6500m HOV Project
Stage 1: A-4500 HOV

Integrated Master Schedule

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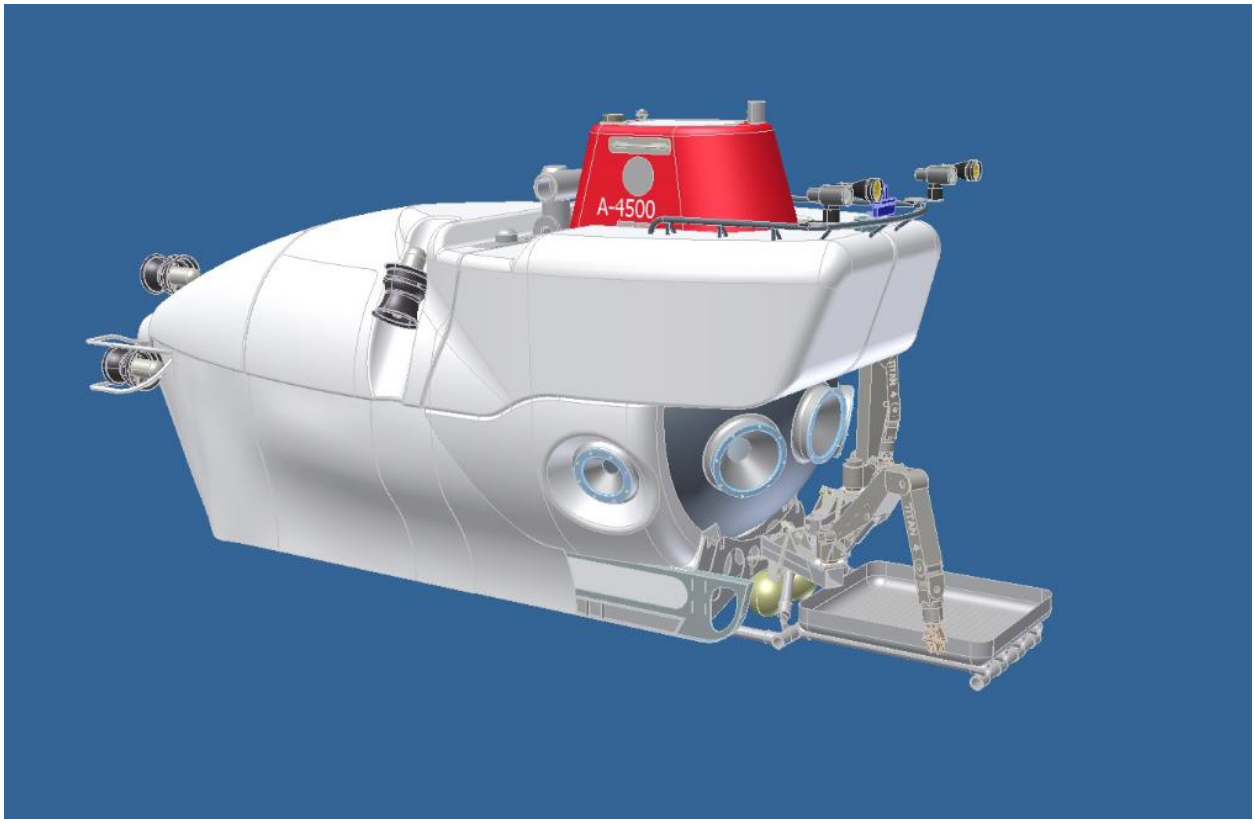

WOODS HOLE OCEANOGRAPHIC INSTITUTION
WOODS HOLE, MA 02543

Document Control Sheet

Date	Originator	Description
08-21-09	C. Fairneny	Initial Outline
09-10-09	C. Fairneny	First Draft
09-18-09	C. Fairneny	Second Draft
09-20-09	C. Fairneny	Third Draft
11-06-09	C. Fairneny	Fourth Draft

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1.0 Baseline Integrated Master Schedule

Once complete, the schedule and cost estimate were combined into a cost and resource loaded integrated master schedule. Budgeted hours and dollars were then time-phased to generate a cash flow projection and staffing charts for the program and individual resources. Scope, schedule, cost and resource data are now fully integrated in the P3 scheduling tool, which will serve as the basis for our Earned Value Management System.

2.0 Work Breakdown Structure (WBS)

The project scope is broken into five major headings to produce the work breakdown structure (WBS). The breakdown has major headings for project management, certification/ classification, the A-4500 HOV, support equipment, and construction and test. The vehicle breakdown represents the major sub-systems of the A-4500 HOV. Technical leads worked individually or together to estimate each work package under the WBS.

2.1 Work Breakdown Dictionary

The WBS dictionary is a narrative that describes in detail the scope and features of the A-4500 HOV. The preferred design option includes modifications to the *Alvin* frame to install the new personnel sphere, which will have both wire and fiber optic penetrators. All syntactic foam will be replaced with 6500 m rated foam. There are also new designs for the main ballast system soft tanks, manipulator mounts, science basket, life support system, and internal arrangement. In addition, the A-4500 HOV will have a new command and control system, and an upgraded lighting and imaging system. The vehicle will continue to use lead acid batteries with a 120 volt bus. A full description can be found in the *A-4500 HOV Work Breakdown Structure and Dictionary*.

2.2 Work Packages

The WBS elements have been further broken down into work packages by discipline. This approach served to identify the responsible technical leads, who then identified detailed activities that were then logically sequenced and estimated. Cost estimating worksheets include pricing for the preliminary design, final design, procurement and fabrication. For the purpose of this IMS document, the schedule and cost estimating worksheets are organized by the work packages.

A list of work packages is shown in Table 1.

Table 1. Work Package List

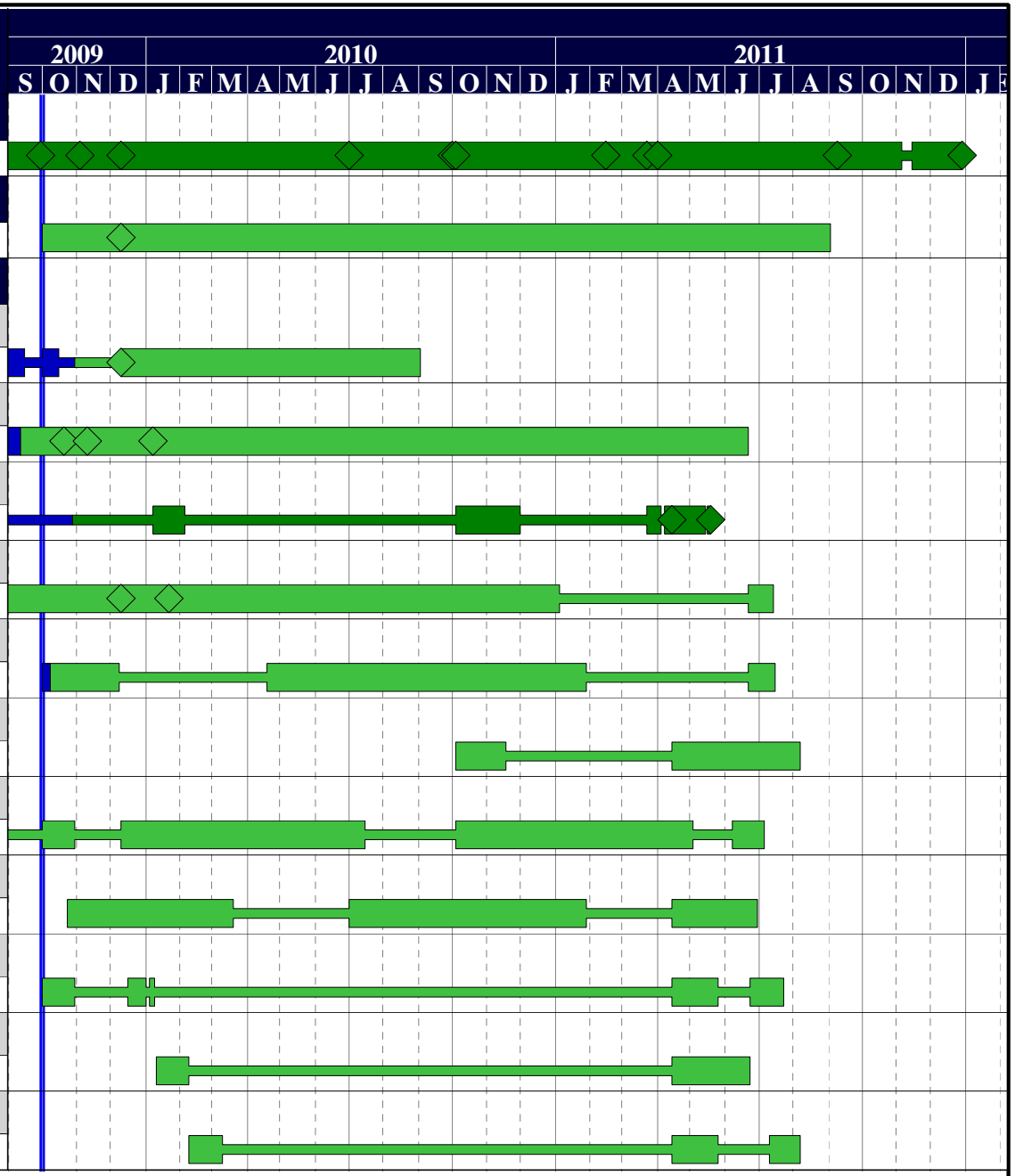
Work Pkg ID	Work Package Description
000	Historical Information
002-01	Project Management
002-02	Project Management Plans
002-03	Preliminary Design Report
002-04	Final Design Report
003	Classification/Certifiction
A00	A00 General Information
A02-01	A02-01 External Arrnagement
A02-03	A02-03 Penetrators
A02-06C	A02-06 Internal Arrangements, Core Components
A02-06E	A02-06 Internal Arrangement, Electrical
A02-06M	A02-06 Internal Arrangement, Mechanical
A04	A04 Frame & Structural Components
A06	A06 Fixed Buoyancy Assemblies
A08	A08 Skins, Fairings and Sail
A10	A10 Main Battery Systems
A12-01	A12-01 Junction Boxes
A12-03D	A12-03 Data Bottle
A12-03P	A12-03 Power Bottle
A14	A14 Main Ballast System
A16	A16 Variable Ballast System
A18	A18 Propulsion Control System
A20	A20 Main Hydraulic System
A22	A22 Mercury Trim System
A24	A24 Life Support Systems
A26	A26 Compensation System
A28	A28 Service Releases
A30	A30 Manipulators
A32	A32 Operational Equipment & Controls
A34	A34 Science Data System, Electrical
A34-AA	A34 Science Data Sys Imaging / Illumination
A36	A36 Command, Control & Computing
B50	A50 Support Equip. General Support
B52	A52 Support Equip. Launch and Recovery System
A54	Support Equip. Shipboard Modifications
OV	Construction
ST	Integration and Test

3.0 Schedule Development

3.1 Summary Schedule

The summary schedule is depicted in the Gantt/Bar Chart in Figure 1. Activities are organized into the WBS. Project management activities have been summarized into a single line. The activities are grouped and then summarized to the second level of the WBS representing the A-4500 HOV's major system components. Support equipment, construction, and integration and test have also been summarized to single lines. Figure 1 contains summary information including the duration, early start, early finish and total float. Note: the narrow portion of the bar represents non-work periods for that element of work.

Activity ID	Activity Description	Early Start	Early Finish
+ Project Management			
		03OCT05A	28DEC11
+ Classification/Certification			
		01OCT09	01SEP11
Vehicle A-4500			
+ A00	General Information		
		31JUL09A	02SEP10
+ A01	Sphere and Attachments		
		31JUL09A	21JUN11
+ A04	Frame and Structural Comp.		
		31JUL09A	19MAY11
+ A06	Fixed Buoyancy		
		31JUL09A	13JUL11
+ A08	Skins, Fairings and Sails		
			15JUL11
+ A10	Battery Systems		
		04OCT10	05AUG11
+ A12	Power Control and Distribution		
		31JUL09A	05JUL11
+ A14	Main Ballast Styem		
		23OCT09	28JUN11
+ A16	Variable Ballast System		
		01OCT09	22JUL11
+ A18	Propulsion System		
		11JAN10	23JUN11
+ A20	Main Hydraulic System		
		09FEB10	05AUG11



Start Date	01SEP05	AL28	Sheet 1 of 2
Finish Date	28DEC11		
Data Date	01OCT09		
Run Date	06NOV09 01:52		

