction

2.2.2.1 Inner Track simulation and reconstruction software

Software, including calibration, for simulation and reconstruction for the inner tracker subsystem.

2.2.2.2 Transition Radiation Tracker simulation and reconstruction software

Software, including calibration, for simulation and reconstruction for the TRT subsystem.

2.2.2.3 Liquid Argon Calorimeter simulation and reconstruction software

Software, including calibration, for simulation and reconstruction for the L Ar subsystem.

2.2.2.4 Tilecal simulation and reconstruction software

Software, including calibration, for simulation and reconstruction for the tilecal subsystem.

2.2.2.5 Muon simulation and reconstruction software

Software, including calibration, for simulation and reconstruction for the muon subsystem.

2.2.2.6 Trigger/DAQ software

Software supporting the trigger and DAQ system.

2.2.2.7 Background studies

Associated with shielding, etc.

2.2.3 Collaborative Tools

Tools that allow collaboration from remote sites, including video conferencing, virtual notebooks, etc.

2.2.4 Software Support

Installation, support, and help desk for US installations of ATLAS offline software. US ATLAS Software Librarian.

2.2.5 Training

Training of physicists and students in software methodology, documentation and ATLAS specific packages.

2.3 Facilities

2.3.1 Tier 1 Regional Center at BNL

2.3.1.1 Hardware

2.3.1.1.1 Development and Test systems

Development software platforms for core and detector specific simulation and reconstruction software. Testing of prototype systems for full scale regional center.

2.3.1.1.2 Simulation and reconstruction

Simulation and reconstruction hardware associated with CPU intensive tasks at the Regional center.

2.3.1.1.3 Data storage

Tape and disk hardware for storage of simulated and actual data.

2.3.1.1.4 Information servers

Web sites and e-mail servers.

2.3.1.1.5 Desktop systems

Desktop computing resources for local users and visitors to regional center.

2.3.1.1.6 Data Mining/Analysis

2.3.1.1.7 Local Area Network

2.3.1.1.8 Infrastructure support

2.3.1.2 Facilities Software

Support for third party and community software tools used by ATLAS, and facility-related software. Note that in many cases, the majority of the software tools are written elsewhere, but they must be supported for U.S. users, including necessary adaptations to U.S. platforms, needs, etc.

2.3.1.2.6 Database and database management

Software purchase, modifications and interfaces for the management of event, calibration and other data resident at Regional Center.

2.3.1.2.7 Data distribution software

This includes collection of data from CERN, and distribution of data to U.S. ATLAS users at remote sites.

2.3.1.2.8 Production Software

Software supporting large scale simulation, reconstruction and analysis production jobs, and relevant server software.

2.3.1.3 System and User Support

2.3.1.3.6 Documentation

Support for the preparation, access to, management of and distribution of documentation for ATLAS software and the detector.

2.3.1.3.7 Code Management and Distribution Tools

Software tools to support code versioning, building releases and distribution.

2.3.1.3.8 Software Development Tools

Tools for designing, developing and testing software.

2.3.1.3.9 System Administration, Monitoring Tools

Tools for administration and monitoring of the regional center – accounts, usage, etc.

2.3.1.3.10 User Help Desk

Personnel and tools to support consultancy

2.3.1.3.7 Facility R&D, Prototyping, Design and Integration

2.3.1.4 Maintenance

2.3.1.4.6 Hardware maintenance

Maintenance contracts, etc for center hardware

2.3.1.4.7 Software maintenance

Cost of licensing and maintenance of regional center software

2.3.1.4.8 Systems operation

Cost of regional center operation, includes media costs, operations staff

2.3.1.4.9 Infrastructure support

Management staff, building and site expenses.

2.3.2 Remote (Tier 2,3) analysis centers

2.3.2.1 Hardware

2.3.2.1.1 Development and Test Systems

Support software platforms for core and detector specific simulation and reconstruction software.

2.3.2.1.2 Simulation and reconstruction

Simulation and reconstruction hardware associated with CPU intensive tasks at remote analysis centers.

2.3.2.1.3 Data storage

Tape and disk hardware for storage of simulated and actual data.

2.3.2.1.4 Information servers

Web and e-mail servers at remote sites

2.3.2.1.5 Desktop systems

Desktop computing resources to users at remote sites

2.3.2.1.6 Local Area Network

2.3.2.2 Software

Software particular to remote sites.

