

April 12, 2007

**U.S. ATLAS Research Program
Management Plan**

SUBMISSION AND APPROVALS

This Management Plan defines the organization, systems and relevant interfaces for the U.S. Collaboration's participation in the operation of the ATLAS detector at the Large Hadron Collider (LHC) at the European Laboratory for Particle Physics (CERN), and in the planned physics investigations enabled by the detector. This management plan covers both pre-operations, operations, and detector maintenance, upgrade R&D and software and computing efforts required for successful U.S. participation in the research program. The U.S. role in the operation of the ATLAS detector is funded jointly by the U.S. Department of Energy and the National Science Foundation. This document is intended to meet the expectation for management plans addressing pre-operations, operations, upgrade detector R&D and software & computing discussed in Reference 1 and Appendix 1 (DOE/NSF MOU and BNL Host Lab Letter).

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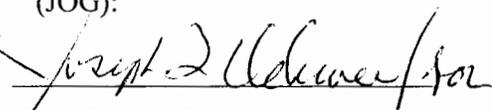

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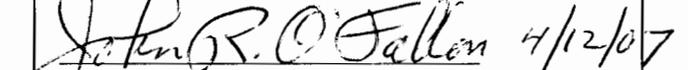

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TABLE OF CONTENTS

LIST OF ABBREVIATIONS	5
1 INTRODUCTION	7
1.1 The U.S. ATLAS Research Program and the Transition from the U.S. ATLAS Construction Project	7
1.1.1 Overview of the Research Program Management Plan.....	7
1.2 Description of Detector	8
2 ATLAS OBJECTIVES.....	9
2.1 Scientific Objectives	9
2.2 Technical Objectives.....	9
2.3 Cost and Schedule Objectives.....	10
3 ATLAS ORGANIZATION	10
3.1 The International ATLAS Experiment and its Management.....	10
3.1.1 ATLAS Computing and Physics Management	11
3.2 Membership of the U.S. ATLAS Collaboration.....	12
3.3 Management Organization of the U.S. ATLAS Research Program	13
3.3.1 U.S. ATLAS Research Program Manager and Deputy Research Program Manager	13
3.3.2 Institutional Board.....	14
3.3.3 Executive Committee	15
3.3.4 Education/Outreach Coordinator (WBS 3.8)	15
3.3.5 Subsystem Managers.....	15
3.3.6 Associate Program Manager for Physics Support and Computing	15
3.3.7 Executive Program Manager for Physics Support and Computing.....	16
3.3.8 Physics Advisor (PA).....	16
3.3.9 Software and Analysis Support Manager (SASM)	16
3.3.10 Facilities Manager.....	17
3.3.11 Upgrade R&D Manager	17
3.3.12 Brookhaven National Laboratory (BNL) and Columbia University	17
3.3.13 Detector Advisory Panel (DAP) and Computing Advisory Panel (CAP).....	18
3.4 U.S. Funding Agencies	18
3.5 Research Program Responsibilities	18
4 WORK BREAKDOWN STRUCTURE (WBS)	19
5 SCHEDULES AND MILESTONES OF THE RESEARCH PROGRAM	19
5.1 Schedules	19
5.2 Summary Schedule.....	19
6 COST ESTIMATES	19
6.1 Cost Objectives	19
7 MANAGEMENT SYSTEM	20
7.1 Prioritization of Different Parts of the Research Program.....	20
7.2 Performance.....	20
7.3 Reporting.....	20
7.3.1 Technical Progress	20
7.3.2 Costs.....	20
7.3.3 Procurements.....	20
7.4 Change Control.....	20
7.5 Meetings with DOE and NSF	22

7.6	Periodic Reviews	22
8	SUPPORTING FUNCTIONS.....	22
8.1	Quality Assurance	22
8.2	Environment, Safety & Health	23
8.3	Property Management	23
9	ORGANIZATION OF THE U.S. ATLAS RESEARCH PROGRAM OFFICE (RPO)	23
10	REVIEW AND MODIFICATION OF THIS RESEARCH PROGRAM MANAGEMENT PLAN	24
11	REFERENCES	24

LIST OF TABLES

Error! No table of figures entries found.	Table 7-2: U.S. ATLAS Change Control Process	21
	Table 7-3: U.S. ATLAS Change Control Thresholds	22

APPENDICES

Appendix 1: Letter to Dr. J. Marburger from the Joint Oversight Group, 11/21 2000	25
Appendix 2: U.S. ATLAS Participating Institutions	27
Appendix 3: Current Institutional Responsibilities	28
Appendix 4: Letter to Dr. P. Chaudhari from the Joint Oversight Group, 11/7 2003	29
Appendix 5: Research Program Organization	31
Appendix 6: MOU, Funding and Reporting Process	32
Appendix 7: DOE-NSF-U.S. LHC Research Program Organization	33
Appendix 8: WBS	34

LIST OF ABBREVIATIONS

ACWP	Actual Cost of Work Performed
ALD	BNL Associate Laboratory Director for High Energy and Nuclear Physics
APM	Associate Program Manager for Physics Support and Computing
AY	At Year (referring to a dollar value)
BCP	Baseline Change Proposal
BCWP	Budgeted Cost of Work Performed
BCWS	Budget Cost of Work Scheduled
BAO	Brookhaven Area Office
BNL	Brookhaven National Laboratory
CB	ATLAS Collaboration Board
CCB	Change Control Board
CDD	CERN Drawing Directory
CERN	European Laboratory for Particle Physics
CH	Chicago Operations Office
CMB	Computing Management Board
COB	Computing Oversight Board
C-RRB	Computing Resources Review Board
CY	Calendar Year
DOE	Department of Energy
DRPM	Deputy Research Program Manager
EC	Executive Committee
EDIA	Engineering Design, Inspection and Assembly
EDMS	Engineering Data Management System
EPM	Executive Program Manager for Physics Support and Computing
ES&H	Environmental Safety and Health
GriPhyN	GRId PHYsics Network (NSF Funded)
HEP	DOE Headquarters Office of High Energy Physics
IB	Institutional Board
ICB	International Computing Board
IMOU	Institutional MOU (between U.S. ATLAS Research Program Office and an Institution)
IPA	Intergovernmental Personnel Appointment
IT	Information Technology
iVGDL	International Virtual Data Grid Laboratory (NSF Funded)
JOG	Joint Oversight Group
L2	WBS Level 2, e.g. 2.2
LCG	Large Hadron Collider Computing Grid Project
LHC	Large Hadron Collider
LHCC	CERN LHC Committee
M&O	Maintenance and Operations
MEG	M&O Evaluation Group
MOU	Memorandum of Understanding
MRE	Major Research Equipment
NSF	National Science Foundation
OSG	Open Science Grid
PBS	Product Breakdown Structure
PCAP	Physics and Computing Advisory Panel
PEB	Project Execution Board (for computing)
PO	U.S. ATLAS Project Office
POB	Project Oversight Board (for computing)
PPDG	Particle Physics Data Grid (DOE Funded)
QAP	Quality Assurance Plan

QAR	Quality Assurance Representative
R&D	Research and Development
RMCS	Research Management Control System
RPAP	Research Program Advisory Panel
RPM	U.S. ATLAS Research Program Manager
RPMP	Research Program Management Plan
RPO	U.S. ATLAS Research Program Office
RPMS	Research Program Management System
RRB	ATLAS Resource Review Board
SASM	Software and Analysis Support Manager
SC	DOE Office of Science
SC2	Software Computing Committee
SG	Scrutiny Group
SL	ATLAS System Leader
SM	U.S. ATLAS Subsystem Manager
SPMB	Software Project Management Board
TDR	Technical Design Report
TRT	Transition Radiation Tracker
WBS	Work Breakdown Structure

1 INTRODUCTION

1.1 The U.S. ATLAS Research Program and the Transition from the U.S. ATLAS Construction Project

1.1.1 Overview of the Research Program Management Plan

The U.S. Department of Energy and National Science Foundation are supporting the U.S. involvement in the two large detectors for the CERN Large Hadron Collider (LHC), ATLAS and CMS, through the fabrication of equipment and systems for those detectors as well as the U.S. involvement in the ensuing Research Program. The U.S. ATLAS Program thus includes the U.S. ATLAS Construction Project and the U.S. ATLAS Research Program. The U.S. ATLAS Construction Project, the fabrication, delivery and installation of detector components for the initial ATLAS detector by U.S. institutions, is well underway and is managed according to the U.S. ATLAS Construction Project Management Plan (USATLAS 99-20), originally approved in March 1998.

The DOE and NSF have chosen to treat the totality of activities necessary for the U.S. to participate in the LHC as a single program that includes construction and subsequent research efforts for U.S. ATLAS, U.S. CMS and the U.S. LHC Accelerator. The management structures, roles, and responsibilities will be described in individual research program management plans such as this document, addressing both M&O, Software & Computing and Upgrade R&D. The U.S. LHC Construction Project Execution Plan (PEP) (Reference 2) will continue to define the management, execution and oversight arrangements for the U.S. ATLAS Detector Construction Project until its completion.

Since the U.S. work on the ATLAS Experiment is funded by both DOE and NSF, a Joint Oversight Group formed by the two agencies performs periodic reviews and assesses technical, schedule and cost performance. The specific responsibilities of the JOG are addressed in a Memorandum of Understanding between the DOE and the NSF on U.S. Participation in the LHC Program (Reference 1) and the Research Program Execution Plan (Reference 2).

The International Cooperation Agreement between CERN and DOE and NSF Concerning Scientific and Technical Cooperation on Large Hadron Collider Activities of December 8, 1997 defines the U.S. responsibilities common to all parts of the LHC Program. The Experiments Protocol Concerning Scientific and Technical Cooperation on the Large Hadron Collider ATLAS and CMS Detectors of December 19, 1997, describes DOE and NSF responsibilities for the detectors. Finally, there are Memoranda of Understanding between nations participating in the LHC experiments and CERN, describing the responsibilities of all participants in these experiments. The Memorandum of Understanding (MOU) for Maintenance and Operation of the Detector between The European Organization for Nuclear Research (CERN) and the Funding Agencies of the Collaboration governing M&O of the experiment defines the roles, responsibilities and obligations of the U.S. ATLAS institutions during the operation and maintenance phases of the experiment (CERN-RRB-2002-035).

In addition to the ATLAS MOU for M&O agreement on pre-operations and operations, there will also be an ATLAS Memorandum of Understanding between CERN and the ATLAS funding agencies governing the Software & Computing (S&C) aspects of the LHC Research Program. The Software and Computing MOU has been preceded by Software Agreements covering responsibilities for software development before the final MOU is defined.

