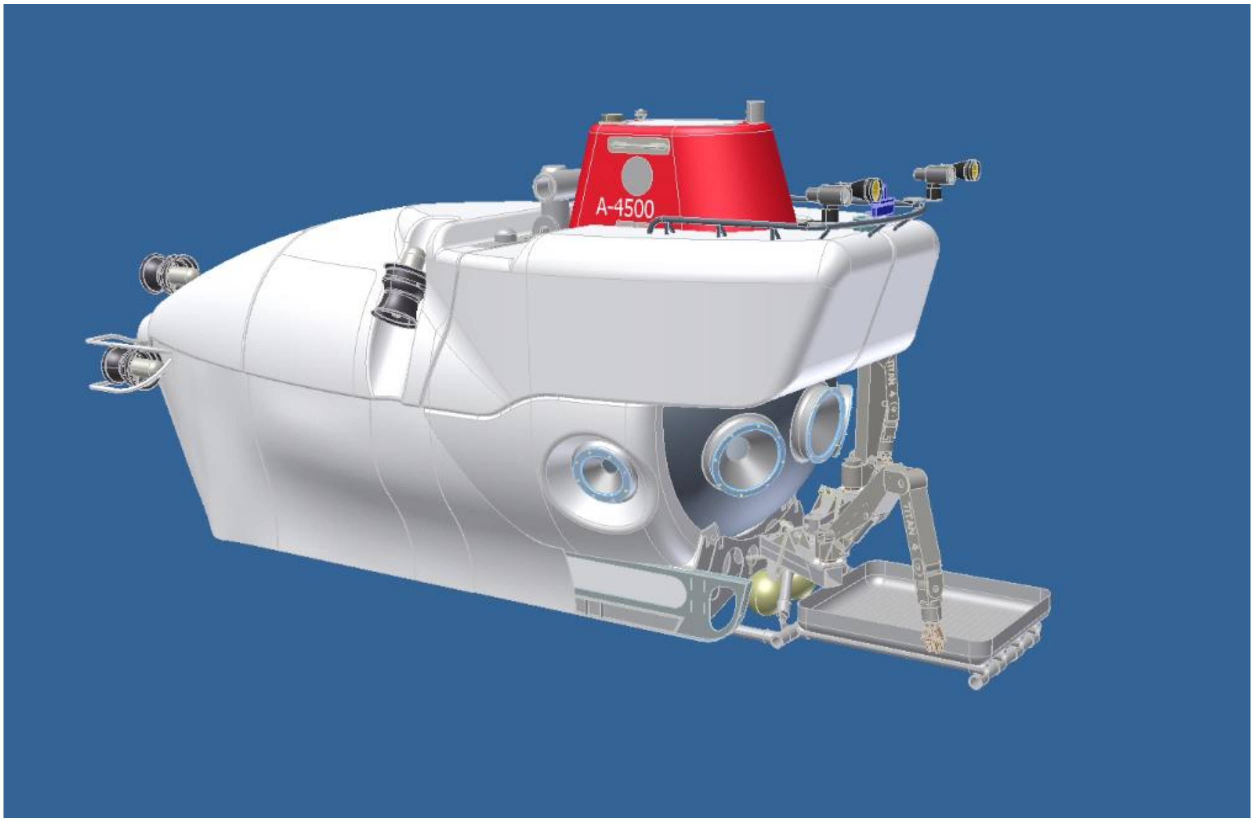
6500m HOV Project
Stage 1: A-4500 HOV

Project Management Plan

Document Control No.: 0000000
06-November-2009



WOODS HOLE OCEANOGRAPHIC INSTITUTION
WOODS HOLE, MA 02543

Document Control Sheet

Date	Originator	Description
08-21-09	C. Fairneny	Initial Outline
09-08-09	C. Fairneny	Original Draft
09-13-09	C. Fairneny	Draft, Revision 1
09-20-09	C. Fairneny	Draft, Revision 2
11-06-09	C. Fairneny	Draft, Revision 3

Table of Contents

1.0 Introduction

1.1 Purpose

The A-4500 HOV Project Management Plan establishes the project organization, responsibilities, processes and methods used to create the baseline project plan and define the processes by which the project will be monitored and controlled during the execution stage. Controlling a project is dependent on identification of problems early so that corrective actions can be implemented as early as possible.

1.2 Scope

The primary project management objective, defined in this document, is the development of a comprehensive baseline plan to be executed and managed for the delivery of the A-4500 HOV. The plan includes scope definition, schedule development, creation of a bottom up estimate, risk identification and contingency.

The scope, schedule, cost estimate and risks will be prepared by experienced technical experts in the field. Activities were identified for each work package defined within the work breakdown structure. These activities were then scheduled and priced as part of a bottom up estimate. Estimates were prepared for labor, material, equipment and other expenses necessary to complete this project. Once complete, the schedule and cost information was input into risk management software, which was then used to generate cost and schedule contingencies for each work package.

This document includes the basic processes for updating, variance identification and evaluation. Once evaluated, this document provides guidance to implement change management. The complete change process is defined in the *A-4500 HOV Configuration Management Plan*.

Scope, schedule, cost and risk will be monitored and controlled over the life of the project by the Project Management Team. The Integrated Master Schedule (IMS) is the basis of the plan. Work will be progressed in the schedule to determine earned value. Actual costs will be posted against those costs and earned value measurements will be used to identify potential problems and issues for management review. The control system is designed to identify problems early so that corrective action can be taken quickly.

2.0 Project Management

Construction of the A-4500 HOV is managed through a Cooperative Agreement between the NSF and Woods Hole Oceanographic Institution. The A-4500 HOV project management structure and approach has been organized to create a structure that will efficiently provide support and clear lines of authority for the construction project. The Principal Investigator has overall responsibility for the project.

2.1 Organization Chart

The program management organization created for this project is depicted in Figure 1, and it shows several important relationships.

The first, and very important, relationship depicted is between the Principal Investigator representing WHOI and the National Science Foundation, plus the external oversight committee (the HOV Replacement Oversight Committee – RHOC) that includes a representative from the Deep Submergence Science Committee (DESSC). This relationship ensures that the public trust conveyed to WHOI, through the grant provided to develop a replacement for the current DSV *Alvin*, will be handled in a responsible manner and will meet the needs of the science community to the maximum extent practicable within the funding provided. An important aspect of this structure is the direct reporting relationship of the Project Manager to the Principal Investigator, and the direct line of communication with the President and Director of WHOI.

Secondly, there is the relationship between the Principal Investigator and the Internal Oversight Committee. This relationship allows the PI, the Project Manager, and the A-4500 HOV project to take advantage of the resident experience of additional WHOI professionals, who can provide independent and objective oversight of the project and ensure that lessons learned from other WHOI projects are considered.

The third relationship depicted is between the PIs and the National Deep Submergence Facility (NDSF), including the Chief Scientist for Deep Submergence (CSDS), at WHOI. This relationship will ensure that the project considers and does not lose sight of the vehicle capabilities and characteristics needed by the scientific community.

The fourth relationship is that between the Project Management Team and the submersible operations and ship operations that take place at sea during science missions. This relationship will ensure that the engineering and construction of the vehicle will fully consider the real world operating constraints, concerns, and interfaces necessary for successful operations at sea.

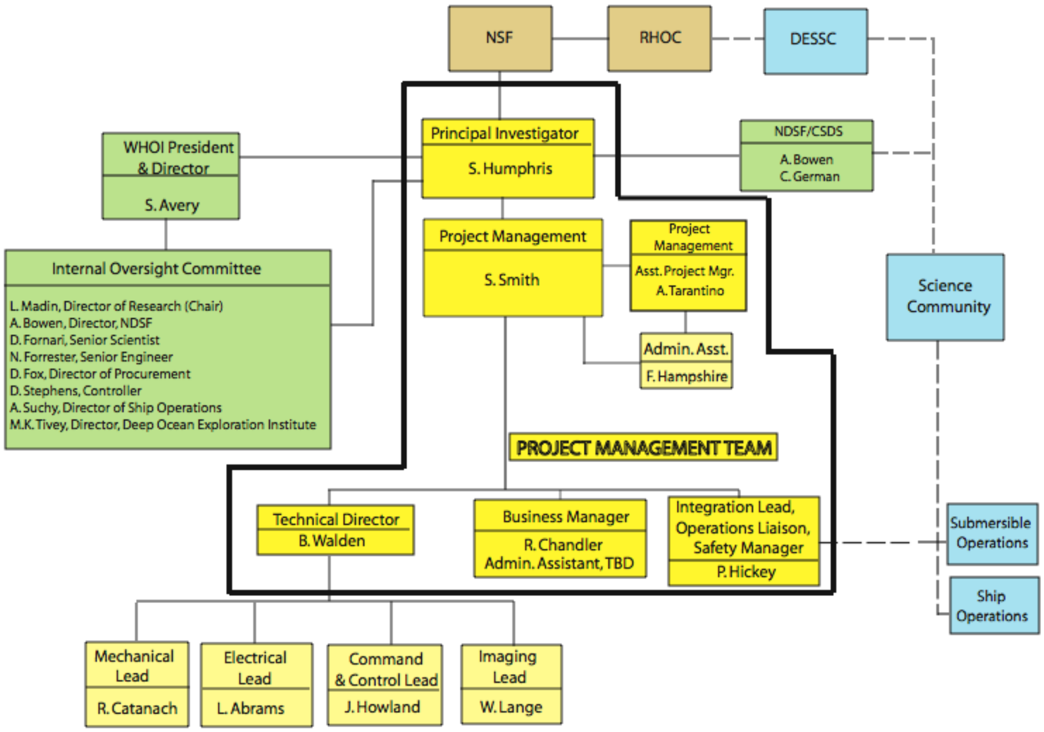


Figure 1. Project Management Organization

Finally, the Project Management Team, consisting of the PIs, the Project Manager, Assistant Project Manager, Technical Director, Business Manager, and the Integration Lead/Operations Liaison/Safety Manager, has been set up so that each function that is tied to the schedule and the commitment to maintain the schedule with zero cost over-runs is represented. Collectively, they are responsible for directing and executing the project. The specific qualifications, roles and responsibilities of each of these members is described below.

2.1.1 Project Management Team

The Principal Investigator is directly responsible to the NSF and to WHOI's President and Director for the successful completion of the project. The Project Manager has the overall responsibility, and is accountable for, managing and executing the project. He/she is assisted in this role by the Assistant Project Manager, who will maintain the master schedule, manage the outside major contracts, and coordinate various other activities, including compliance as applicable with the American Bureau of Shipping's (ABS) *Rules for Building and Classing Underwater Vehicles, Systems and Hyperbaric Facilities 2002* and subsequent amendments. Reporting directly to the Project Manager is the Technical Director, the Business Manager, and the Integration Lead/Operations Liaison/Safety Manager. The Technical Director is responsible for all technical aspects of the project. He will establish the technical and engineering objectives and will provide the necessary guidance to a group of team leaders who report directly to him. The Business Manager is responsible for compiling and tracking the project budget and costs. The Business Manager is also responsible for procurement and document management. For the major outside contracts, the Director of Procurement will provide the necessary contractual support to ensure that all contract-related documents are in place and to ensure compliance with WHOI's Subcontracting Plan. The Integration Lead/Operations Liaison/Safety Manager will manage the construction of the A-4500 HOV, and also provides the linkage to the submersible operations group, the ship operations group (as it pertains to submersible operations from the R/V *Atlantis*), and to the science user community. In addition, he acts as the A-4500 HOV Project's Safety Manager.

The Project Management Team has extensive program management experience and substantial technical expertise in submersible engineering and operations. The qualifications of the team members along with their responsibilities on the project are as follows:

***Principal Investigator – Susan Humphris*:**

Susan Humphris is a Senior Scientist in the Geology & Geophysics Department who has studied hydrothermal systems on mid-ocean ridges for the last thirty years. She has completed dozens of dives in the *Alvin*, and has used ROVs and AUVs quite extensively. She has more than 70 scientific publications and has been a member of WHOI's Deep Submergence Advisory Committee. She also has extensive managerial experience, including community-wide service as part of the NSF Ridge Program's project office at WHOI, Department Chair for the Geology & Geophysics Department, and Acting Vice President at WHOI for Marine Operations and Facilities.

Role and Responsibilities

The Principal Investigator is directly responsible to the NSF and to the President and Director of Woods Hole Oceanographic Institution for the successful completion of the project. The Project Manager reports directly to the Principal Investigator.

Specific duties of the Principal Investigator include:

(1) Overseeing the progress of the project to ensure it proceeds and is completed within budget and on schedule.

(2) Ensuring the internal oversight committee, the NDSF, and the external advisory committee are informed and participate in oversight of the project.

(3) Acts as the spokesperson for the project.

(4) Chairs the Change Control Board and approves changes in compliance with the approved change control process documented in the Project Execution Plan and Configuration Management Plan.

Project Manager – Steven Smith

Steven Smith has 25 years of broad project management experience, including 15 years involvement in the design, certification, and testing of manned and unmanned deep submergence vehicles. He served as the Engineering and Logistics Office for the U.S. Navy's deep submergence assets, and was also Officer in Charge of the U.S. Navy's Deep Submergence Rescue Vehicle MYSTIC DSRV-1. He has experience with ABS, Navy, and USCG certification requirements.

Role and Responsibilities

Reporting to the Principal Investigator, the Project Manager is responsible and accountable for executing the project.

The Project Manager's project must meet cost, schedule and performance/scope targets. Project Manager must demonstrate initiative in incorporating and managing an appropriate level of risk to ensure best value. In cases where significant cost overruns and/or delays are about to occur, the Project Manager alerts NSF in a timely manner and takes appropriate steps to mitigate these cost overruns or delays.

Specific duties of the Project Manager include:

(1) Establishes key milestones and overall schedules.
(2) Defines project objectives and technical scope, schedule, and cost.
(3) Manages project resources, including establishing baseline costs, and completing the project within budget and on schedule.
(4) Manages risk to ensure best value.
(5) Establishes and implements the management systems.
(6) Develops the project team staffing plan and issues the Team Charter.
(7) Plans, implements, and completes a project using a Systems Engineering approach.
(8) Initiates development and implementation of key project documentation (e.g., Project Execution Plan, Risk Management Plan).
(9) Defines project cost, schedule, performance, and scope baselines.
(10) Is responsible for design, construction, environmental, safety, health, and quality efforts.
(11) Evaluates and verifies reported progress; makes projections of progress and identifies trends.

(12) Serves as the single point of contact between WHOI and NSF staff for all matters relating to the project and its performance.
(13) Serves as the Contracting Officer's Representative.
(14) Leads the Project Team and provides broad program guidance. Delegates appropriate decision-making authority to the Project Team members.
(15) Implements changes in compliance with the approved change control process documented in the Project Execution Plan.
(16) Ensures that safety is fully integrated into design and construction.
(17) Approves all project reports and reporting.
(18) Acts as a member of the Change Control Board.

Assistant Project Manager – Anthony Tarantino

Anthony Tarantino is an electrical engineer with over 14 years of experience in test, service and production. Prior to this, he spent 6 years with the *Alvin* Operations Group as the Electrical Section Leader and completed over 100 dives as an *Alvin* pilot. He as been with the project since 2007, and has provided technical and programmatic oversight and support, as well as being the technical liaison between WHOI and both Lockheed-Martin and the Southwest Research Institute.

Role and Responsibilities

Reporting to the Project Manager, the Assistant Project Manager assists in managing the project to ensure its successful execution. The Assistant Project Manager provides support to the Project Manager, and acts completely on behalf of the Project Manager in his absence.

Specific duties of the Assistant Project Manager include:
(1) Ensures the quality, accuracy and timelines of all the processes, products and documentation deemed necessary by the Project Manager.
(2) Maintains the overview of project cost, schedule, and technical performance via the reporting systems, performance measurement systems, project status review meetings, and regular communication with project participants.
(3) Manages contracts for the Project Manager to ensure successful project execution.
(4) Ensures all stakeholders have been appropriately involved in the project planning.
(5) Ensures the preparation of project reports.
(6) Acts as a member of the Change Control Board.
(7) Ensures that safety is fully integrated into design and construction.

Technical Director – Barrie Walden

Barrie Walden has been with WHOI since 1969, with the exception of a 2-year leave of absence to serve as the Manager and Operations Directory of the National Underwater Laboratory System I (Hydrolab) in St. Croix, USVI. For many years, he was the *Alvin* Group's primary engineer with overall responsibility for the submersible and related support ship facilities. He has held many positions, including Manager of the *Alvin* Program, Manager of the NDSF, and Manager of the Operational Scientific Services Group.

<u>Roles and Responsibilities</u>
Reporting to the Project Manager, the Technical Director is responsible for managing project technical scope, schedule and cost.

Specific duties include:
(1) Supports the Project Manager and Assistant Project Manager as needed.
(2) Provides oversight of all construction, reviews change requests and leads construction meetings as required.
(3) Employs a Systems Engineering approach to ensure all system requirements are achieved.
(4) Ensures project interfaces are identified, defined, and managed to completion
(5) Plays a major role in the Risk Management Plan development and risk tracking/reporting related to project scope.
(6) Identifies, defines, and manages to completion the project environmental, safety, health, and quality assurance requirements.
(7) Performs periodic reviews and assessments of project performance and status against established performance parameters, baselines, milestones, and deliverables.
(8) Plans and participates in project reviews as necessary.
(9) Creates all PDR and FDR technical packages.
(10) Reviews project technical products (e.g., drawings, specifications, procurement, and construction packages).
(11) Acts as a member of the Change Control Board.
(12) Participates, as required, in Operational Readiness Reviews or Readiness Assessments.
(13) Supports preparation, review, and approval of project completion and closeout documentation.
(14) Ensures that safety is fully integrated into design and construction.

Business Manager – Rick Chandler

Rick Chandler has over 20 years of experience with providing support for the *Alvin*, the *ABE* and *Sentry* autonomous vehicles, and shipboard scientific services programs. His responsibilities have included expense tracking, procurement budget preparation, purchase specifications generation, procurement, quality control oversight, document control for all systems drawings, manuals, specifications and designs, and material disposition.

Role and Responsibilities

Reporting to the Project Manager, the Business Manager compiles and tracks the project budget and costs. The Business Manager is also responsible for procurement and document management.

Specific duties include:

(1) Supports the Project Manager and Assistant Project Manager as requested and needed.
(2) Acts as a member of the Change Control Board.
(3) Assists the Project Manager with risk management and risk tracking/reporting related to project budget and schedule.
(4) Maintains the EVMS system and provides reports to the APM, PM, NSF and others as required.
(5) Serves as Contracting Officer's Representative (COR), reviews all vouchers and recommends payment.
(6) Ensures all material, documents and preparations for a CCB are accurate and timely.
(7) Assists the PM and APM in allocating and monitoring financial resources throughout the Project Team.
(8) Assembles and analyzes data to support project funding needs, tracks funding requests and expenditures.
(9) Processes all purchase orders and ensures that the Procurement Plan is followed.
(10) Ensures record copies of RHOV documents are preserved in the official WHOI RHOV project files.
(11) Ensures timely, reliable, and accurate integration of contractor performance data into the project's scheduling, accounting, and performance measurement systems.

Integration Lead/Operations Liaison/ Safety Manager – Pat Hickey

Pat Hickey is the Manager of the Submersible Engineering & Operations Group (SE&OG) at WHOI. Before coming to WHOI, he worked in the oil industry as a diver, ROV Operator and Submersible Pilot qualified on multiple commercially available HOV's including *Pisces*, *Aquarius*, *Leo* and several Perry submersibles. He joined WHOI in 1987 as a Pilot, and spent 21 years at sea with DSV *Alvin* assuming the position of Expedition Leader in 1993. He was promoted to DS&OG Manager in 2007. He has 631 logged dives and 4550 hrs of in water time in DSV *Alvin*.

Role and Responsibilities

Reporting to the Project Manager, the Integration Lead/Operations Liaison/Safety Manager will manage the construction of the A-4500 HOV, and also provides the linkage to the submersible operations group, the ship operations group (as it pertains to submersible operations from the R/V *Atlantis*), and to the science user community. In addition, he acts as the A-4500 HOV Safety Manager.

Specific duties include:

(1) Interfaces with A-4500 HOV engineers as to operability and practicability of system designs and interfaces.
(2) Keeps the Operations Group informed as to the status of the project, proposed designs and current schedule.
(3) Provides operational feedback on proposed designs following Operations Group reviews of those designs.
(4) Interfaces with the Project Manager so as to have Operational staff attend vendor testing and facilities when practical.
(5) Interfaces with the science community regarding equipment interfaces and new equipment being proposed for use with the submersible, so that accommodations in the designs for such additional equipment can be made.
(6) Interfaces with the ship operations group to ensure a smooth transition to the new vehicle with regard to shipboard requirements and modifications.
(7) Manages the disassembly of *Alvin*, and the assembly of the A-4500 HOV.
(8) Manages the project's Environmental Health and Safety Plan and ensures project personnel receive appropriate training and are in compliance with the plan.
(9) Acts as a member of the Change Control Board.

2.1.2 Communications and Coordination

The Project Management Team (PMT) will use a variety of techniques to ensure that it has adequate visibility and project control. Weekly meetings will be convened by the Project Manager with the PMT to review the status of the project down to the individual task level. These meetings will serve to keep all members fully aware of each other's technical, schedule and budget progress and their collective progress. Prior to the PMT meetings, the Technical Lead will meet with all the engineering leads to determine progress and identify issues that need to be addressed at the PMT meeting. The PMT meetings will provide an important forum to cover integration issues and to discuss and resolve issues that may affect the team's performance. The Project Manager will also be kept apprised of the resource requirements in order to ensure that the team has adequate resources at their disposal. Minutes of these meetings will be distributed as appropriate with action items and persons responsible clearly noted. The physical proximity of the team members is such that it will facilitate impromptu meetings or exchange of ideas and information on an ongoing basis. The use of E-mail, file sharing and shared calendars will serve to promote an "open environment" throughout the organization.

2.1.3 Decision-Making Authority

As the person responsible and accountable for executing the project, the Project Manager has the authority to make engineering trades and other decisions that are within cost, schedule and budget. However, the Project Manager will alert the Principal Investigator of any situation for which a decision:

- Adversely affects safety
- Changes policy
- Impacts the scientific capabilities of the vehicle

Any change to the initial design and capability, cost, and schedule control accounts (often referred to as baselines) after the Preliminary Design Review will be subject to the change control process explained in the *Configuration Management Plan*. The PI chairs the Change Control Board and approves changes in compliance with the approved change control process.

2.2 Internal Oversight

An Internal Oversight Committee has been created to provide high-level review and advice as the project proceeds. The charge to the committee is as follows:

> "The Internal Oversight Committee (HOV IOC) is established to provide guidance to the A-4500 HOV project management team, based on their expertise and experience in WHOI and with other projects, on issues that pertain to successful completion of the project by WHOI. These include deep submergence science, engineering, marine operations, finances, procurement, and management of large vehicle construction projects. In addition, the HOV IOC will be consulted for advice and assistance on ways to move forward when there are major difficulties or changes to the project (e.g. scope, schedule, budget, policies, personnel) that will impact the capabilities of the vehicle, the scientific user community, or WHOI's ability to complete the project.
>
> The HOV IOC will meet no less than quarterly, and more frequently as necessary, and will report directly to the President and Director of WHOI. They will participate as available in the bi-weekly conference calls with NSF and the external advisory committee, and will

> receive the monthly reports provided to NSF as well as the minutes from the conference calls. On an as-needed basis, they will be called upon to assist at any time with specific issues. "

The membership of the Committee is:

- Dr. Larry Madin (Chair) – Vice President and Director of Research
- Mr. Andy Bowen – Director, NDSF
- Dr. Dan Fornari – Senior Scientist, Chair of the RIDGE 2000 Program
- Mr. Ned Forrester – Senior Engineer
- Mr. Dennis Fox – Director of Procurement
- Mr. Al Suchy – Director of Ship Operations
- Mr. Dave Stephens – Controller
- Dr. Meg Tivey – Senior Scientist, Director of the Deep Ocean Exploration Institute

It is anticipated that the HOV IOC will meet monthly prior to the Final Design Review, and then no less than quarterly post-FDR.