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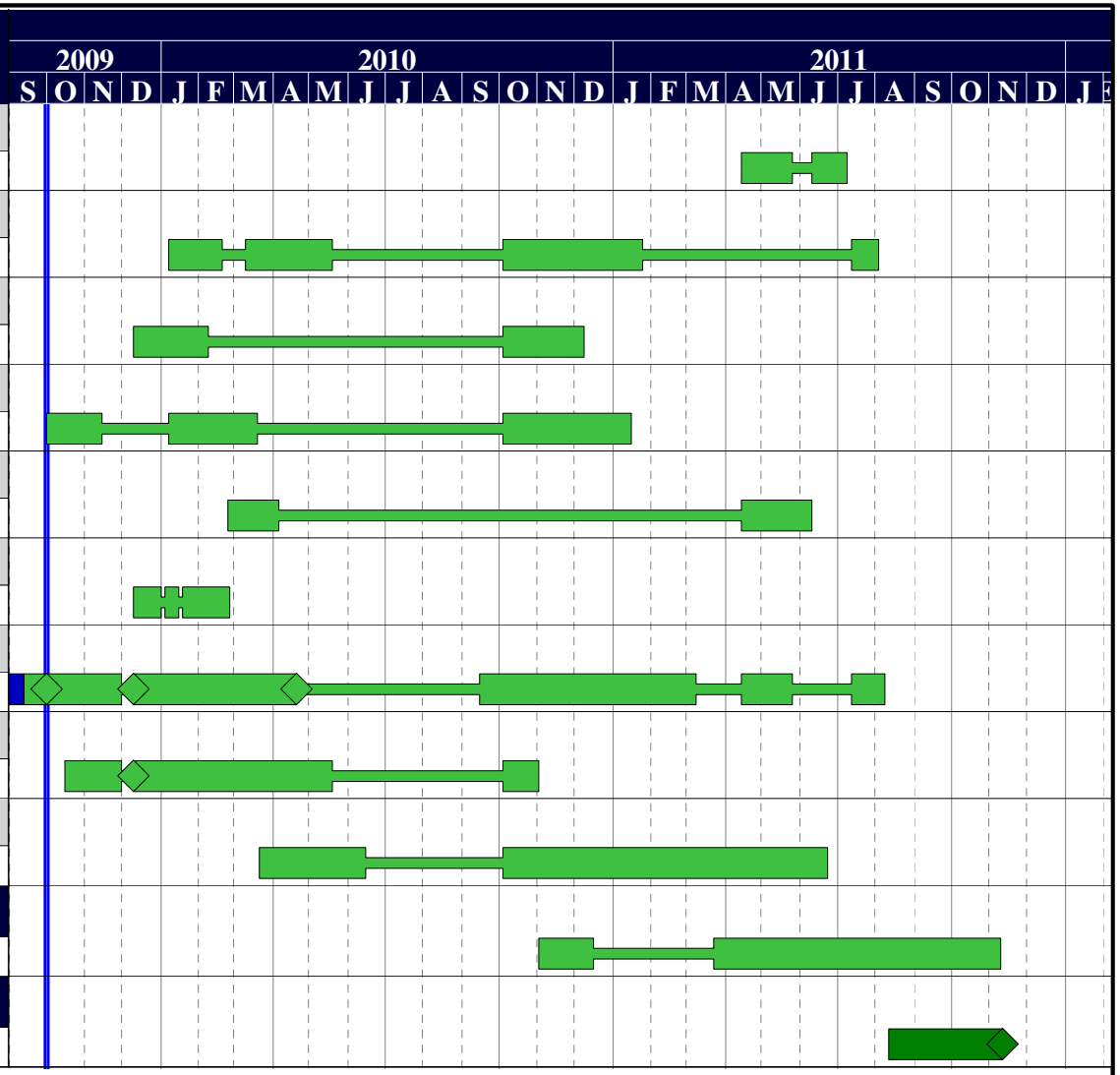
Figure 3.1 Summary Schedule by WBS

Activity ID	Activity Description	Early Start	Early Finish
+ A22	Mercury Trim System		
		14APR11	08JUL11
+ A24	Life Support & Habitability		
		07JAN10	02AUG11
+ A26	Compensation System		
		10DEC09	07DEC10
+ A28	Releases and Cutters		
		01OCT09	14JAN11
+ A30	Manipulators		
		24FEB10	09JUN11
+ A32	Operational Equipment		
		10DEC09	25FEB10
+ A34	Science Interface Systems		
		01SEP09A	08AUG11
+ A36	Command and Control		
		16OCT09	01NOV10
+ Navigation, Communication & Tracking			
		22MAR10	22JUN11
+ Construction			
		02NOV10	09NOV11
+ Integration and Test			
		11AUG11	10NOV11

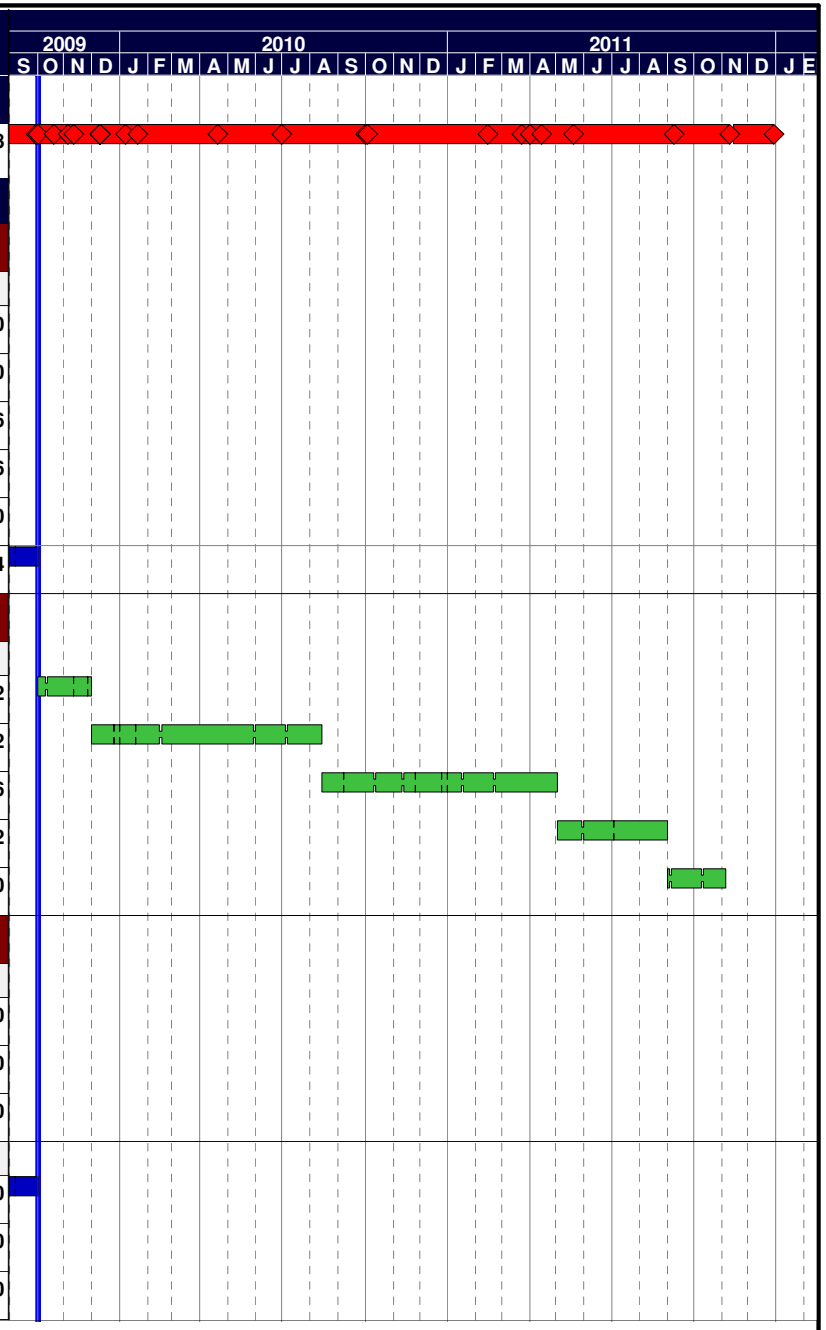


3.2 Detailed Schedule

The detailed schedule is illustrated in Figure 2 and contains over 475 activities. The list of activities is organized by work package for ease of use with the cost estimating worksheets. The top section contains key milestones so that the Project Management Team can quickly see the overall project status. Each activity line shows the activity identification number, description of the work, duration, early start, early finish, total float.

Once the project begins, this report will be updated to include actual start, actual finish dates, percent complete. The original baseline bars will be included in the bar view so that the team will be able to visually see activity variances in addition to the total float.

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 01:53

Early Bar
Progress Bar
Critical Activity

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Figure 3.2 Detailed Activities