The U.S. ATLAS Research Program consists of three major components: 1) Physics Support and Computing (including software and related hardware; 2) pre-operations, operations, detector maintenance and education/outreach (collectively referred to as M&O); and 3) Upgrade R&D. The grouping of these three components follows the guidance of the Joint Oversight Group of the DOE and NSF (JOG) (see Appendix 1 and subsequent funding guidance).

The M&O follows the large U.S. investment in the construction of major pieces of the ATLAS detector. It is crucial that the U.S. provide continuous support to assure that physics can be obtained by U.S. Groups. The U.S. ATLAS Research Program provides the computer professionals and equipment that will assure that U.S. physicists will have sufficient capability to contribute strongly to the physics analysis. It is not the intention of the U.S. ATLAS Research Program to manage the physics analysis. A long lead investment for Detector Upgrade R&D is needed in order to be ready to do physics with an upgraded LHC currently expected for 2012-15.

The present document describes an organization and management plan for U.S. responsibilities during the pre-operations and research program of the ATLAS experiment. This program begins with pre-operations of completed components of the detector before the turn-on of the initial detector, now expected in CY 2007. It includes U.S. responsibilities for M&O of the detector and its subsystems and for Upgrade R&D for the detector. This management plan anticipates that the upgrades, when proposed and approved, will be managed within the Research Program and an amendment will be made at that time. The Research Program of the ATLAS experiment will last for an indefinite time after initial turn-on and is expected to extend for at least 20 years, as established in the "International Cooperation Agreement" between CERN and the U.S. (Appendix A of Reference 1).

The U.S. ATLAS Collaboration presently consists of scientists and engineers from 32 U.S. universities and three national laboratories, and is part of the international ATLAS Collaboration that has overall responsibility for the ATLAS detector. U.S. institutions admitted to the ATLAS Experiment (Appendix 2) are automatically included in the U.S. ATLAS organization. The Host Laboratory for the U.S. ATLAS Research Program will be Brookhaven National Laboratory, where the U.S. ATLAS Research Program Office will be located (see Appendix 1 – Letter to Marburger).

During this next 20-year period, physicists on U.S. ATLAS will be involved and committed to the exploitation of the ATLAS detector for the advancement of knowledge of particle physics. However, funding for physicists at U.S. ATLAS institutions and the conduct of their research activities will not be managed under this Research Program Management Plan. It is assumed that salaries and all expenses of scientific personnel for U.S. ATLAS will be provided via the core research program, and fulfill the needs and challenges of U.S. operational responsibilities on the ATLAS detector. We expect U.S. physicists to continue to be leading contributors to the ATLAS physics analysis program. MOUs will be written between each institution and the U.S. ATLAS Research Program Office that will list all physicists working on data analysis as well as those contributing to the Research Program.

1.2 Description of Detector

The ATLAS detector consists of an inner tracking system with silicon pixels, silicon strips and a transition radiation tracker (TRT); a liquid argon electromagnetic and a forward calorimeter; a scintillating tile hadronic calorimeter; a muon spectrometer; and a trigger and data acquisition system. There is a superconducting solenoid and superconducting toroid magnets to provide charge and momentum measurements of charged-particle products of the collisions. U.S. groups are involved in almost all of these components of the ATLAS detector, which is being built by a large international collaboration. Detailed descriptions of all these systems are given in the Technical Design Reports (TDRs), which have been reviewed by the CERN LHC-Committee (LHCC) and approved by the Director General of CERN.

2 ATLAS OBJECTIVES

2.1 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 requires an experiment that can examine a large rate of particle collisions at very high energy. The LHC will collide protons against protons every 25 ns at a center-of-mass energy of 14 TeV and a luminosity of $10^{34} \text{ cm}^{-2} \text{ s}^{-1}$. It will likely take a few years of running to reach the full design luminosity.

The detector is designed to be capable of reconstructing a variety of interesting final states. It must be able 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 possible structure in the WW scattering amplitude, the new energy regime will also offer the opportunity to probe quark substructure and to search for new phenomena. The detector must be sufficiently versatile to detect and identify the final state products in such 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, τ leptons, and photons, and be sensitive to energy carried off by weakly interacting particles such as neutrinos or supersymmetric particles that cannot be detected directly. The ATLAS detector has been designed to have all these capabilities.

2.2 Technical Objectives

The ATLAS detector is designed to perform a comprehensive study of the source of electroweak symmetry breaking, as well as to search for a host of other phenomena that may be observed at these new energies. It is expected to operate for twenty or more years at the CERN LHC, observing collisions of protons, and recording more than 10^9 events per year. The critical objectives needed to achieve these goals are:

- Excellent photon and electron identification capability, as well as measurement of their energies and directions.
- Efficient charged-particle track reconstruction and good momentum resolution.
- Excellent muon identification capability and momentum resolution.
- Well-understood trigger system to go from a 1 GHz interaction rate to ~ 100 Hz readout rate, with minimal loss of interesting signal.
- Excellent coverage in calorimetry to provide accurate measurement of the directions and energies of quarks and gluons, and excellent reconstruction of missing transverse momentum.
- Efficient tagging of b-decays and b-jets.

The detector completed as part of the Construction Project will be extremely versatile and will meet all of these requirements. Reliable operation of the detector will also be required to meet the physics objectives. Appropriate attention must be paid to calibration of each detector element, selection and implementation of triggers, and maintenance and reliability, among other requirements.

Upgrades to the initial detector will be needed to meet objectives that are understood now but could not be met with the initial detector because of cost and/or schedule constraints. In addition, new capabilities are expected to be identified that may be needed or highly desirable as a result of the understanding of both the physics requirements and detector capabilities that will emerge from initial operating experience. A major upgrade is envisaged in the next decade in light of plans to increase the luminosity of the LHC by a factor of ten to $10^{35} \text{ cm}^{-2} \text{ s}^{-1}$. Any proposed upgrades will have a well-defined approval procedure within ATLAS, as well as thorough outside peer and U.S. agency reviews for the portions of the detector funded by the U.S.

2.3 Cost and Schedule Objectives

ATLAS has made an estimate of M&O costs through a committee established by the Collaboration Board. The committee included representatives of ATLAS Management and of each detector system. The resulting report titled "ATLAS M&O Working Group Conclusions and Recommendations" was accepted by the Collaboration Board and has been reviewed by CERN management.

The ATLAS M&O budgets are prepared yearly. These estimates include category A, B and C items. Category A represents common responsibilities shared by all funding agencies, proportional to the number of scientific authors; category B represents costs for a particular system in ATLAS, and is shared by the institutes with responsibility for that system, based on their investment in the initial detector; and Category C is the responsibility of the host lab (CERN).

Detailed schedules for installation, commissioning, operations and maintenance are developed by the ATLAS Technical Coordination organization. First collisions at the LHC are scheduled in 2007. The lifetime of the experiment will be determined through a variety of considerations, including the richness of emerging physics, availability of funds, and the construction of new facilities in the field. Nevertheless, it is expected that the experiment will take data for a minimum of 20 years.

There is an MOU for Collaboration in the Deployment and Exploitation of the LHC Computing Grid (CRRB-D200). This MOU specifies the contributions of the U.S. Tier 1 and Tier 2 computing facilities. An Addendum of this MOU for Core Computing specifies the software professionals needed for ATLAS and the U.S. contribution to this effort.

3 ATLAS ORGANIZATION

3.1 The International ATLAS Experiment and its 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 marshalling 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 the term. The CB Chairperson appoints (and the CB ratifies) a smaller advisory group that can be consulted between ATLAS collaboration meetings.

Executive responsibility within ATLAS is carried by the Spokesperson who is elected by the CB for renewable three-year terms. The Spokesperson is empowered to nominate one or two deputies to serve for the duration of the Spokesperson's term in office. The Spokesperson represents the ATLAS Collaboration in all its external activities.

The ATLAS central management team presently includes Technical and Resource Coordinators, both CERN staff members whose appointments require CERN management approval. The Technical Coordinator has overall responsibility for technical aspects of detector construction. This includes responsibility for integration of ATLAS subsystems and for coordinating with the CERN infrastructure, including the installation of the experiment at surface and underground areas. The Resource Coordinator is responsible for the budget and human resources, including securing Common

Fund resources, and negotiating the MOUs with funding agencies. It is likely that the management will evolve to meet the needs of the Research Program.

The ATLAS Spokesperson presently chairs an Executive Board (EB), consisting of representatives from the major detector subsystems, the Technical, Resource, Computing, Physics and Electronics Coordinators and two at-large members. Computing Coordination involves the Computing Coordinator and the Software Project Leader. The Executive Board directs the execution of the ATLAS experiment according to the policies established by the Collaboration Board.

There is also a Technical Management Board chaired by the Technical Coordinator that meets monthly.

Each ATLAS subsystem has a Project Leader responsible for ensuring that the design, construction, installation and commissioning of the corresponding subsystem is 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. A Physics Coordinator leads the different physics analysis groups.

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. With regard to oversight of the ATLAS M&O costs, the RRB is assisted by a CERN Scrutiny Group, the role of which is to analyze critically the M&O reports and estimates made by the Collaboration, refine estimates in consultation with the Collaboration and advise the RRB on any course of action. The Scrutiny Group is set up to include representatives from Member States and Non-Member states, so far including a U.S. representative.

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) 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 will use these management procedures and tools in the same way as other ATLAS institutions. Similar structures are expected to be used for any future upgrade projects for the ATLAS detector.

3.1.1 ATLAS Computing and Physics Management

An organization is in place in the ATLAS Collaboration for the development of computing and analysis capabilities. In this section, we give a brief description of the main elements.

The organization of ATLAS Computing is illustrated in the chart found at the URL: <http://atlas.web.cern.ch/Atlas/GROUPS/SOFTWARE/OO/Organisation/>

The top level of management of ATLAS Computing, which reports to the ATLAS EB, consists of the Computing Coordinator and the Software Project Leader. These positions have three-year terms, and are filled by the Spokesperson following a nomination process and subsequent approval by the Collaboration Board. The highest level of oversight for computing is left to the Computing Oversight Board (COB), which consists of the ATLAS Spokesperson, Deputy Spokesperson, Physics Coordinator, Computing Coordinator and Software Project Manager. The Computing Coordinator is advised by the International Computing Board (ICB). The International Computing Board is chaired

by a member nominated and elected by the Board, with the approval of the Spokesperson. The ICB consists of one member from each country associated with resources employed by ATLAS Computing, and has the purpose of refining and approving the computing model, gathering and assigning resources and acting as an interface between ATLAS Computing and the national funding agencies. Ultimately, computing resources specific to ATLAS are reviewed in the ATLAS Resources Review Board (RRB).