WHOI also has a Deep Submergence Advisory Committee (DSAC) that is charged with providing advice on matters relating to the operation and management of the National Deep Submergence Facility (NDSF) and associated deep submergence science at WHOI. Chaired by Dr. Chris German, Chief Scientist for Deep Submergence, the Committee consists of a representative from each Department plus one at-large member. At its quarterly meetings, DSAC will be briefed on the status of construction and will also be consulted on decisions that need to be made that will impact the capabilities and future operations of the vehicle.

2.3 Community Oversight

Community oversight of, and input to, the project is achieved through the HOV Replacement Oversight Committee (RHOC) that was established by NSF in 2004. The NSF charge to RHOC is as follows:

> "The HOV Replacement Oversight Committee is established to obtain community input and advice on all aspects of the design and construction of a Human Occupied Vehicle (HOV) replacement for the Deep Submersible Vehicle (DSV) *Alvin*. This includes hull construction, testing and certification; the design, construction and testing of major vehicle sub-systems; and the selection and placement of scientific sensors. The Committee will also provide advice on the establishment of design and budget priorities to ensure the project remains within the agreed scope and cost. The Committee will respond to specific questions posed by NSF and

WHOI management and will provide reports to NSF following each meeting. The Committee will communicate regularly with WHOI management providing advice on all aspects of the design and construction project. WHOI management will ensure that the committee is well informed in a timely way of all construction-related issues and decisions, or any significant changes in design plans. A dedicated web page will be established by WHOI to facilitate this communication.

The Committee will consist of 7-10 members, including a Chair. Employees of WHOI, or subcontractors involved in this project, may not be members of this Committee but may participate in an ex-officio capacity. The Committee is established and supported by WHOI, and its membership and scope of activities are approved by NSF.

It is anticipated that the HOV Replacement Oversight Committee will have carried out their charge with the completion of science sea trials. Thus, shortly thereafter the Committee will be dissolved."

WHOI consults RHOC on all major issues that impact the scientific community in terms of the capabilities of the vehicle prior to any decisions being made. This is done through bi-weekly teleconferences to keep RHOC members and NSF apprised of the project's status and to receive their continued guidance. Minutes of these meetings are posted on the UNOLS website. RHOC also reviews documents produced for the project. In addition, formal yearly meetings are held to discuss the project's performance both at the summary level and at the detail level.

While RHOC reports to NSF, the Deep Submergence Science Committee (DESSC) is a standing Committee of the University - National Oceanographic Laboratory System (UNOLS). DESSC provides advisory responsibilities for the National Deep Submergence Facility, and hence they can act as an advisory body for this project.

The full Terms of Reference for the DESSC can be found in Annex 7 of the UNOLS Charter (http://www.unols.org/info/ucharter.pdf). The purpose of DESSC as described in their Terms of Reference is as follows:

"The DEep Submergence Science Committee provides oversight responsibilities in the use of *Alvin*, the Remotely Operated Vehicle (ROV) *Jason 2*, and the Autonomous Underwater Vehicle (AUV) *ABE/Sentry* that are assets of the National Deep Submergence Facility. Incumbent in this is fulfilling an ombudsman role for the deep submergence community, insuring maximum participation in the utilization of these deep submergence assets. It is also the responsibility of the DESSC to promote new technology for *Alvin*, ROVs and AUVs to maintain cutting edge capability for the National Facility.

The DESSC shall continue to work with the user community, federal sponsors and the operator of the NDSF to encourage deep submergence research in traditional areas and expeditions to remote geographic regions. Additionally, DESSC shall also encourage the advancement of cooperative international programs for the enhancement of multidisciplinary submersible science throughout the academic community."

Communications with DESSC occurs through two avenues. First, the Chair of DESSC is a member of RHOC, and hence participates in the bi-weekly teleconferences. Second, presentations are made at the bi-annual DESSC meetings that provide an update to the community on progress on the project. These presentations are also posted on the UNOLS website.

3.0 Project Management Control System

The project control management system consists of planning, monitoring and controlling scope, schedule, cost and resources. Planning consists of development of the work breakdown structure, schedule and cost estimate. Monitoring consists of schedule updates, cost accumulation and earned value calculations in order to determine relevant variances in a timely manner. Controlling the project is the result of variance analysis and implementation of appropriate corrective action through the change management process.

3.1 Project Initiation and Planning

This document describes the planning and project initiation steps that were followed to develop a baseline integrated master schedule. During the initiation and planning phase, the project team organized, developed a critical path schedule, and prepared a bottom up estimate. These were combined into Primavera Project Planner (P3) 3.1 to create a baseline Integrated Master Schedule, which will be used as the basis for our earned value management system (EVMS).

3.1.1 Project Organization

Key project organization components include the Work Breakdown Structure (WBS), organizational breakdown structure (OBS) and responsibility assignment matrix (RAM). These structures will serve as the basis of planning and managing this project. The project scope is broken down in accordance with the *Alvin* sub-assembly breakdown structure. This breakdown is consistent with the way in which the Submersible Engineering and Operations Group (SE&OG) has worked for many years, so it is familiar to the entire team. The team is organized by technical discipline, which also reflects its historic and current configuration. The OBS illustrates this configuration and delineates technical responsibilities. At the intersection of both of these structures lies a RAM and associated control accounts. Control accounts are visible manageable pieces of work with clear lines of responsibility. They are the building blocks for planning and earned value management reporting. Control accounts exist during the planning, executing, monitoring and controlling phases of the project so that the cost estimate can be traced and tracked horizontally throughout the project lifecycle.

3.1.1.1 Work Breakdown Structure (WBS)

The A-4500 HOV Project scope is broken in accordance with the *Alvin* sub-assembly breakdown structure (Figure 2). The breakdown has major headings for project management, the A-4500 HOV, and support equipment. The vehicle breakdown represents the major systems on the submarine. Work packages are called out by technical discipline and priced as such to ensure that all scope is included in the project. The WBS dictionary is defined in detail in the Integrated Master Schedule document.

3.1.1.2 Responsibility Assignment Matrix (RAM)

The intersection of the WBS (groups) and the OBS (technical leads) serves as the basis of our responsibility assignment matrix (Figure 3) and control accounts. The matrix clearly aligns technical expertise into manageable work packages that are scoped, schedule and estimated. As such, the team is well acquainted with the structure and works within the parameters naturally. Each of the technical leads reviewed each work package to determine the level of work required for their department. They defined activities, provided durations and sequenced this work. The activities became the basis for the critical path method schedule and the cost estimates worksheets.

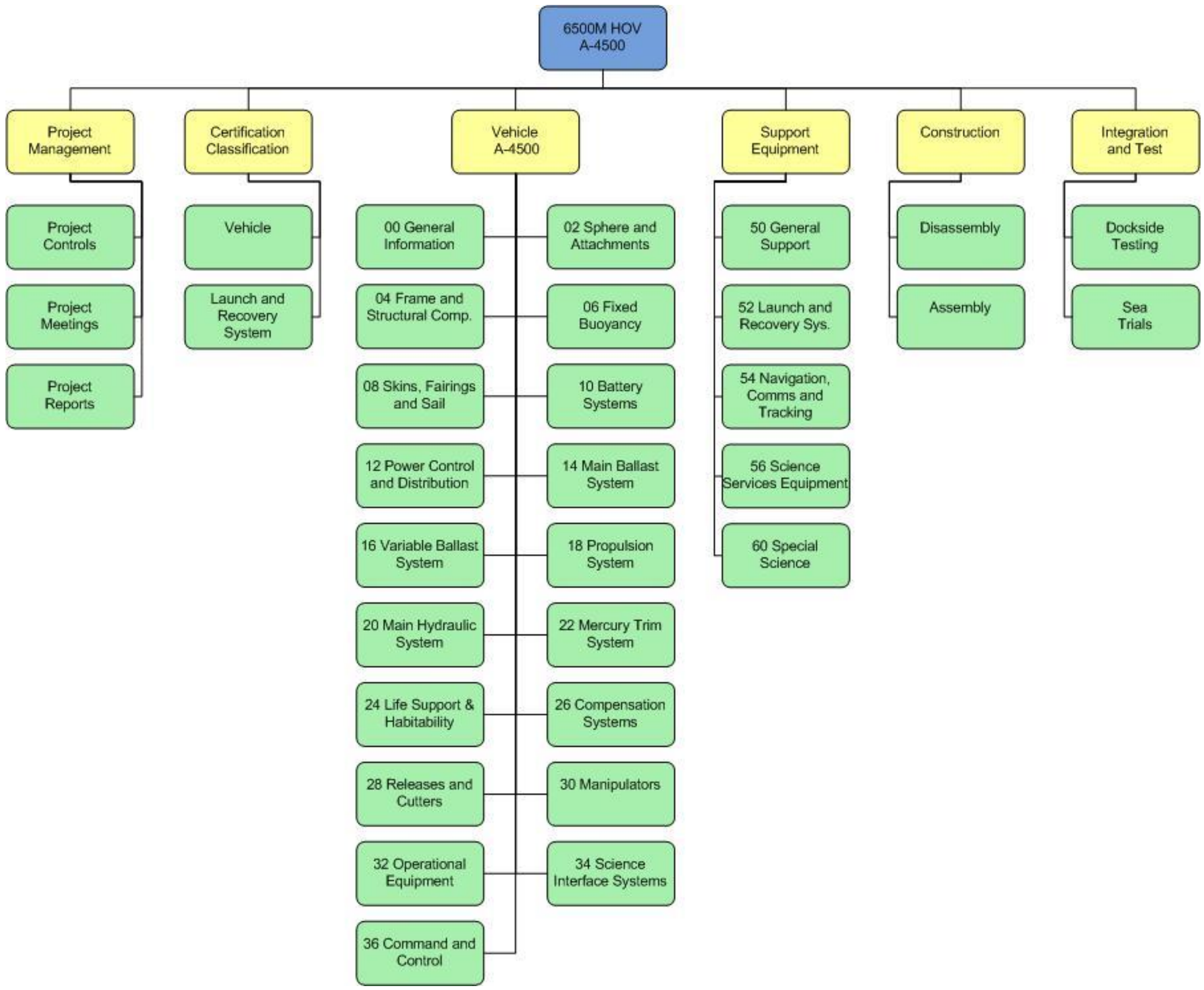


Figure 2. **A-4500 HOV Project Work Breakdown Structure**

3.1.1.3 Control Accounts and Control Account Managers (CAM)

Financial reports will be organized so that the control account manager (technical lead) is able to examine actual costs against technical progress and schedule to quickly identify variances from the plan. The control account manager can then use his/her authority over the specific resources who will execute the activities to take the appropriate corrective actions. This configuration allows each technical lead to act quickly to resolve or elevate problems and opportunities.

Organization Breakdown Structure

			Project Management S. Smith	Core Components B.Walden	Mech. R. Catanach	Elec. L. Abrams	Command & Control J. Howland	Imaging W.Lange	Integration P.Hickey
		Project Management	X						x
		ABS Classification	X						
	A00	General			X				
	A02	Sphere and Attachment		X					
	A04	Frame and Structure			X				
	A06	Fixed Buoyancy		X					
	A08	Skins, Fairings and Sail			X				
	A10	Battery System		X					
	A12	Power Control & Distribution				X			
	A14	Main Ballast System			X				
	A16	Variable Ballast System			X				
	A18	Propulsion System				X			
	A20	Main Hydraulic System			X				
	A22	Mercury Trim System			X				
	A24	Life Support & Habitablity				X			
	A26	Compensation Systems			X				
	A28	Releases and Cutters			X				
	A30	Manipulators			X				
	A32	Operational Equipment			X				
	A34	Science Interface Systems						X	
	A36	Command & Contol					X		
	A38	Loads			X				
	A50	General Support							X
	A52	Launch and Recovery System							X
	A54	Navigation, Comms and Tracking							NA
	A56	Science Services Equipment							X
E	A60	Special Science							NA

Figure 3. **Responsibility Assignment Matrix**

3.1.2 Schedule Development

Once the work breakdown structure and associated work packages were identified, the project scope was further broken down into detailed activities that could be scheduled. Interactive planning sessions conducted with each technical lead produced network logic diagrams that depict the sequence (logic) of activities. Activities, logic ties and durations went into P3 to produce a critical path method schedule. The overall schedule is made up of ~500 detailed activities, which have been cost and resource loaded. The result of the cost/resource loading will establish a scheduled value for each activity that will be measured as part of the EVMS.

3.1.2.1 Summary Schedule

The summary schedule shows the project scope by work breakdown structure (Figure 4). The WBS top level is broken into project management, the A-4500 HOV, and support equipment. The second level depicts the major vehicle systems components.

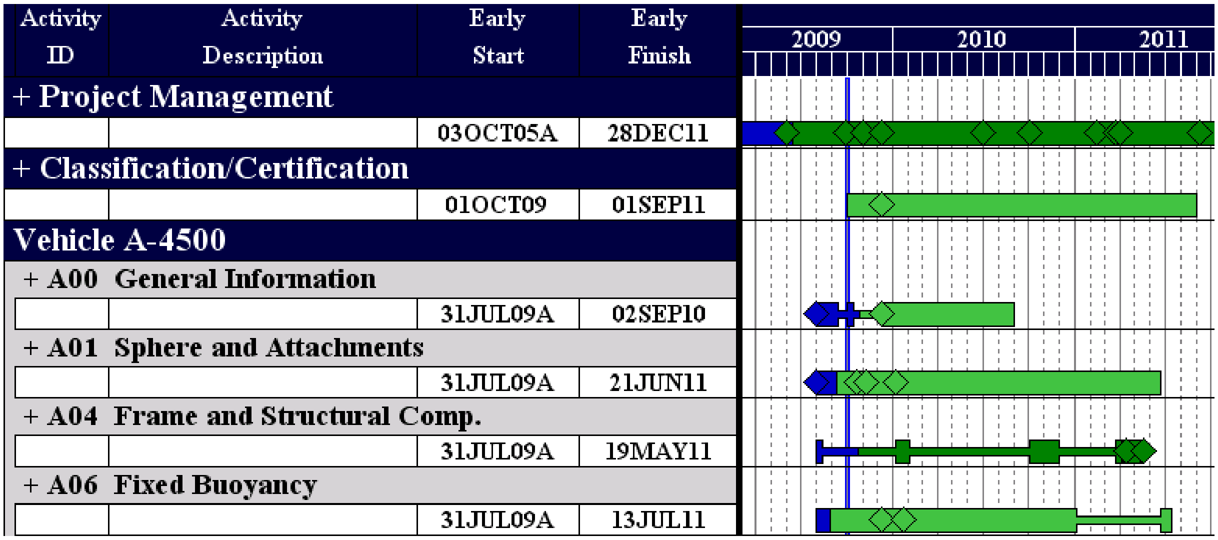


Figure 4. Summary Schedule by WBS

3.1.2.2 Detailed Schedule

As part of the interactive planning sessions, network logic diagrams were prepared for each work package. All activities lead to a major milestone such as the preliminary design report, final design report, purchasing required materials, and preparation for the vehicle construction. Detailed activities for vehicle construction are defined and scheduled so that opportunities to fast track individual components can be identified and managed. Non-procurement activities have durations of 20 work days or less so that earned value is measurable within a reporting month. Most activities are between 10-20 days in duration. Procurement and fabrication activities are the exception with durations of up to 6 months. The detailed schedule is shown in Appendix A.

3.1.2.3 Critical Path Method Activities

The critical path for the baseline schedule (Figure 5) goes through construction of the new personnel sphere, which was identified as a long lead item, and construction is well underway. SwRI has begun manufacturing and expects to deliver a completed sphere on March 23, 2011. As a result, construction is scheduled to begin on April 1, 2011.

A secondary near critical path goes through the preliminary design, procurement and manufacturing of the syntactic foam. The manufacturing, shaping and glassing process for the syntactic foam is expected to take 9 months at a minimum. This is based on vendor quotes, which were based on a preliminary specification provided to the vendors for prototyping activities. The team would like to recommend that a special notice to proceed with the procurement of foam be issued upon review and acceptance of the preliminary design. Mitigating the manufacturing duration in this manner will require that final shaping and fitting of the foam be done during the final design and construction.

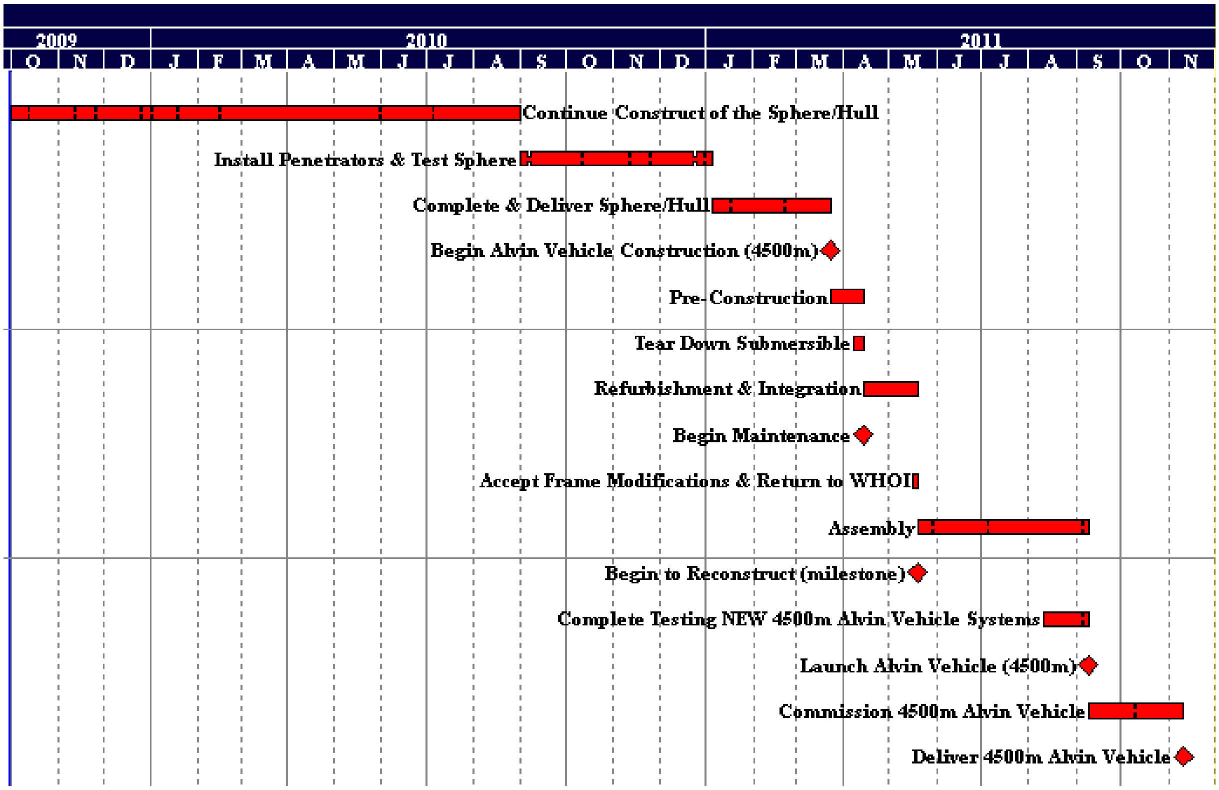


Figure 5. Critical Path Activities

3.1.3 Cost Estimate

A bottom up cost estimate was prepared from the scheduled activities. The estimates were broken into work packages (see Appendix B – cost estimating worksheet). Each sheet was prepared by the technical lead responsible for managing that work. Pricing was verified where possible with vendor quotes and or estimates. Our bottom up estimate identified pricing for several vehicle design options under consideration so that the price of each vehicle configuration could be evaluated against the vehicle's technical requirements and scientific objectives. Appendix C provides the cost estimate for the preferred A-4500 HOV design.

The schedule and cost estimate were combined into a cost and resource loaded IMS, which was used to generate cash flow projections and staffing charts. All data were compiled in our P3 scheduling tool so that scope, schedule, cost and resources are fully integrated. All data was imported into Oracle's Primavera Risk Analysis in order to calculate contingency for each work package. A complete discussion on contingency can be found in the *A-4500 HOV Risk Management Plan*.

All cost data are collected at the work package level. The basis of estimate (BOE) for cost data includes a narrative to describe the work element, a list of activities with estimated man weeks of work, and pricing for various cost categories.

Estimator Confidence

Estimators noted assumptions based on their knowledge at the preliminary design phase. Items in the cost estimate are tagged with a confidence descriptor that characterizes the uncertainty associated with the estimate. The categories established for the project are shown in Table 1. Where possible, estimators solicited vendor pricing to refine initial estimates and/or validate pricing assumptions. Supporting documentation is provided in the cost book.

Table 1. Estimator confidence level categories

Confidence Level	Descriptor Code	Description
High	CP	Catalog prices for off-the-shelf items
	VQ	Vendor quotation based on finished drawings, followed by vendor quotes on preliminary drawings or specifications
	HD	Historical data from previous *Alvin* experience with similar components and efforts
Low	EE	Engineering estimates based on the estimator's judgment and experience

Pricing Categories

Pricing categories include labor, travel, materials, equipment, subcontractors, expenses, and consulting. Labor rates are loaded for benefits/fringe, indirect, G&A and lab costs. Estimates were prepared using individual salary rates for each team member.

Escalation

The basis of estimate for each work package is based on current-2009 year dollars. Escalation is applied in the scheduling software once the budgets are time-phased in accordance with Table 2.

Table 2. Escalation Factors

Fiscal Year	**2010**	**2011**	**2012**
LABOR & Non-Labor			
%	4.0	4.0	4.0
Cum Effect	1.0400	1.0816	1.1249

Taxes

It is anticipated that all equipment purchased under this agreement will be purchased directly by WHOI acting as purchasing agent. The purchasing agent will take title to the equipment at the time of acquisition. Therefore, the estimator assumed the appropriate non-profit tax assessment applicable to the state where the purchase is made, with respect to the acquired equipment.

3.1.4 Staffing Plan

The staffing plan (Figure 6) indicates the number of dedicated team members needed to execute this project. The current staffing chart is time-phased and shows that several departments will be overloaded during the preliminary and final design phases of the project. However, many of the activities with float will be prioritized and staggered to level the resource requirements. Leveling priorities will be based on an activity's float so that critical activities are not delayed. The result is expected to be approximately 12-14 full time employees on average during the design phase. The procurement period requires approximately 5-7 full time people. During construction, the effort increases to approximately 15 people.

Durations were developed assuming that staff availability is half time. This assumption is intended to mitigate interruptions to work caused by unplanned calls to sea. The team members actively participate in various projects at WHOI and so interruptions are unavoidable. Resources will be required to work on this project as their activities are on or near the critical path.

Resources were loaded on an individual basis so that key resources could be managed appropriately. The team does not intend to track staffing hours or costs on an individual basis because maintenance at this level is significant and it provides no additional value to the EVMS calculations. Detailed staffing charts can be found in the Integrated Master Schedule document.