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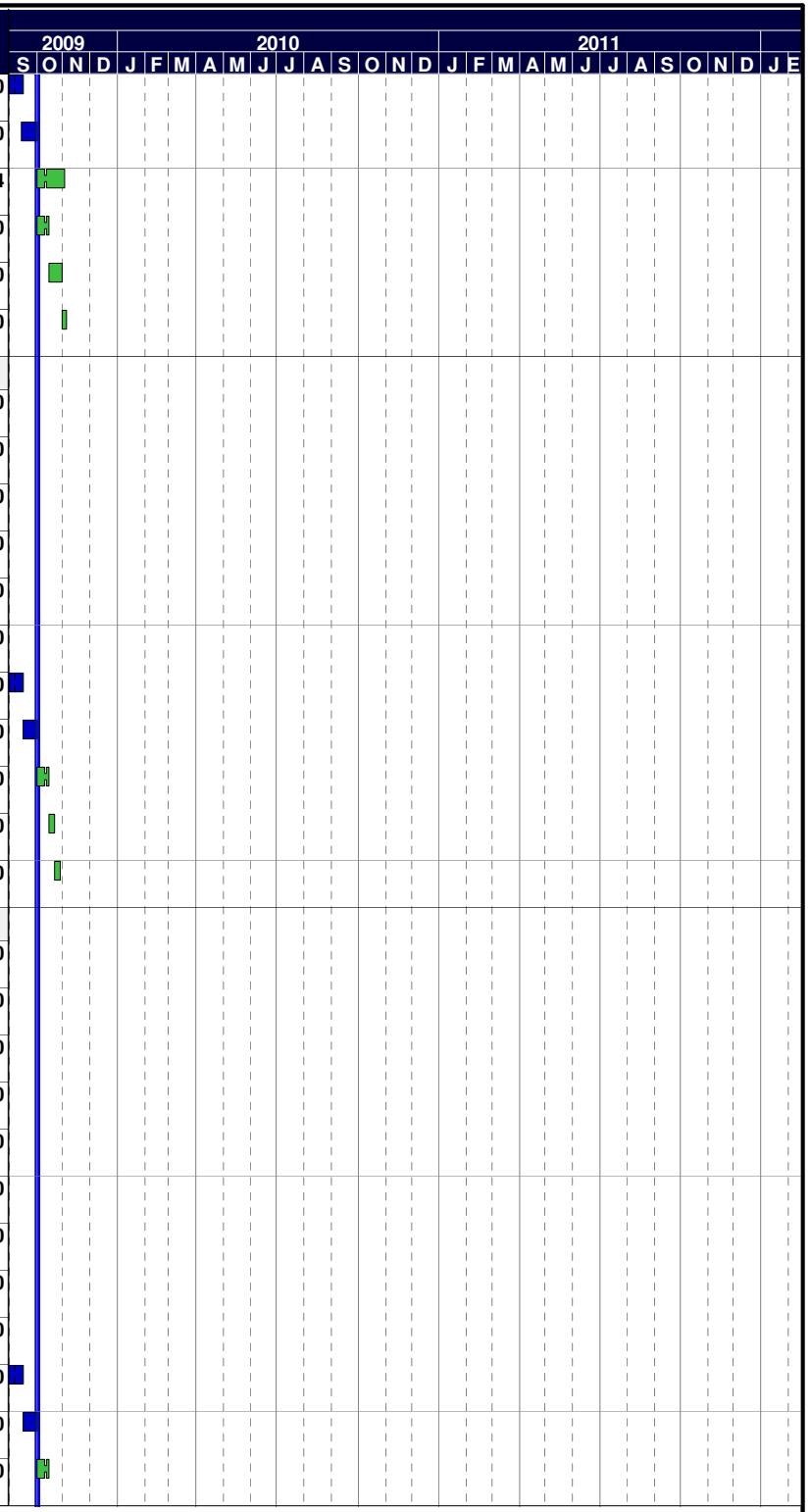
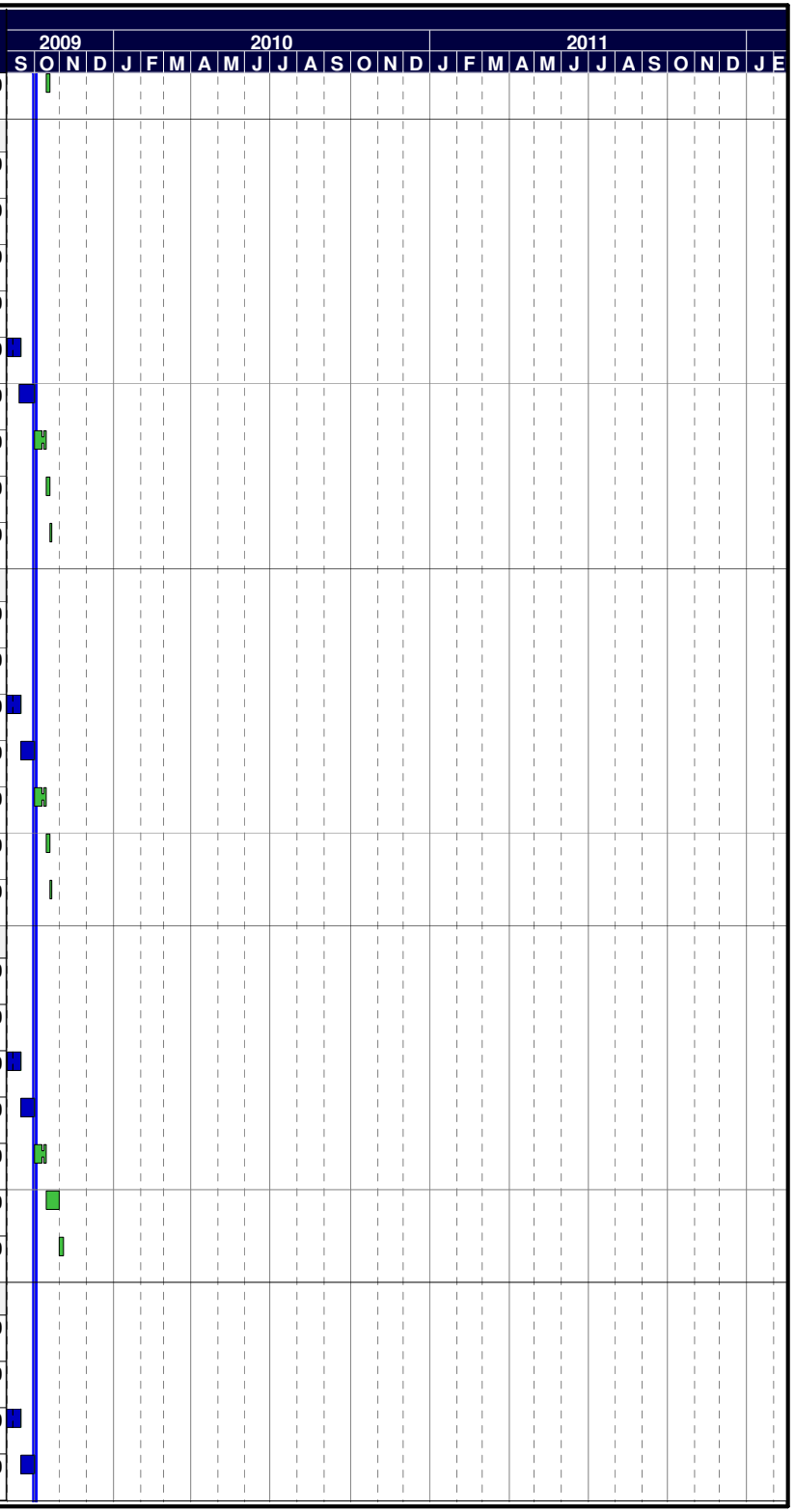
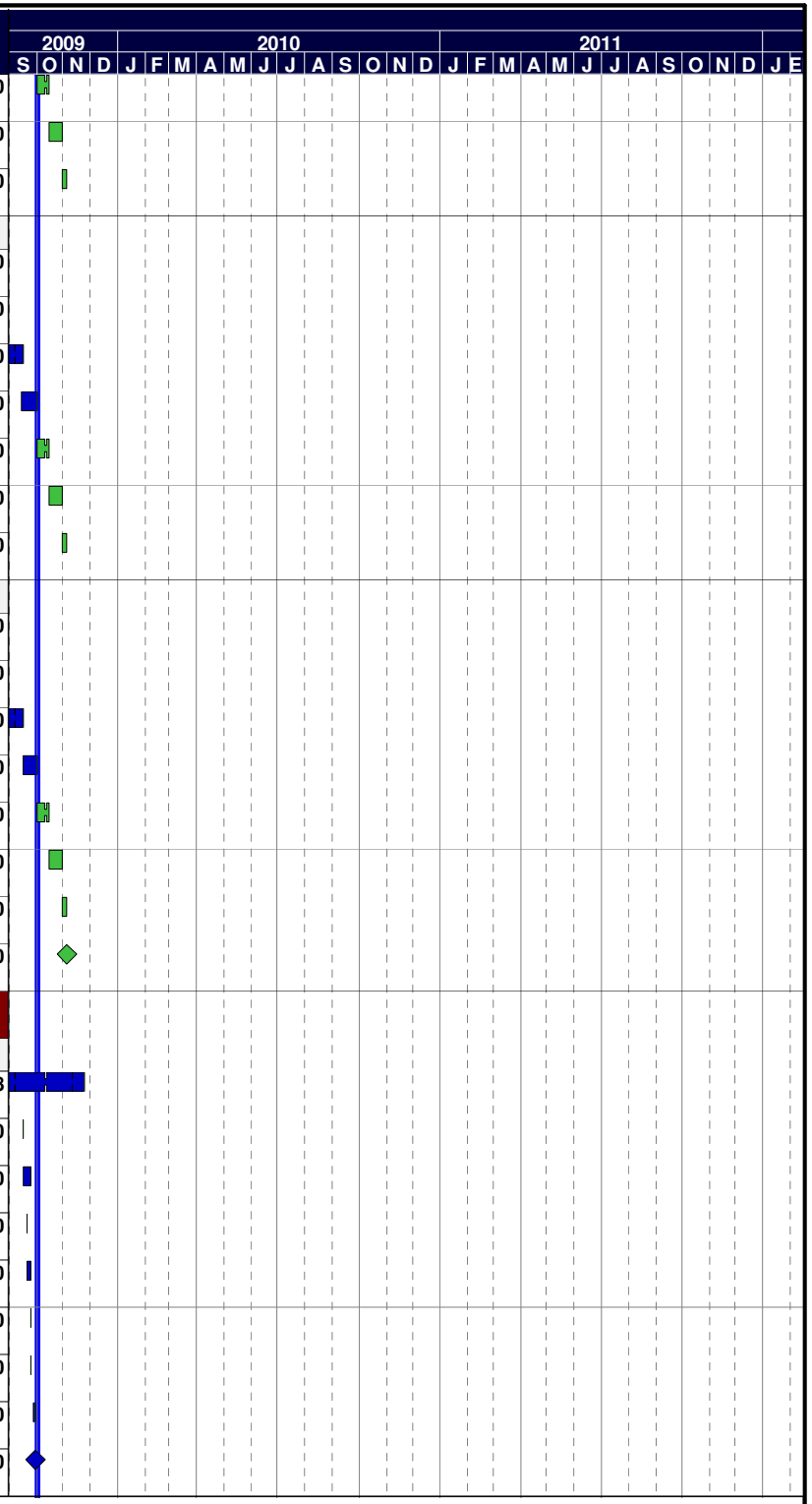
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
0433	Internal Review/Comment: Project Execution Plan	3	01SEP09A	15SEP09A		0.00
0435	External Review/Comment: Project Execution Plan	3	15SEP09A	30SEP09A		0.00
0237	Project Management Final Plans	22	01OCT09A	02NOV09	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



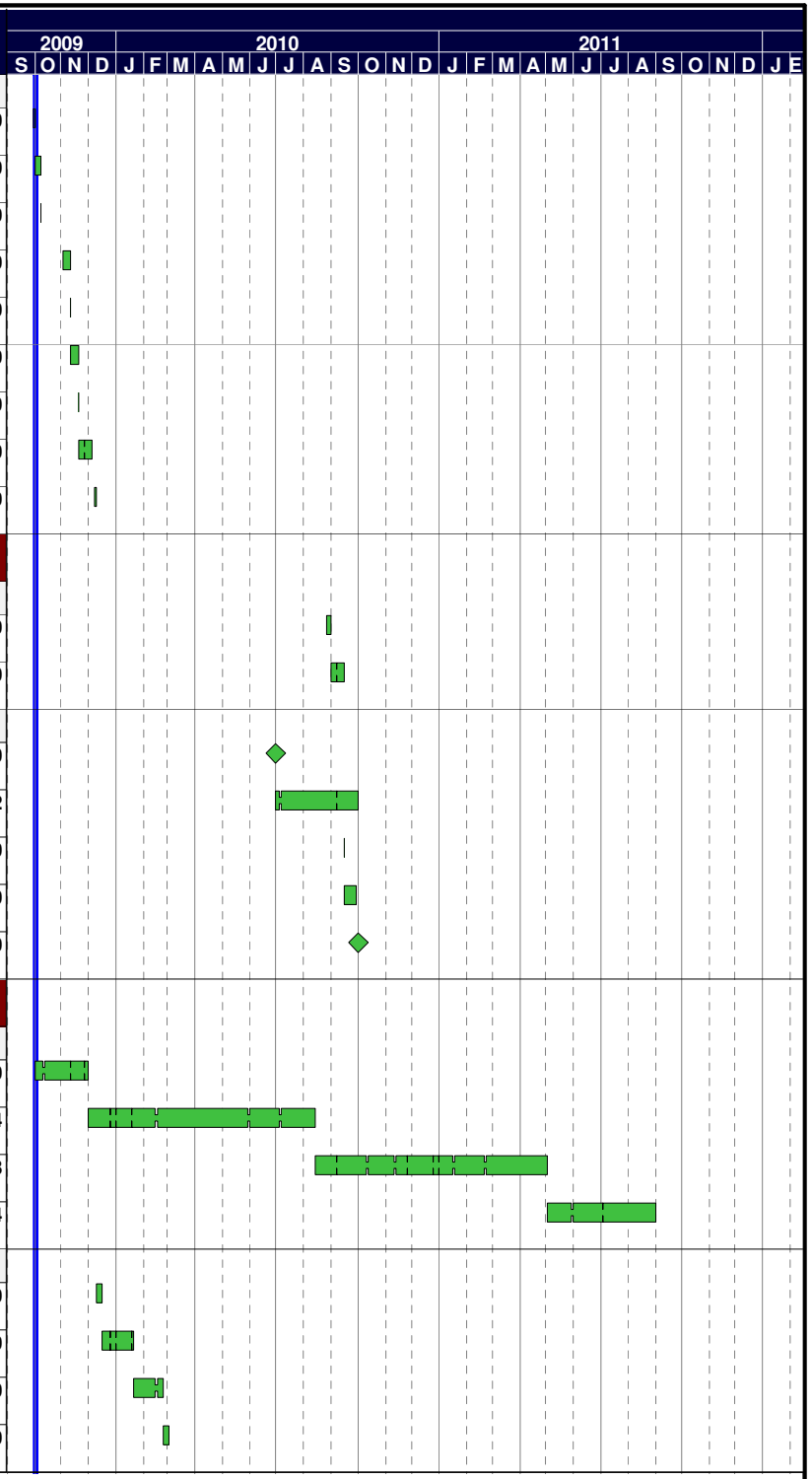
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
0590	External Review/Comment: Project Management Plan	2	16OCT09	19OCT09	33	0.00
Risk Management Plan						
0285	Prepare Risk Worksheets	3	03AUG09A	07AUG09A		0.00
0291	Prepare Outline: Risk Management Plan	1	05AUG09A	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



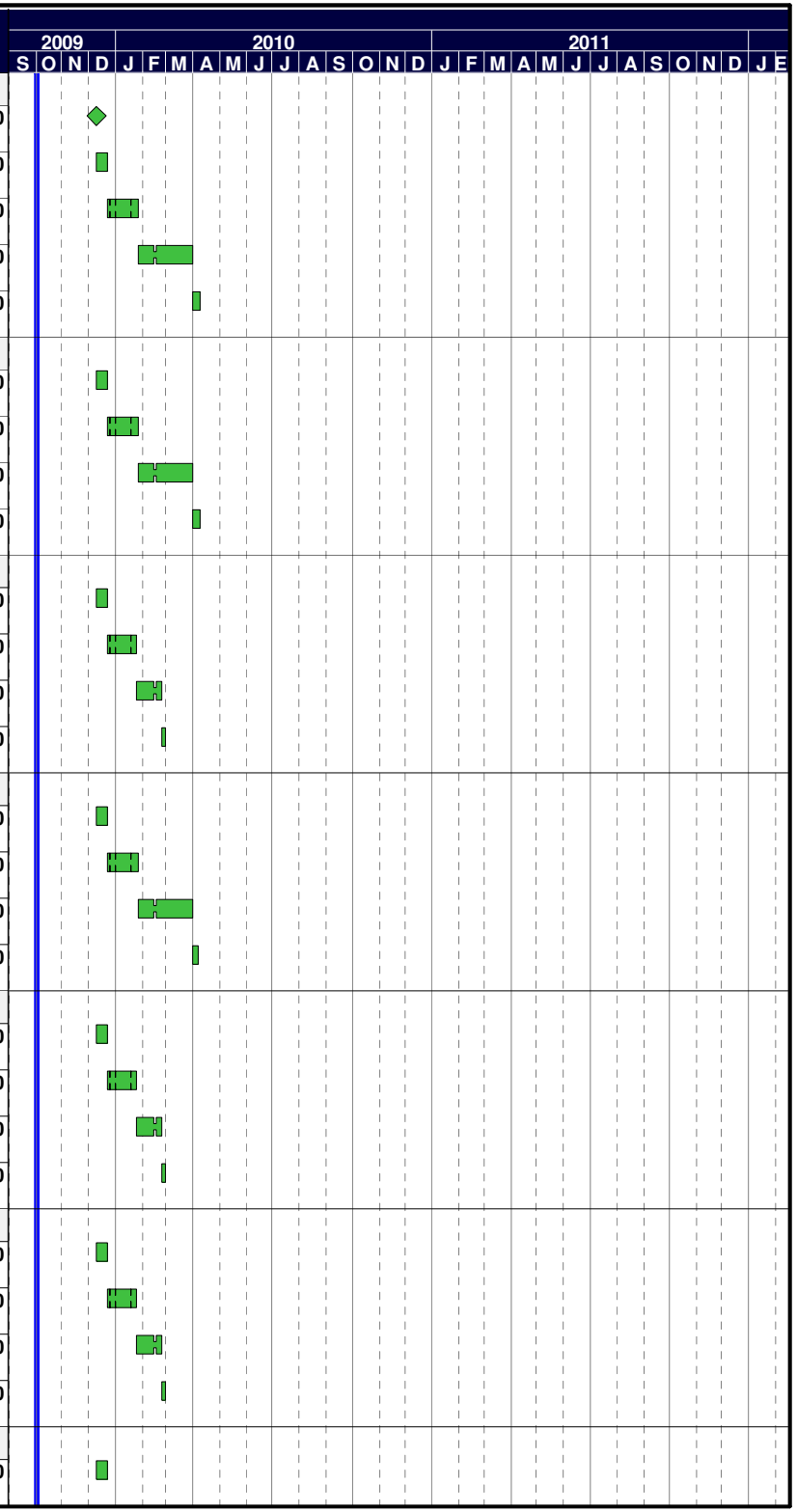
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
0565	Prepare 2nd Draft: QC/QA Plan	10	01OCT09A	15OCT09	22	0.00
0575	Internal Review/Comment: QC/QA Plan	10	16OCT09	29OCT09	22	0.00
0585	External Review/Comment: QC/QA Plan	3	30OCT09	03NOV09	22	0.00
Environmental 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