A Computing Management Board (CMB) reports to the Computing Coordinator. The CMB consists of members who act as liaisons in several domains that affect ATLAS Computing: the ICB Chair, a liaison for the Trigger and Data Acquisition subsystem, a liaison to Physics Coordination, Commissioning, Data Model, Data Management, Grid and Data Challenge Coordinators and the Planning and Resources Organizer. The Software Project Manager works with the Architecture Team (A-Team) to build, document, and maintain the primary software services required by ATLAS Computing. Subsystem-specific software, such as detector simulation and reconstruction, are the responsibilities of the detector subsystems, but require liaisons from each of the subsystems to the Software Project Manager. In addition to the subsystem-specific software, there are areas that are coordinated by the Software Project Manager: Simulation, Core Services, Infrastructure (e.g., code management), Calibration/Alignment, Event Selection and a liaison to the Data Management. Each of these areas has a person reporting to the Software Project Manager. Taken together, the responsible parties form the Software Project Management Board (SPMB).

A second area of computing that U.S. ATLAS participates in is the LHC Computing Grid Project (LCG). The LCG is a project that is central to all four LHC experiments and is intended to provide the computing infrastructure required in common to LHC via the use of computational grids. The LCG organization structure can be found at the following URL: <http://lcg.web.cern.ch/LCG/project-structure.html>.

Resources specific to LCG are reviewed by the Computing Resources Review Board (C-RRB). High level oversight of the LCG is undertaken by the Project Oversight Board (POB), which consists of one member from each nation contributing significant resources to LHC Computing, the LCG Project Manager, a representative of CERN management, the Director of the Information Technology Division (IT) at CERN, a recording secretary, and the computing coordinator from each of the four experiments. The POB meets three times a year. Operations of the LCG are managed by the Project Execution Board (PEB), which is managed by the LCG project manager, appointed by the CERN Director General. The PEB consists of distinct work areas, such as common application support, CERN computing infrastructure, grid middleware etc., each with its own sub-manager. All managers of work areas covered by LCG are members of the PEB and report to the LCG Project Manager. The PEB is responsible for executing the computing requirements established by the Software and Computing Committee (SC2) which consists of representatives from each of the LHC experiments and some regional centers. In addition to establishing the computing requirements, the SC2 meets monthly and tracks milestones and progress of the LCG.

3.2 Membership of the U.S. ATLAS Collaboration

The U.S. ATLAS Collaboration consists of physicists and engineers from U.S. institutions collaborating on the ATLAS experiment at the CERN LHC. Appendix 2 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. Current institutional responsibilities are shown in Appendix 3. New U.S. institutions formally voted in as members of ATLAS become automatic members of U.S. ATLAS.

While the current U.S. ATLAS physics program focuses on High Energy Physics and is supported by the HEP and EPP divisions of DOE and NSF, we expect that the U.S. scientific program will expand beyond that area to include, for example, Heavy Ion Physics (which has been a component of the overall ATLAS physics program). Given that support for Heavy Ion Physics in the U.S. is provided

by the Nuclear Physics divisions of the DOE and NSF, this Research Program Management Plan will be amended to address the related support issues for such a U.S. program when it is approved.

3.3 Management Organization of the U.S. ATLAS Research Program

A Research Program Management structure has been established to facilitate interactions with U.S. funding agencies and for effective management of U.S. ATLAS activities and resources. This structure is supported by the Research Program Offices located at the host lab, BNL, and the university that is the home institution of the Research Program Manager or the Deputy, currently Columbia, and is in accord with the letter (see Appendix 4) from the Joint Oversight Group to the BNL Director requesting that a U.S. ATLAS Research Program Manager and Deputy Research Program Manager be appointed. We will use "Columbia" in a representative sense the rest of this document. Appendix 5 shows the organization chart for the U.S. ATLAS Research Program. It is headed by a U.S. ATLAS Research Program Manager and Deputy. Reporting directly to the Research Program Manager are a Coordinator for Education/Outreach, Managers for each subsystem, an Upgrade R&D Manager and the two managers for Physics Support and Computing. The organization also includes an Institutional Board with representation from each collaborating institution, and an Executive Committee. The responsibilities of each are described below. U.S. ATLAS planning and management is being done in close cooperation with the overall ATLAS management team. The U.S. Subsystem Managers interact closely with the corresponding overall ATLAS System Leaders, and there is also close cooperation between Physics Support and Computing Managers, and the U.S. ATLAS Research Program Manager and Deputy maintain close contact with the ATLAS Spokesperson, Deputy Spokespersons, and the Technical and Resource Coordinators.

3.3.1 U.S. ATLAS Research Program Manager and Deputy Research Program Manager

The U.S. ATLAS Research Program Manager (RPM) has the responsibility of providing programmatic coordination and management for the U.S. ATLAS Research Program. The RPM represents the U.S. ATLAS Collaboration in interactions with overall ATLAS management, CERN, DOE, NSF, the universities and national laboratories involved and BNL, the Host Laboratory, on all issues concerning the Research Program. The RPM is appointed by the Director of BNL with concurrence of the Joint Oversight Group (JOG) of DOE and NSF and recommendation from the U.S. ATLAS Institutional Board. The RPM serves renewable terms of five years and reports to the BNL Director (or an appointed representative). The RPM is advised by an Executive Committee, as described below. A U.S. ATLAS Deputy Research Program Manager (DRPM) is also appointed by the Director of BNL and shares responsibilities with the RPM. The DRPM may represent the RPM as needed. With respect to technical, budgetary, and managerial issues, the Deputy Research Program Manager, the Subsystem Managers, the Upgrade R&D Manager, and the Physics Support and Computing Manager, augmented by the Convener of the Institutional Board, act as a subcommittee of the Executive Committee to provide advice to the RPM. Consultation with this subcommittee is part of the process by which the RPM makes major technical and managerial decisions. An example of this kind of managerial decision would be a modification of institutional responsibilities.

The responsibilities of the U.S. ATLAS Research Program Manager include:

1. Appointing, after consultation with the U.S. ATLAS Collaboration and approval of the IB, the U.S. Subsystem Managers for M&O, the Upgrade R&D Manager, and the Physics Support and Computing Managers.
2. Preparing the yearly funding requests to DOE and NSF for the anticipated U.S. ATLAS Research Program.
3. Recommending to DOE and NSF the institution-by-institution U.S. ATLAS Research Program funding allocations to support the U.S. ATLAS Research Program. These recommendations will be made with the advice of the U.S. ATLAS Executive Committee.
4. Approving budgets and allocating funds in consultation with the SMs and with the EPM for Physics Support and Computing and Management Reserve, in accord with the Change Control Process in Section 7.4.

5. Establishing, with the support of BNL and Columbia management, a U.S. ATLAS Research Program Office offering appropriate support services.
6. Working with BNL management and the U.S. LHC Research Program Office (RPO) to set up and respond to other mechanisms needed to carry out oversight responsibility.
7. Keeping the BNL Director or representative and the U.S. LHC Research Program Office well informed on progress of the U.S. ATLAS Research Program, and reporting promptly any problems whose solutions may benefit from joint efforts of the RPM, BNL management and the U.S. LHC Research Program Office.
8. Interacting with CERN and ATLAS management on issues affecting resource allocation and availability, and preparation of international MOUs defining U.S. responsibilities and signing 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 (IMOU) representing agreements between the U.S. ATLAS Research Program Office and the U.S. ATLAS collaborating institutions specifying responsibilities and resources available on an institution-by-institution basis.
11. Reporting periodically on U.S. ATLAS Research Program status and other issues to the U.S. LHC Research Program Office and the Joint Oversight Group.
12. Representing the U.S. ATLAS collaboration in discussions with funding agencies and planning bodies, including the APS Division of Particles and Fields and HEPAP.
13. 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.
14. Making periodic reports to the U.S. ATLAS Institutional Board to ensure that the Collaboration is fully informed about prevailing issues.
15. Overseeing ES&H and QA/QC Management for the U.S. institutions.
16. Discussion for priorities for supplemental support from the core program with DOE/NSF.

The channels for Research Program funding, reporting, and transmission of MOUs are shown in Appendix 6. DOE Research Program funding will be a mixture of grants and Research Contracts through BNL. NSF funding will be carried out via subcontracts through Columbia University. Further details on the titles and roles of participants in the governance of the U.S. ATLAS Collaboration are given below.

3.3.2 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 three-year renewable term. The IB will normally meet at least once 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. Only IB members or their designates can vote on any question.

The IB members represent the interests of their institutions, and serve as contacts between the U.S. ATLAS management structure and the collaborators from their institutions, who select their respective representatives.

The Institutional Board deals with general issues of policy affecting the U.S. ATLAS Collaboration. For example, the IB discusses applications of new institutions to join ATLAS and forward the conclusion to the U.S. ATLAS Research Program Manager. As chairman of this board, the Convener organizes meetings on issues of general interest and represents U.S. ATLAS on issues that affect the Collaboration. The Convener also prepares nominations of ad hoc committees to run elections for which the IB is responsible, including those for additional subsystem members of the Executive Committee and for IB Convener. The committees must be approved by the IB. The Convener recommends to the Institutional Board the establishment of any standing committees to deal with Collaboration-wide issues if the need arises. A Subcommittee of the Institutional Board also provides its recommendation on the appointment of the Research Program Manager and Deputy to the BNL Director, and to the U.S. LHC Research Program Office.

3.3.3 Executive Committee

The Executive Committee is chaired by and advises the Research Program Manager on global and policy issues affecting the U.S. ATLAS Collaboration or the U.S. ATLAS Research Program. Its membership is constituted from the following:

- The Research Program Manager
- The Construction Project Manager (as long as one exists)
- The Deputy Research Program Manager
- The Subsystem Managers and the Physics Support and Computing Managers
- Physics Advisor
- One Subsystem Representative from each subsystem in which U.S. groups play a major role
 - * Silicon tracker
 - * TRT
 - * Liquid argon calorimeter and forward calorimeter
 - * Tile calorimeter
 - * Muon spectrometer
 - * Trigger/DAQ subsystems
- The Education/Outreach Coordinator
- Software and Analysis Support Manager
- Facilities Manager
- The U.S. members of the overall ATLAS Executive Board
- The Convener of the Institutional Board
- Upgrade R&D Manager and
- Other members mandated by the Institutional Board

3.3.4 Education/Outreach Coordinator (WBS 3.8)

The Education/Outreach Coordinator, appointed by the RPM, is expected to champion educational programs associated with ATLAS and with the U.S. member institutions, to report to the Executive Committee on these issues, and to 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.