2.3.2.2.6 Database and database management

Purchase and maintenance of database systems at remote sites.

2.3.2.2.2 Simulation Software

Support of simulation software at remote sites.

2.3.2.2.3 Data and Physics Analysis Software

Support of reconstruction and analysis software for U.S. users at remote sites

2.3.2.3 System and User Support

2.3.2.3.1 Collaborative tools

Collaborative tools that enable the linkage of remote sites and support of the collaboration over long distances.

2.3.2.3.6 Code Management and Distribution Tools

Software tools to support code versioning, building releases and distribution

2.3.2.3.7 Software Development Tools

Tools for designing, developing and testing software

2.3.2.3.8 System Administration, Monitoring

Administration and monitoring of remote sites.

2.3.2.4 Maintenance at Remote Sites

2.3.2.4.6 Hardware maintenance

Maintenance contracts, etc. for hardware at remote sites

2.3.2.4.7 Software maintenance

Cost of licensing and maintenance of software at remote sites

2.3.2.4.8 Systems operations

Cost of remote site operations, including media costs, operations staff

2.3.2.4.9 Infrastructure support

Management staff, building and site expenses

2.3.3 World Wide Networking

2.3.3.1 WAN R&D, modeling and monitoring

2.3.3.2 Domestic Networking

2.3.3.3 International Networking

Includes hardware, leasing, infrastructure and operations of networking capabilities to CERN, for data transfer, collaboration needs (video conferencing), server links, etc.

Cost of shipping tapes from CERN to U.S. can be considered “networking” – broadly considered.