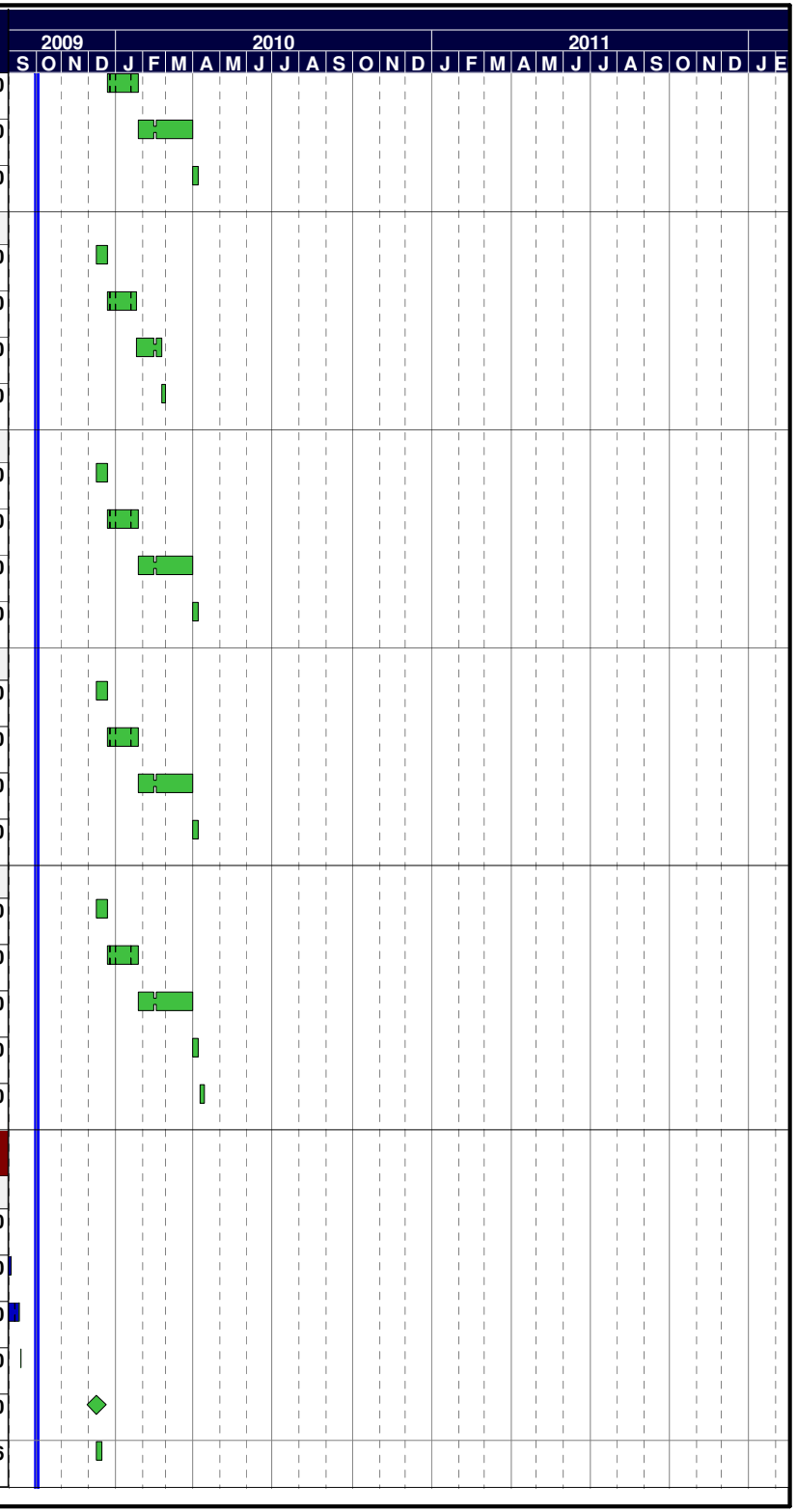
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
Preliminary Design Report						
0124	Advisors Provide Review Comments	5	30SEP09A	01OCT09A		0.00
0126	Revise PDR Documents	5	01OCT09A	07OCT09	17	0.00
0128	Revise PDR Presentation Outline	1	08OCT09	08OCT09	17	0.00
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



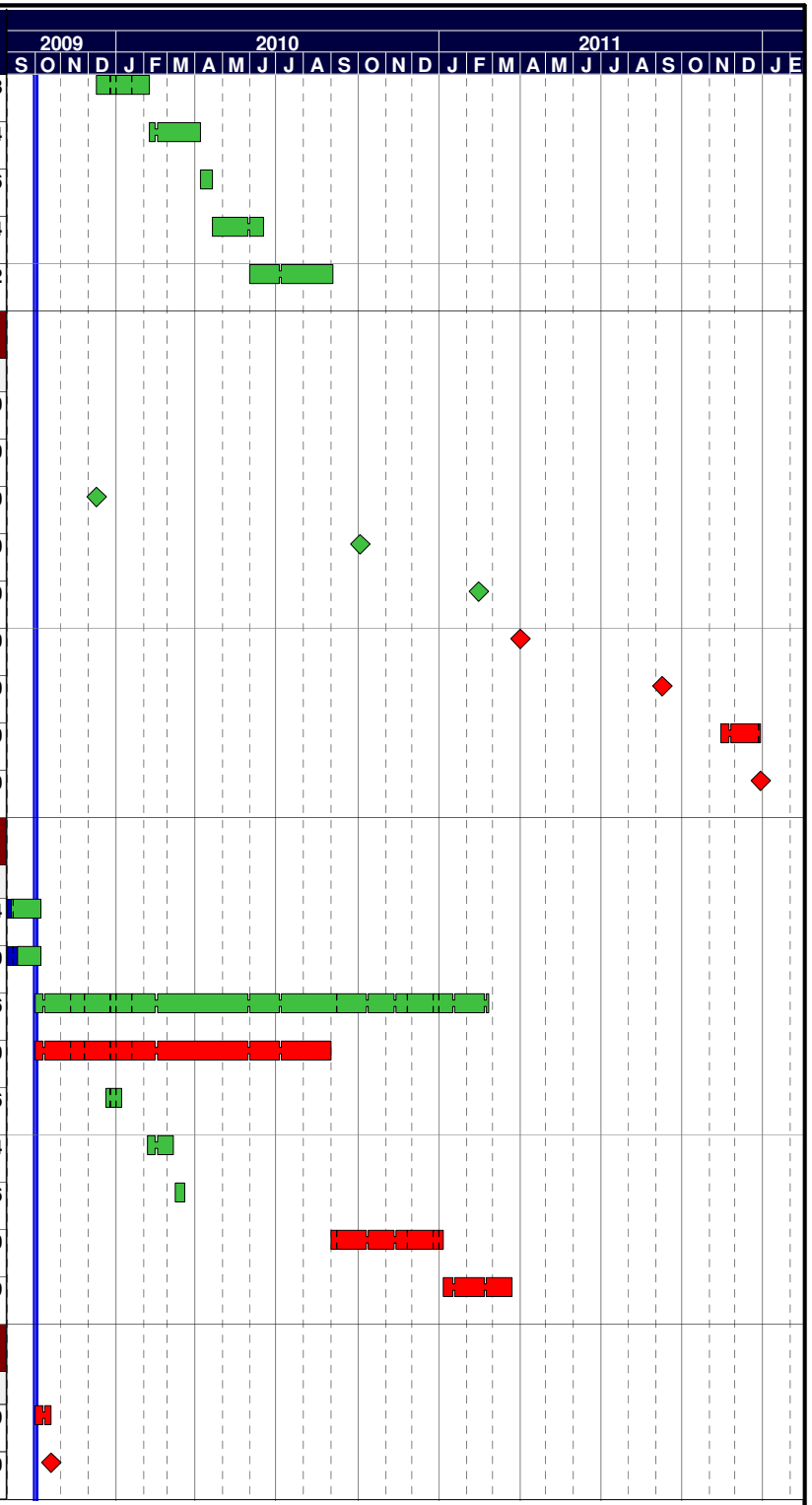
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
Existing Equipment Group						
0139	Begin ABS Submittal Process	0	10DEC09		1	0.00
0140	Prepare ABS Submittal: Existing Equip Group	10	10DEC09	23DEC09	100	0.00
0150	ABS Review/Comment: Existing Equip Group	22	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



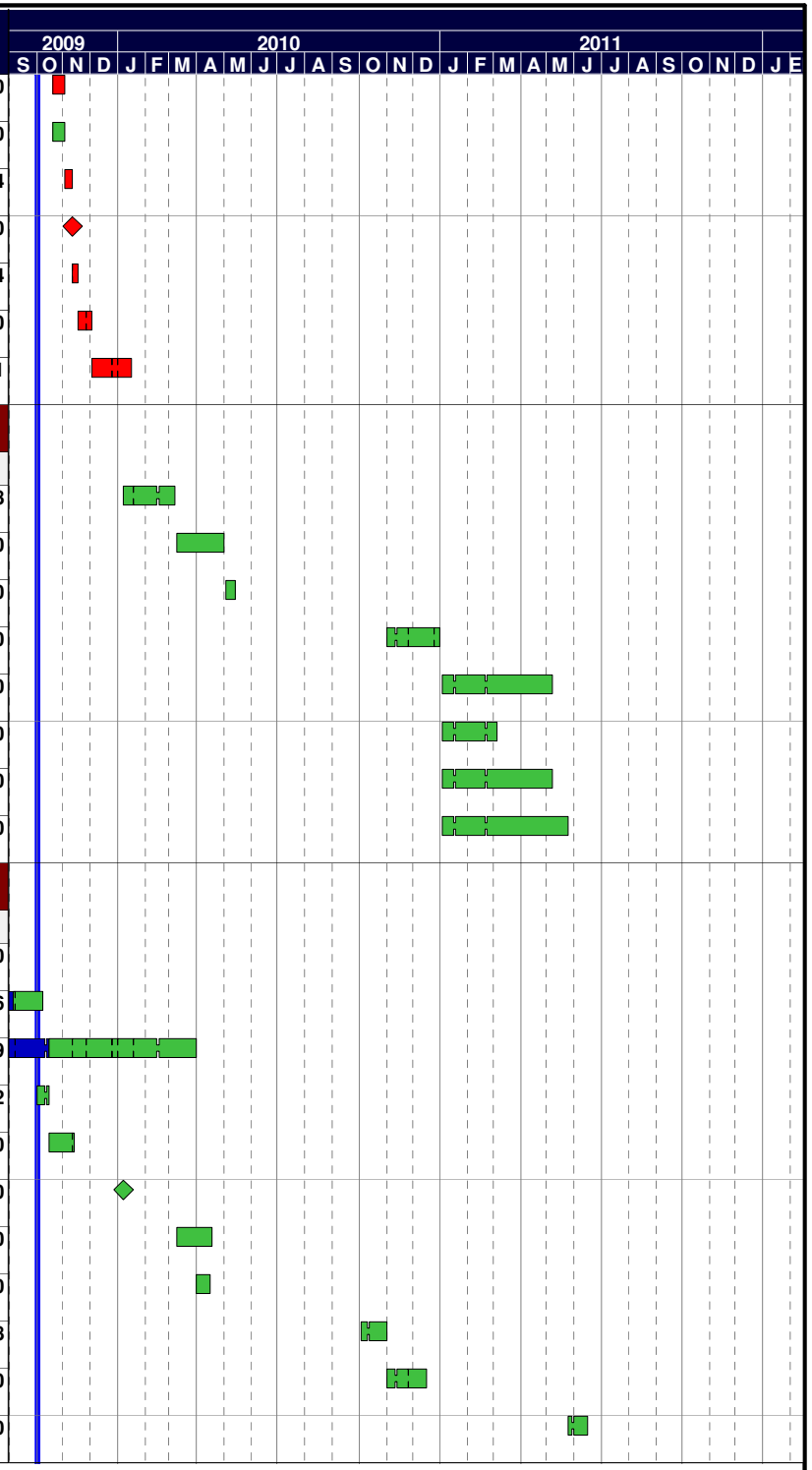
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
9210	ABS Review/Comment: Emergency Sys Group	22	24DEC09	27JAN10	102	0.00
9220	Resolve Issues with ABS : Emergency Sys Group	44	28JAN10	31MAR10	102	0.00
9230	Finalize/Submit ABS Submittal: Emergency Sys Grp	3	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