3.3.5 Subsystem Managers

The Subsystem Managers (for WBS 3.1-3.6, 3.10) are responsible for the technical, schedule, and cost aspects of the M&O for their subsystems. They are appointed by the U.S. ATLAS Research Program Manager upon recommendation of the IB members whose institutions are involved in that subsystem. They develop budgets for the institutions participating in their subsystems and serve on a subcommittee of the Executive Committee advising the RPM on technical, budgetary, and managerial issues relevant to the U.S. ATLAS Program.

3.3.6 Associate Program Manager for Physics Support and Computing

The Associate Program Manager for Physics Support and Computing (APM), appointed by the RPM with concurrence of the IB, is responsible for technical, managerial, political, and schedule aspects of broader external entities that overlap, include or impact on U.S. ATLAS Computing and Physics program. Examples of such entities are the DOE and NSF, BNL, the LHC Computing Grid (LCG) project, the Open Science Grid (OSG), the Particle Physics Data Grid (PPDG), GriPhyN and the International Virtual Data Grid Laboratory (iVDGL).

The management responsibilities of the APM include:

1. Development of long-term strategies for funding the physics support and computing program.

2. Coordination of long-term computing strategies with U.S. Funding agencies, other U.S. organizations (U.S. CMS, Regional centers, other sciences), International ATLAS and CERN.
3. Acting as liaison between the program and the ATLAS Computing management, in particular in matters with broader impact and long-range effect such as the grid computing efforts.
4. Act as a liaison between the U.S. ATLAS Research Program and the LCG.
5. Act as a liaison between the U.S. ATLAS Research Program and other relevant grid projects such as PPDG and iVDGL.

3.3.7 Executive Program Manager for Physics Support and Computing

The Executive Program Manager for Physics Support and Computing (EPM), appointed by the RPM with concurrence of the IB is responsible for the technical, schedule and cost aspects of U.S. ATLAS Computing, overseeing the work of the Level 2 Software-Analysis and Facilities Managers. The EPM develops the budgets for the participating institutions.

Management responsibilities of the EPM include:

1. Establishing and maintaining the organization of the work breakdown structure and tracking based on the resources of the U.S. ATLAS Research Program Office; this includes the management of procurements, schedules, reporting, etc.
2. Developing the annual budget request for the RPM; the budget requests are reviewed by level 2 project managers and are approved by the RPM.
3. Acting as a liaison between U.S. ATLAS physics support and computing efforts and the ATLAS Computing management on matters concerning the WBS, manpower and U.S. deliverables.
4. Appointing the Physics Advisor, Software and Analysis Support Manager and the Facilities Manager with the concurrence of the RPM and the IB.
5. Providing coordination and management direction to the subprojects, including requirements for appropriate reporting and tracking, and responses to technical reviews.
6. Reviewing and recommending approval of memoranda of understanding (MOU) between CERN and the U.S. ATLAS Program concerning physics and computing.
7. Preparing change control requests within program change control protocols.
8. Establishing advisory committees where appropriate.
9. Providing reports and organizing reviews in conjunction with the U.S. LHC Research Program Office.
10. Reviewing and recommending approval of institutional memoranda of understanding (IMOU) between the U.S. ATLAS Research Program Office at BNL and U.S. ATLAS institutions.

3.3.8 Physics Advisor (PA)

The Physics Advisor is charged with providing advice to the EPM to ensure that the overall goals of LHC physics are considered in any decision-making process. The PA also acts as a U.S. ATLAS liaison to ATLAS physics management, advises U.S. ATLAS physicists and ensures that U.S. physicists are aware of developments in ATLAS physics. The PA is appointed by the EPM, with the approval of the RPM and the IB.

3.3.9 Software and Analysis Support Manager (SASM)

SASM is a L2 manager responsible for the technical, schedule, and cost aspects of U.S. work on ATLAS software and analysis support. SASM appoints the L3 managers for Core Services, Data Management, Application Software, and Infrastructure Support in consultation with EPM. SASM has the overall responsibility of ensuring that U.S. physicists have access to the necessary software tools and support to enable them to participate effectively in the LHC physics program. SASM develops the budgets for the institutions participating in work on software and analysis support. SASM is appointed by the EPM with the approval of the RPM and the IB.

The Chair of the Analysis Support Group (ASG, WBS 2.2.6) is appointed by the RPM, DRPM, EPM and SASM.

3.3.10 Facilities Manager

The Facilities Manager is a L2 manager responsible for the technical, schedule, and cost aspects of U.S. ATLAS computing facilities. The U.S. ATLAS Facilities Organization provides the support for computing facilities used for the analysis of data by U.S. ATLAS physicists and carries out specific computing tasks for the International ATLAS experiment per agreement between the two. The Facility Manager's responsibilities include Level 3 tasks involving the national Tier 1 computing center at Brookhaven National Laboratory; Tier 2 centers, of which there will be roughly 5 for U.S. ATLAS; Production; implementation of grid software; and optimizing use of resources. Level 3 Managers will be appointed by the Facilities Manager for each of these tasks. The Facilities Manager is appointed by the Executive Program Manager, with approval of the Research Program Manager and the IB.

3.3.11 Upgrade R&D Manager

The Upgrade R&D Manager is responsible for technical, schedule and cost aspects of U.S. ATLAS Upgrade R&D. This R&D is focused on developing detectors that are envisaged for ~2015 in the plan to increase LHC luminosity to 10^{35} cm²s⁻¹. A separate organization under the Upgrade R&D Manager may be required in the future.

3.3.12 Brookhaven National Laboratory (BNL) and Columbia University

The DOE and NSF have assigned BNL management oversight responsibility for the U.S. ATLAS Research Program. The BNL Director has the responsibility to assure that the operations effort is being managed soundly, that technical responsibilities are executed in a timely way, that technical or financial problems, if any, are being identified and properly addressed, and that management organization is in place and functioning effectively. The BNL Director has delegated certain responsibilities and authorities to the Associate Laboratory Director for High Energy and Nuclear Physics. The Associate Laboratory Director is responsible for day-to-day management oversight of the Research Program and the U.S. ATLAS Research Program Manager reports to him/her. Specific responsibilities of the BNL Directorate include:

1. Upon recommendations of the U.S. ATLAS Collaboration, appointing the U.S. ATLAS Research Program Manager and Deputy, subject to the concurrence of the Joint Oversight Group;
2. Establishing an advisory structure external to the U.S. ATLAS Research Program for the purpose of monitoring both management and technical progress for all U.S. ATLAS activities;
3. Assuring that the Research Program Manager has adequate staff and support, and that U.S. ATLAS management systems are matched to the needs of the tasks;
4. Consulting regularly with the Research Program Manager to assure timely resolution of management challenges;
5. Concurring with any International Memoranda of Understanding specifying U.S. responsibilities for the U.S. ATLAS Research Program funded by DOE and NSF.
6. Concurring with the institutional Memoranda of Understanding for the U.S. ATLAS collaborating institutions that specify responsibilities and resources for each institution;
7. Ensuring that there is accurate and timely reporting to the U.S. LHC Research Program Office.
8. Approving Research Program Change Proposals, as indicated in Section 7, which includes any use of Management Reserve.

As the host laboratory for U.S. ATLAS, BNL will have the following responsibilities:

1. Staffing and operating the U.S. ATLAS Research Program Office;
2. Operating and upgrading as needed the U.S. ATLAS Tier 1 center for computing support;
3. Ensuring that funding and facilities permit strong participation in physics analysis by U.S. ATLAS researchers.

The NSF Division of Physics has delegated financial accountability to Columbia University inclusive of line management authority, responsibility and accountability for overall implementation of operations,
U.S. ATLAS Research Program Management Plan

and contract administration. The Director of Nevis Laboratory of Columbia University is responsible for dispersal of NSF funds according to the allocations recommended by the U.S. ATLAS Research Program Manager, and in accordance with NSF policies. Brookhaven and Columbia are also collaborators in U.S. ATLAS with specific responsibilities for Physics and Computing, M&O and Upgrade R&D work, as well as full participation in physics analysis activities.

3.3.13 Detector Advisory Panel (DAP) and Computing Advisory Panel (CAP)

The Brookhaven Associate Laboratory Director for High Energy & Nuclear Physics (ALD) appoints the Detector Advisory Panel (DAP) and Computing Advisory Panel (CAP), consisting of individuals outside of the U.S. ATLAS Collaboration with expertise in technical areas relevant to the Research Program and the management of large projects. The DAP assists the ALD in oversight responsibility for the work performed in the Research Program, including the operation of the detector, work on upgrade R&D, and provides advice on the rate of progress and adherence to the operations plan as it relates to cost, schedule and technical performance. The CAP assists the ALD in oversight responsibility for the work performed in the Research Program including computing and provides advice on the rate of progress and adherence to the operations plan as it relates to cost, schedule and technical performance. The primary mechanism for performing this oversight role is through the Research Program Manager's periodic reviews of the U.S. ATLAS subsystems, followed by discussions among the attending DAP and CAP members and U.S. ATLAS principals and Subsystem Managers. If necessary, additional mechanisms may be employed as deemed necessary to exercise the oversight function. These can include special reviews or meetings of the U.S. ATLAS Research Program. The DAP and CAP report to Laboratory management by means of verbal discussions and written reports following each major DAP and CAP review. DAP and CAP reports are transmitted to DOE and NSF and the U.S. LHC Research Program Office. The ALD works with the RPM to address any problems uncovered in these reviews.

3.4 U.S. Funding Agencies

The Department of Energy and the National Science Foundation are the funding agencies for the U.S. participation in ATLAS Research Program. As such the agencies determine the program scope, approve annual budgets, and monitor program implementation. The organization structure of DOE and NSF as it relates to the U.S. ATLAS Research Program is shown in Appendix 7.

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

The U.S. ATLAS Research Program 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 established a U.S. LHC Joint Oversight Group (JOG) as the highest level of joint U.S. LHC Research Program management oversight.

The detailed description of the JOG and the U.S. LHC Research Program Office are found in a separate document (Reference 2).

3.5 Research Program Responsibilities

General responsibilities for the operation and upgrade of the detector components will be assigned through the traditional process of matching interests, capabilities, and resources of the members of the U.S. ATLAS Collaboration. These responsibilities for M&O are specified in the international Memorandum of Understanding (MOU) agreed to by all the funding agencies. U.S. institution-by-institution responsibilities will be detailed in Institutional Memoranda of Understanding (MOUs) executed by the U.S. ATLAS Research Program Office with the individual U.S. institutions. Appendix 3 lists the current U.S. institutions participating in the U.S. ATLAS Research Program.