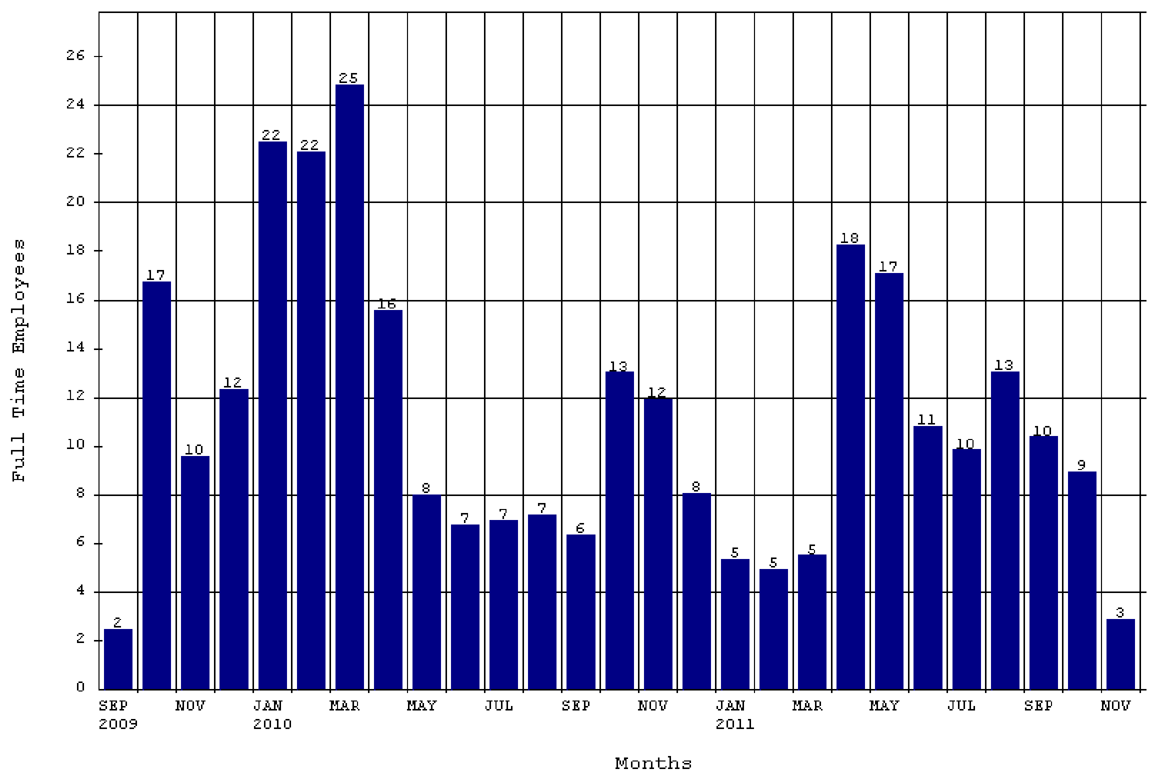


Figure 6. Staffing Plan

3.1.5 Earned Value Management

Once the preferred vehicle option was selected, the schedule was cost and resource loaded. This results in a scheduled value for each activity in the schedule. This allocation is the basis for earned value management. The scheduled values can be horizontally traced to the cost estimate by activity so that the pricing assumptions are not lost. The scheduled values can also be vertically traced or rolled up to the appropriate cost account so that actual costs can be compared to the earned value. In this manner, performance curves are updated monthly so that variances can be identified and corrective action taken.

3.1.5.1 Scheduled Values

Once the preferred vehicle design option was selected, the schedule was cost and resource loaded per activity. The value of each activity is the basis for earning value (Figure 7). The schedule is coded by project phase, WBS, work package, and departments so that the cost data can be evaluated in several different ways.

Activity ID	Activity Description	Scheduled Value
A06 Fixed Buoyancy		
7360	Determine Shape & Location of Foam Blocks	9,018.18
7370	Calculate Adjustable Fixed Ballast Weight	9,018.18
1190	Prepare Purchase & Test Spec: Syntactic Foam	6,692.04
7380	Prepare Prel Design Documents: Fixed Buoyancy	19,315.44
1220	Modify & Submit Foam Specification to ABS	21,092.04
1235	Respond to ABS Comments on Foam Spec	3,479.94
1280	Purchase/Manufacture/Shape Syntactic Foam	1,556,509.76
1290	Vendor Shape/Glass Syntactic Foam	1,556,509.76
1100	Final Design: Fixed Buoyancy Assemblies	25,741.44
1240	WHOI/ABS Resolve Issues with Foam Spec	12,858.84
1260	Procure Syntactic Foam Vendor	3,479.94
1270	Vendor Qualify Syntactic Foam	114,400.00

Figure 7. Sample of Scheduled Value of Activities

3.1.5.2 Performance Curves

The performance curve describes the planned value of work scheduled. The baseline time-phased budget anticipated for this project is shown in Figure 8. This chart will be updated monthly to show the earned value based on work completed and the actual cost of work performed. The schedule variance and cost variance will also be provided. However, the team will manage the project using the total float as the principal indicator of schedule variance and the cost variance at completion as the principal indicator of cost variance. Trend calculations will be prepared if the project thresholds are exceeded.

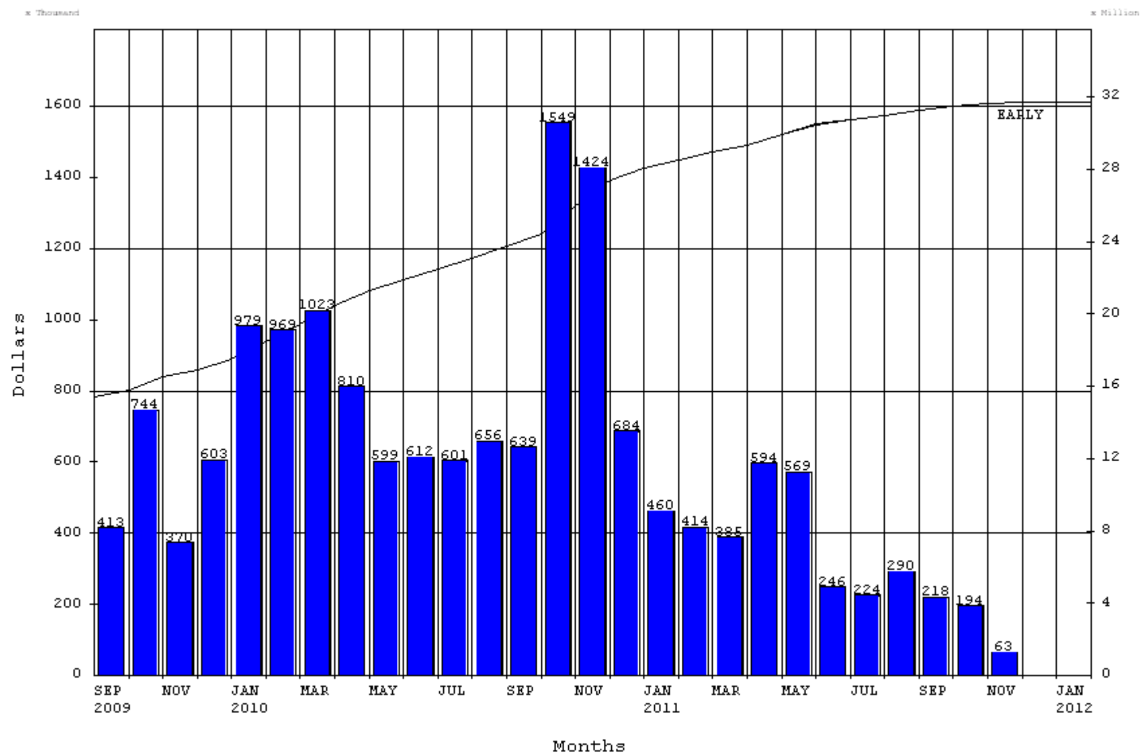


Figure 8. Baseline Time-Phased Budget

3.1.6 Risk Analysis Contingency

Contingency is based on a standardized risk analysis as described in the *A-4500 HOV Risk Management Plan* (RMP). The technical lead is responsible for providing risk factors for each work package and assuring that valid contingency is assigned to each WBS work package.

For each work package, the technical leads evaluate technical, cost and schedule risk for the package or individual activities. Technical, cost and schedule risk factors are input fields within the Oracle's Primavera Risk Analysis software. The software allows risk percentages to be assigned by discipline, work package or individual activity. Standard descriptions and ranges have been defined for technical, cost and schedule risk parameters so that the team is working from a common point of reference. The standard parameters and definitions used for this project are identified in the RMP.

The process the team used to identify risks began with several workshops where each WBS element was reviewed for threats and opportunities. Once identified, the technical lead completed a risk form which addressed the statement of risk, probability, consequence, risk level, risk handling approach and plan. Cost and schedule impacts were identified. The data from the form were then entered into Oracle's Primavera Risk Analysis software where the contingency is calculated. The risk will be monitored quarterly and managed. The overall project risks are captured in the Risk Summary and Handling Impact worksheet in the RMP.

3.2 Update Process

The update process begins with a monthly schedule update whereby progress is posted for each activity in the schedule. Actual costs and earned value are tallied for work completed and summarized at the control account level. A "bottom up" estimate to complete is then prepared for each control account and an estimate at completion is calculated. The estimate at completion is validated using earned value trend calculations.

3.2.1 Schedule Update

The schedule will be updated monthly. The control account manager will status the actual start and finish dates, percent complete and remaining duration for each activity in the schedule. New scope items will be added and tagged as such. The schedule will then be recalculated to determine the current project's total float, which will be the principal indicator for measuring schedule impacts. A report showing these data alongside the baseline schedule will serve to identify schedule variance information.

3.2.2 Cost Accumulation

The accounting system collects, measures, and reports project costs in accordance with the charge numbers defined for the project. The charge numbers are reflective of the control account defined in the responsibility matrix. Actual costs are accumulated as direct and indirect costs.

WHOI's financial system meets Generally Accepted Accounting Principles (GAAP) standards and financial processes are in place to meet Office of Management and Budget Circulars A-133 and A-122 guidance and be subject to annual audits. The systems are GAAP compliant and provide basic labor and expenditures tracking for the program. These systems provide the formal invoicing of the cost incurred by the project.

Procedures and processes are in place to ensure proper tracking of labor, sub-contract, material costs and other expenses by control account. Periodic financial status reports and invoices will be used to monitor and analyze progress. These costs are calculated and collected in accordance with the current WHOI accounting process.

3.2.3 Estimate to Complete

A bottom up estimated to complete will be prepared monthly. The cost estimating worksheets are updated to reflect work completed. The remaining work is the basis for the estimate to complete. Additional activities and costs are added if the scope and/or assumptions change. See Appendix B – Example Cost Estimating Worksheet.

A monthly cost control report will be published to the project team. The team will then analyze the cost variances and prepare a narrative explanation of the variance.

3.2.4 Earned Value Trend Analysis

Earned value trend calculations (Figure 9) will be used to validate the estimate at completion produced by the bottom up estimate. The team will use schedule variance (SV), schedule performance index (SPI), cost variance (CV) and the cost performance index (CPI). These indices can be used to produce a range of values to generate the optimistic, pessimistic and most likely outcome for the project's final costs.

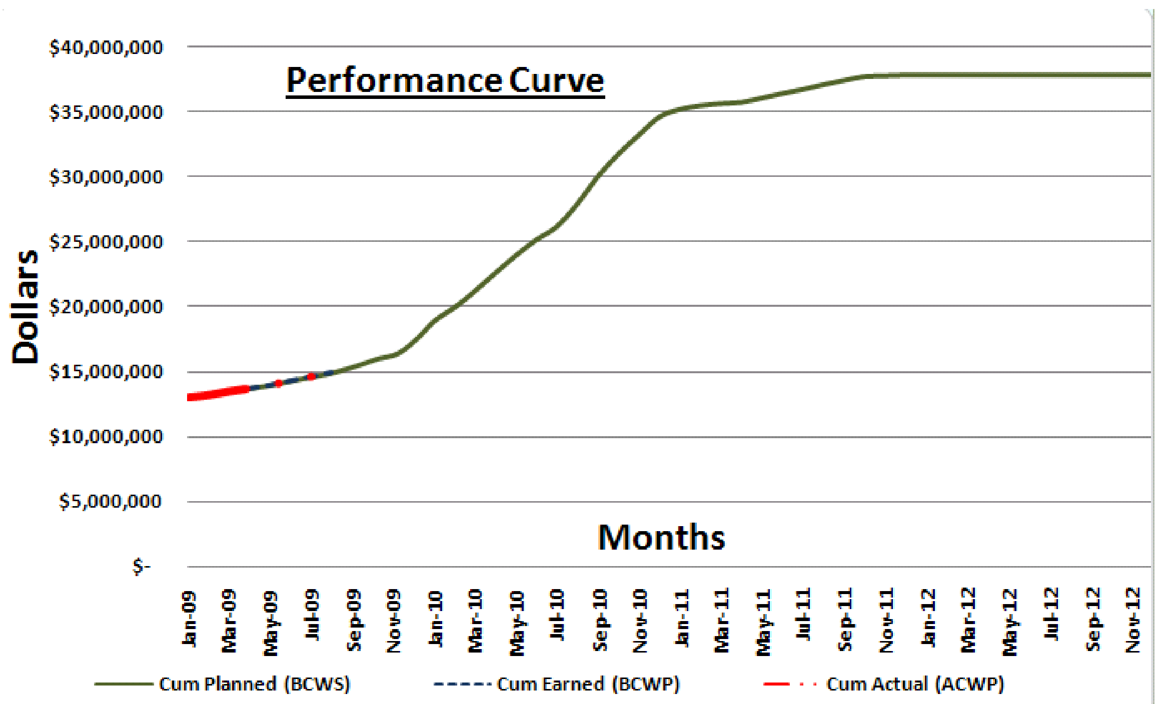


Figure 9. Performance Curve

3.3 Control Process

Upon completion of the update process, variances for scope, schedule, cost and resources will be identified. A draft progress report will serve as an agenda for a monthly meeting to discuss progress, review variances, problems and/or opportunities. Corrective actions will then be identified and carried into the weekly team meeting to ensure visibility. The respective control account managers will work with the Project Manager and Principal Investigator to resolve issues as they arise.

3.3.1 Variance Analysis

Once variances for scope, schedule, cost and resources have been identified, an in-depth assessment will be made for variances that exceed 10% or +/-$25,000. The causes and potential corrective actions will be prepared by the control account manager (technical lead) in conjunction with the Project Manager. These potential corrective actions will be reviewed by the Change Control Board. Corrective actions that can be done internally will be directed as such. NSF and the RHOC will be notified as needed for those that require external direction. Changes will be addressed as described in the configuration management procedure in the A-4500 HOV *Configuration Management Plan* (CMP).

3.3.2 Risk Assessment

Risk identification, assessment and management will continue through the project life cycle. Issues identified during the planning stage will be reviewed monthly and will either continue or be retired. Other risks and/or opportunities may be introduced during the execution phase. Continuous discussions of risk will be part of the monthly project review cycle.

3.3.3 Monthly Reporting

The monthly report will include an update on progress and risk, identification of problems/issues based on a complete variance analysis, and a discussion on corrective actions and changes.

3.4 Change Management

Change Management is required during the life-cycle of the program to maintain the integrity of the IMS and to ensure authorized changes are visible and fully coordinated. Our EVMS provides the checks and balances necessary to ensure IMS changes are timely, accurate and auditable. Estimates to Complete (ETC) are revised monthly considering past performance and remaining work. Management reserve may be allocated to accommodate scope changes or variance mitigation actions. In some cases, work and associated scope budget may be transferred between Control Accounts.

Internal Changes

"Within scope" changes directed by a CAM or PM are considered "internal" if they can be accomplished within the limits of existing allocated budgets and Management Reserve (MR) without extending the project completion date. These adjustments are made to work within existing CAs. The CAM will process a Change Control Request (CCR) form documenting the revisions to be made to the IMS, and justification for the change. The change classes that require a CCR are documented in the *A-4500 HOV Configuration Management Plan* (CMP)). In general, all changes that impact MR, critical path will require completion of a CCR.

The process for reviewing, approving, implementing and documenting IMS changes are prescribed by the *A-4500 HOV Configuration Management Plan*. Appropriate entries of required transactions will be identified in the program log for Management Reserve (MR) and other CA adjustments to the budget. Changes to the performance measurement baseline (PMB) will follow the standard guidelines for planning identified in the EVMS and performed within the EVMS.

External Changes

If an Over the Baseline (OTB) situation develops where available contract budgets are insufficient to complete the remaining work, a formal reprogramming may be required to add funding or reduce scope. This is considered an external change" and formal customer approval is required as per the *Configuration Management Plan*.

Over Target Baseline

An Over Target baseline (OTB) is a condition in which the project budget and schedule in the existing PMB exceeds the program CBB. Here, the baseline that results from increasing budgets for remaining work, without a related increase in the contract value, causes the total allocated budget to exceed the target cost. The process of implementing an OTB is formal re-programming or re-baseline.

Formal Re-programming

Formal re-programming is implemented when an OTB situation occurs and requires prior approval from the funding agency/customer to proceed.

It is a formal declaration that the project is in an overrun condition and a redistribution of remaining work, considering the overrun to date, will need to be accomplished in order to complete the program. Special guidelines to follow when performing a re-program are required as performance measurement data and trend analysis data will most likely be lost or significantly affected.

Changes as a result of customer-driven events are also considered to be external and follow a process that begins with a contract modification and ends with the approved increase/or decrease reflected in the contract upper limit.

External changes must be incorporated in a timely fashion (generally within two full reporting periods). This type of change includes revisions to the project completion date, total project cost, and work scope affecting user goals and objectives.

Retroactive Changes

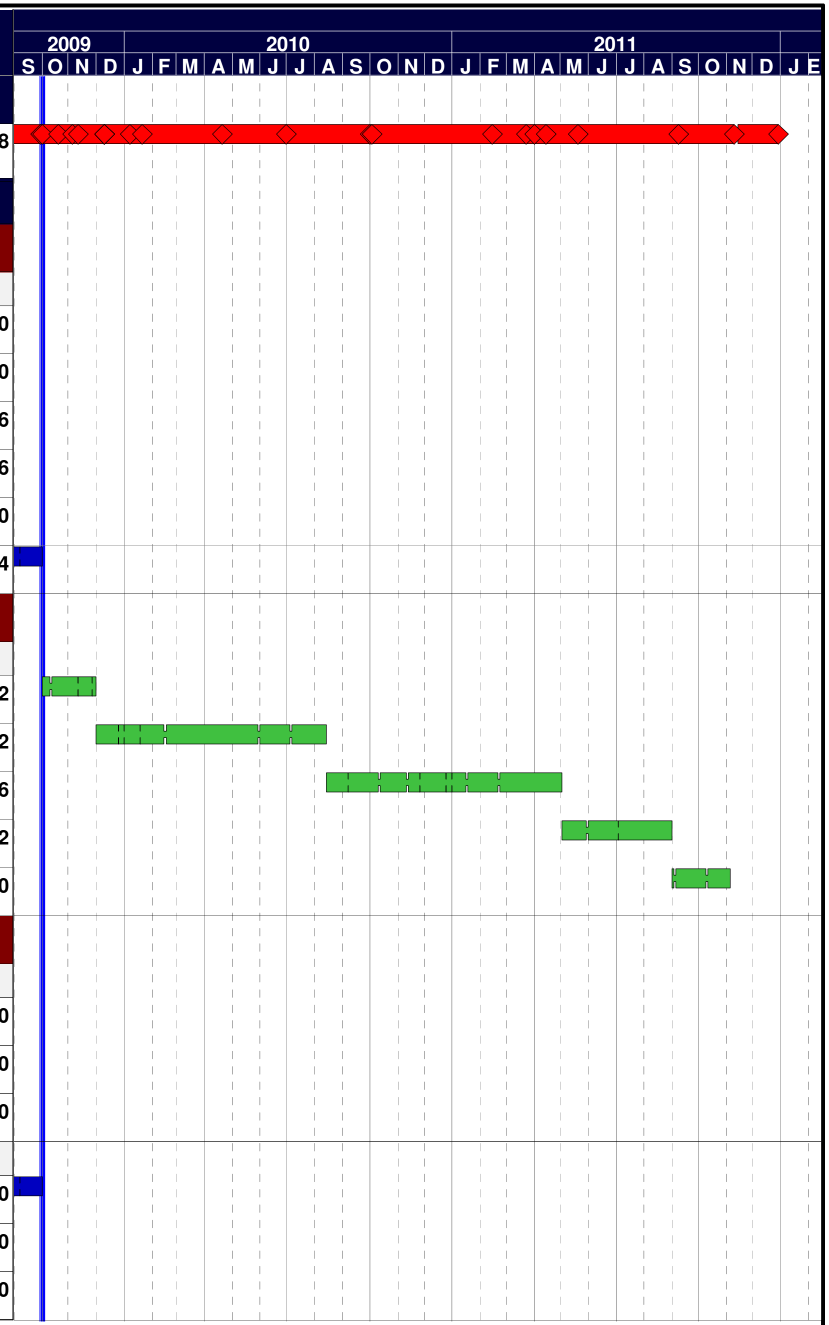
Retroactive changes to budgets, actual costs for completed work, or schedules are not permitted except for normal accounting adjustments or correction to errors. Retroactive changes to BCWP are not permitted without clear and objective substantiation of the basis for the change. This practice will only be permitted on a case-by-case basis when necessary to accurately reflect completed work. All accounting adjustments, reconciliations, or correction of errors will be made in the current reporting period.

3.5 Contingency Management

NSF will hold contingency funds. Contingency management will follow the detailed procedure described in Section 3.0 of the *A-4500 HOV Configuration Management Plan* (CMP).