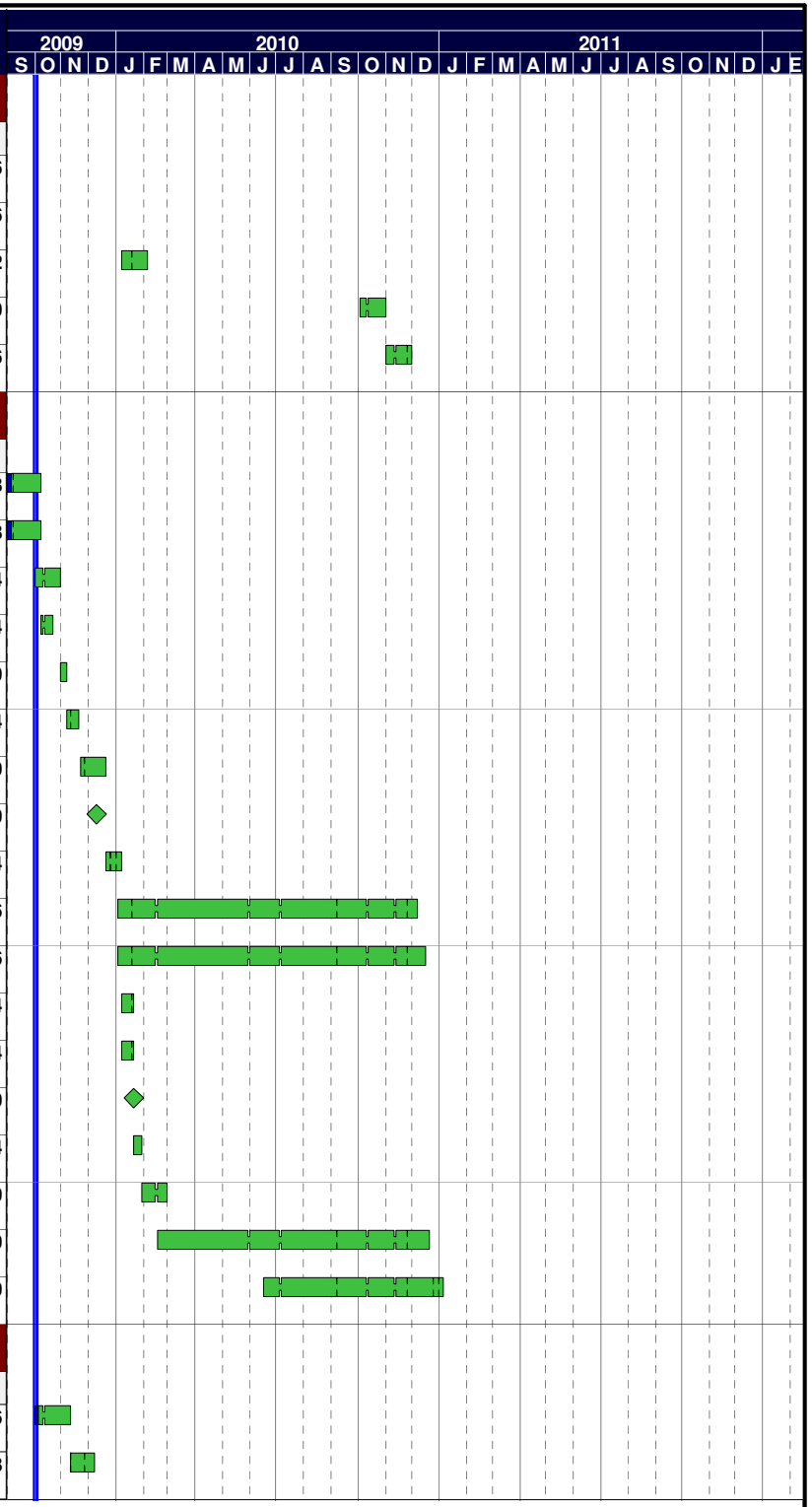
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
5690	Build/Test EE Prototype: Command Structure	40	10DEC09	08FEB10	40	22,345.88
5693	Build/Test EE Prototype: Controls	40	09FEB10	06APR10	40	45,744.64
5695	Build/Test EE Prototype: Propulsion	10	07APR10	20APR10	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



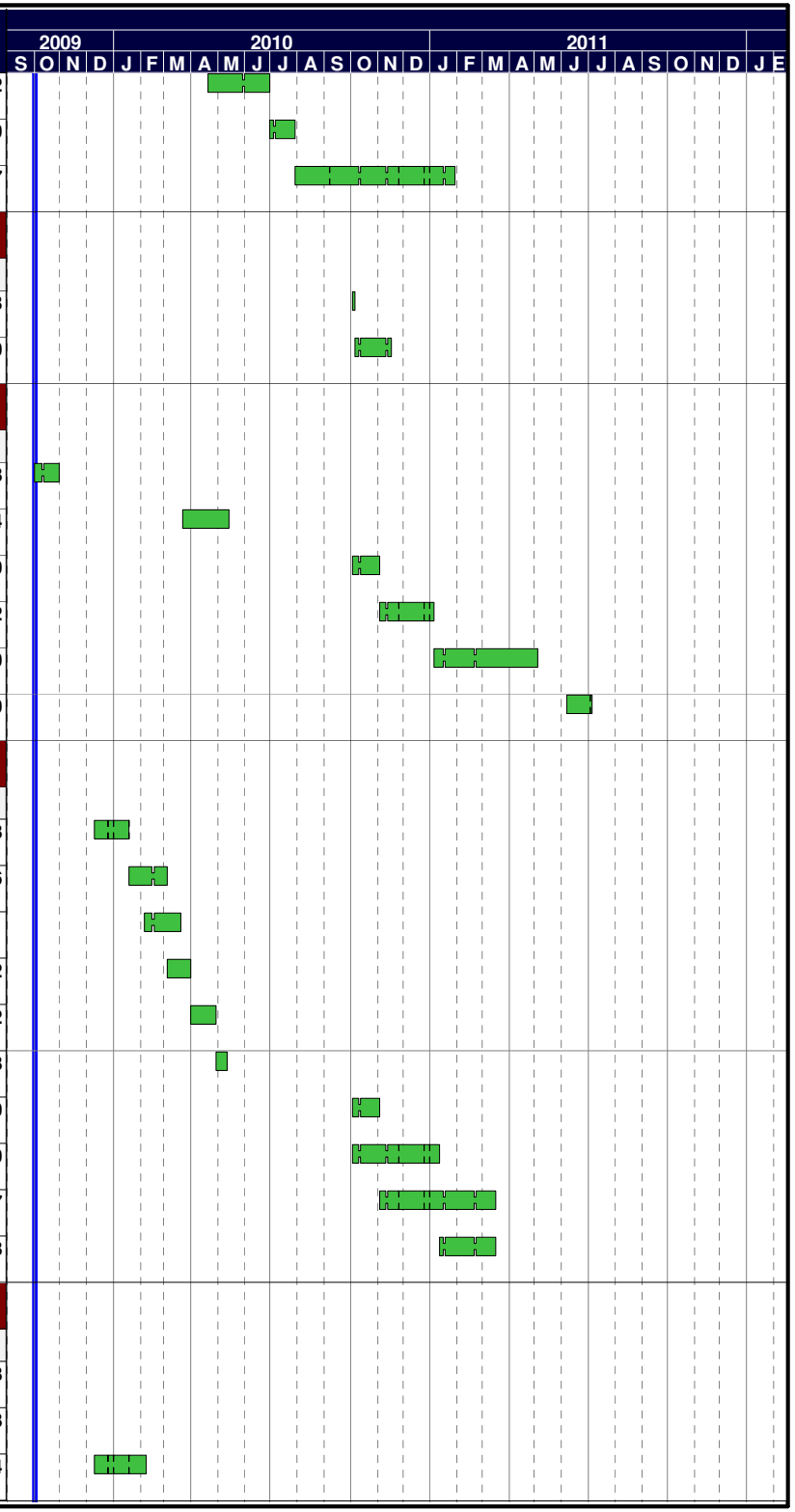
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
1120	ABS Review Comment on Spec: Penetrators	10	20OCT09	02NOV09	0	0.00
1130	Vendor Provide Penetrator Quotes	10	20OCT09	02NOV09	5	0.00
1140	Incorporate ABS Comments: Penetrator Spec	5	03NOV09	09NOV09	0	10,016.64
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



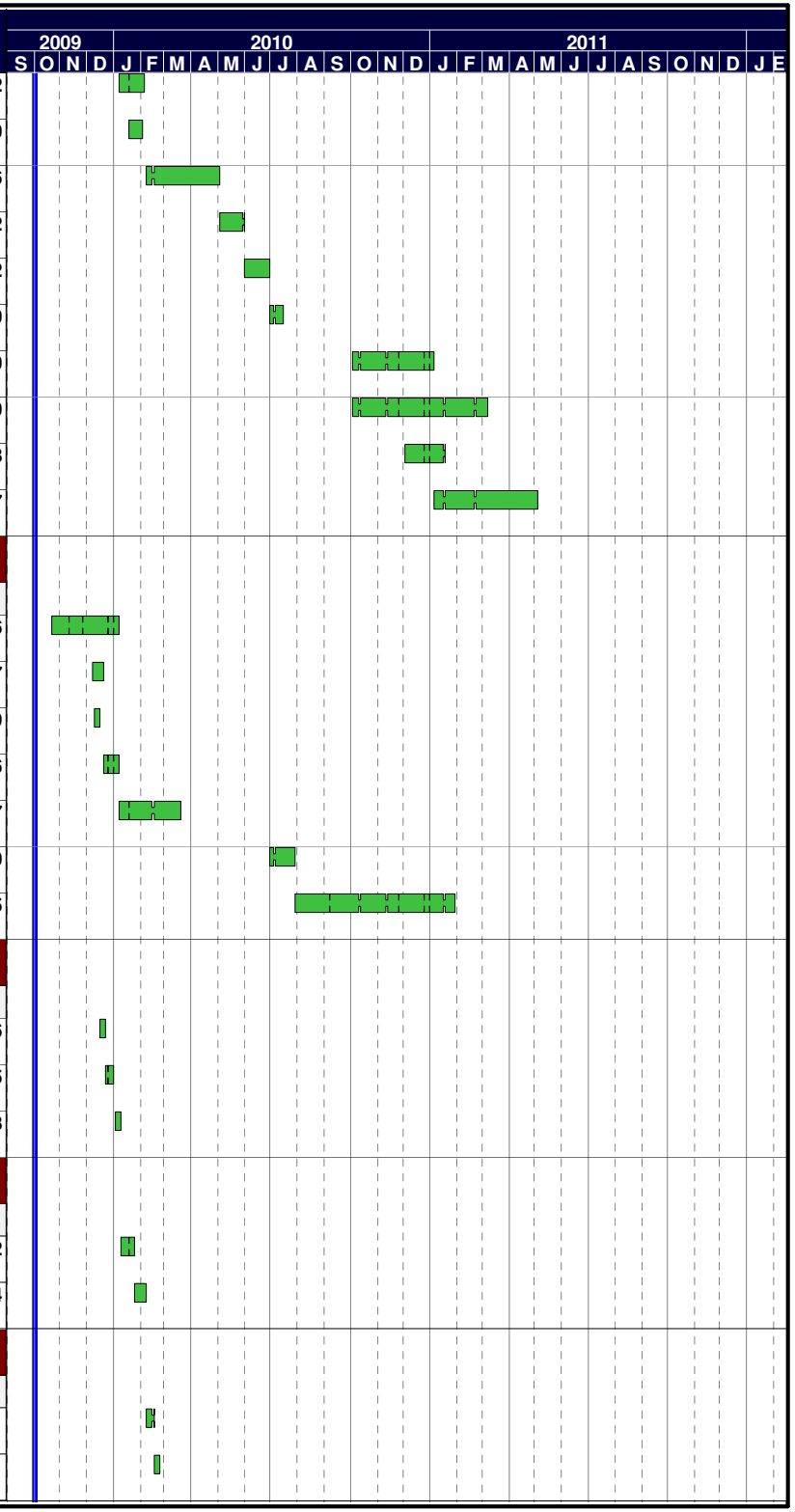
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
A04 Frame & Structural Components						
7340	Prepare Design & Calculations for Frame Mods	10	31JUL09A	06AUG09A		5,672.16
7350	Prepare Prel Design Documents: Frame Mods	10	07AUG09A	13AUG09A		5,672.16
0310	Final 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