4 WORK BREAKDOWN STRUCTURE (WBS)

Project Management procedures, as described in Sections 4 to 7, will be applied to work on upgrades to the ATLAS detector and to the execution of other parts of the Research Program, as deemed useful and appropriate. In general, the work on pre-operations and M&O will follow from the detector components that the U.S. delivers to ATLAS. Although a detailed WBS will be prepared for pre-operations, M&O, upgrade R&D and Physics Support and Computing, only any future Upgrades (Construction), following proposal and approval, will use a traditional resource-loaded schedule and performance measures.

All work required for the successful conduct of the U.S. ATLAS Research Program will be organized into a Work Breakdown Structure. The WBS completely defines the scope of work, the deliverables, and is the basis for planning, cost and schedule estimates, and measurement of performance. The current WBS is given in Appendix 8 and will be expanded to a level sufficient to allow definition of individual tasks/elements for which costs can be estimated.

Cost estimates will be generated at the most detailed level of the WBS and summed to the top level to determine the total cost of the U.S. ATLAS Research Program. Schedules with milestones are established. Interdependencies (project logic) will be defined between the WBS elements to generate detailed schedules that phase each task. The analysis of completed milestones and costs provides a method for measuring performance.

To take into account uncertainties in cost estimates, contingency based on a risk analysis for each WBS element are added to the costs. The result is a 25% Management Reserve created to avoid the risk of overruns on these tasks.

5 SCHEDULES AND MILESTONES OF THE RESEARCH PROGRAM

Schedules for the U.S. ATLAS Research Program will be generated based on the WBS.

5.1 Schedules

The detailed schedules will be generated by each Subsystem Manager to show milestones and resources for all efforts associated with work required to be provided for that subsystem. Activity duration, start and completion dates are coordinated with ATLAS schedule activities to ensure that the completion date for ATLAS is maintained. These activities are logically interconnected to form networks with all other elements that comprise the subsystem. These schedules are maintained by the Subsystem Managers and are kept consistent with the current cost estimate. The detailed schedules from each subsystem will be used to generate the summary schedules that are used for estimating the schedule and costs.

5.2 Summary Schedule

Key U.S. ATLAS milestones and other selected milestones from the schedules are incorporated into a summary milestone schedule that is used for reporting purposes. This summary schedule addresses all subsystems and provides an overview of work in process. These schedules are updated on the basis of status inputs and used for periodic reporting. Whenever possible we use ATLAS milestones.

6 COST ESTIMATES

6.1 Cost Objectives

Cost estimates will be prepared by the Managers using the WBS. All estimates will include all labor, materials and supplies (M&S) and travel required to complete the work comprising the U.S. ATLAS Research Program and will be specified in MOUs and yearly updates. A Management Reserve will be controlled by the Research Program Manager. Escalation will be based on the latest DOE guidance.

7 MANAGEMENT SYSTEM

7.1 Prioritization of Different Parts of the Research Program

Acting on the basis of the yearly funding guidance from the U.S. LHC RPO, the Research Program Manager sets target budgets for each Level 2 component of the Research Program including M&O, Physics Support and Computing, and Upgrade R&D. Priority may have to be placed on one of these areas, depending on the level of the guidance and the needs of the experiment. Prioritization by the RPM will be established in consultation with the Executive Committee.

7.2 Performance

The management of funds will be guided by the level of support from DOE and NSF in accordance with the estimated needs of the U.S. ATLAS Research Program. Funding is planned to be distributed as much as twice each year. Work authorization is provided for each U.S. institution through a yearly Institutional MOU process. Standard accounting procedures are used to collect costs for completed work and to define the funds available for the remainder of the fiscal year. A status report is to be issued each quarter, as shown in Table 7-1.

Table 7-1: Periodic Reports to DOE and NSF

REPORT	FREQUENCY	SOURCE	RECIPIENTS
Research Program Status	Quarterly	U.S. ATLAS Collaboration	U.S. LHC Research Program Office BNL Associate Laboratory Director RPAP, Executive Committee, PCAP Institutional Representatives

7.3 Reporting

7.3.1 Technical Progress

The individual responsible for each activity at each institution will report the progress in each quarter. Each item should refer to the appropriate Level 3 WBS element and any completed milestones. This is due on the 5th of the month following the end of the quarter and is sent to be sent to the Subsystem Manager. Each level 2 Manager collects the input and enters a summary by the 15th of the month. The Executive Manager for Physics Support and Computing writes a summary of the activities for those areas. The Research Program Manager collects the whole report and writes an overall assessment and summary, and finishes the report by the 25th of the month following the end of the quarter.

7.3.2 Costs

Each institution reports on each active Level 5 item. Reports are provided to the U.S. ATLAS Research Program Office.

7.3.3 Procurements

The U.S. ATLAS Research Program has defined procurements over \$100k as major and subject to U.S. ATLAS Research Program Office tracking and control. U.S. ATLAS will work closely with the ATLAS Technical or Operations Coordinator in making sure that proper design reviews are conducted. The U.S. ATLAS Research Program Manager must approve major procurements and the U.S. LHC Program Manager must be notified at least two days prior to the award of a contract larger than \$1,000,000.

7.4 Change Control

Management Reserve funds are held by the U.S. ATLAS Research Program Manager.

The Change Control Process outlined in Table 7-2 is used to control changes to Technical Scope Costs or Schedules. The membership of the Change Control Board (CCB) consists of the following:

- Chair - Research Program Manager
- Deputy Research Program Manager
- Subsystem Managers
- Physics Support and Computing Managers
- U.S. ATLAS Research Program Office (See Section 9.0)

Research Program Change Proposals (RPCP) for changes to the Technical Scope, Cost or Schedule are referred to the CCB. The following changes are required to be submitted for consideration by the CCB:

Any change that affects the interaction between different detector systems, the interaction region, or hall safety issues. Such changes also require the concurrence of international ATLAS.

Any change beyond the threshold in Table 7-3 that alters the scope, the cost or schedule as defined in major Agency Reviews of the Research Program.

Any change to the budget of the Management Reserve.

After the CCB recommends action on the RPCP, the RPM approves or rejects the RPCP. The BNL Associate Laboratory Director is also required to approve all RPCPs involving a technical, cost or schedule change. The ATLAS Spokesperson must be notified of all changes. The U.S. LHC Research Program Office must also approve any changes. Upon approval, the change is incorporated into a log. An audit trail is provided for each change.

Table 7-2: U.S. ATLAS Change Control Process

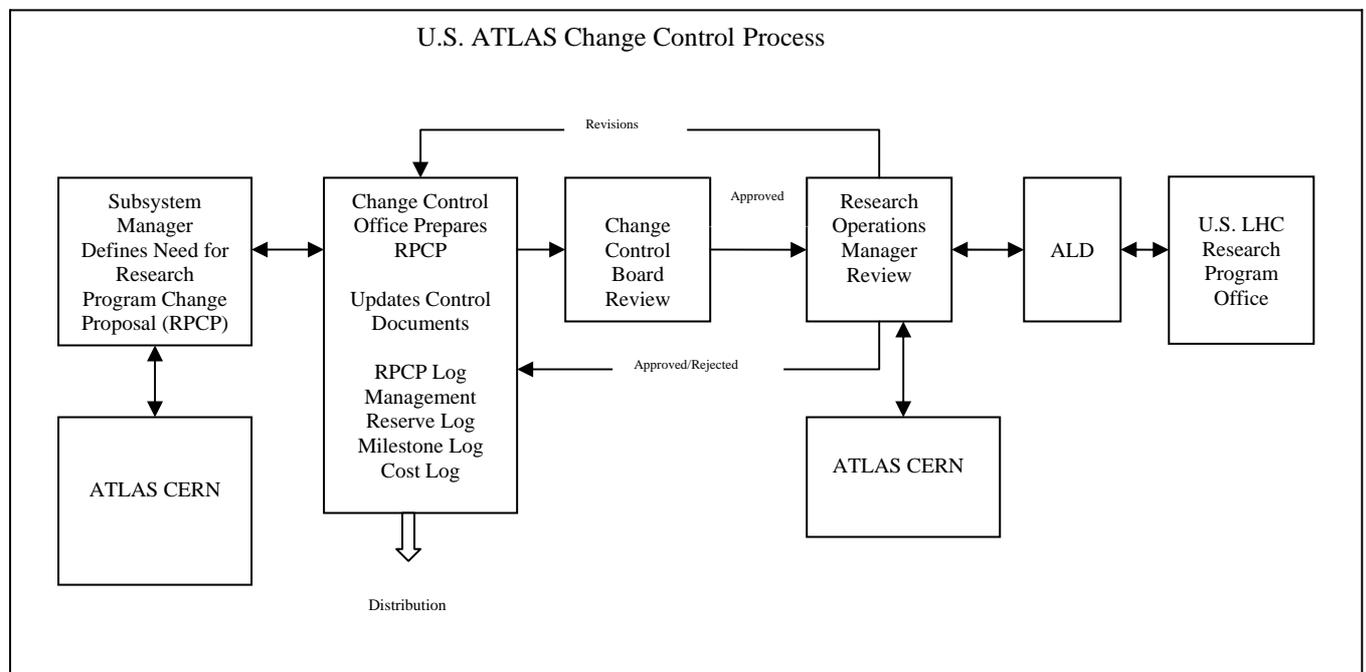


Table 7-3: U.S. ATLAS Change Control Thresholds

Level 3 U.S. ATLAS Research Program Manager and BNL Associate Laboratory Director	
Technical	Changes in scope.
Cost	Changes to the cost at WBS Level 2 compared to the previous agency review.
Schedule	Greater than a 3 month change in a high level milestone.

7.5 Meetings with DOE and NSF

There are regular coordination meetings between the DOE/NSF U.S. LHC Research Program Management, the Joint Oversight Group, the ALD, and U.S. ATLAS Research Program Management personnel for problem identification, discussion of issues, and development of solutions. Written reports on the status of the U.S. ATLAS Research Program are submitted regularly, as specified in Table 7-1. See RPEP.

7.6 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 Research Program Advisory Panel, appointed by the BNL Associate Laboratory Director provides a major mechanism for review. The PCAP provides reviews of the Physics Support and Computing activities and reports to the EPM. The U.S. LHC Research Program Office conducts separate reviews of U.S. ATLAS pre-operations, operations activities and plans, and software and computing activities. In addition, the RPM conducts internal reviews to provide technical assessments of U.S. ATLAS activities, as deemed appropriate. Normally, reports from reviews are made available to members of the U.S. ATLAS Collaboration. However, if a particular report contains material that is too sensitive for general dissemination, it may be deleted and replaced by a summary for the benefit of the Collaboration.

In addition to the day-to-day interaction of the line managers there are major mechanisms for periodic formal assessment of the U.S. ATLAS Research Program. These mechanisms include meetings of the JOG or periodic peer-reviews and evaluations conducted at the request of the U.S. LHC Research Program Office, the host laboratory and through any internal reviews conducted by laboratory and university program managers.