Appendix A – Detailed Schedule

Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
6500m HOV Project						
Total		1,584	03OCT05A	28DEC11	0	31,722,893.98
Stage 1: A-4500 HOV						
Historical Information						
0000	Begin Project	0	03OCT05A			0.00
0001	Historical 2005	63*	03OCT05A	30DEC05A		238,025.10
0002	Historical 2006	256*	03JAN06A	29DEC06A		900,177.96
0003	Historical 2007	257*	02JAN07A	31DEC07A		5,176,003.16
0004	Historical 2008	258*	02JAN08A	31DEC08A		6,312,281.00
0005	Historical 2009	103*	02JAN09A	30SEP09A		2,959,953.94
Project Management						
General Oversight						
0107	Project Management during Preliminary Design	40*	01OCT09A	30NOV09	4	140,427.92
0110	Project Management during Final Design	177*	01DEC09	12AUG10	4	670,238.72
0160	Project Management during Procure & Fabrication	179*	13AUG10	02MAY11	4	693,407.26
0190	Project Management during Construction	86	03MAY11	01SEP11	4	412,126.92
0192	Project Management during Sea Trials	44	02SEP11	04NOV11	35	18,147.40
Project Management Plans						
Meetings & Data Collection						
0105	Meet with National Science Foundation	1	16JUL09A	16JUL09A		0.00
0230	Identify Science Requirements	1	17JUL09A	17JUL09A		0.00
0280	Conduct Scoping Meeting	1	21JUL09A	21JUL09A		0.00
Project Execution Plan						
0236	Project Management Draft Plans	33	17JUL09A	30SEP09A		0.00
0430	Prepare Outline: Project Execution Plan	1	17JUL09A	17JUL09A		0.00
0431	Prepare 1st Draft: Project Execution Plan	12	20JUL09A	31AUG09A		0.00



Start Date	01SEP05
Finish Date	28DEC11
Data Date	01OCT09
Run Date	06NOV09 01:31

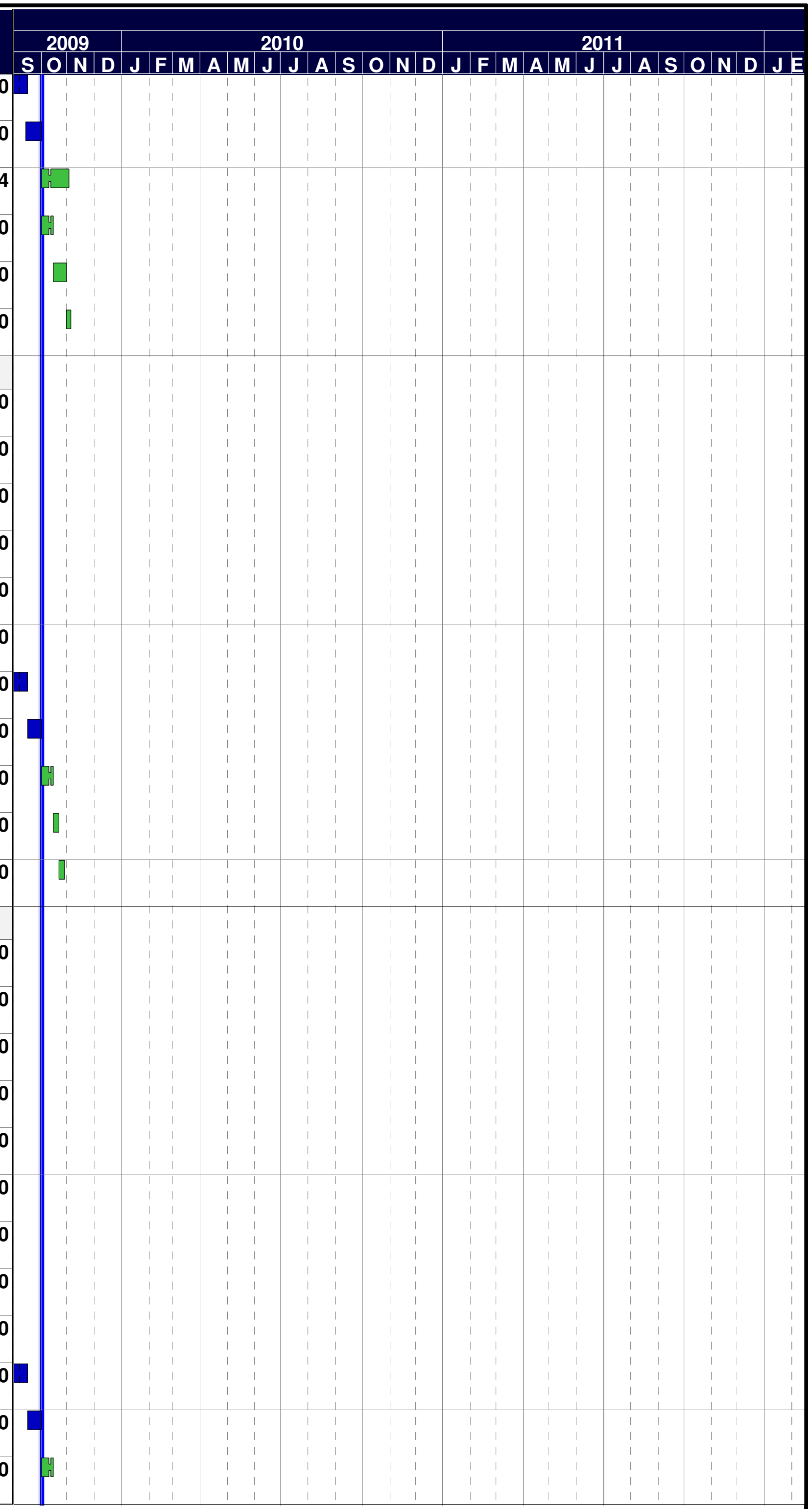
Early Bar
Progress Bar
Critical Activity

AL28 Sheet 1 of 19

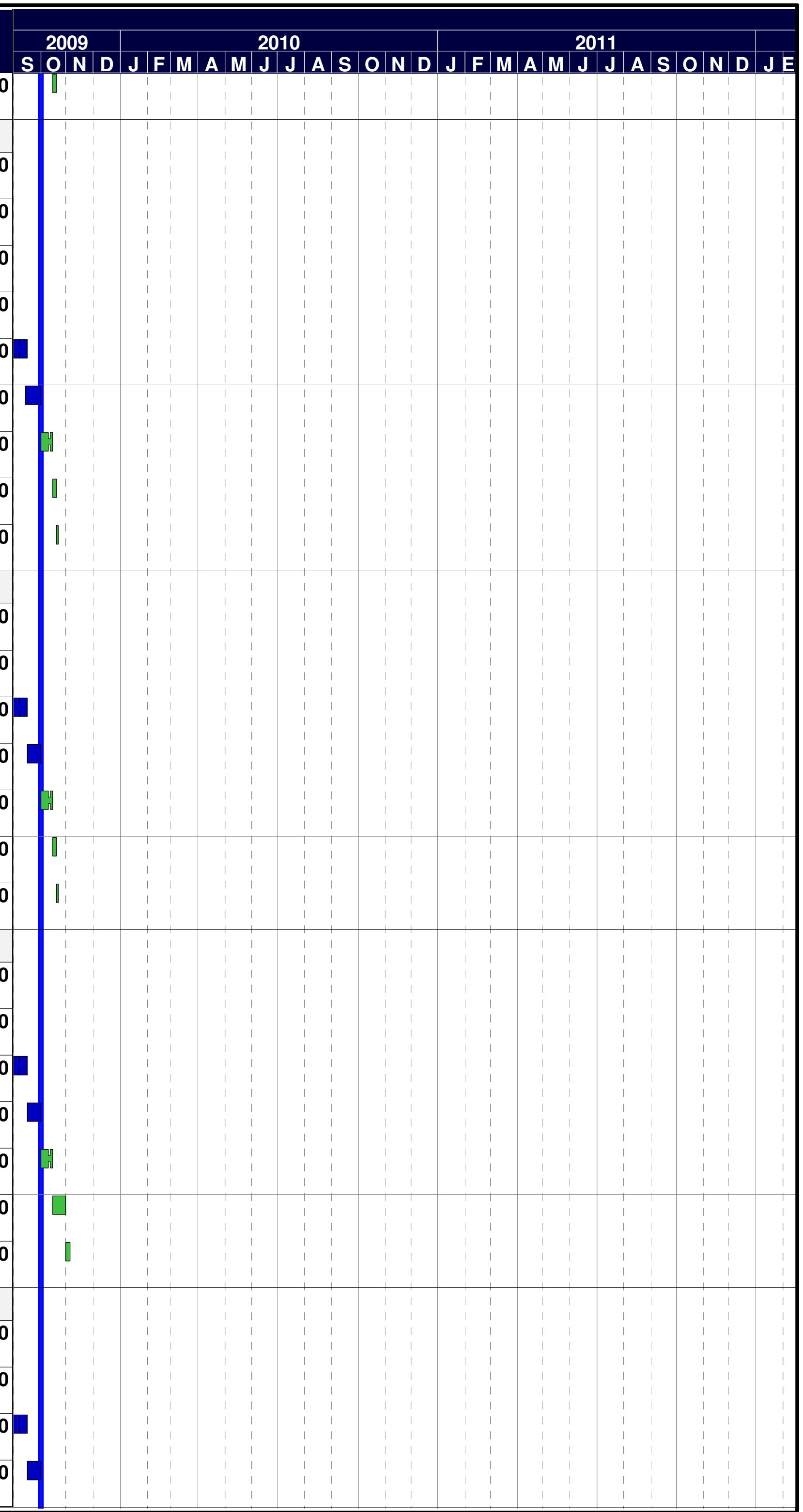
Woods Hole Oceanographic Institution
6500m HOV Project
Figure 3.2 Detailed Activities

WOODS HOLE OCEANOGRAPHIC INSTITUTION 1930

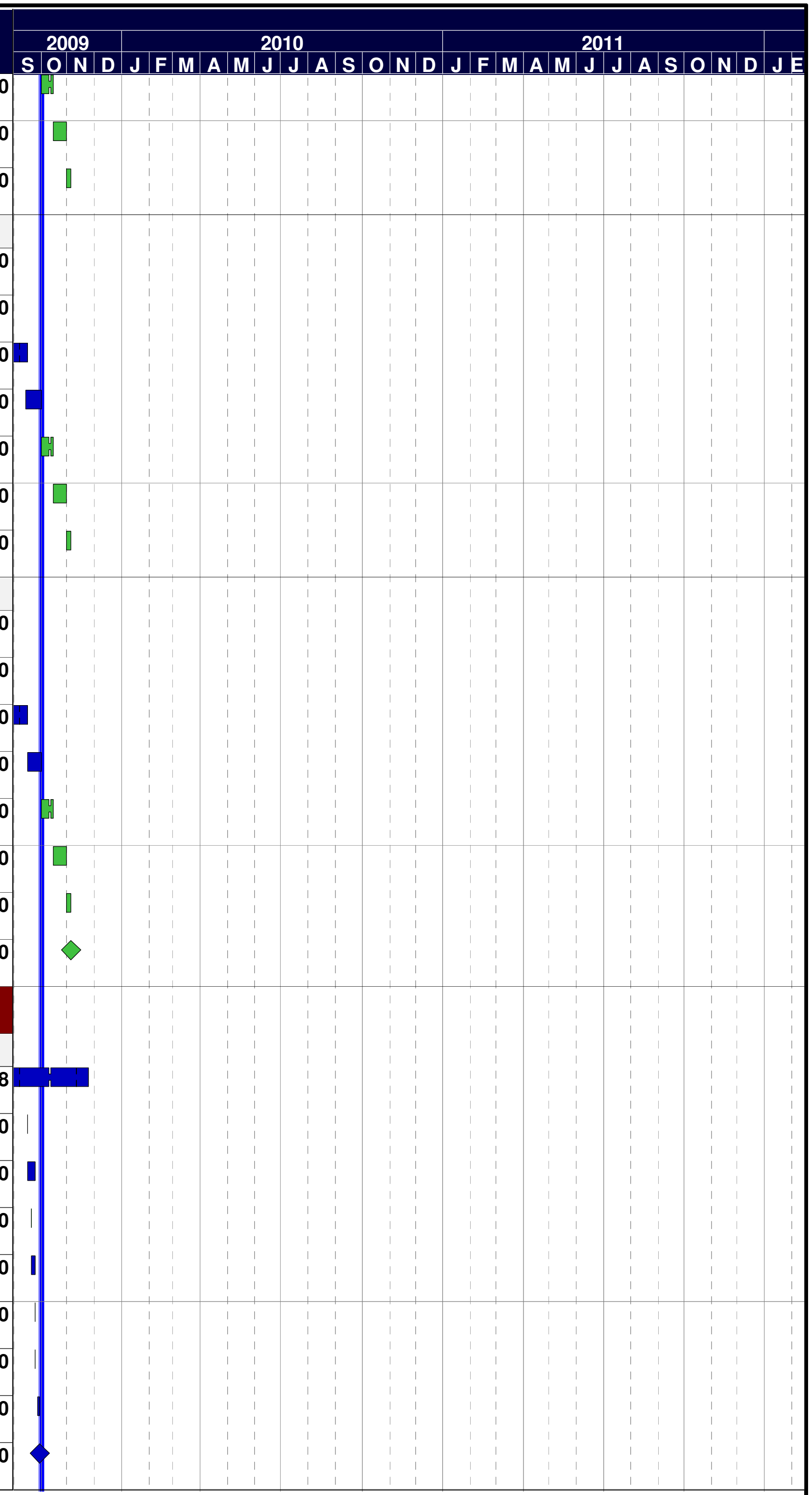
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
0433	Internal Review/Comment: Project Execution Plan	3	01SEP09A	15SEP09A		0.00
0435	External Review/Comment: Project Execution Plan	3	15SEP09A	30SEP09A		0.00
0237	Project Management Final Plans	22	01OCT09A	02NOV09	1	212,884.04
0437	Prepare 2nd Draft: Project Execution Plan	10	01OCT09A	15OCT09	22	0.00
0439	Internal Review/Comment: Project Execution Plan	10	16OCT09	29OCT09	22	0.00
0441	External Review/Comment: Project Execution Plan	3	30OCT09	03NOV09	22	0.00
Vehicle Design Plan						
0235	Prepare Outline: Vehicle Design Plans	1	17JUL09A	17JUL09A		0.00
0240	Identify Technical Requirements	1	20JUL09A	20JUL09A		0.00
0250	Identify Candidate Designs	1	22JUL09A	22JUL09A		0.00
0260	Conduct Trade-off Study	5	23JUL09A	29JUL09A		0.00
0270	Select Preferred Vehicle	1	30JUL09A	30JUL09A		0.00
0442	Prepare 1st Draft: Vehicle Design Plans	10	31JUL09A	31AUG09A		0.00
0443	Internal Review/Comment: Vehicle Design Plans	3	01SEP09A	15SEP09A		0.00
0445	External Review/Comment: Vehicle Design Plans	3	16SEP09A	30SEP09A		0.00
0447	Prepare 2nd Draft: Vehicle Design Plans	10	01OCT09A	15OCT09	27	0.00
0449	Internal Review/Comment: Vehicle Design Plans	5	16OCT09	22OCT09	27	0.00
0452	External Review/Comment: Vehicle Design Plans	3	23OCT09	27OCT09	27	0.00
Project Management Plan						
0275	Collect Detailed Schedule Information	2	17JUL09A	20JUL09A		0.00
0277	Prepare Cost Worksheets	3	22JUL09A	24JUL09A		0.00
0279	Prepare Integrated Master Schedule	4	22JUL09A	27JUL09A		0.00
0281	Prepare WBS & Dictionary	1	22JUL09A	22JUL09A		0.00
0470	Prepare Outline: Project Management Plan	1	22JUL09A	22JUL09A		0.00
0380	Conduct Team Review: Interactive Master Schedule	1	28JUL09A	28JUL09A		0.00
0390	Prepare Cost Book	5	29JUL09A	04AUG09A		0.00
0410	Revise Integrated Master Schedule	3	29JUL09A	31JUL09A		0.00
0480	Prepare 1st Draft: Project Management Plan	10	30JUL09A	11AUG09A		0.00
0550	Internal Review/Comment: Project Management Plan	2	13AUG09A	15SEP09A		0.00
0560	External Review/Comment: Project Management Plan	2	16SEP09A	30SEP09A		0.00
0570	Prepare 2nd Draft: Project Management Plan	10	01OCT09A	15OCT09	33	0.00



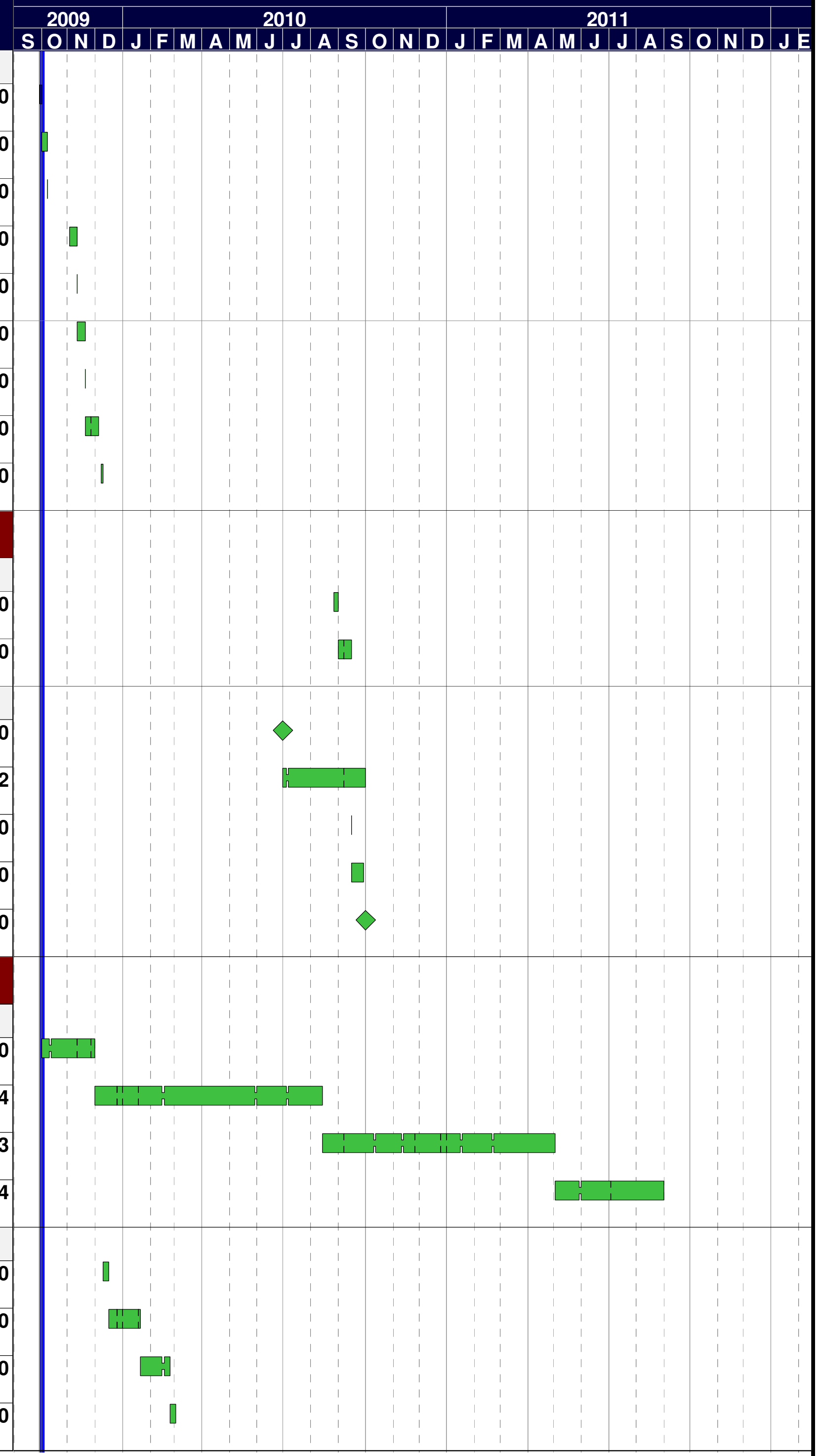
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
0590	External Review/Comment: Project Management Plan	2	16OCT09	19OCT09	33	0.00
Risk Management Plan						
0285	Prepare Risk Worksheets	3	03AUG09A	07AUG09A		0.00
0291	Prepare Outline: Risk Management Plan	1	05AUG09A	05AUG09A		0.00
0286	Prepare Risk Register	5	17AUG09A	21AUG09A		0.00
0492	Prepare 1st Draft: Risk Managment Plan	10	21AUG09A	28AUG09A		0.00
0494	Internal Review/Comment: Risk Managment	2	01SEP09A	15SEP09A		0.00
0495	EXTERNAL Review of Risk Mngt Plan & Register	2	15SEP09A	30SEP09A		0.00
0498	Prepare 2nd Draft: Risk Managment Plan	10	01OCT09A	15OCT09	31	0.00
0501	Internal Review/Comment: Risk Managment	2	16OCT09	19OCT09	31	0.00
0503	External Review/Comment: Risk Managment Plan	2	20OCT09	21OCT09	31	0.00
Contingency Management Plan						
0500	Prepare Outline: Contingency Managment Plan	3	03AUG09A	05AUG09A		0.00
0502	Prepare 1st Draft: Contingency Managment Plan	10	06AUG09A	19AUG09A		0.00
0504	Internal Review/Comment: Contingency Managment	2	20AUG09A	15SEP09A		0.00
0506	External Review/Comment: Contingency Managment	2	16SEP09A	30SEP09A		0.00
0508	Prepare 2nd Draft: Contingency Managment Plan	10	01OCT09A	15OCT09	31	0.00
0511	Internal Review/Comment: Contingency Managment	2	16OCT09	19OCT09	31	0.00
0513	External Review/Comment: Contingency Managment	2	20OCT09	21OCT09	31	0.00
Acquisition Plan						
0510	Prepare Outline: Acquisition Plan	1	20JUL09A	20JUL09A		0.00
0512	Prepare 1st Draft: Acquisition Plan	10	21JUL09A	31AUG09A		0.00
0514	Internal Review/Comment: Acquisition Plan	3	01SEP09A	15SEP09A		0.00
0516	External Review/Comment: Acquisition Plan	3	16SEP09A	30SEP09A		0.00
0518	Prepare 2nd Draft: Acquisition Plan	10	01OCT09A	15OCT09	22	0.00
0522	Internal Review/Comment: Acquisition Plan	10	16OCT09	29OCT09	22	0.00
0524	External Review/Comment: Acquisition Plan	3	30OCT09	03NOV09	22	0.00
Quality Control/Assurance Plan						
0520	Prepare Outline: QC/QA Plan	1	20JUL09A	20JUL09A		0.00
0535	Prepare 1st Draft: QC/QA Plan	10	21JUL09A	21AUG09A		0.00
0545	Internal Review/Comment: QC/QA Plan	3	24AUG09A	15SEP09A		0.00
0555	External Review/Comment: QC/QA Plan	3	16SEP09A	30SEP09A		0.00



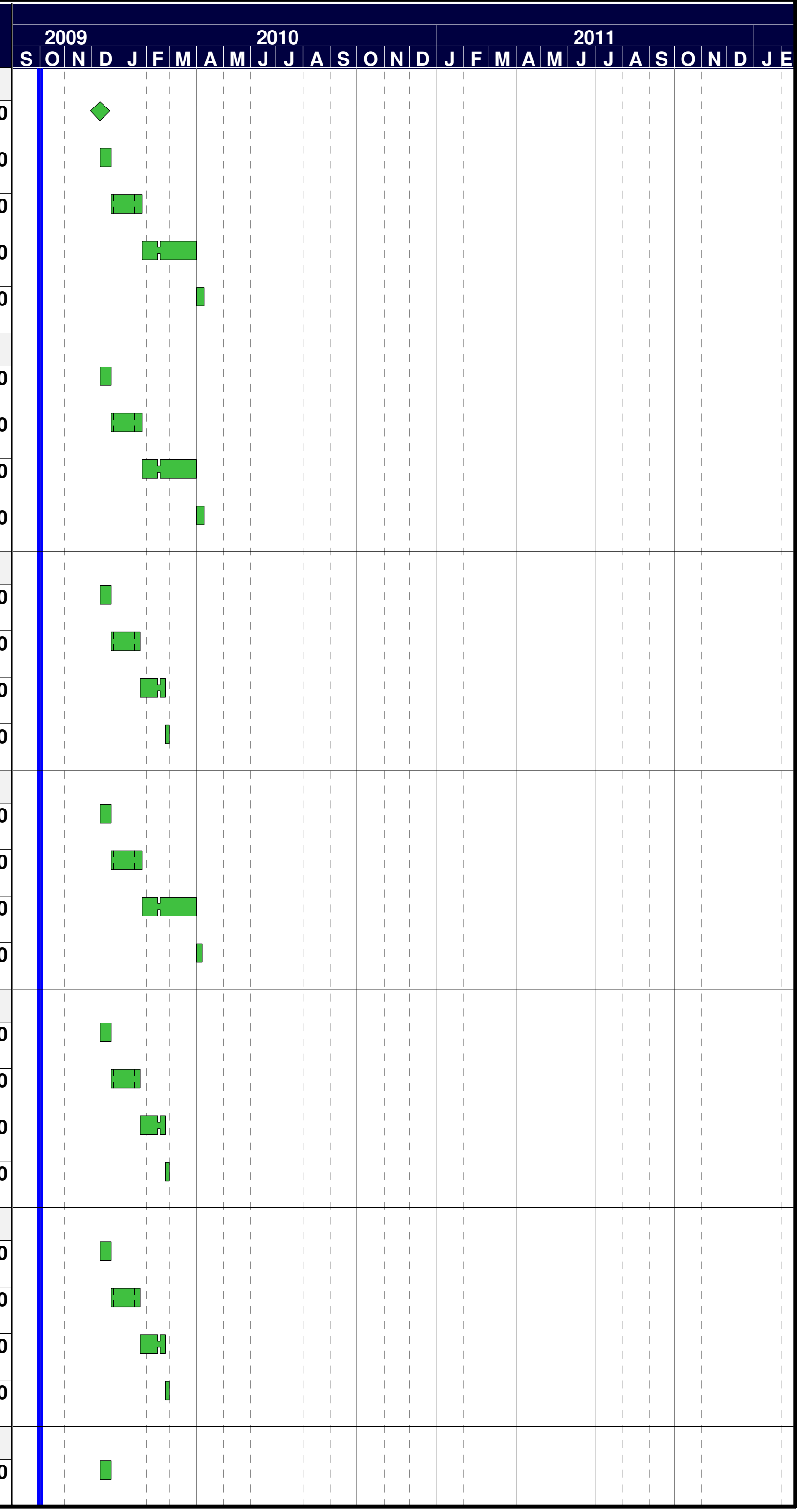
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
0565	Prepare 2nd Draft: QC/QA Plan	10	01OCT09A	15OCT09	22	0.00
0575	Internal Review/Comment: QC/QA Plan	10	16OCT09	29OCT09	22	0.00
0585	External Review/Comment: QC/QA Plan	3	30OCT09	03NOV09	22	0.00
Environmental Health & Safety Plan						
0530	Prepare Outline: Health & Safety Plan	1	20JUL09A	20JUL09A		0.00
0532	Prepare 1st Draft: Health & Safety Plan	10	21JUL09A	20AUG09A		0.00
0534	Internal Review/Comment: Health & Safety Plan	3	21AUG09A	15SEP09A		0.00
0536	External Review/Comment: Health & Safety Plan	3	15SEP09A	30SEP09A		0.00
0538	Prepare 2nd Draft: Health & Safety Plan	10	01OCT09A	15OCT09	22	0.00
0542	Internal Review/Comment: Health & Safety Plan	10	16OCT09	29OCT09	22	0.00
0544	External Review/Comment: Health & Safety Plan	3	30OCT09	03NOV09	22	0.00
Transistion Plan						
0540	Prepare Outline: Transition Plan	1	22JUL09A	22JUL09A		0.00
0541	Prepare 1st Draft: Transition Plan	10	23JUL09A	19AUG09A		0.00
0543	Internal Review/Comment: Transition Plan	3	20AUG09A	15SEP09A		0.00
0546	External Review/Comment: Transition Plan	3	16SEP09A	30SEP09A		0.00
0547	Prepare 2nd Draft: Transition Plan	10	01OCT09A	15OCT09	22	0.00
0549	Internal Review/Comment: Transition Plan	10	16OCT09	29OCT09	22	0.00
0551	External Review/Comment: Transition Plan	3	30OCT09	03NOV09	22	0.00
0101	Complete Project Management Plans	0		03NOV09	22	0.00
Preliminary Design Report						
Preliminary Design Readiness Review						
0099	Prepare Preliminary Design	89	17JUL09A	23NOV09A		126,955.88
0104	Conduct 1st Dry Run with Team	1	16SEP09A	16SEP09A		0.00
0106	Revise Presentation	5	17SEP09A	25SEP09A		0.00
0102	Prepare Presentation Outline	1	21SEP09A	21SEP09A		0.00
0103	Prepare Presentation	4	22SEP09A	25SEP09A		0.00
0108	Conduct 2nd Dry Run with Internal WHOI Advisors	1	25SEP09A	25SEP09A		0.00
0112	Refine Presentation for Readiness Review	5	25SEP09A	25SEP09A		0.00
0122	Conduct Readiness Review	3	28SEP09A	29SEP09A		0.00
0100	NSF Provide PDR Agenda (not provided)	0	30SEP09A			0.00