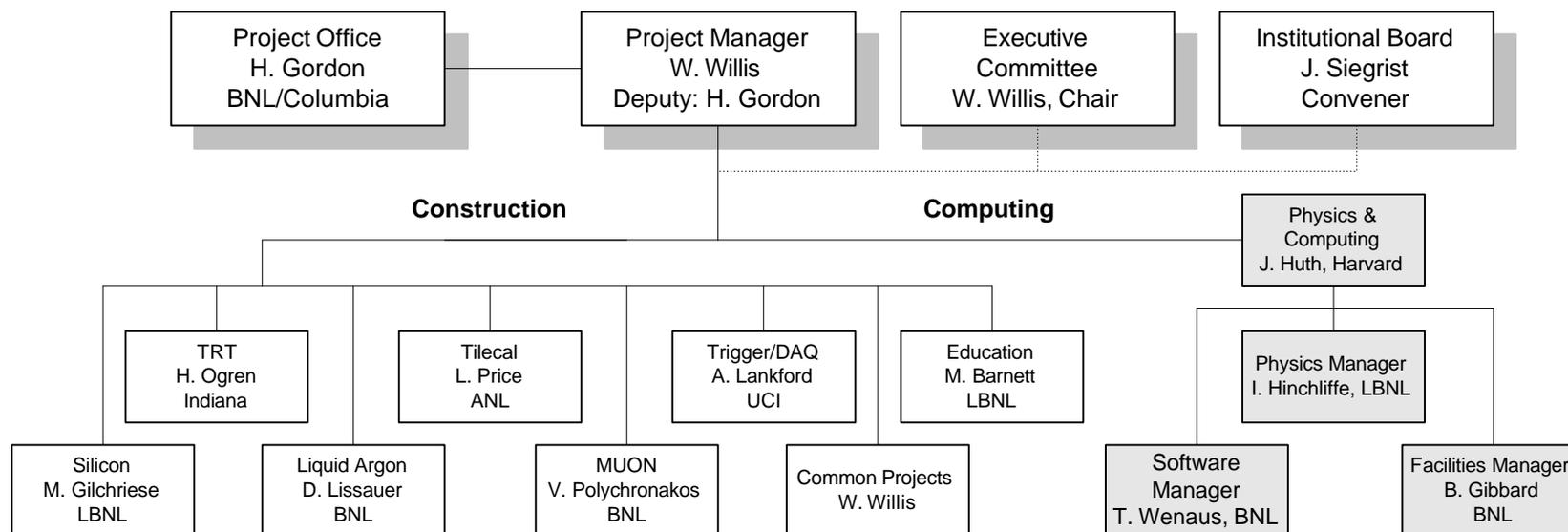
2.3.4 MONARC

Analysis of networked architectures for ATLAS computing

Appendix 1 - Proposed Budget for U.S. ATLAS Computing

Item	99 FTE	\$k	00 FTE	\$k	01 FTE	\$k	02 FTE	\$k	03 FTE	\$k	04 FTE	\$k	05 FTE	\$k	06 FTE	\$k	Total FTE	Total \$k
Core																		
Control	0.6	120	1.7	340	4	800	4	800	4	800	3	600	2	400	2	400	21.3	4260
Data management	0.7	140	3	600	5	1000	6	1200	7	1400	7	1400	7	1400	7	1400	42.7	8540
Subtotal	1.3	260	4.7	940	9	1800	10	2000	11	2200	10	2000	9	1800	9	1800	64	12800
																	0	0
Sim/recon																		
Inner Detector			0	0	0	0	1	150	2	300	2	300	2	300	2	300	9	1350
TRT			0	0	1	150	2	300	2	300	2	300	2	300	2	300	11	1650
E-Cal	0.5	75	1	150	2	300	2	300	2	300	2	300	2	300	2	300	13.5	2025
Tilecal			1	150	2	300	2	300	2	300	2	300	2	300	2	300	13	1950
Muons			0	0	1	150	2	300	2	300	2	300	2	300	2	300	11	1650
Trigger/DAQ			0	0	0	0	1	150	2	300	2	300	2	300	2	300	9	1350
Subtotal		75	2	300	6	900	10	1500	12	1800	12	1800	12	1800	12	1800	66	9975
Physics																		
Event Generator					1	140	1	140	1	140	1	140	1	140	1	140	6	840
																	0	0
Appl. Subtotal	1.3	335	6.7	1240	15	2840	20	3500	23	4000	22	3800	21	3600	21	3600	130	22915
																	0	0
Facilities																		
Tier 1 Hardware		114	0	521	0	1030	0	1462	0	1842	0	1854	0	1876	0	1904	0	10603
Tier 1 Staffing	3	420	4.5	630	7	980	9	1260	12	1680	17	2380	24	3360	24	3360	100.5	14070
Tier 2 Staffing	0	0	2	280	4	560	11	1540	12	1680	13	1820	10	1400	8	1120	60	8400
Tier 2 Hardware			0	200	0	500	0	2000	0	2000	0	2000	0	2000	0	2000	0	10700
Tier 2 Subtotal			0	480	4	1060	11	3540	12	3680	13	3820	10	3400	8	3120	58	19100
Networking		22.8	0	104.2	0	206	0	292.4	0	368.4	0	370.8	0	375.2	0	380.8	0	2120.6
Subtotal	3	556.8	6.5	1735.2	11	3276	20	6554.4	24	7570.4	30	8424.8	34	9011.2	32	8764.8	160.5	45893.6
																	0	0
Subtotal (no Tier 2)	4.3	891.8	11.2	2495.2	22	5056	29	6514.4	35	7890.4	39	8404.8	45	9211.2	45	9244.8	230.5	49708.6
Total (w/ Tier 2)	4.3	891.8	13.2	2975.2	26	6116	40	10054	47	11570	52	12225	55	12611	53	12365	290.5	68808.6
Multipliers																		
Core FTE to \$	200																	
Sim/recon FTE to \$	150																	
Facility FTE to \$	140																	
FY Multipliers	0.98		1	1	1	1.025	1	1.0517	1	1.0811	1	1.114	1	1.1436	1	1.1779	1	
Application Sub	328.3			1240		2911		3681		4324.4		4233.2		4117		4240.4		25075.25
Contingency	1.4	459.62		1736		4075.4		5153.3		6054.2		5926.5		5763.7		5936.6		35105.35
Reg. Cen. Facilities		545.66	6.5	1255.2	7	2271.4	9	3170.2	12	4205.9	17	5129.7	24	6417	24	6649		
Contingency	1.4	763.93		1757.3		3180		4438.3		5888.3		7181.6		8983.8		9308.6		41501.8035
Tier 2		0	0	480	4	1086.5	11	3723	12	3978.4	13	4255.5	10	3888.2	8	3675		
Contingency	1.4	0		672		1521.1		5212.2		5569.8		5957.7		5443.5		5145.1		29521.4276

Appendix 2: U.S. ATLAS Organization



Appendix 3: DOE-NSF-U.S. ATLAS Organization