In particular, regular reviews are conducted by the U.S. LHC Research Program Office of both the U.S. LHC Detector Maintenance & Operations (M&O) and the U.S. LHC Software & Computing (S&C) elements. A U.S. LHC Detector M&O Evaluation Group (MEG) has been established with members having expertise in maintenance and operation of particle physics detectors. The MEG assesses the U.S. ATLAS and U.S. CMS Collaborations' proposals concerning the M&O scope and costs, and reports to the U.S. LHC Research Program Office. Similarly, the U.S. LHC S&C efforts of U.S. CMS and U.S. ATLAS are reviewed annually by a committee of computing experts that reports to the U.S. LHC Research Program Office.

8 SUPPORTING FUNCTIONS

8.1 Quality Assurance

The overall ATLAS Management has established a Quality Assurance Plan (QAP) at CERN to assure that the detector systems will achieve the technical requirements and reliability needed for operation
U.S. ATLAS Research Program Management Plan

at the LHC. A general description of the ATLAS QAP is given in ATLAS Document ATL-GE-CERN-QAP-0101.00. It assigns overall responsibility for this task to the ATLAS Spokesperson, assisted by the Technical Coordinator. Furthermore, each ATLAS System Leader (SL) is assigned the responsibility of implementing a Quality Assurance Plan relevant to that subsystem. Each SL is expected to designate a Quality Assurance Representative (QAR) with the authority and organizational freedom to identify potential and actual problems that could result in a degradation of quality, to recommend corrective actions and to verify implementation of solutions.

Quality Assurance is an integral part of the U.S. ATLAS Research Program. The U.S. ATLAS Research Program Manager has overall responsibility for quality assurance. In general, the U.S. ATLAS Subsystem Managers have the quality assurance responsibilities for their subsystems including the following aspects of quality control:

- Identification of those areas, concepts and components that require in-depth studies, prototyping and testing
- Incorporation of necessary acceptance tests into plans and specifications.
- Verification of system performance.
- Documentation of procedures and test results for fabrication and procurement phases.

8.2 Environment, Safety & Health

International ATLAS Management has established an ES&H program at CERN to assure that the delivered detector systems conform to safety standards in force for LHC operations at CERN operations. This program meshes well with the policies of the CERN Safety Commission. Specifically, work in ATLAS follows a Work Package procedure where the leader of a given Work Package not only plans the work, but also identifies the risks and methods of mitigating any risks. The leader of a given Work Package is responsible for specifying any necessary training required by individuals doing particular work and for ensuring that those individuals complete any required training. The U.S. ATLAS Research Program Manager has overall responsibility for ensuring that members of any subsystem within the U.S. ATLAS Research Program work together with the ATLAS Group Leader in Matters of Safety (GLIMOS) to satisfy all ATLAS-specified safety regulations and that all institutional ES&H requirements are fully met for work performed at any U.S. ATLAS institutions.

In December 2006, ATLAS adopted a notification procedure for any accident determined serious by the ATLAS management, whereby the Institutional Representative from every institution in the world will be kept informed about details of such an incident and any follow-up. In turn, the U.S. ATLAS Research Program Manager and/or Deputy will inform the Director and/or the Head of ES&H at the host lab, BNL, as well as LHC Program Manager and Deputy in the DOE and NSF. The U.S. Research Program Manager and Deputy can then follow-up any issues raised by any incident.

8.3 Property Management

All property will be managed in accordance with established practices of the participating U.S. ATLAS institutions. Property transferred to CERN will be subject to provisions of the International Agreement.

9 ORGANIZATION OF THE U.S. ATLAS RESEARCH PROGRAM OFFICE (RPO)

The U.S. ATLAS Research Program Office is located at the Host Laboratory, Brookhaven National Laboratory and at Columbia University. The RPO provides technical coordination and financial support to the Research Program Manager and Deputy. The Research Program Manager or Deputy provides direction to RPO staff and manages the day-to-day operations of the RPO. The RPO will be staffed to coordinate administrative and technical activities of U.S. ATLAS including:

- Annual preparation of budget,
- Financial and Technical reporting,

- Development of Proposals for any future Upgrade of the detector.

The RPO staff will include a Planning Manager and a program engineer. The Operations Office will have the responsibility of reviewing and issuing contracts in support of Research Operations. This includes funding specific activities at collaborating U.S. institutions.

10 REVIEW AND MODIFICATION OF THIS RESEARCH PROGRAM MANAGEMENT PLAN

After its adoption, this Research Program Management Plan will be reviewed periodically by the Research Program Manager and the other Managers as part of the preparation for reviews by the RPAP. Proposals for its modification may be initiated by the RPM, the Executive Committee, the BNL Associate Laboratory Director, and the funding agencies. Significant changes to the plan require approval of the U.S. LHC Research Program Office and Joint Oversight Group. Modifications of the Research Program Management Plan will require approval of the RPM, the Associate Laboratory Director, the U.S. LHC Program Manager, and the Joint Oversight Group.

11 REFERENCES

1. U.S. LHC Construction Project Execution Plan, Rev. 1, October, 2002.
2. U.S. Research Program for the Large Hadron Collider, Research Program Execution Plan, January 2005.

Appendix 1: Letter to Dr. John Marburger from the Joint Oversight Group Fall, 2000



*U.S. Department of Energy
and the
National Science Foundation*



JOINT OVERSIGHT GROUP

NOV 21 2000

Dr. John Marburger
Director
Brookhaven National Laboratory
P.O. Box 5000
Upton, New York 11973-5000

Dear Dr. Marburger:

The U.S. Department of Energy (DOE) and the National Science Foundation (NSF) are supporting construction of the Large Hadron Collider (LHC) at the European Center for Particle Physics (CERN) under the terms of the International Agreement between CERN and the U.S. with its protocols and the interagency Memorandum of Understanding of December, 1999. Under that Agreement the U.S. ATLAS Construction Project has been managed by Brookhaven National Laboratory (BNL) as Host Laboratory. Brookhaven National Laboratory, as the Host Laboratory, has provided the central management to oversee and coordinate project activities and reporting, in addition to providing specific elements of the project as a collaborating institution.

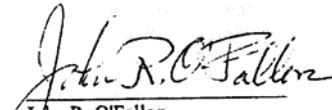
The International Agreement provides that, beyond the LHC Construction Project, U.S. scientists will participate as full partners in the LHC Research Program. The DOE and the NSF are now considering the elements necessary for successful U.S. participation in the Research Program, including both the pre-operational and operational phases. The first elements of that participation are in place, namely the designation of BNL and Fermilab as Host Laboratories, respectively, for the U.S. ATLAS and U.S. CMS Research Programs. The Host Laboratories, in partnership with the U.S. ATLAS and CMS collaborations, have already made substantial progress in organizing and implementing the U.S. LHC Software and Computing Project. In particular, the management structures are in place, Project Management Plans have been drafted, and software development and Tier 1 computing centers have been initiated. A baseline review of the Project is scheduled for November 2000.

Another major component of the U.S. LHC Research Program, pre-operational and operational support of U.S. participation in the ATLAS and CMS detectors beyond base support, must now be put in place. You have agreed to be Host Laboratory for the U.S. ATLAS Research Program. In that capacity we now request that you initiate planning and assume management oversight for the pre-operational and operational phases of the U.S. ATLAS Research Program. This management oversight includes the development of annual budget requests, and the preparation, in concert with the U.S. ATLAS Collaboration, of a Management Plan for Pre-operations and Operations. The draft Plan should be submitted to the DOE/NSF Joint Oversight Group for approval.

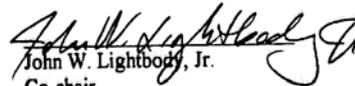
Plans to be developed with the appropriate leadership at CERN could be expected to include:

- Participation in detector operations and data monitoring;
- Support for monitoring and maintenance of U.S.-provided subsystems;
- Establishment of an environment at BNL including a virtual control room to facilitate U.S.-based ATLAS physics analysis; and,
- Continuing R&D, with possible fabrication, of upgrades to enhance the physics productivity of the detector.

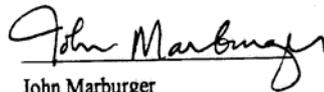
This document further specifies the responsibilities agreed upon in the Host Laboratory letter of August 1999. Funding will be identified to carry out the U.S. ATLAS Research Program, including both U.S. Software and Computing, and Pre-operations and Operations. We expect that the methods for allocating the designated funding will be similar to those used for the U.S. ATLAS Construction Project. The methods of allocation should be specified in the Project Management Plan.


John R. O'Fallon
Co-chair
U.S. LHC Joint Oversight Group
Department of Energy

Sincerely,


John W. Lightbody, Jr.
Co-chair
U.S. LHC Joint Oversight Group
National Science Foundation

On behalf of Brookhaven National Laboratory, I accept this further specification of the Host Laboratory role for the U.S. ATLAS Research Program.


John Marburger
Director
Brookhaven National Laboratory

Appendix 2: U.S. ATLAS Participating Institutions

Argonne National Laboratory
University of Arizona
Boston University
Brandeis University
Brookhaven National Laboratory
University of California, Berkeley/Lawrence Berkeley National Laboratory
University of California, Irvine
University of California, Santa Cruz
University of Chicago
Columbia University (Nevis Laboratory)
Duke University
Hampton University
Harvard University
University of Illinois at Urbana-Champaign
Indiana University
Iowa State University
University of Iowa
Louisiana Tech University
U. of Massachusetts, Amherst
Massachusetts Institute of Technology
Michigan State University
University of Michigan
University of New Mexico
New York University
State University of New York at Albany
State University of New York at Stony Brook
Ohio State University
University of Oklahoma/Langston University
Oklahoma State University
University of Oregon
University of Pennsylvania
University of Pittsburgh
Stanford Linear Accelerator Center
University of South Carolina
Southern Methodist University
University of Texas at Arlington
University of Texas at Dallas
Tufts University
University of Washington
University of Wisconsin, Madison
Yale University