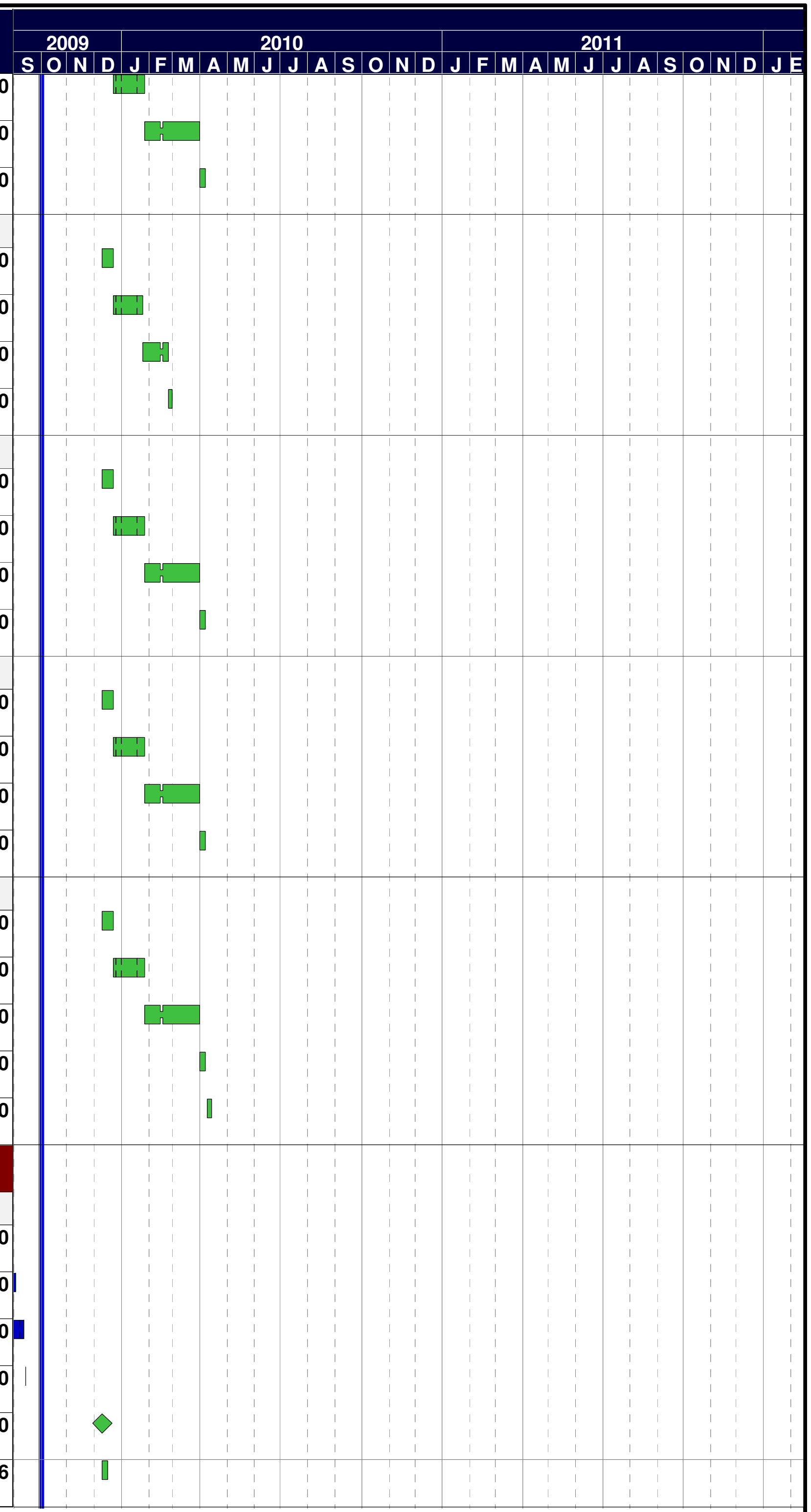
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
Preliminary Design Report						
0124	Advisors Provide Review Comments	5	30SEP09A	01OCT09A		0.00
0126	Revise PDR Documents	5	01OCT09A	07OCT09	17	0.00
0128	Revise PDR Presentation Outline	1	08OCT09	08OCT09	17	0.00
0132	Prepare PDR Presentation	5	03NOV09	09NOV09	1	0.00
0133	Conduct 1st PDR Dry Run with Team	1	10NOV09	10NOV09	1	0.00
0134	Revise PDR Presentation	5	12NOV09	18NOV09	1	0.00
0136	Conduct 2nd PDR Dry Run w/Internal WHOI Advisors	1	19NOV09	19NOV09	1	0.00
0138	Refine Presentation for PDR	10	20NOV09	04DEC09	1	0.00
0141	NSF Conduct PDR Review	3	07DEC09	09DEC09	1	0.00
Final Design Report						
Engineering Review						
0561	Conduct EXTERNAL Engineering Review	3	27AUG10	31AUG10	4	0.00
0571	Engineer Review Report	10	01SEP10	15SEP10	4	0.00
Final Design Report						
1999	Compile Mechanical Final Design	0		30JUN10	2	0.00
1998	Prepare Final Design	65	01JUL10	01OCT10	2	132,032.52
8000	Compile Final Design Documents	1	15SEP10	15SEP10	4	0.00
8100	Review/Approve Final Design Documents	10	16SEP10	29SEP10	4	0.00
8300	Issue Final Design Documents (Sept, 2010)	0		01OCT10	2	0.00
Classification/Certifiction						
General Oversight						
0115	ABS Certification during Preliminary Design	40*	01OCT09	30NOV09	4	28,800.00
0120	ABS Certification during Final Design	177	01DEC09	12AUG10	4	218,157.04
0170	ABS Certification during Procure & Fabrication	179	13AUG10	02MAY11	4	224,781.73
0200	ABS Certification during Construction	86	03MAY11	01SEP11	4	167,874.84
ABS Certification Plan						
0125	Prepare/Submit Draft ABS Classification Plan	5	10DEC09	16DEC09	44	0.00
0135	ABS Review/Comment on ABS Plan	22	17DEC09	20JAN10	44	0.00
0145	Incorporate Comments on ABS Plan	22	21JAN10	22FEB10	44	0.00
0155	Submit Final ABS Plan (by 01MAY10)	5	23FEB10	01MAR10	44	0.00



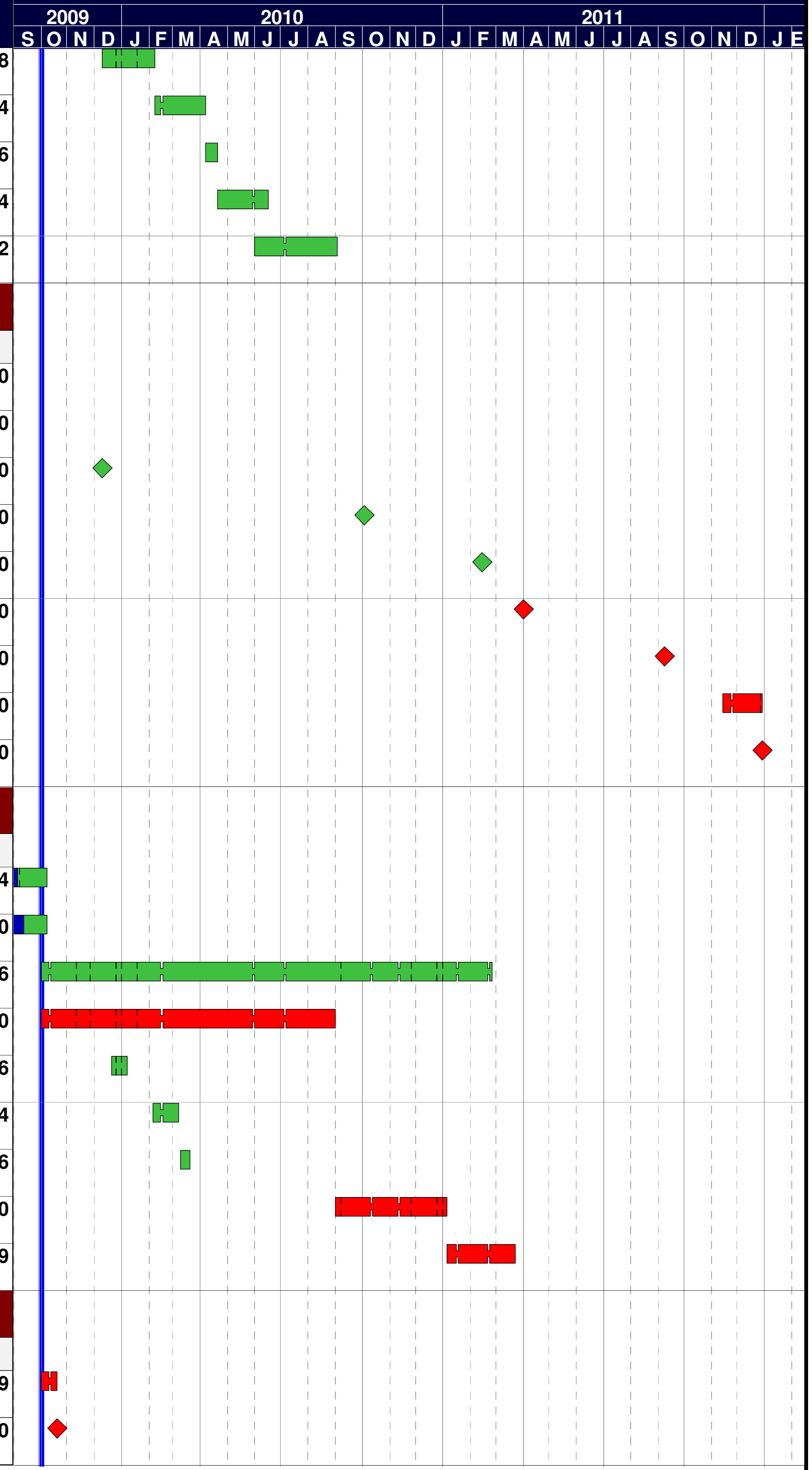
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
Existing Equipment Group						
0139	Begin ABS Submittal Process	0	10DEC09		1	0.00
0140	Prepare ABS Submittal: Existing Equip Group	10	10DEC09	23DEC09	100	0.00
0150	ABS Review/Comment: Existing Equip Group	22	24DEC09	27JAN10	100	0.00
0220	Resolve Issues with ABS : Existing Equip Group	44	28JAN10	31MAR10	100	0.00
0290	Finalize/Submit ABS Submittal: Existing Equip Gr	5	01APR10	07APR10	100	0.00
General Group						
9000	Prepare ABS Submittal: General Group	10	10DEC09	23DEC09	100	0.00
9010	ABS Review/Comment: General Group	22	24DEC09	27JAN10	100	0.00
9020	Resolve Issues with ABS : General Group	44	28JAN10	31MAR10	100	0.00
9030	Finalize/Submit ABS Submittal: General Group	5	01APR10	07APR10	100	0.00
Mechanical Equipment Group						
9040	Prepare ABS Submittal: Mech Equip Group	10	10DEC09	23DEC09	1	0.00
9050	ABS Review/Comment: Mech Equip Group	20	24DEC09	25JAN10	1	0.00
9060	Resolve Issues with ABS : Mech Equip Group	20	26JAN10	23FEB10	1	0.00
9070	Finalize/Submit ABS Submittal: Mech Equip Group	3	24FEB10	26FEB10	1	0.00
Pressure Vessel Group						
9080	Prepare ABS Submittal: Pressure Vessel Group	10	10DEC09	23DEC09	102	0.00
9090	ABS Review/Comment: Pressure Vessel Group	22	24DEC09	27JAN10	102	0.00
9100	Resolve Issues with ABS : Pressure Vessel Group	44	28JAN10	31MAR10	102	0.00
9110	Finalize/Submit ABS Submittal: Pressure Vessel G	3	01APR10	05APR10	102	0.00
Ballast Group						
9120	Prepare ABS Submittal: Main Ballast Group	10	10DEC09	23DEC09	1	0.00
9130	ABS Review/Comment: Main Ballast Group	20	24DEC09	25JAN10	1	0.00
9140	Resolve Issues with ABS : Main Ballast Group	20	26JAN10	23FEB10	1	0.00
9150	Finalize/Submit ABS Submittal: MainBallast Group	3	24FEB10	26FEB10	1	0.00
Electrical Installation Group						
9160	Prepare ABS Submittal: Elec Install Group	10	10DEC09	23DEC09	1	0.00
9170	ABS Review/Comment: Elec Install Group	20	24DEC09	25JAN10	1	0.00
9180	Resolve Issues with ABS : Elec Install Group	20	26JAN10	23FEB10	1	0.00
9190	Finalize/Submit ABS Submittal: Elec Install Grp	3	24FEB10	26FEB10	1	0.00
Emergency Systems Group						
9200	Prepare ABS Submittal: Emergency Sys Group	10	10DEC09	23DEC09	102	0.00



Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
9210	ABS Review/Comment: Emergency Sys Group	22	24DEC09	27JAN10	102	0.00
9220	Resolve Issues with ABS : Emergency Sys Group	44	28JAN10	31MAR10	102	0.00
9230	Finalize/Submit ABS Submittal: Emergency Sys Grp	3	01APR10	05APR10	102	0.00
Ballast Group, Syntactic Foam						
9240	Prepare ABS Submittal: Ballast Group, Foam	10	10DEC09	23DEC09	1	0.00
9250	ABS Review/Comment: Ballast Group, Foam	20	24DEC09	25JAN10	1	0.00
9260	Resolve Issues with ABS : Ballast Group, Foam	20	26JAN10	23FEB10	1	0.00
9270	Finalize/Submit ABS Submittal: Ballast Grp, Foam	3	24FEB10	26FEB10	1	0.00
Life Support Group						
9320	Prepare ABS Submittal: Life Support Group	10	10DEC09	23DEC09	102	0.00
9330	ABS Review/Comment: Life Support Group	22	24DEC09	27JAN10	102	0.00
9340	Resolve Issues with ABS : Life Support Group	44	28JAN10	31MAR10	102	0.00
9350	Finalize/Submit ABS Submittal: Life Support Grou	3	01APR10	05APR10	102	0.00
Procedure and test Group						
9360	Prepare ABS Submittal: Procedure & Test Group	10	10DEC09	23DEC09	102	0.00
9370	ABS Review/Comment: Procedure & Test Group	22	24DEC09	27JAN10	102	0.00
9380	Resolve Issues with ABS : Procedure & Test Group	44	28JAN10	31MAR10	102	0.00
9390	Finalize/Submit ABS Submittal: Procedure & Test	3	01APR10	05APR10	102	0.00
Manuals Group						
9400	Prepare ABS Submittal: Manuals Group	10	10DEC09	23DEC09	102	0.00
9410	ABS Review/Comment: Manuals Group	22	24DEC09	27JAN10	102	0.00
9420	Resolve Issues with ABS : Manuals Group	44	28JAN10	31MAR10	102	0.00
9430	Finalize/Submit ABS Submittal: Manuals Group	3	01APR10	05APR10	102	0.00
9435	Complete ABS Submittal Process	3	08APR10	12APR10	100	0.00
A00 General Information						
5660	Resume EE Preliminary Design	0	31JUL09A			0.00
5670	Develop Preliminary Electrical Architecture	50	31JUL09A	03SEP09A		0.00
5697	Develop Propulsion Control Architecture	10	14AUG09A	11SEP09A		0.00
5730	Complete Preliminary Design Elec Architecture	1	14SEP09A	14SEP09A		0.00
5681	Begin Electrical Final Design Activities	0	10DEC09		11	0.00
5682	Design Monitoring Alarm Interface to Battery Sys	5	10DEC09	16DEC09	125	8,874.36

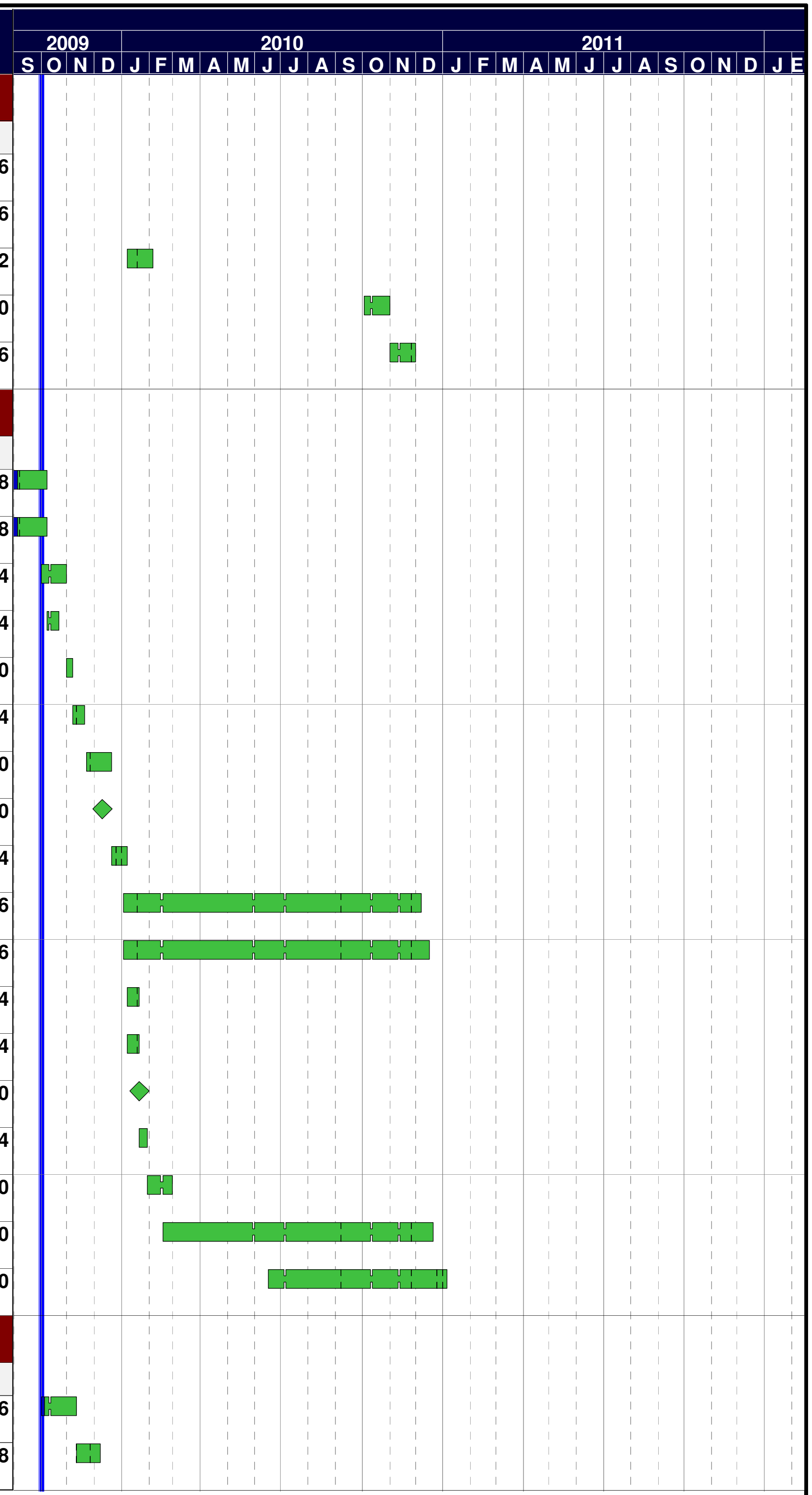


Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
5690	Build/Test EE Prototype: Command Structure	40	10DEC09	08FEB10	40	22,345.88
5693	Build/Test EE Prototype: Controls	40	09FEB10	06APR10	40	45,744.64
5695	Build/Test EE Prototype: Propulsion	10	07APR10	20APR10	40	20,628.16
5698	Develop Hydraulic Control Architecture	40	21APR10	16JUN10	40	48,007.44
5735	Complete Electrical Schematics and Specs	66	02JUN10	02SEP10	11	46,744.42
Key Milestones						
0010	Begin Project	0	01JUN09A			0.00
0012	Begin Long Lead Procurement Activities	0	01JUN09A			0.00
0020	Authorize NTP for Final Design	0	10DEC09		1	0.00
0030	Begin Procurement Activities	0	04OCT10		12	0.00
0060	Complete Procurement Activities	0		14FEB11	26	0.00
0040	Alvin Certification Expires (April, 2011)	0	01APR11*		0	0.00
0080	Launch Alvin Vehicle (4500m)	0		08SEP11	0	0.00
9900	Schedule Contingency	31	14NOV11	28DEC11	0	0.00
9999	Complete Project	0		28DEC11	0	0.00
A02 Sphere & Attachments						
7270	Determine External Tabs and Lug Placement	40	31JUL09A	07OCT09	556	22,688.64
7280	Prepare Prel Design Documents: Sphere & Attach	10	14AUG09A	07OCT09	94	12,793.80
0300	Perot Sys Project Management during Final Design	350	01OCT09A	25FEB11	18	198,874.76
5410	Continue Construct of the Sphere/Hull	230*	01OCT09A	31AUG10	0	1,600,000.00
7290	Compile Mechanical PDR Documentation	10	22DEC09	06JAN10	2	5,672.16
1002	Final Design: Sphere & Attachments	20	05FEB10	05MAR10	2	29,611.44
5447	Procure & Fabricate Sphere Attachments	10	08MAR10	19MAR10	300	5,898.96
5440	Install Penetrators & Test Sphere	84	01SEP10	04JAN11	0	674,269.00
5470	Complete & Deliver Sphere/Hull	54	05JAN11	23MAR11	0	550,468.79
A02-03 Penetrators						
1090	Prepare Penetrator Final Design & Specifications	12	01OCT09	19OCT09	0	24,558.59
1110	Submit Penetrator Spec to ABS and Vendors	0		19OCT09	0	0.00