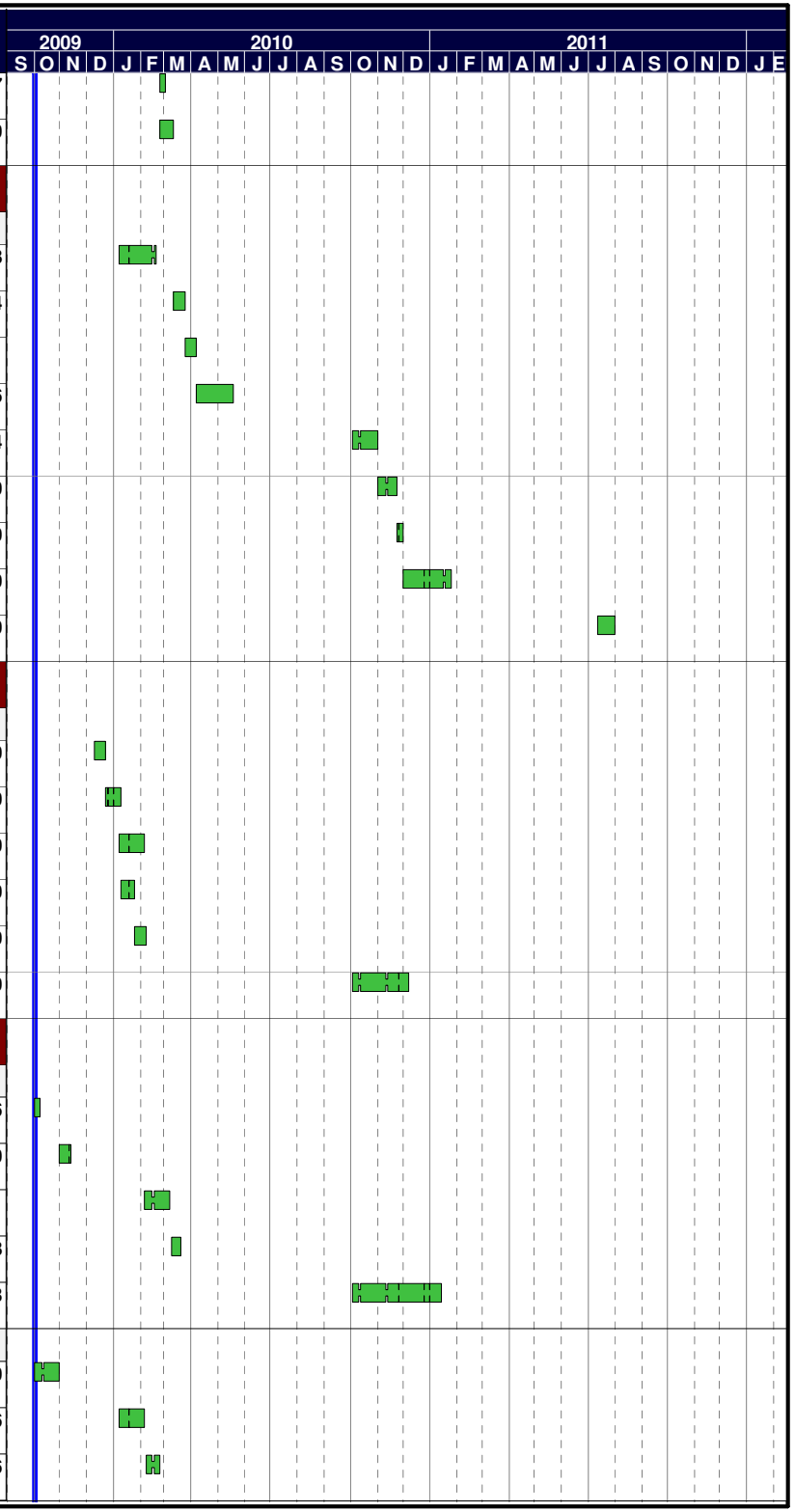
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
1200	Final Design: Skins, Fairings & Sail	52	19APR10	30JUN10	2	25,540.92
3400	Procure: Skins, Fairings & Sail	20	01JUL10	29JUL10	120	0.00
3402	Fabricate: Skins, Fairings & Sail	124	30JUL10	28JAN11	120	105,300.27
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



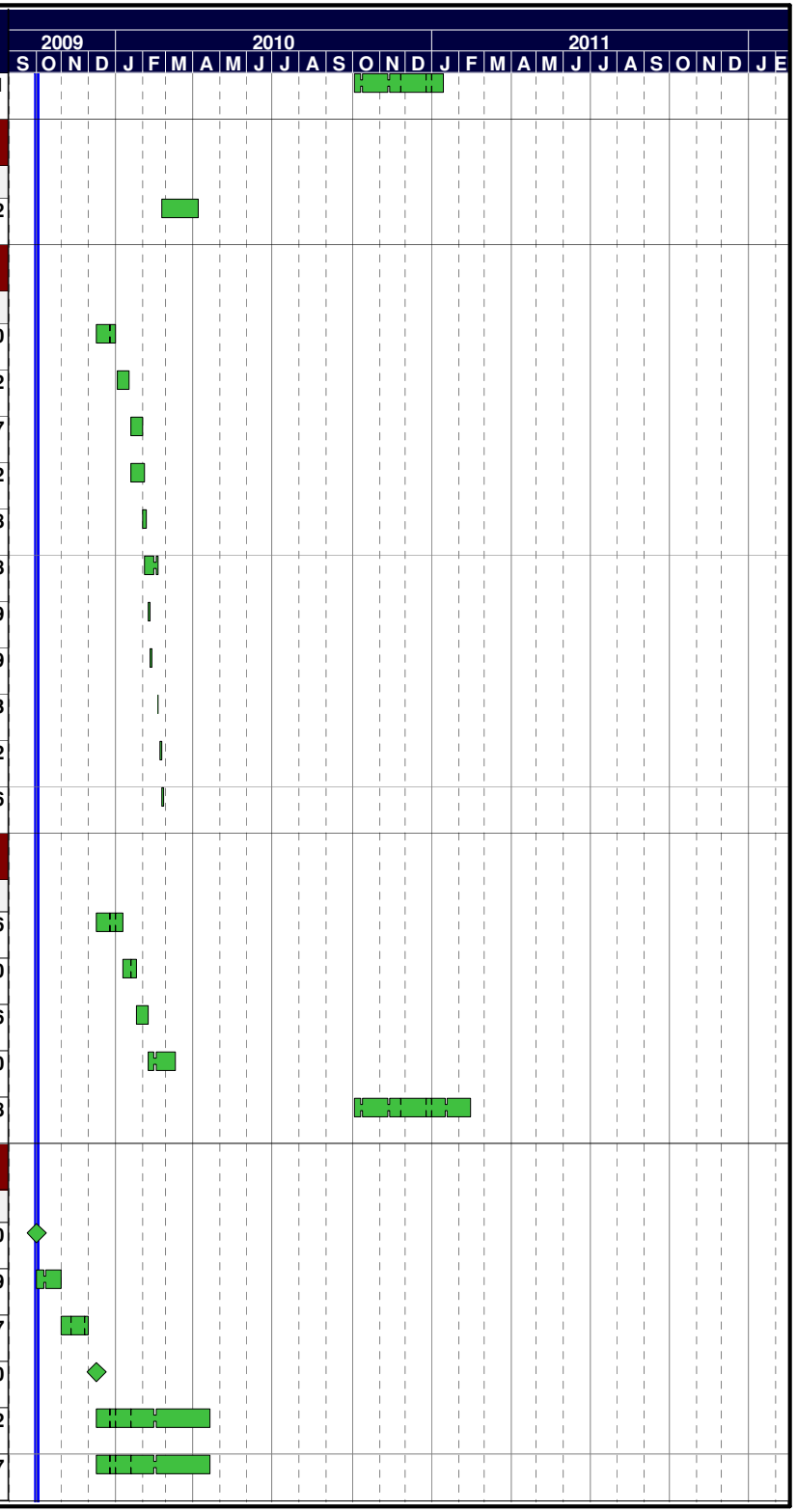
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
1400	Final Design: Power Pressure Housing (Bottle)	20	07JAN10	04FEB10	34	8,325.72
5772	Complete Design of Lanecon Software Interface	10	20JAN10	02FEB10	15	13,176.90
5780	Prototype Selected Components: Power Bottle	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



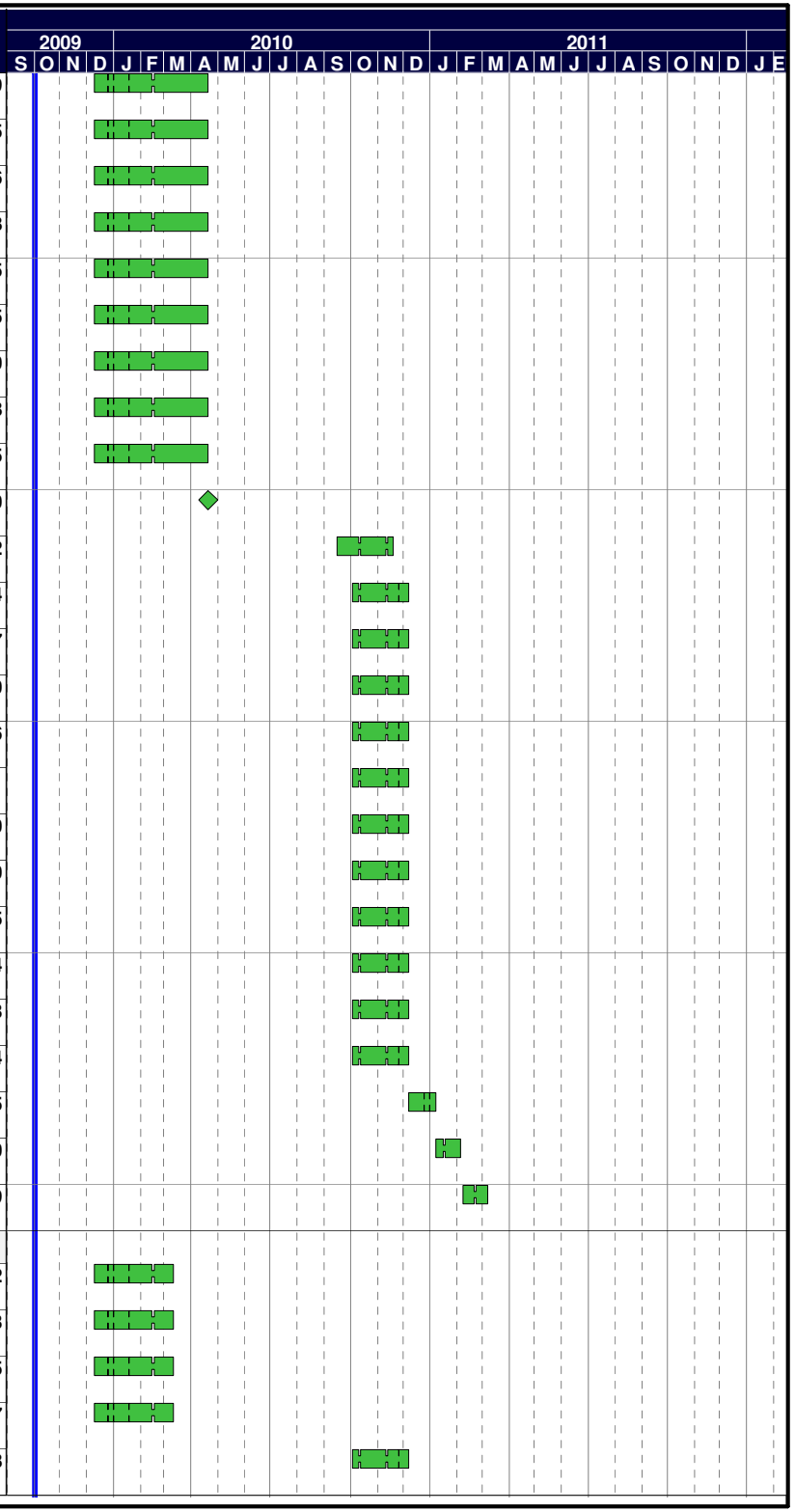
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
6150	Revise Schematic: Hydraulic System	5	24FEB10	02MAR10	75	3,782.77
6152	Command & Control Integration: Hydraulic System	10	24FEB10	09MAR10	50	5,493.60
A24 Life Support Systems						
6174	Final Design: Life 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



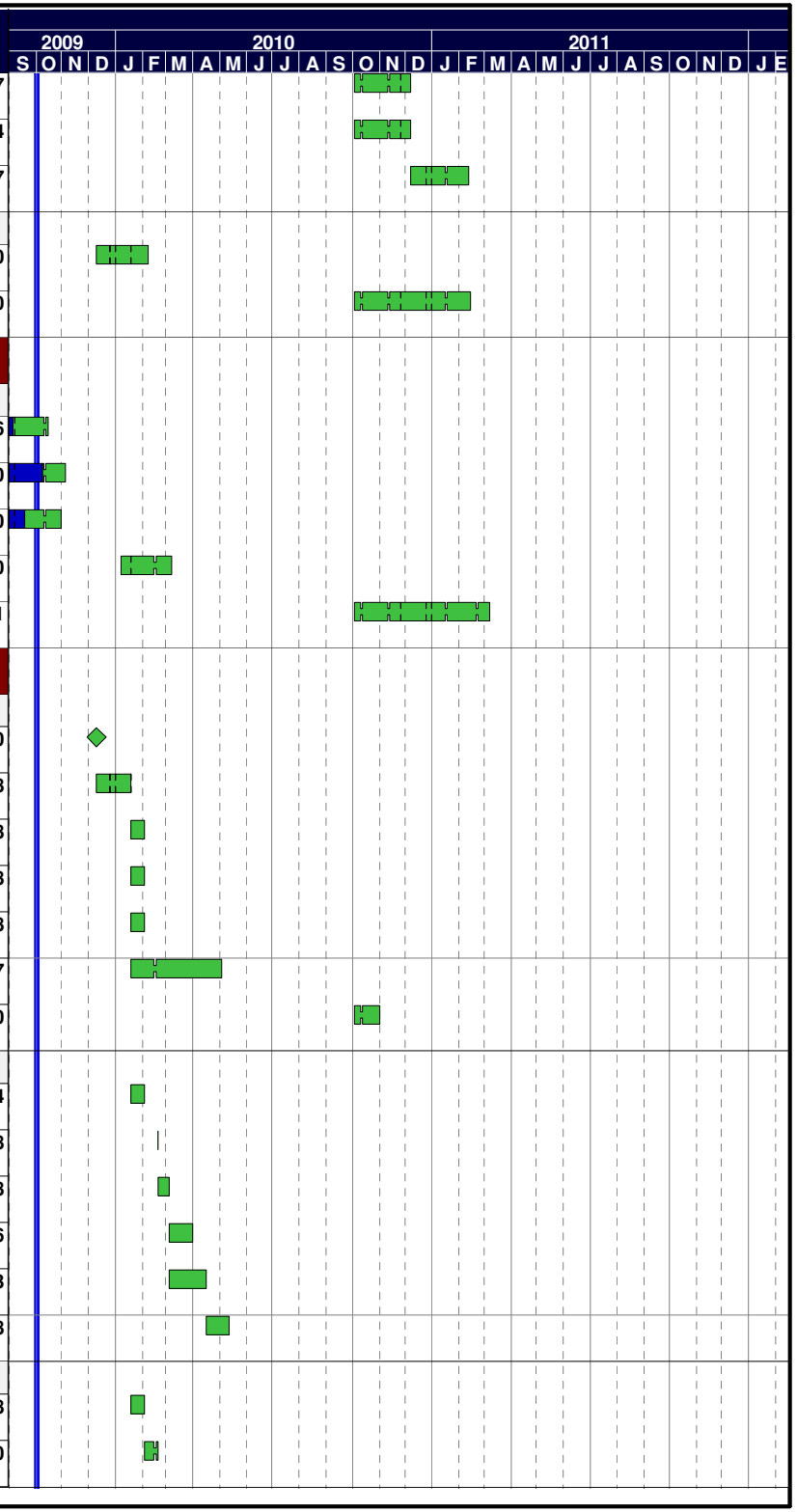
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
4600	Procure & Fabricate: Service Releases	70	04OCT10	14JAN11	103	8,936.41
A30 Manipulators						
2600	Final Design: 4-wire Telemetry	30	24FEB10	06APR10	50	14,657.72
A32 Operational Equipment & Controls						
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