Appendix 3 – Current Institutional Responsibilities

Subsystem	Institutions
Silicon	UC-Berkeley/LBNL, UC-Irvine, UC-Santa Cruz, Iowa State, Iowa, Louisiana Tech, New Mexico, Ohio State, Oklahoma, SLAC, SUNY-Albany, Wisconsin
TRT	Duke, Hampton, Indiana, Pennsylvania, Yale
Liquid Argon Calorimeter	Arizona, BNL, Columbia, Pittsburgh, Rochester, Southern Methodist U., SUNY-Stony Brook
Tile Calorimeter	ANL, Chicago, Illinois at Champaign-Urbana, Michigan State, SLAC, UT-Arlington
Muon Spectrometer	Arizona, Boston, BNL, Brandeis, Harvard, Massachusetts-Amherst, MIT, Michigan, SUNY-Stony Brook, South Carolina, Tufts, UC-Irvine, Washington
Trigger and DAQ	ANL, BNL, UC-Irvine, Michigan State, Oregon, SLAC, Wisconsin
Software	Arizona, ANL, Boston, BNL, Chicago, Harvard, Indiana, LBNL, Massachusetts-Amherst, Pittsburgh, SMU, UT-Arlington
Facilities	Boston, BNL, Chicago, Harvard, Langston, New Mexico, Indiana, Michigan, Michigan State, Oklahoma, SLAC, UT-Arlington
Upgrade R&D	BNL, Columbia, Hampton, LBNL, New Mexico, New York, Oklahoma, Oklahoma State, Pennsylvania, SUNY-Stony Brook, UC-Santa Cruz, Southern Methodist University, Yale

Appendix 4: Letter to Dr. Praveen Chaudhari from the Joint Oversight Group. November 7, 2003

Official 2003-2



*U.S. Department of Energy
and the
National Science Foundation*



November 7, 2003

Joint Oversight Group

Dr. Praveen Chaudhari
Director
Brookhaven National Laboratory
Building 460
Upton, NY 11973-5000

Dear Dr. Chaudhari:

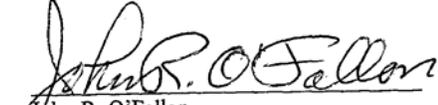
At its recent meeting the Joint Oversight Group (JOG) decided to augment the management structure for the U.S. ATLAS and U.S. CMS Programs by creating a Deputy Program Manager position for both programs. This letter defines a process for making this a reality.

This management structure is consistent with the original expectations of line management through the Host Laboratories and the Program Managers appointed by the Host Laboratories. Program Management responsibilities include the on-going detector construction projects and the elements of the research program: detector Maintenance & Operations (M&O) and Software & Computing (S&C). The addition of a Deputy Program Manager position is in direct response to this broad scope of responsibility and the desire to provide additional opportunities for empowering universities in leadership positions. Regarding the Program Manager and Deputy Program Manager, it is anticipated that one be from a National Laboratory and the other from a U.S. university. It is expected that in each U.S. detector program either the Program Manager or the Deputy Program Manager, whichever is from a university, will also serve as the Principal Investigator for the NSF Cooperative Agreement covering the research program funding. The NSF Principal Investigators will be responsible for ensuring that NSF research program funds are allocated in accordance with the decisions made by the Program Managers.

When identifying appropriate candidates for the Program or Deputy Program Manager positions it is expected that the Host Laboratories and/or Program Managers will solicit active involvement, support and concurrence by the U.S. collaborations and communicate progress along the way to the agencies. This should be followed by requests from the Host Laboratories for concurrence by the JOG and finally appointments by the Host Laboratories. Management documents should be revised to reflect this new structure along with descriptions of the roles and responsibilities of the Program Managers and Deputy Program Managers. We expect the Host Laboratories to provide primary oversight on issues that may arise with the implementation of this new management structure.

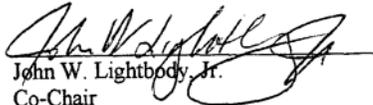
Implementing this Program/Deputy Program Management structure is an important step toward meeting the challenge and needs of the rapidly expanding U.S. LHC Research Program, overall. It is hoped that this structure also will reflect the diversity of the National Laboratory and University communities, as well as the Agencies, involved in these detector collaborations.

Sincerely,



John R. O'Fallon
Co-Chair

U.S. LHC Joint Oversight Group
Department of Energy



John W. Lightbody, Jr.
Co-Chair

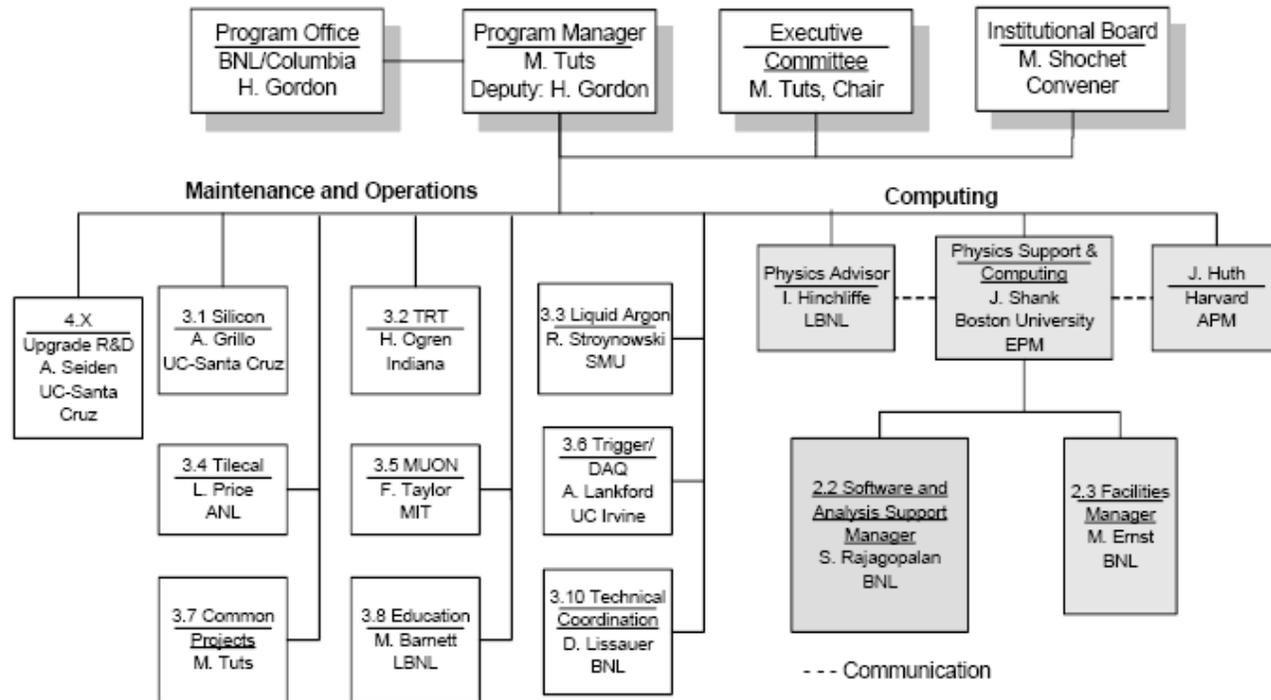
U.S. LHC Joint Oversight Group
National Science Foundation

Cc:

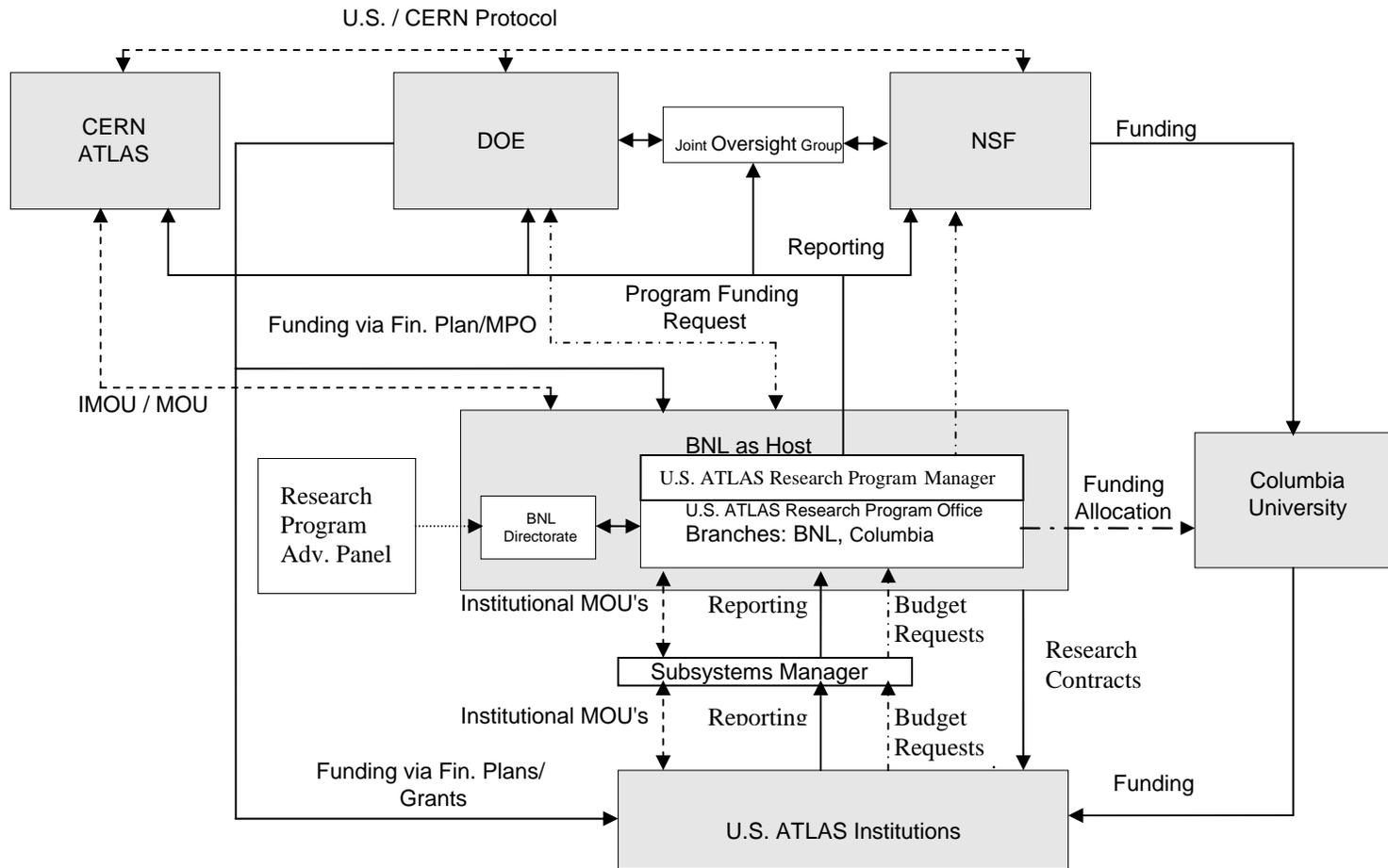
Robin Staffin, SC-20
John R. O'Fallon, SC-20
Jack Lightbody, NSF
Aesook Byon-Wagner, SC-20
Moishe Pripstein, SC-20
Marv Goldberg, NSF
Jim Whitmore, NSF
Pepin Carolan, FAO
Thomas Kirk, BNL
William Willis, Columbia University