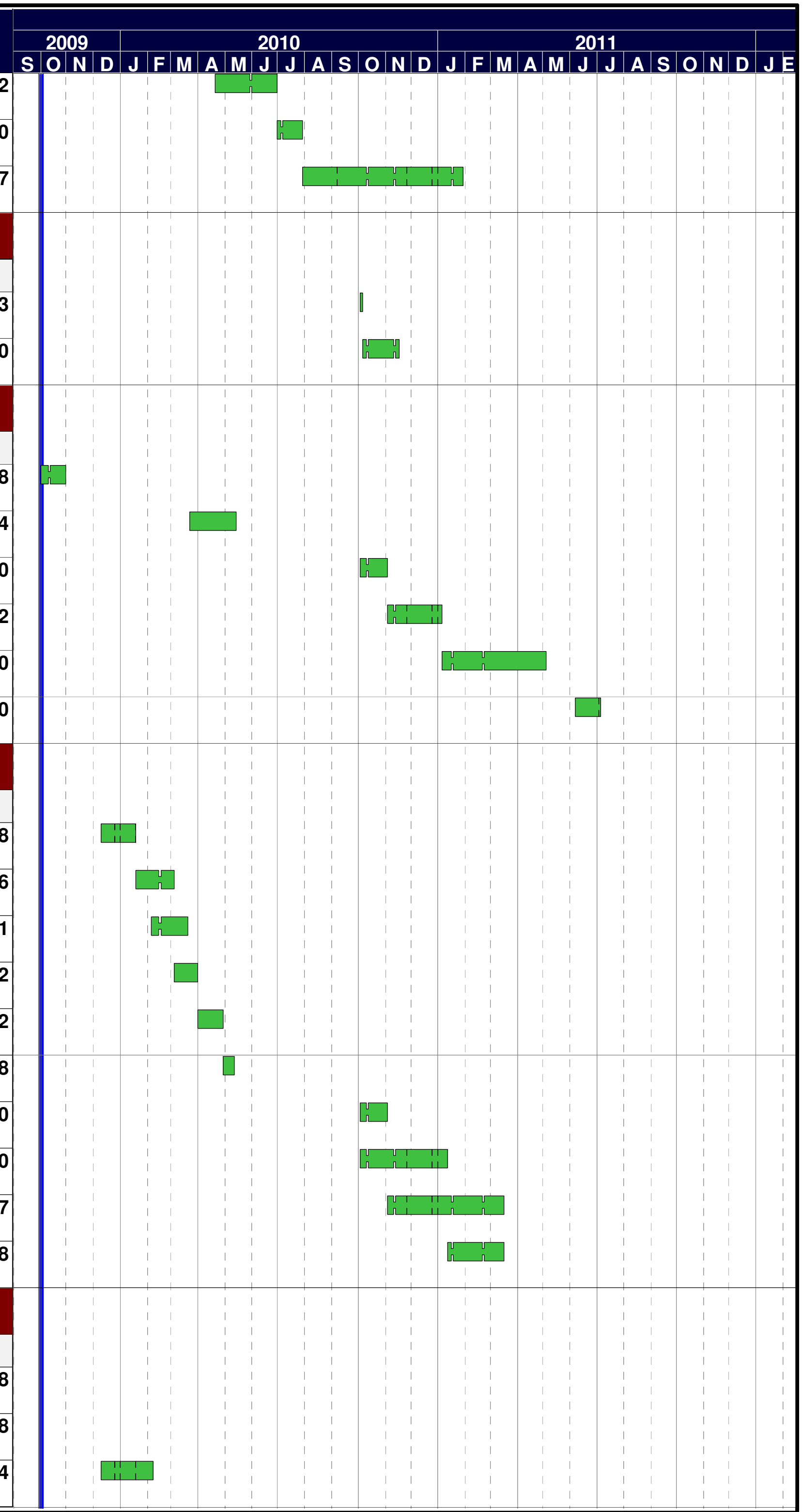


Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
1120	ABS Review Comment on Spec: Penetrators	10	20OCT09	02NOV09	0	0.00
1130	Vendor Provide Penetrator Quotes	10	20OCT09	02NOV09	5	0.00
1140	Incorporate ABS Comments: Penetrator Spec	5	03NOV09	09NOV09	0	10,016.64
1150	ABS Approve Penetrator Specification	0		09NOV09	0	0.00
1160	Issue Purchase Order for Penetrators	5	10NOV09	17NOV09	0	6,692.04
1170	Vendor Evaluate Penetrator Test Requirements	10	18NOV09	02DEC09	0	11,889.00
1180	Vendor Manufacture/Deliver Penetrators	30	03DEC09	15JAN10	0	265,801.51
A02-06 Internal Arrangement, Electrical						
1057	Prepare Final Panel Schematic	40	07JAN10	05MAR10	22	21,879.18
1058	Design Panels	40	08MAR10	30APR10	22	22,528.80
1059	Design Penetrator Enclosure	10	03MAY10	14MAY10	22	3,744.00
0164	Fabricate Internal Panels & Equip Cases	40	02NOV10	30DEC10	2	0.00
0162	Fabricate Internal Sphere Wiring Harness	88	03JAN11	06MAY11	30	75,060.00
0166	Assemble & Bench Test Internal Panels & Equip	43	03JAN11	04MAR11	75	0.00
0168	Outfit Internal Panels & Equip - Mockup Birdcage	88	03JAN11	06MAY11	30	0.00
0169	Test Installed Internal Comm & Control Birdcage	100	03JAN11	24MAY11	2	0.00
A02-06 Internal Arrangement, Mechanical						
7265	Resume Mechanical Preliminary Design	0	31JUL09A			0.00
7320	Determine Internal Arrangements	10	31JUL09A	07OCT09	556	112,686.16
7330	Buildup Internal Sphere Mockup	175	03AUG09A	31MAR10	230	62,794.19
5555	Assemble Birdcage	10	01OCT09	15OCT09	526	23,749.92
5560	Install New Components into Birdcage	20	16OCT09	13NOV09	526	27,216.00
1000	Begin Mechanical Final Design	0	07JAN10		2	0.00
1050	Final Design: Internal Arrangement	30	08MAR10	16APR10	2	23,855.40
7332	Initial Fix Layout & Integrate Finished Comp'ts	11	01APR10	15APR10	230	0.00
3100	Procure: Birdcage	20	04OCT10	01NOV10	112	6,259.68
7090	Fabricate & Assemble: Birdcage	30	02NOV10	15DEC10	112	0.00
3104	Complete Fix Layout & Integrate Finished Comp'ts	16	25MAY11	16JUN11	2	0.00

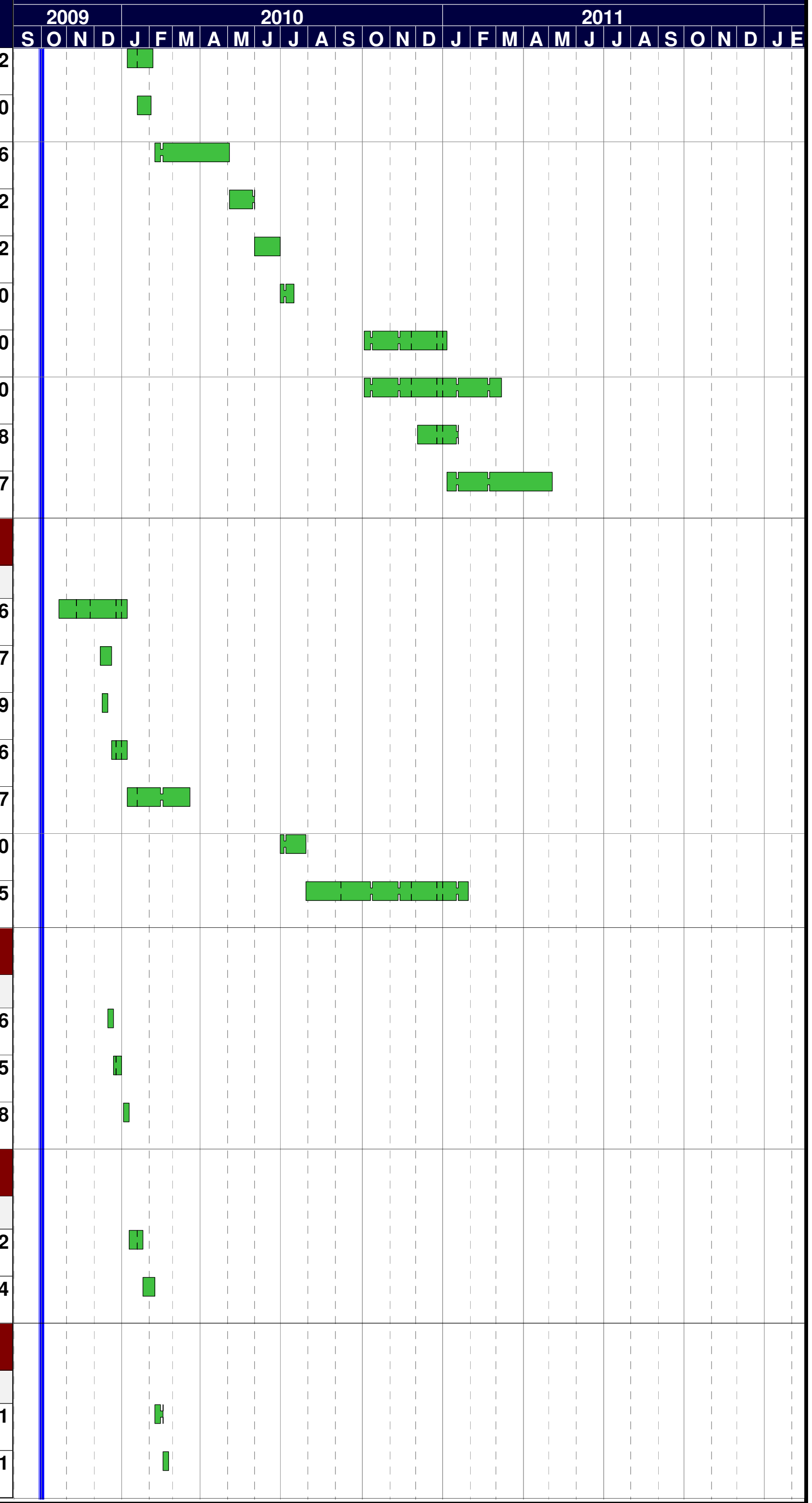
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
A04 Frame & Structural Components						
7340	Prepare Design & Calculations for Frame Mods	10	31JUL09A	06AUG09A		5,672.16
7350	Prepare Prel Design Documents: Frame Mods	10	07AUG09A	13AUG09A		5,672.16
0310	Final Design: Frame & Structural Components	20	07JAN10	04FEB10	2	11,457.72
0320	Procure: Frame & Structural Componen	20	04OCT10	01NOV10	94	0.00
0322	Fabricate: Frame & Structural Componen	18	02NOV10	29NOV10	94	137,874.96
A06 Fixed Buoyancy Assemblies						
7360	Determine Shape & Location of Foam Blocks	40	31JUL09A	07OCT09	84	9,018.18
7370	Calculate Adjustable Fixed Ballast Weight	10	31JUL09A	07OCT09	84	9,018.18
1190	Prepare Purchase & Test Spec: Syntactic Foam	20	01OCT09	29OCT09	183	6,692.04
7380	Prepare Prel Design Documents: Fixed Buoyancy	10	08OCT09	22OCT09	84	19,315.44
1210	Obtain Navy Concurrance on Spec	5	30OCT09	05NOV09	183	0.00
1220	Modify & Submit Foam Specification to ABS	10	06NOV09	20NOV09	183	21,092.04
1230	ABS Review/Comment on Foam Spec	20	23NOV09	21DEC09	183	0.00
1255	NSF Issue NTP for Foam Purchase	0	10DEC09		138	0.00
1235	Respond to ABS Comments on Foam Spec	10	22DEC09	06JAN10	183	3,479.94
1280	Purchase/Manufacture/Shape Syntactic Foam	233	04JAN10	06DEC10	138	1,556,509.76
1290	Vendor Shape/Glass Syntactic Foam	241	04JAN10	16DEC10	138	1,556,509.76
1100	Final Design: Fixed Buoyancy Assemblies	10	07JAN10	21JAN10	114	25,741.44
1240	WHOI/ABS Resolve Issues with Foam Spec	10	07JAN10	21JAN10	183	12,858.84
1250	ABS Approve Foam Spec	0		21JAN10	183	0.00
1260	Procure Syntactic Foam Vendor	5	22JAN10	28JAN10	183	3,479.94
1270	Vendor Qualify Syntactic Foam	20	29JAN10	26FEB10	183	114,400.00
1310	Pressure Test All New Syntatic Foam	213	17FEB10	20DEC10	138	0.00
1312	Fit New Syntactic Foam to Personnel Sphere Templ	136	17JUN10	03JAN11	138	0.00
A08 Skins, Fairings and Sail						
7390	Determine Shape of Skins, Fairings & Sail	30	01OCT09A	09NOV09	2	15,703.56
7660	Prepare Prel Design Documents: Skins/Fair./Sail	18	10NOV09	07DEC09	2	12,867.48



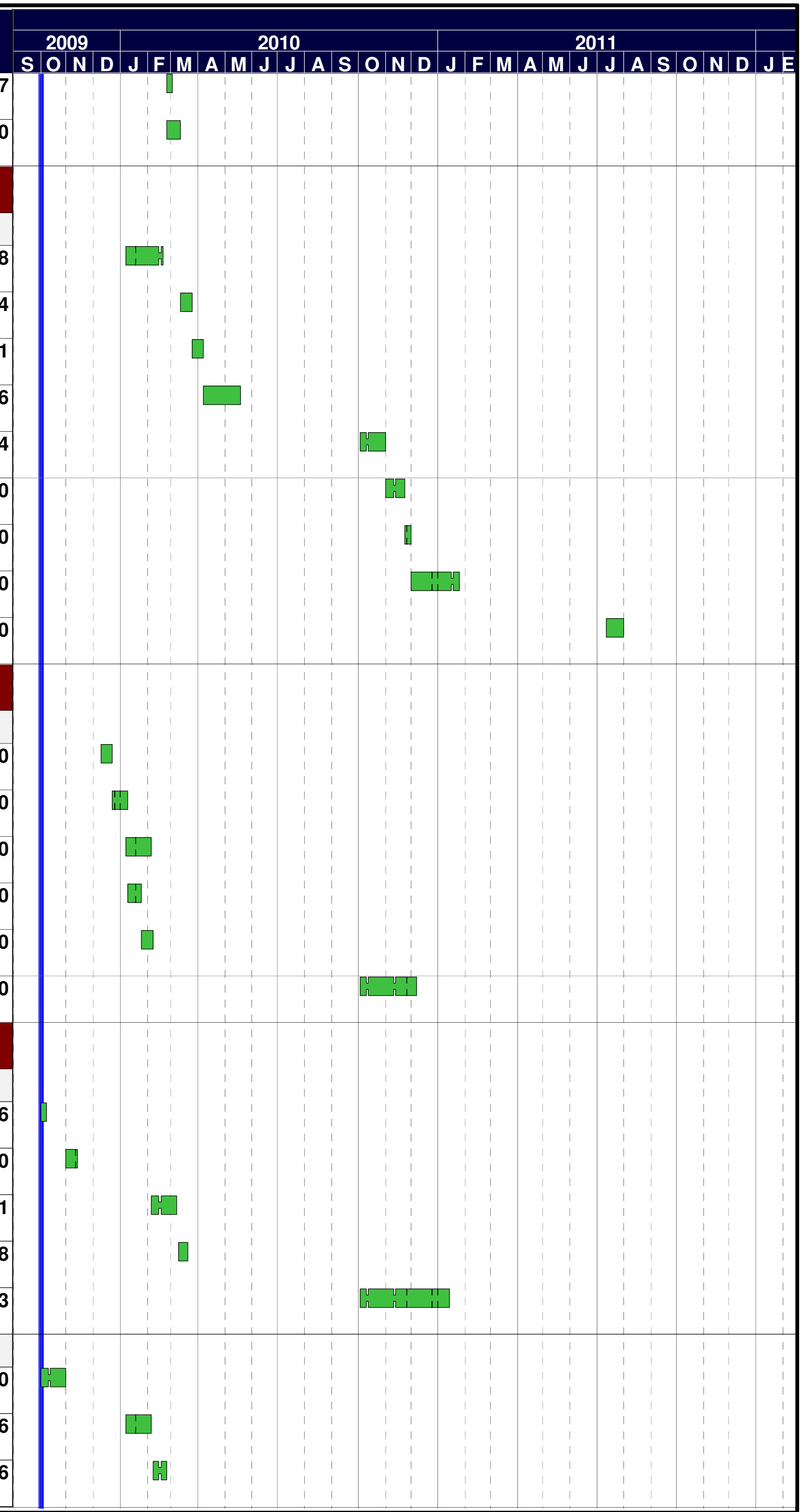
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
1200	Final Design: Skins, Fairings & Sail	52	19APR10	30JUN10	2	25,540.92
3400	Procure: Skins, Fairings & Sail	20	01JUL10	29JUL10	120	0.00
3402	Fabricate: Skins, Fairings & Sail	124	30JUL10	28JAN11	120	105,300.27
A10 Main Battery Systems						
6485	Procure Lead Acid Battery Cells	1	04OCT10	04OCT10	133	375.73
6487	Fabricate & Deliver Lead Acid Battery Cells	30	05OCT10	17NOV10	133	34,112.00
A12-01 Junction Boxes						
1595	Determine Requirements/Pre-Design: Junction Box	20	01OCT09	29OCT09	37	22,321.98
1600	Final Design: Junction Boxes	40	22MAR10	14MAY10	34	28,910.04
3800	Procure: (2) Junction Boxes	21	04OCT10	02NOV10	30	0.00
3802	Fabricate: (2) Junction Boxes	41	03NOV10	04JAN11	30	40,954.82
3804	Assemble: (2) Junction Boxes	83	05JAN11	03MAY11	30	0.00
3806	Fit New: (2) Junction Boxes to Frame	19	08JUN11	05JUL11	6	0.00
A12-03 Data Bottle						
5870	Identify Requirements: Data Bottle	26	10DEC09	19JAN10	24	2,262.78
5880	Prototype Selected Components: Data Bottle	30	20JAN10	03MAR10	24	21,595.86
1500	Final Design: Data Pressure Housing (Bottle)	30	05FEB10	19MAR10	34	20,990.61
5890	Develop Schematic: Data Bottle	20	04MAR10	31MAR10	24	9,256.32
5930	Design Chassie: Data Bottle	20	01APR10	28APR10	24	11,522.52
5935	Revise Schematic: Data Bottle	10	29APR10	12MAY10	24	2,314.08
3700	Procure: Data Pressure Housing(Data)	21	04OCT10	02NOV10	82	0.00
5920	Purchase Components: Data Bottle	66	04OCT10	10JAN11	82	0.00
3702	Fabricate: Data Pressure Housing(Data)	91	03NOV10	17MAR11	82	65,982.17
5922	Fabricate Components: Data Bottle	46	11JAN11	17MAR11	82	70,526.78
A12-03 Power Bottle						
7670	Determine Overall Dimensions & Specs: Power Bot.	10	31JUL09A	13AUG09A		8,243.28
7680	Prepare Prel Design Documents: Power Bottle	20	14AUG09A	27AUG09A		8,243.28
5770	Identify Requirements: Power Bottle	40	10DEC09	08FEB10	11	2,715.34



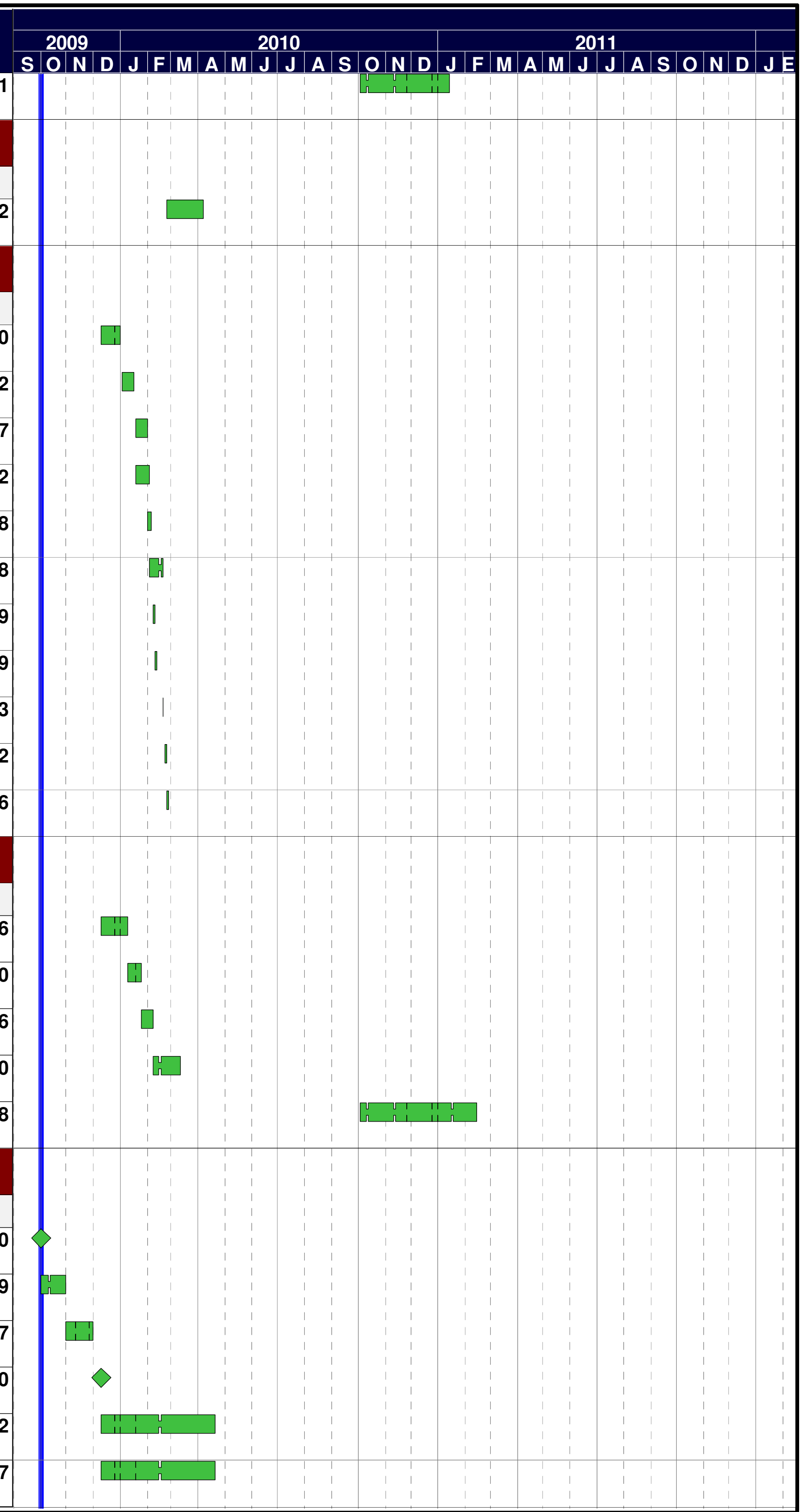
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
1400	Final Design: Power Pressure Housing (Bottle)	20	07JAN10	04FEB10	34	8,325.72
5772	Complete Design of Lanecon Software Interface	10	20JAN10	02FEB10	15	13,176.90
5780	Prototype Selected Components: Power Bottle	59	09FEB10	03MAY10	11	35,205.66
5790	Develop Schematic: Power Bottle	20	04MAY10	01JUN10	11	9,256.32
5860	Design Chassie: Power Bottle	20	02JUN10	29JUN10	11	4,286.52
5865	Revise Schematic: Power Bottle	10	30JUN10	14JUL10	105	2,776.90
3600	Procure: Power Pressure Housing(Pwr)	61	04OCT10	03JAN11	49	0.00
5850	Purchase Components: Power Bottle	104	04OCT10	07MAR11	90	91,873.60
5852	Assemble Components: Power Bottle	31	02DEC10	18JAN11	123	2,813.98
3602	Fabricate: Power Pressure Housing(Pwr)	84	04JAN11	03MAY11	49	41,858.37
A14 Main Ballast System						
7285	Prepare Weight & Balance Analysis for (12) cond	50	23OCT09	06JAN10	84	26,701.96
7690	Determine Shape of Main Ballast System	10	08DEC09	21DEC09	2	4,296.17
5950	Prepare Schematic: Main Ballast System	5	10DEC09	16DEC09	50	2,247.39
7700	Prepare Prel Design Documents: Main Ballast	10	22DEC09	06JAN10	2	4,012.56
1700	Final Design: Main Ballast System	50	07JAN10	19MAR10	150	27,665.17
3900	Procure & Fabricate: Main Ballast System	20	01JUL10	29JUL10	78	0.00
3902	Fit New Main Ballast Tanks to Personnel Sphere	124	30JUL10	28JAN11	78	57,334.35
A16 Variable Ballast System						
5990	Prepare Schematic: Variable Ballast System	5	17DEC09	23DEC09	50	2,225.16
6010	Build/Test Prototype: Variable Ballast System	5	24DEC09	31DEC09	50	2,291.85
6020	Revise Schematic: Variable Ballast System	5	04JAN10	08JAN10	50	2,314.08
A18 Propulsion Control System						
6040	Prepare Schematic: Propulsion System	10	11JAN10	25JAN10	50	4,450.32
6060	Revise Schematic: Propulsion System	10	26JAN10	08FEB10	50	9,115.24
A20 Main Hydraulic System						
6080	Prepare Schematic: Hydraulic System	5	09FEB10	16FEB10	50	3,671.51
6090	Build/Test Prototype: Hydraulic System	5	17FEB10	23FEB10	50	3,671.51