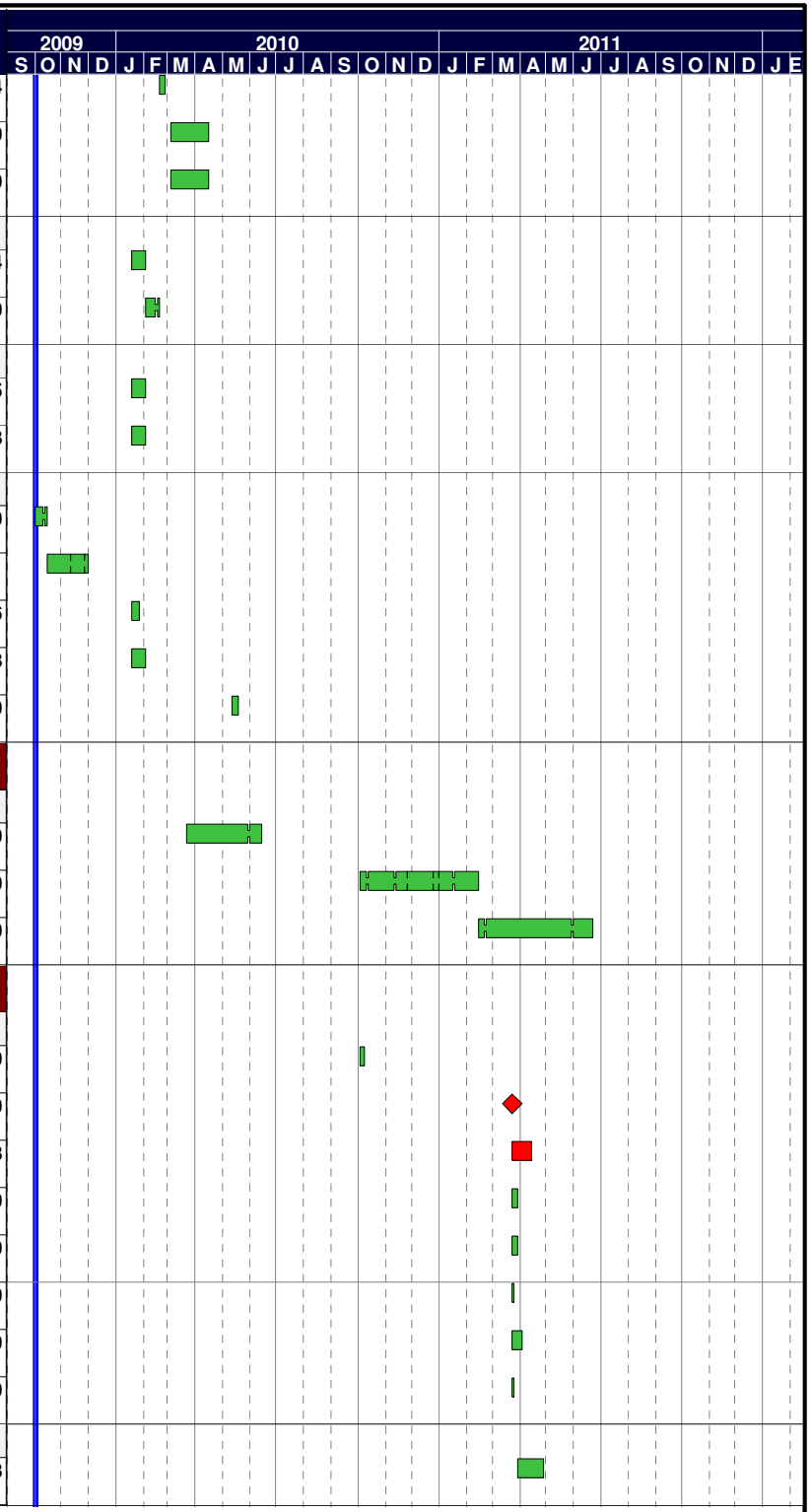
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
4840	Prepare Final Design: Camera Interface/Telemetry	90	10DEC09	20APR10	106	26,191.49
4860	Prepare Final Design: Acquisition System	90	10DEC09	20APR10	106	19,663.95
4880	Prepare Final Design: Internal Camera 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



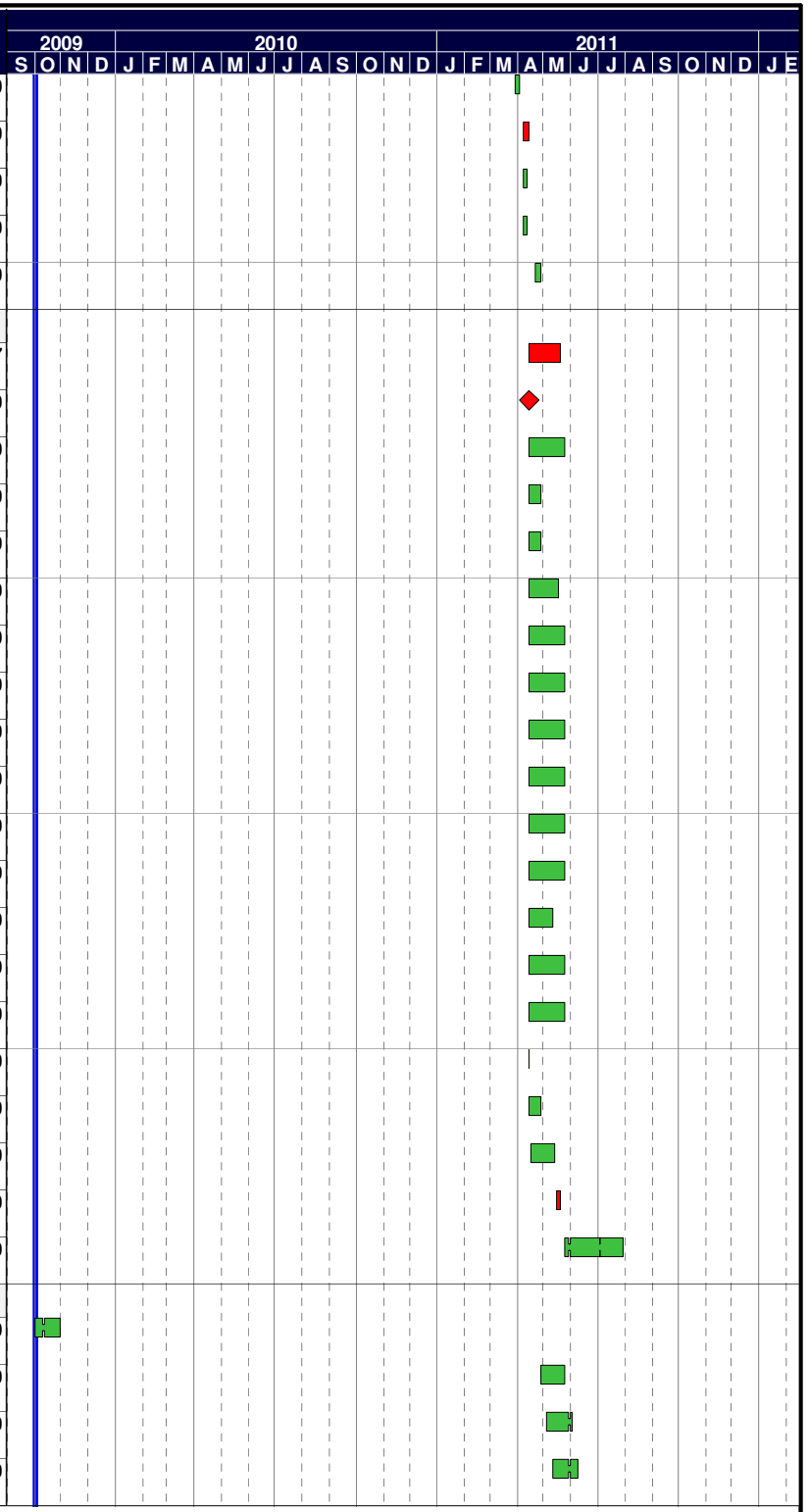
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
5050	Procure/Fabricate: Power Control & Modulation	44	04OCT10	07DEC10	28	127,565.67
5090	Procure/Fabricate: Lighting Control	44	04OCT10	07DEC10	28	53,717.94
5094	Intetrate Lighting System	44	08DEC10	10FEB11	28	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



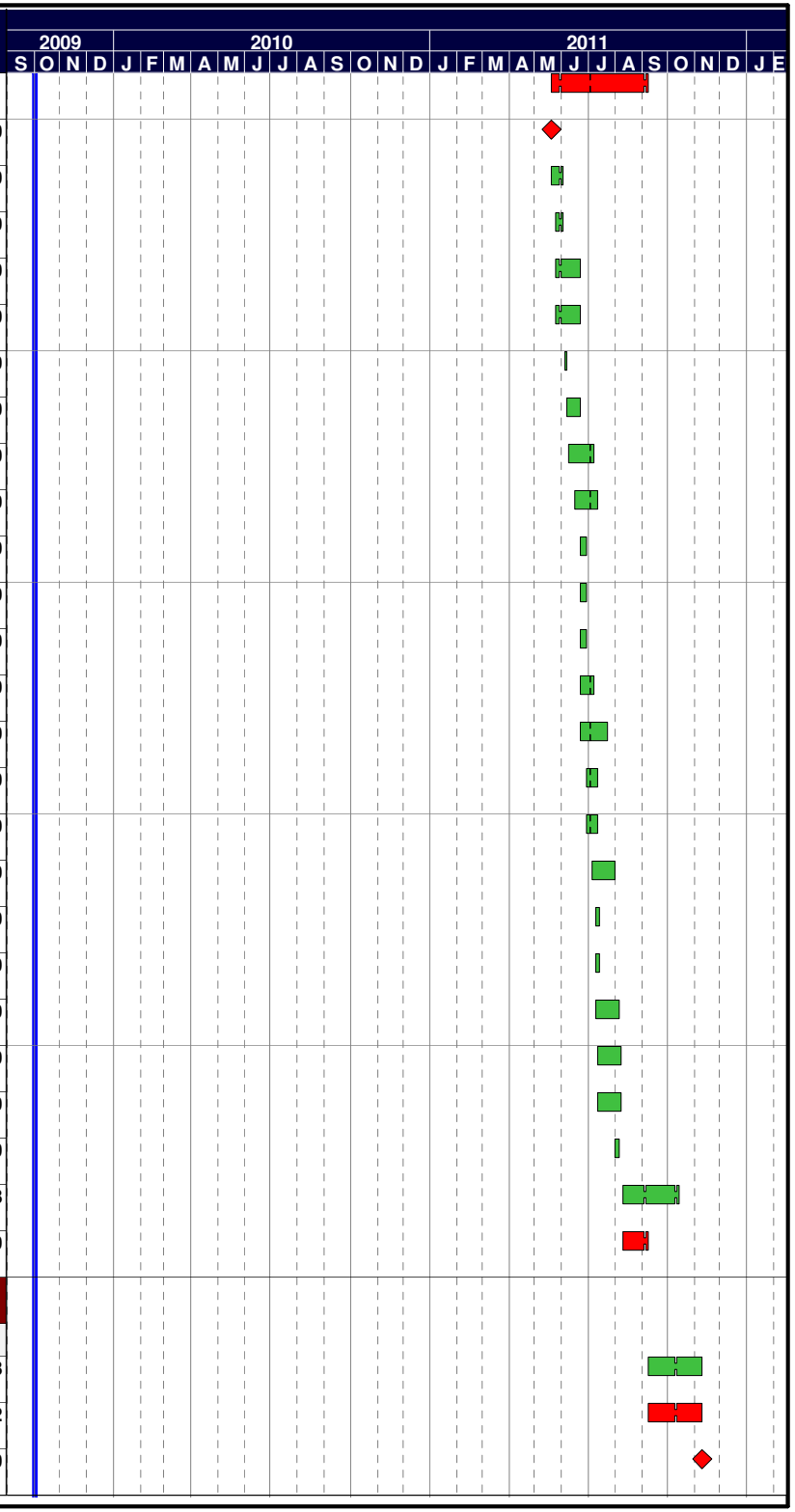
Activity ID	Activity Description	Orig Dur	Early Start	Early Finish	Total Float	Budgeted Cost
7530	develop submarine simulators	5	18FEB10	24FEB10	90	5,601.24
7540	produce beta version of RTC	30	04MAR10	14APR10	85	59,446.20
7582	produce beta version of GUI	30	04MAR10	14APR10	85	45,443.10
Navigation						
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



3.3 Critical Path Activities

The critical path activities go through construction of the personnel sphere (Figure 3). This ongoing effort by SwRI is being managed with a subcontractor-provided monthly milestone schedule. Construction of the personnel sphere will be updated in accordance with that schedule so that any impact to the project schedule can be readily seen. SwRI and WHOI have implemented aggressive oversight of this project. A SwRI representative is on-site at their subcontractors, there are weekly telephone conferences on progress, monthly written status reports, site visits, and quality control checks being conducted to ensure that sphere construction and delivery schedule are met.