Appendix 5

U.S. ATLAS Research Program Organization as of February 1, 2007

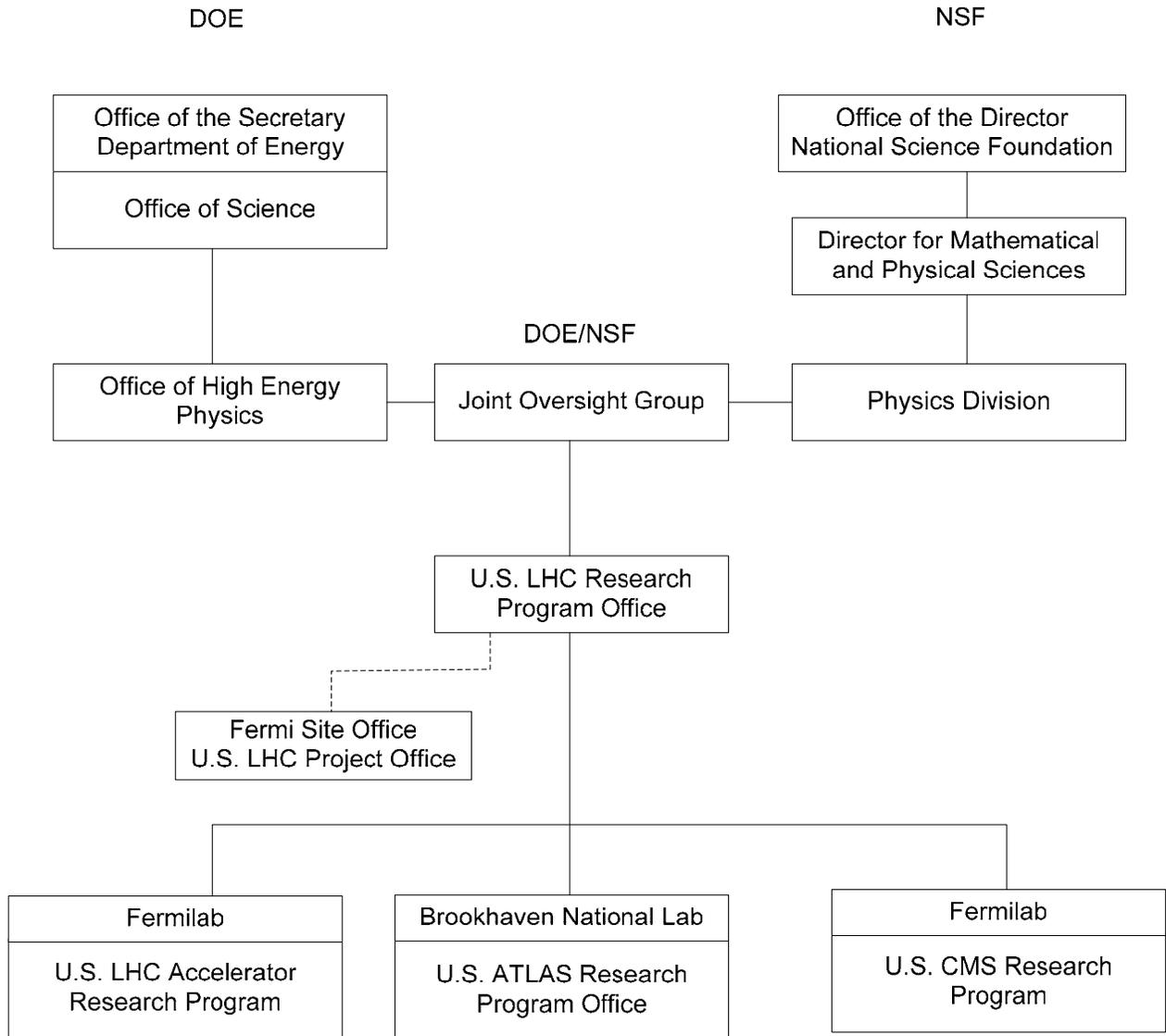


Appendix 6: MOU, Funding and Reporting Process



Funding
 Reporting
 Budget requests/Funding Allocation
 - - - MOU preparation and signatures
 Advisory

Appendix 7: DOE-NSF-U.S. LHC Research Program Organization



- Program Direction and Reporting
- Communication and Coordination

APPENDIX 8: WBS

WBS #	Description
2.2	Software
2.2.1	Coordination
2.2.1.1	Software Project Coordination
2.2.1.2	Data Management Coordination
2.2.2	Core Services
2.2.2.1	Framework
2.2.2.2	EDM Infrastructure
2.2.2.3	Detector Description
2.2.2.4	Graphics
2.2.2.5	Analysis Tools
2.2.2.6	Grid Integration
2.2.3	Database
2.2.3.1	Database Services and Servers
2.2.3.2	Common Data Mgmt Software
2.2.3.3	Event Store
2.2.3.4	Non-event Data Management
2.2.3.5	Collections, Catalogs, Metadata
2.2.4	Application Software
2.2.4.1	Monte Carlo Generators
2.2.4.2	Simulation
2.2.4.3	Subsystem Reconstruction
2.2.4.4	Combined Reconstruction
2.2.4.5	Analysis
2.2.4.6	Trigger
2.2.4.7	Combined Testbeam Software

2.2.5	Infrastructure Support
2.2.6	Physics Analysis Support
2.3	Computing Facilities
2.3.1	Tier 1 Facilities
2.3.1.1	Management/Administration
2.3.1.2	Tier 1 Fabric Infrastructure
2.3.1.3	Tier 1 Linux Systems
2.3.1.4	Tier 1 Storage Systems
2.3.1.5	Tier 1 Wide Area Services
2.3.1.6	Tier 1 Operations
2.3.2	Tier 2 Facilities
2.3.2.1	Tier 2 A, B, C Facilities
2.3.3	Wide Area Network
2.3.4	Grid Tools and Services
2.3.4.1	Grid Infrastructure
2.3.4.2	Workflow Services
2.3.4.3	Data Services
2.3.4.4	Monitoring Services
2.3.4.5	Production Frameworks
2.3.4.6	Analysis Frameworks
2.3.5	Grid Production
2.3.5.1	Software Acceptance
2.3.5.2	Deployment of Software Services
2.3.5.3	Validation and Hardening
2.3.5.4	Operations
2.9	Program Support
2.9.1	Program Support - Nevis

3.0	U.S. ATLAS M&O Est.
3.1	Silicon
3.1.1	Pixels
3.1.1.1	Pre-operations
3.1.1.2	Operations
3.1.1.3	Maintenance
3.1.2	SCT
3.1.2.1	Pre-Operations
3.1.2.2	Operations
3.1.2.3	Maintenance
3.1.3	RODs
3.1.3.1	Pre-operations
3.1.3.2	Operations
3.1.3.3	Maintenance
3.1.4	Common Silicon/ID
3.2	TRT
3.2.1	TRT Subsystem
3.2.1.1	TRT Pre-operations
3.2.1.2	TRT Operations
3.2.1.3	TRT Maintenance
3.2.2	Common TRT/ID
3.2.2.1	Pre-operations
3.2.2.2	Maintenance and Operations (IU)
3.2.2.3	Maintenance and Operations (Nevis)
3.3	Liquid Argon
3.3.1	Mechanical LAr M&O
3.3.1.1	Pre-operations and Commissioning
3.3.1.2	Operations
3.3.1.3	Maintenance
3.3.2	Electrical LAr M&O
3.3.2.1	Pre-operations and Commissioning
3.3.2.2	Operations

- 3.3.2.3 Maintenance
- 3.3.3 Beam Tests and Cosmic Ray Runs
 - 3.3.3.1 FCAL Hadronic Tail Measurement
 - 3.3.3.2 Test Beam – Optical Links
 - 3.3.3.3 Front-end Readout Commissioning
 - 3.3.3.4 Beam Test Equipment Modification
- 3.3.4 CERN Living Expenses
- 3.3.5 Common LAr
- 3.3.6 On-line/Off-line Performance Monitoring
- 3.4 TileCal System
 - 3.4.1 Tile Cal – Specific Costs
 - 3.4.1.1 Pre-operations
 - 3.4.1.2 Operations (Beam On)
 - 3.4.1.3 Maintenance (Beam Off)
 - 3.4.2 Calibration and Monitoring
 - 3.4.2.1 Pre-operations
 - 3.4.2.2 Operations (Beam On)
 - 3.4.2.3 Maintenance (Beam Off)
 - 3.4.3 Common Costs
- 3.5 Muon Subsystem
 - 3.5.1 MDT Pre-operations, Operations and Maintenance
 - 3.5.1.1 MDT Pre-operations
 - 3.5.1.2 MDT Operations (Beam On)
 - 3.5.1.3 MDT Maintenance (Beam Off)
 - 3.5.1.4 MDT Spares – Mechanical and Elect
 - 3.5.2 CSC Pre-operations, Operation and Maintenance
 - 3.5.2.1 CSC Pre-operations
 - 3.5.2.2 CSC Operations (Beam On)
 - 3.5.2.3 CSC Maintenance (Beam Off)
 - 3.5.2.4 CSC Spares – Mechanical and Elec
 - 3.5.3 Alignment System Pre-operations, M&O

- 3.5.3.1 Alignment System Pre-operations
- 3.5.3.2 Alignment System Operation (Beam On)
- 3.5.3.3 Alignment System Maintenance (Beam Off)
- 3.5.4 Muon Endcap Common Costs
 - 3.5.4.1 Engineering Coordination of Endcap
 - 3.5.4.2 Muon Endcap Common Cost Operation
- 3.5.5 Monitoring and Calibration
 - 3.5.5.1 Monitoring and Calibration Beam Operation
 - 3.5.5.2 Muon Test Beams
- 3.6 Trigger/DAQ
 - 3.6.1 Pre-operations
 - 3.6.1.1 Supervisor RoI Builder
 - 3.6.1.2 Communications and Travel
 - 3.6.1.3 Programming Support
 - 3.6.1.4 Equipment
 - 3.6.2 Operations
 - 3.6.2.1 Supervisor RoI Builder
 - 3.6.2.2 Communications and Travel
 - 3.6.2.3 Programming Support
 - 3.6.2.4 Test Facilities
- 3.6.3 CERN Common Costs
- 3.7 Common ATLAS
- 3.8 Education/Outreach
- 3.9 Program Management
 - 3.9.1 BNL Program Management
 - 3.9.2 Nevis Program Management
 - 3.9.3 Michigan Program Management Work - Collaboratory Tools
- 3.10 Technical Coordination
- 4.0 Upgrade R&D