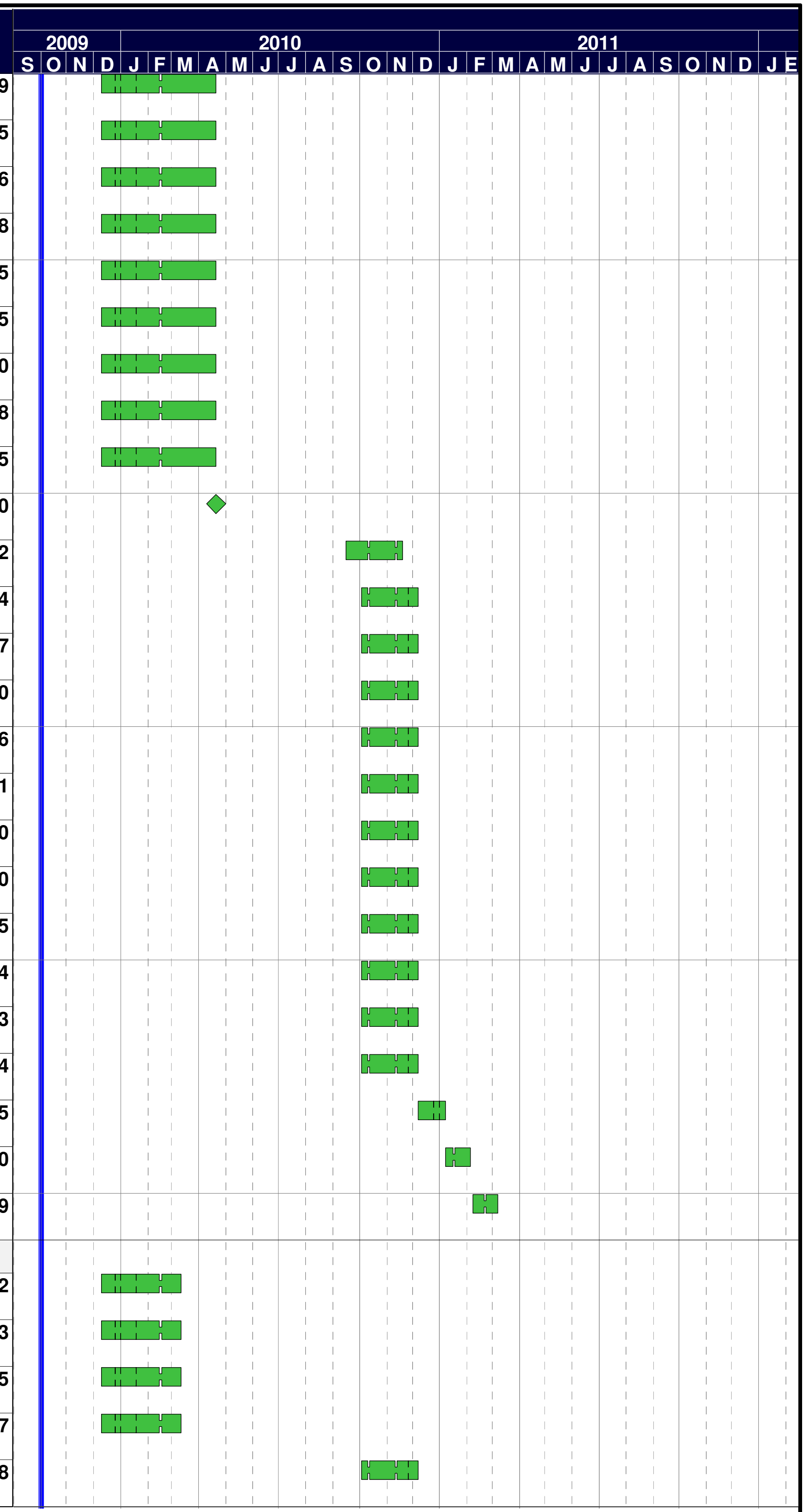
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
6150	Revise Schematic: Hydraulic System	5	24FEB10	02MAR10	75	3,782.77
6152	Command & Control Integration: Hydraulic System	10	24FEB10	09MAR10	50	5,493.60
A24 Life Support Systems						
6174	Final Design: Life Support & Habitability	30	07JAN10	19FEB10	94	20,443.68
6160	Identify Requirements: Life Support & Habitabil	10	10MAR10	23MAR10	50	7,796.34
6170	Prep EE Schematic: Life Support & Habitability	10	24MAR10	06APR10	50	7,965.61
6172	Provided Design: Life Support & Habitability	30	07APR10	18MAY10	50	20,844.36
4400	Procure & Fabricate: Life Support & Habitability	20	04OCT10	01NOV10	123	242,379.74
4402	Fit New Life Support Equip into Mockup Birdcage	14	02NOV10	22NOV10	123	0.00
4404	Function Test New Life Support System in Mockup	4	23NOV10	29NOV10	123	0.00
4406	Remove All Life Support & Send Vendor Cleaning	37	30NOV10	24JAN11	123	0.00
7200	Install: Life Support & Habitability	16	12JUL11	02AUG11	6	0.00
A26 Compensation System						
6280	Identify Requirements: Compensation	10	10DEC09	23DEC09	50	0.00
6290	Prepare Schematics: Compensation	10	24DEC09	08JAN10	50	0.00
2300	Final Design: Compensation Systems	20	07JAN10	04FEB10	104	10,400.00
6370	Build Prototype: Compensation	10	11JAN10	25JAN10	50	0.00
6420	Test Prototype: Compensation	10	26JAN10	08FEB10	50	0.00
4500	Procure & Fabricate: Compensation Systems	44	04OCT10	07DEC10	129	0.00
A28 Service Releases						
Emergency Release						
6445	Prepare Schematic: Emergency Release	5	01OCT09	07OCT09	172	2,225.16
2495	Prel Design: Emerg Releases(basket,manp,aux wt)	10	30OCT09	13NOV09	27	3,564.00
2500	Final Design: Emerg Releases(basket,manp,aux wt)	20	05FEB10	05MAR10	14	10,063.71
2505	Final Design: Emerg Releases(res buoy)	10	08MAR10	19MAR10	14	6,400.08
4700	Procure & Fabricate: Emergency Releases	70	04OCT10	14JAN11	103	15,217.73
Service Release						
2395	Preliminary Design: Service Releases	20	01OCT09	29OCT09	27	8,910.00
2400	Final Design: Service Releases	20	07JAN10	04FEB10	14	13,161.96
6440	Prepare Schematic: Service Release	10	09FEB10	23FEB10	50	2,225.16



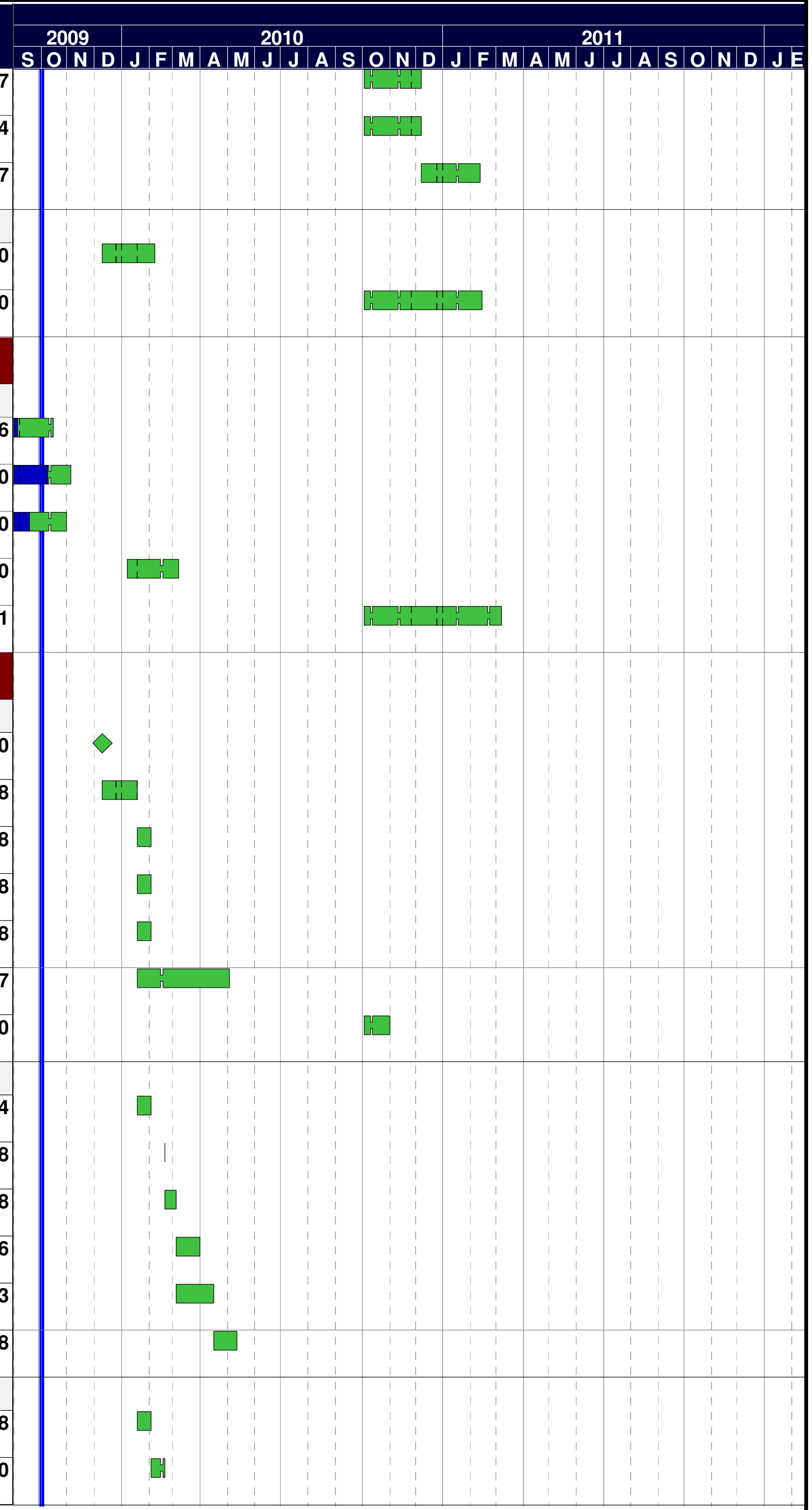
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
4600	Procure & Fabricate: Service Releases	70	04OCT10	14JAN11	103	8,936.41
A30 Manipulators						
2600	Final Design: 4-wire Telemetry	30	24FEB10	06APR10	50	14,657.72
A32 Operational Equipment & Controls						
6470	Refine HDD design & provide input to drawings	15	10DEC09	31DEC09	174	14,027.20
6480	Write HDD purchase sepc and obtain quotes	10	04JAN10	15JAN10	174	9,745.72
7240	Build HDD	10	19JAN10	01FEB10	174	6,777.47
7210	Write purchase spec & obtain quotes for handbox	10	20JAN10	02FEB10	165	9,745.72
6510	Refine design for remainder of controls & indic	4	02FEB10	05FEB10	174	7,673.48
6490	Refine handbox design & provide input to drawing	10	03FEB10	17FEB10	165	13,140.88
7250	Integrate HDD	2	08FEB10	09FEB10	174	3,090.59
7004	Test HDD	2	10FEB10	11FEB10	174	3,012.09
7220	Build handbox	2	18FEB10	19FEB10	165	2,454.83
7230	Integrate handbox	2	22FEB10	23FEB10	165	3,230.62
4900	Test Handbox	2	24FEB10	25FEB10	165	2,872.06
A34 Science Data System, Electrical						
6520	Prepare Schematic: Science Interface Systems	20	10DEC09	08JAN10	70	8,989.56
6530	Design Science Panel: Science Interface Systems	10	11JAN10	25JAN10	70	3,744.00
6540	Outside Bottle Schematic	10	26JAN10	08FEB10	70	4,628.16
6550	Prepare Bottle Design & Chassies	20	09FEB10	09MAR10	70	7,488.00
5100	Procure & Fabricate: Science Interface Systems	90	04OCT10	14FEB11	26	52,577.78
A34 Science Data Sys Imaging / Illumination						
Imaging System						
4710	Begin Preliminary Design for Imaging	0	01OCT09		521	0.00
4720	Prepare Imaging System Architecture	20	01OCT09	29OCT09	521	14,015.59
4722	Prepare Illumination System Architecture	20	30OCT09	30NOV09	521	7,177.37
4730	Begin Final Design Imaging/Illumination	0	10DEC09		106	0.00
4780	Prepare Final Design: Science Utility Camera	90	10DEC09	20APR10	106	19,765.62
4800	Prepare Final Design: HDTV Camera System	90	10DEC09	20APR10	106	19,092.37



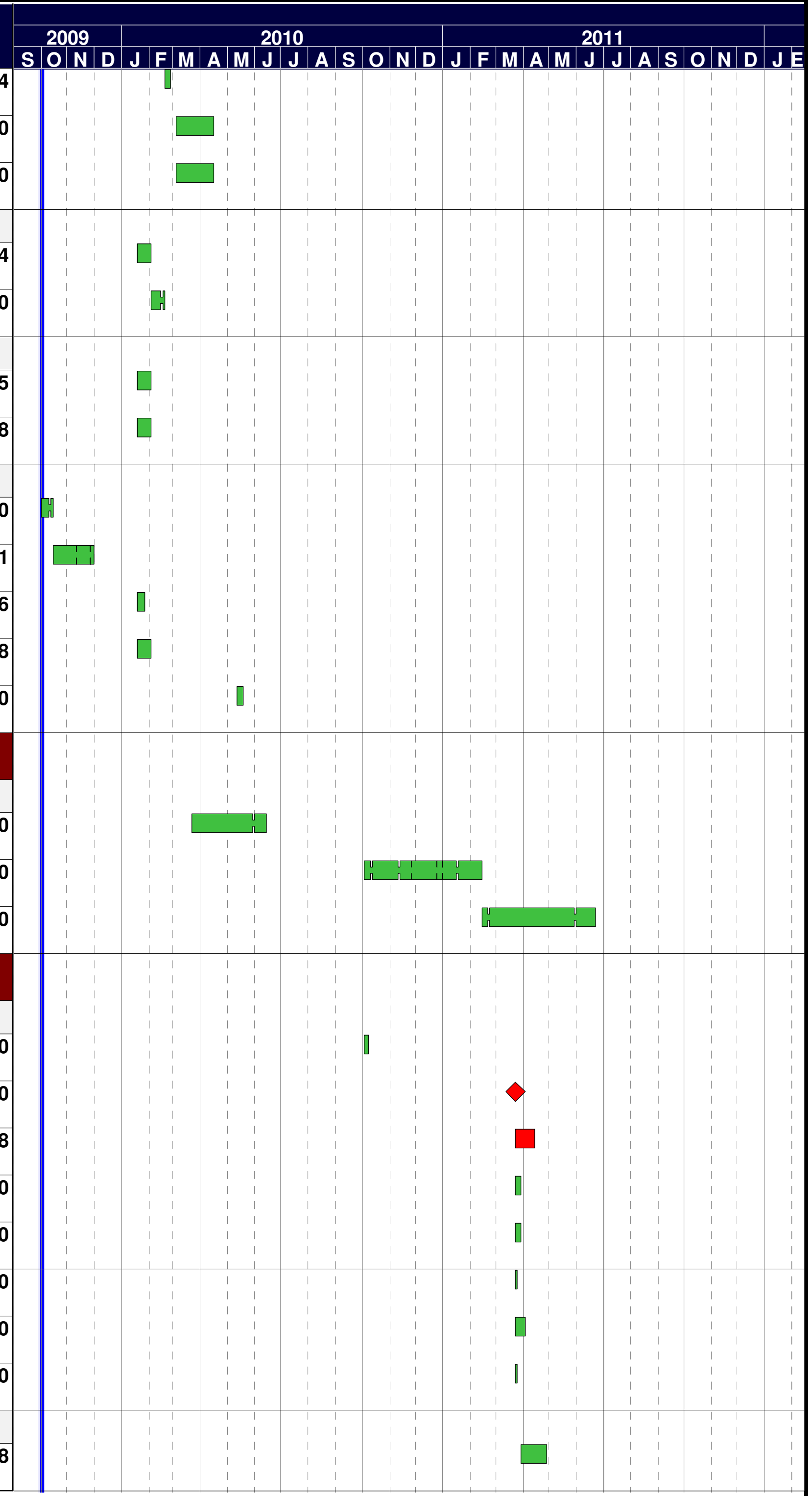
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
4840	Prepare Final Design: Camera Interface/Telemetry	90	10DEC09	20APR10	106	26,191.49
4860	Prepare Final Design: Acquisition System	90	10DEC09	20APR10	106	19,663.95
4880	Prepare Final Design: Internal Camera Interf/Tel	90	10DEC09	20APR10	106	18,584.76
4910	Prepare Final Design: Internal Acquisition Syst	90	10DEC09	20APR10	106	21,786.68
4920	Prepare Final Design: Control/Display/Monitoring	90	10DEC09	20APR10	106	24,687.25
4940	Prepare Final Design: Science Image Data Distrib	90	10DEC09	20APR10	106	19,663.95
4960	Prepare Final Design: Offload Data System	90	10DEC09	20APR10	106	20,409.40
4980	Prepare Final Design: Alvin Data Duplication Sys	90	10DEC09	20APR10	106	19,060.38
5005	Prepare Final Design: Science Data Processing	90	10DEC09	20APR10	106	19,663.95
5140	Complete Final Imaging/Illumination Design	0		20APR10	106	0.00
5095	Prepare Integration Plan	44	16SEP10	18NOV10	24	11,510.92
4782	Prepare Final Design: Science Utility Camera	44	04OCT10	07DEC10	72	28,174.14
4810	Procure/Fabricate: Primary Science Camera System	44	04OCT10	07DEC10	12	205,424.67
4850	Procure/Fabricate: Exter Camera Interf/Telemetry	44	04OCT10	07DEC10	12	237,730.60
4870	Procure/Fabricate: Internal Acquisition System	44	04OCT10	07DEC10	12	26,029.66
4890	Procure/Fabricate: Internal Camera Interf/Telem	44	04OCT10	07DEC10	12	45,885.01
4930	Procure/Fabricate: Control/Display/Monitoring	44	04OCT10	07DEC10	12	222,598.60
4950	Procure/Fabricate: Science Image Data Distribut	44	04OCT10	07DEC10	12	0.00
4970	Procure/Fabricate: Offload Data System	44	04OCT10	07DEC10	12	34,443.15
4990	Procure/Fabricate: Alvin Data Duplication System	44	04OCT10	07DEC10	12	66,637.34
5010	Procure/Fabricate: Science Data Processing Syst	44	04OCT10	07DEC10	12	108,793.93
5012	Procure/Fabricate: Science Data Duplication Syst	44	04OCT10	07DEC10	12	16,701.14
5105	Integrate Imaging System	20	08DEC10	06JAN11	12	21,761.05
5120	Integrate Vehicle	20	07JAN11	04FEB11	12	0.00
5130	Conduct Imaging System Calibration & Testing	20	07FEB11	07MAR11	12	12,102.49
Illumination						
5020	Prepare Final Design: Illumination Field	60	10DEC09	09MAR10	136	18,138.22
5040	Prepare Final Design: Light Head	60	10DEC09	09MAR10	136	14,518.93
5060	Prepare Final Design: Power & Modulation	60	10DEC09	09MAR10	136	25,129.35
5080	Prepare Final Design: Lighting Control	60	10DEC09	09MAR10	136	18,665.97
5030	Procure/Fabricate: Light Head	44	04OCT10	07DEC10	28	172,046.48



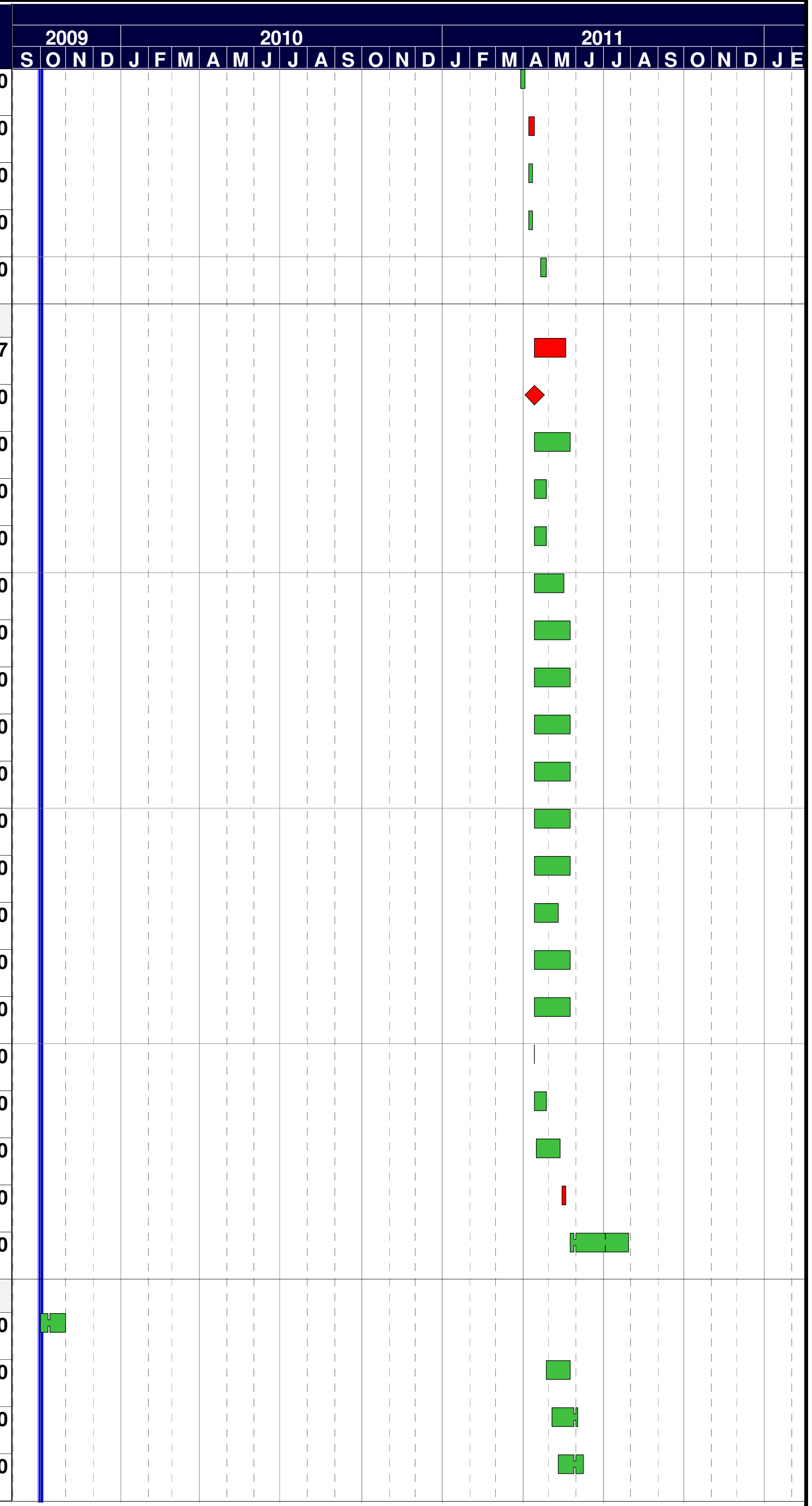
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
5050	Procure/Fabricate: Power Control & Modulation	44	04OCT10	07DEC10	28	127,565.67
5090	Procure/Fabricate: Lighting Control	44	04OCT10	07DEC10	28	53,717.94
5094	Intetrate Lighting System	44	08DEC10	10FEB11	28	23,083.77
Telemetry						
4760	Prepare Final Design: Telemetry	40	10DEC09	08FEB10	156	0.00
4770	Procure/Fabricate: Telemetry	90	04OCT10	14FEB11	26	0.00
A34 - Science Interface (Work Space)						
7325	Determine Requirements	10	01SEP09A	14OCT09	48	21,458.16
7326	prepare PD inventor Model	60	01SEP09A	04NOV09	33	0.00
7327	Prepare PD studio Model	30	01SEP09A	30OCT09	36	0.00
1055	Determine Final External Arrangements	40	07JAN10	05MAR10	84	52,323.00
3105	Procure & Fabricate: External Arrangement	105	04OCT10	08MAR11	68	46,663.61
A36 Command, Control & Computing						
Computer & Network Systems						
1735	Begin C&C Final Design	0	10DEC09		15	0.00
1740	Identify/Design Interfaces; nav, sonar, comm, eq	26	10DEC09	19JAN10	15	10,954.08
7460	Complete software spec/design real time controll	10	20JAN10	02FEB10	171	11,202.48
7470	Complete software spec/design pilot GUI	10	20JAN10	02FEB10	171	11,202.48
7480	Complete software spec/design navigation engine	10	20JAN10	02FEB10	171	43,539.48
7590	Evaluate & specify computers for purchase	73	20JAN10	03MAY10	108	6,526.87
7490	Purchase computer and network systems	20	04OCT10	01NOV10	2	102,814.00
Handbox						
7550	Complete software spec/design other comp needs	10	20JAN10	02FEB10	103	5,601.24
7560	move computer and network system to birdcage/sph	2	18FEB10	19FEB10	93	18,373.68
7570	develop navigation simulators	10	18FEB10	03MAR10	85	8,606.88
7580	produce beta version of Naveng	20	04MAR10	31MAR10	95	72,336.36
7584	produce beta version of Nav GUI	30	04MAR10	14APR10	85	67,110.33
7586	integrate & test new software systems hardware	20	15APR10	12MAY10	85	43,218.48
HDD						
7510	Complete software spec/design data system	10	20JAN10	02FEB10	93	7,075.58
7520	integrate and test computer & network system T&D	10	03FEB10	17FEB10	93	15,732.00



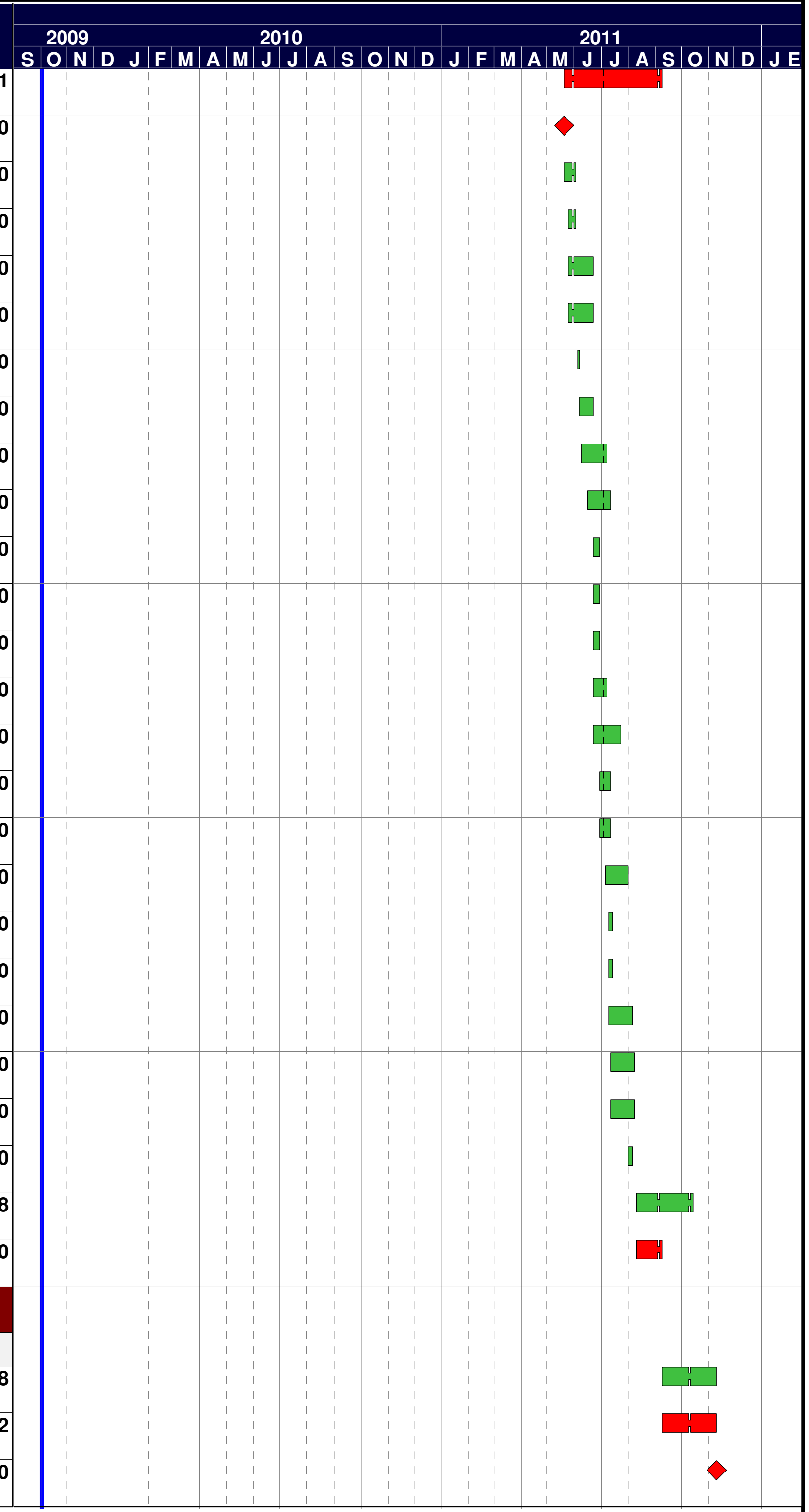
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
7530	develop submarine simulators	5	18FEB10	24FEB10	90	5,601.24
7540	produce beta version of RTC	30	04MAR10	14APR10	85	59,446.20
7582	produce beta version of GUI	30	04MAR10	14APR10	85	45,443.10
Navigation						
7630	commission version control platform	10	20JAN10	02FEB10	85	5,601.24
7640	develop & test code for A/D, D/A, and DIO	10	03FEB10	17FEB10	85	7,452.50
Pilot Submarine Control Proces						
7610	evaluate approaches & specify A/D, D/A and DIO	10	20JAN10	02FEB10	155	16,969.75
7620	produce reference development platform	10	20JAN10	02FEB10	155	11,202.48
5675	Develop System Command & Control Interfaces	10	01OCT09	15OCT09	198	0.00
7495	Prepare C&C Preliminary Design	30	16OCT09	30NOV09	198	26,457.21
7600	design network & evaluate hardware for network	6	20JAN10	27JAN10	159	10,130.76
7650	write final software test plan	10	20JAN10	02FEB10	155	11,202.48
7699	Complete Command & Control Schematics and Specs	5	13MAY10	19MAY10	85	0.00
A54 Navigation, Communication & Tracking						
5172	Final Design: Navigation, Comm & Tracking	60	22MAR10	14JUN10	14	10,400.00
5174	Procure & Fabricate: Navigtion, Comm & Tracking	90	04OCT10	14FEB11	34	0.00
5176	Overhaul: Navigation, Comm & Tracking	90	15FEB11	22JUN11	34	0.00
Construction						
Pre-Construction						
5230	Design Fixture for Personal Sphere	4	04OCT10	07OCT10	115	0.00
0070	Begin Alvin Vehicle Construction (4500m)	0	24MAR11		0	0.00
0195	Pre-Construction	15	24MAR11	13APR11	0	46,966.28
5200	Set Up High Bay	5	24MAR11	30MAR11	3	0.00
5210	Load Test High Bay Crane	5	24MAR11	30MAR11	3	0.00
5220	Set Up Outside Storage, Decking & Stairs	2	24MAR11	25MAR11	6	0.00
5240	Fabricate Fixture for Personal Sphere	8	24MAR11	04APR11	3	0.00
5270	Fabricate VB Storage Sphere	2	24MAR11	25MAR11	10	0.00
Vehicle Tear Down						
0196	Ship Demob & Submersible Disassembly	21	31MAR11	28APR11	22	97,758.28



Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
5250	Offload Submersible & Complete High Bay Setup	3	31MAR11	04APR11	3	0.00
5260	Tear Down Submersible	4	08APR11	13APR11	0	0.00
5280	Store Old VB Sphere	3	08APR11	12APR11	1	0.00
5290	Store Old Personnel Sphere	3	08APR11	12APR11	1	0.00
6513	Disassemble (3) Lead Acid Cells	6	21APR11	28APR11	22	0.00
Maintenance						
0197	Refurbishment & Integration	26	14APR11	19MAY11	0	729,854.07
5300	Begin Maintenance	0	14APR11		0	0.00
5302	Service Crossdeck Internal Components	30	14APR11	25MAY11	143	0.00
5305	Refurbish: Power Pressure Housing (Bottle)	10	14APR11	27APR11	53	0.00
5310	Refurbish: Data Pressure Housing (Bottle)	10	14APR11	27APR11	53	0.00
5315	Refurbish: Existing Junction Boxes	25	14APR11	18MAY11	38	0.00
5320	Refurbish: Main Ballast Tanks	30	14APR11	25MAY11	13	0.00
5325	Refurbish: Existing Variable Ballast Spheres	30	14APR11	25MAY11	148	0.00
5330	Refurbish Propulsion System	30	14APR11	25MAY11	33	0.00
5335	Refurbish: Main Hydraulic System	30	14APR11	25MAY11	33	0.00
5340	Refurbish: Mercury Trim System	30	14APR11	25MAY11	13	0.00
5345	Refurbish Lead Acid Battery Box	30	14APR11	25MAY11	3	0.00
5350	Refurbish: Manipulators	20	14APR11	11MAY11	3	0.00
5355	Refurbish: Imaging Systems	30	14APR11	25MAY11	33	0.00
5360	Refurbish: Science Interface Systems	30	14APR11	25MAY11	33	0.00
5500	Send Frame & Mod Components to Vendor	2	14APR11	15APR11	1	0.00
5510	Refurbish: Frame & Structural Components	10	14APR11	27APR11	16	0.00
5502	Carry Out Frame Modificaitons & Inspections	20	18APR11	13MAY11	1	0.00
5504	Accept Frame Modifications & Return to WHOI	3	17MAY11	19MAY11	0	0.00
6515	Service Lead Acid Cells into Battery Box	45	26MAY11	29JUL11	3	0.00
Construction						
5711	Install: Existing Variable Ballast Spheres	20	01OCT09	29OCT09	446	0.00
5900	Install: Data Pressure Housing (Bottle)	20	28APR11	25MAY11	53	0.00
5800	Install: Power Pressure Housing (Bottle)	20	04MAY11	01JUN11	49	0.00
7000	Install: Manipulators	20	12MAY11	09JUN11	3	0.00



Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
0198	Assembly	77	20MAY11	08SEP11	0	343,093.11
5520	Begin to Reconstruct (milestone)	0	20MAY11		0	0.00
5530	Install Frame Attachments - Tabs & Lugs	10	20MAY11	03JUN11	6	0.00
5715	Install Crossdeck Internal Components in Birdcag	5	26MAY11	02JUN11	143	0.00
6100	Install: Main Ballast Tanks	20	26MAY11	23JUN11	13	0.00
6300	Install Propulsion System	20	26MAY11	23JUN11	33	0.00
5540	Mount Sphere/Hull	2	06JUN11	07JUN11	6	0.00
5550	Schedule Contingency (if sphere doesn't fit)	10	08JUN11	21JUN11	20	0.00
7010	Install: Mercury Trim System	20	10JUN11	08JUL11	3	0.00
7100	Transfer Mockup Command &Control Equip in Sphere	16	17JUN11	11JUL11	2	0.00
5580	Test Fit Foam	5	22JUN11	28JUN11	20	0.00
5590	Test Fit Main Ballast Tanks	5	22JUN11	28JUN11	20	0.00
5600	Test Fit Sail & Bath Tub	5	22JUN11	28JUN11	20	0.00
6105	Install: Skins	10	24JUN11	08JUL11	18	0.00
6200	Install: New Variable Ballast Spheres	20	24JUN11	22JUL11	13	0.00
5605	Fit Up Skins	10	29JUN11	13JUL11	20	0.00
5610	Install Syntactic Foam	10	29JUN11	13JUL11	20	0.00
6000	Install: Junction Boxes	20	06JUL11	02AUG11	6	0.00
6107	Install: Fairings	5	11JUL11	15JUL11	18	0.00
6109	Install: Sail	5	11JUL11	15JUL11	18	0.00
7020	Install: Main Hydraulic System	20	11JUL11	05AUG11	3	0.00
7300	Install: Imaging Systems	20	12JUL11	08AUG11	2	0.00
7400	Install: Science Interface Systems	20	12JUL11	08AUG11	2	0.00
6525	Assemble Lead Acid Batteries Into Alvin	5	01AUG11	05AUG11	3	0.00
0202	Hangar Test and Ship Mobilization	44	11AUG11	13OCT11	20	95,598.28
7500	Complete Testing NEW 4500m Alvin Vehicle Systems	20	11AUG11	08SEP11	0	0.00
Sea Trials						
0201	Dockside Testing and Sea Trials	43	09SEP11	09NOV11	1	245,519.48
0340	Commission 4500m Alvin Vehicle	44	09SEP11	10NOV11	0	119,638.22
0350	Deliver 4500m Alvin Vehicle	0		10NOV11	0	0.00



Appendix B – Example Cost Estimating Worksheet

Project: New Alvin: Design and Fab (83340908) **Work Package:** A06 Fixed Buoyancy Assemblies (Option B) **Technical Lead:** Barrie B. Walden

Description: This work package is for development of fixed buoyancy packages. Activities include density and availability determination, preparation of syntactic foam specification, vendor qualification tests, preliminary design, final design, vendor qualification, procurement, shaping, bonding and delivery of foam.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)					Comments
	FAB	Pressure Test Sample	3	30					
1190	FD	Prepare Purchase & Test Spec	2	20					spread over 2 months
1220	FD	Mod & Submit Foam Spec	4	40					includes respond to ABS and WHOI/ABS resolve Issues
7360	PD	Determine Shape and Location of F	4	40					
7370	PD	Calculate adjustable fixed ballast w	1	10					
7380	PD	Prepare Preliminary Design	1	10					
1100	FD	Prepare Final Design	2	20					
1260	FAB	Procure Syntactic Foam Vendor	1	10					
1270	FAB	Vendor Qualify Foam	0	55					2 1/2 months qualification testing
1280	FAB	Vendor Manufacture Foam	0	250					12 months delivery (380 ft3)
1290	FAB	Vendor Shape Foam	0	250					12 months delivery (380 ft3)
	FAB	Vehicle Foam Production Test	5	50					
		Subtotal:	**23**						

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions	
labor	EE	Barrie B. Walden	5	180	HR					
labor	EE	Donald B. Peters	4	144	HR			7360,7370, 7380,1240	40 hrs per acty	
labor	EE	Megan M. Carroll	6	216	HR			7380,1100	20 hrs - 80 hrs	
labor	EE	Griner	8	288	HR				pressure testing effort	
				0	HR					
		Subtotal Labor:	**23**	**828**			**$ 109,679**			
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.										
supplies	VQ	Foam for 6500m - Forebody		200	ft3	$ 8,156	$ 1,631,220	1280		B
supplies	VQ	Foam for 6500m - Midbody		103	ft3	$ 8,156	$ 840,078	1280		B
supplies	VQ	Foam for 6500m - Tail Block		64	ft3	$ 8,156	$ 521,990	1280		B
supplies	EE	1st Article Qualification Testing		1	LS	$ 100,000	$ 100,000			A,B,D
supplies	EE	pressure tests		50	EA	$ 200	$ 10,000			A,B,D
		Subtotal Expense:		**418**			**$ 3,103,288**			
						Total:	**$ 3,212,967**			

Notes: 35lb foam, manufactured and shaped. Assumes 1/2 purchased foam is wasted. Bonded & shaping is = 1.5x installed

Appendix C – Cost Estimate for the Preferred A-4500 HOV Design

Project Number	Work Package		Project Management	Electrical	Mechanical	Imaging / Illumination	Command & Control	Construction	09/30/09 Actuals	Cost to Complete	Total
Historical Costs											
83340900		**Contract Management**	**$ 604,061**						**$ 604,061**		**$ 604,061**
83340901		**WHOI Management**	**$ 747,183**						**$ 747,183**		**$ 747,183**
83340902		**WHOI Effort**	**$ 309,786**						**$ 309,786**		**$ 309,786**
83340903		**RHOC Costs**	**$ 27,804**						**$ 27,804**		**$ 27,804**
83340905		**Vehicle Preliminary Design**	**$ 5,188,707**						**$ 5,188,707**		**$ 5,188,707**
83340906		**Main Battery Development**	**$ 150,684**						**$ 150,684**		**$ 150,684**
83340907		**Syntactic Foam Certification**	**$ 4,511**						**$ 4,511**		**$ 4,511**
		Miscellaneous Actual Costs	**$ 39,062**						**$ 39,062**		**$ 39,062**
Project Management											
		Project Management									
83340911	A99	**Project Management**	**$ 1,840,384**						**$ 910,768**	**$ 1,840,384**	**$ 2,751,152**
	A99	**PM Plans**	**$ 212,884**						**$ -**	**$ 212,884**	**$ 212,884**
83340940	A99	**Preliminary Design Report**	**$ 126,956**						**$ 52,222**	**$ 126,956**	**$ 179,178**
	A99	**Final Design Report**	**$ 126,956**						**$ -**	**$ 126,956**	**$ 126,956**
Certification/Classification											
83340945	A99	**ABS Classifiction**	**$ 607,120**						**$ 41,705**	**$ 607,120**	**$ 648,825**
Vehicle Fabrication											
83340913	A00	**General Information/Sys Eng**		**$ 177,886**					**$ 172,846**	**$ 177,886**	**$ 350,732**
83340904	A02	**Sphere & Attachments**			**$ 3,099,477**				**$ 6,762,041**	**$ 3,099,477**	**$ 9,861,518**
83340917	A02-03	**Penetrators**			**$ 315,954**				**$ 25,655**	**$ 315,954**	**$ 341,609**
83340916	A02-06,07	**Internal Arrangement**		**$ 116,425**	**$ 251,350**				**$ 152,909**	**$ 367,776**	**$ 520,685**
83340918	A04	**Frame & Structural Components**			**$ 155,261**				**$ 31,714**	**$ 155,261**	**$ 186,975**
83340919	A06	**Fixed Buoyancy Assemblies**			**$ 3,212,967**				**$ 32,847**	**$ 3,212,967**	**$ 3,245,814**
83340920	A08	**Skins, Fairings and Sail**			**$ 154,142**				**$ 446**	**$ 154,142**	**$ 154,588**
83340921	A10	**Main Battery Systems**			**$ 33,161**				**$ 157,630**	**$ 33,161**	**$ 190,791**
83340922	A12-03	**Power Bottle**		**$ 151,774**	**$ 68,253**				**$ 27,564**	**$ 220,027**	**$ 247,591**
83340923	A12-03	**Data Bottle**		**$ 108,932**	**$ 86,810**				**$ 343**	**$ 195,742**	**$ 196,085**
83340924	A12-01	**Junction Boxes**		**$ 36,266**	**$ 53,427**				**$ 115**	**$ 89,694**	**$ 89,809**
83340925	A14	**Main Ballast System**		**$ 2,225**	**$ 116,848**				**$ -**	**$ 119,073**	**$ 119,073**
83340926	A16	**Variable Ballast System**		**$ 6,675**					**$ 49,652**	**$ 6,675**	**$ 56,327**
83340927	A18	**Propulsion System**		**$ 13,301**					**$ 39,232**	**$ 13,301**	**$ 52,533**
83340928	A20	**Main Hydraulic System**		**$ 16,512**					**$ 18,382**	**$ 16,512**	**$ 34,894**
83340929	A22	**Mercury Trim System**		**$ 2,225**					**$ -**	**$ 2,225**	**$ 2,225**
83340930	A24	**Life Support & Habitability**		**$ 288,736**					**$ 2,286**	**$ 288,736**	**$ 291,022**
83340931	A26	**Compensation Systems**			**$ 9,000**				**$ -**	**$ 9,000**	**$ 9,000**
83340932	A28	**Service Releases**		**$ 2,225**	**$ 30,506**				**$ -**	**$ 32,731**	**$ 32,731**
83340933	A28	**Emergency Releases**		**$ 2,225**	**$ 34,427**				**$ -**	**$ 36,652**	**$ 36,652**

Project Number	Work Package		Project Management	Electrical	Mechanical	Imaging / Illumination	Command & Control	Construction	09/30/09 Actuals	Cost to Complete	Total
83340934	A30	**Manipulators**		$ 14,351					$ 265	$ 14,351	$ 14,616
83340935	A32	**Operational Equipment**					$ 79,180		$ -	$ 79,180	$ 79,180
83340936	A34	**Imaging & Illumination**				$ 1,629,324			$ 20,425	$ 1,629,324	$ 1,649,749
83340937	A34	**Science Interface Systems**		$ 74,151	$ 117,052				$ -	$ 191,203	$ 191,203
83340938	A36	**Command & Control**					$ 598,004		$ 15,597	$ 598,004	$ 613,601
Support Equipment											
83340939	A50	**General Support**							$ -	$ -	$ -
83340939	A52	**Launch and Recovery System**			$ 104,620				$ -	$ 104,620	$ 104,620
Construction & Test											
		Preconstruction & Disassembly									
83340960		**Preconstruction**						$ 37,940	$ -	$ 37,940	$ 37,940
83340960		**Disassembly**						$ 89,532	$ -	$ 89,532	$ 89,532
83340960		**Integration**						$ 628,261	$ -	$ 628,261	$ 628,261
		Integration and Test									
83340970		**Assembly**						$ 270,149	$ -	$ 270,149	$ 270,149
83340970		**Hangar Test & Ship Mob**						$ 87,532	$ -	$ 87,532	$ 87,532
83340970		**Dockside Test & Sea Trials**						$ 155,932	$ -	$ 155,932	$ 155,932
83340970		**Sea Trials - Shoreside Labor**						$ 113,121	$ -	$ 113,121	$ 113,121
			$ 9,986,097	$ 1,013,909	$ 7,843,256	$ 1,629,324	$ 677,184	$ 1,382,467	$ 15,586,441	$ 15,460,439	$ 31,046,880
									Does not include escalation or contingency		