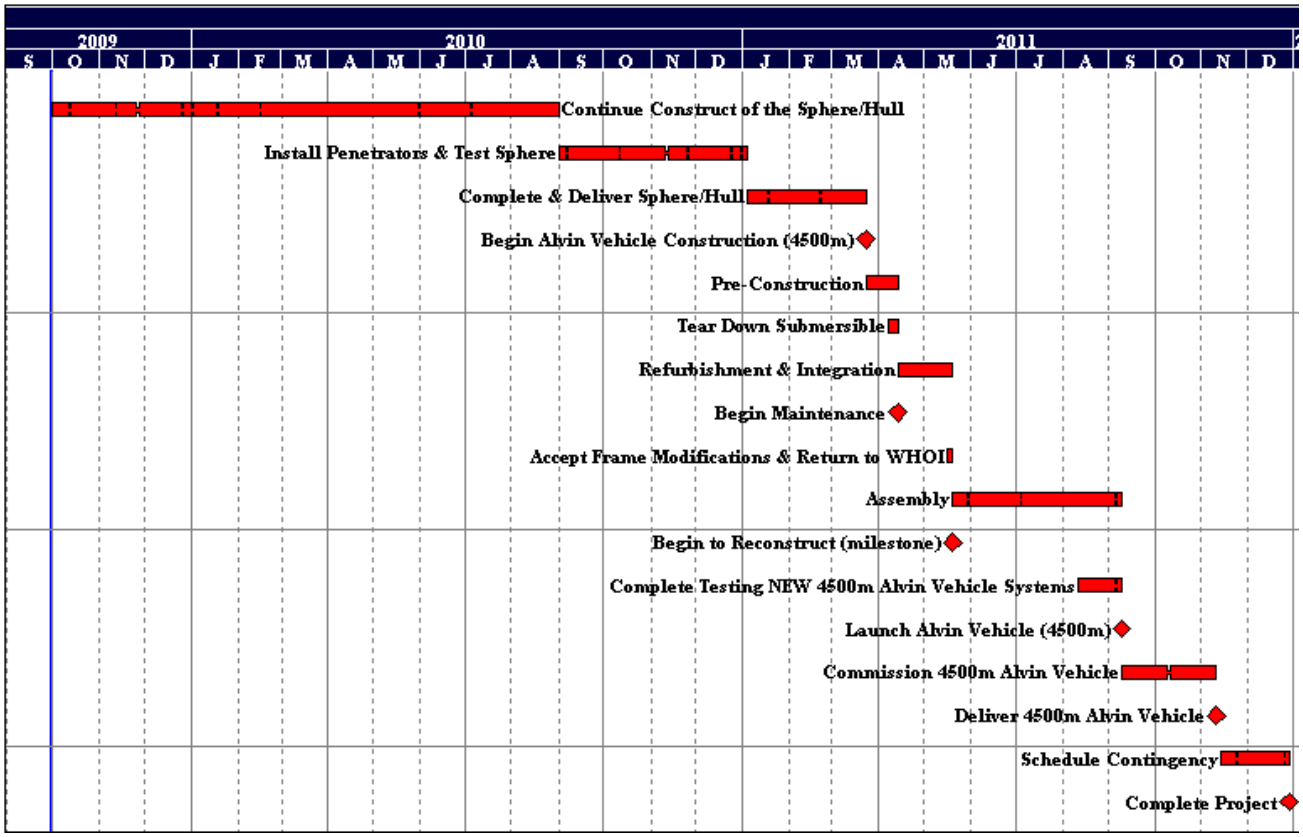


Figure 3. Critical Path Activities

4.0 Cost Estimate

4.1 Cost Summary for Preferred A-4500 HOV Design

A cost summary for the preferred A-4500 HOV design is shown in Table 2. The cost estimate is summarized by work package and was used to prepare the base estimate for the preferred A-4500 HOV design. The costs are priced using 2009 labor rates and quotes. Annual escalation factors have *not* been applied to the figures in this Table.

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		

A detailed cost estimating worksheet was created for each work package. These detailed estimating worksheets can be found in Appendix A. The summary figures were reviewed in a Project Management Team and lead engineers meeting to be sure that all major scope was included in the pricing. The detailed cost estimates have also undergone a second level review within the last month to refine the current figures.

Once the preferred A-4500 HOV design was selected, the costs were loaded into the schedule and escalated according to Table 3.

Table 3. Escalation Factors

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

Contingency was added to these figures in accordance with the Risk Summary Table in the *A-4500 HOV Risk Management Plan*. The project estimated costs are shown in Table 4.

Table 4. A-4500 HOV Project Estimated Costs

PREFERRED A-4500 HOV DESIGN – ESTIMATE

Base Cost……...….$31,046,880
w/Escalation…...……..…..$31,722,894
Contingency……..…….$ 3,452,000
Total Cost Estimate ……..**$35,174,894**

FUNDING

NSF Project…….……$22,910,005
WHOI ……..$ 5,000,000
Ship Modifications……..$ 200,000
Total Funding Available...**$28,110,005**

Funding Variance ……...**$ 7,064,889**

4.2 Cost Estimating Worksheets (see Appendix A)

"Bottom Up" cost estimating worksheets were prepared for each work package. The sheet includes a narrative, list of scheduled activities, labor estimates, personnel and other expenses needed to execute the particular work package. Cost estimates were prepared with 2009 rates. Escalation has not been applied within these worksheets.

All labor was estimated by the technical lead responsible for the work package. Pricing for expenses are either engineers estimates, vendor quotes and/or historically based. Each item is identified as such so that the team can assess the confidence level of the quotation. As the design matures, these sheets will become working documents to refine the cost estimating figures.

The current cost estimate was loaded into the schedule and escalated. The preliminary cash flow shown below is based on that effort.

4.3 Estimated Cash Flow

The data developed in the estimating sheets were then loaded into the schedule and escalated. The cash flow shows anticipated expenditures if the project proceeds on schedule (Figure 4). If activities slip into outer years, escalation will start to impact the costs.

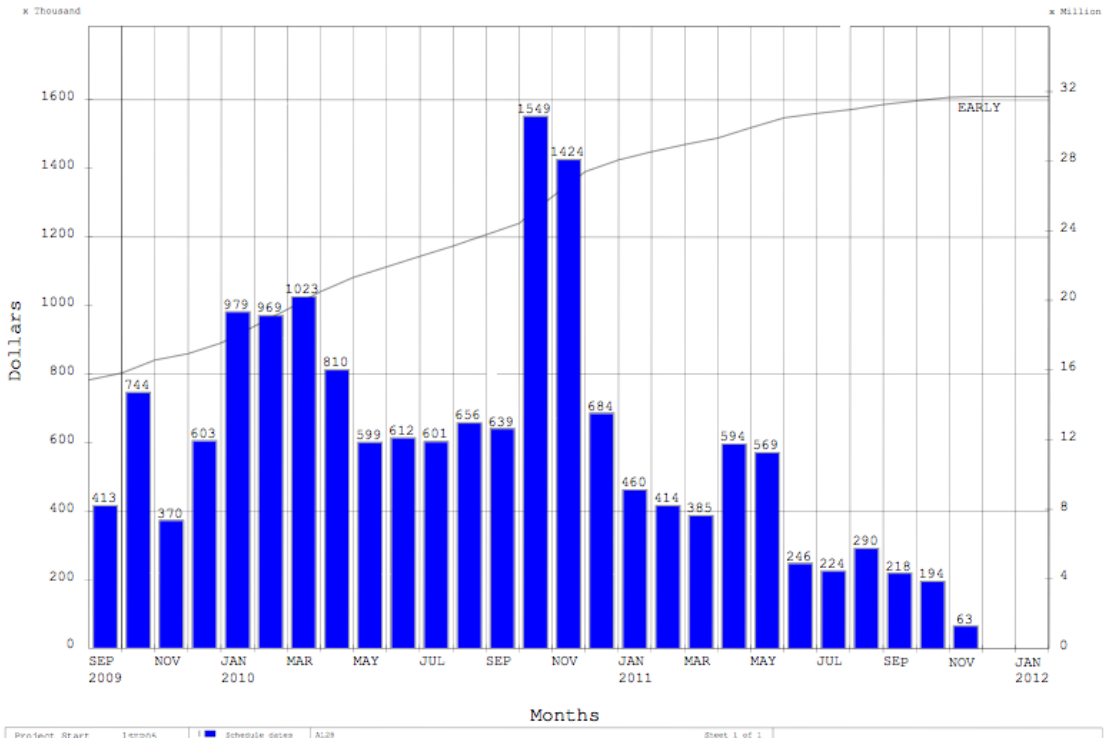


Figure 4. Preliminary Cash Flow Analysis

5.0 Staffing Plan

5.1 Total Staffing

The staffing chart (Figure 5) shows the level of full time personnel needed to execute this project. On average ~12 people will be needed. As part of the second level cost estimate review, the team will review and revise the sequence of activities to level the resources shown below. Where staffing peaks remain, the project team will be supplemented by additional resources. WHOI has a number of employees and graduate students to draw from within their resource pool. Consultant services may also be used to supplement the team for specific activities when needed.

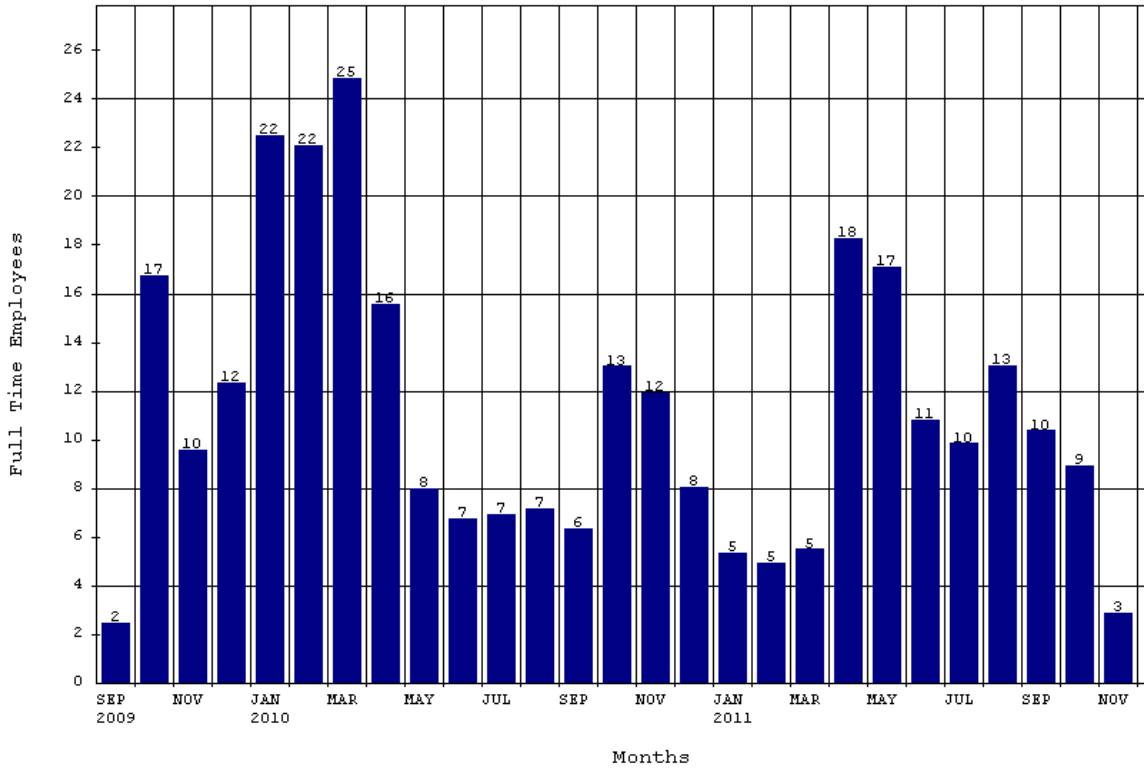


Figure 5. Staffing Chart for the A-4500 HOV Project

5.2 Detailed Staffing

In addition to the overall project staffing, individual staffing plans were created so that the Project Management Team could identify peak periods for key personnel. An effort will be made to level peak period by staggering non-critical activities, re-distributing work

assignments within the department, extending the workweek to include weekends, and/or bringing on additional people.

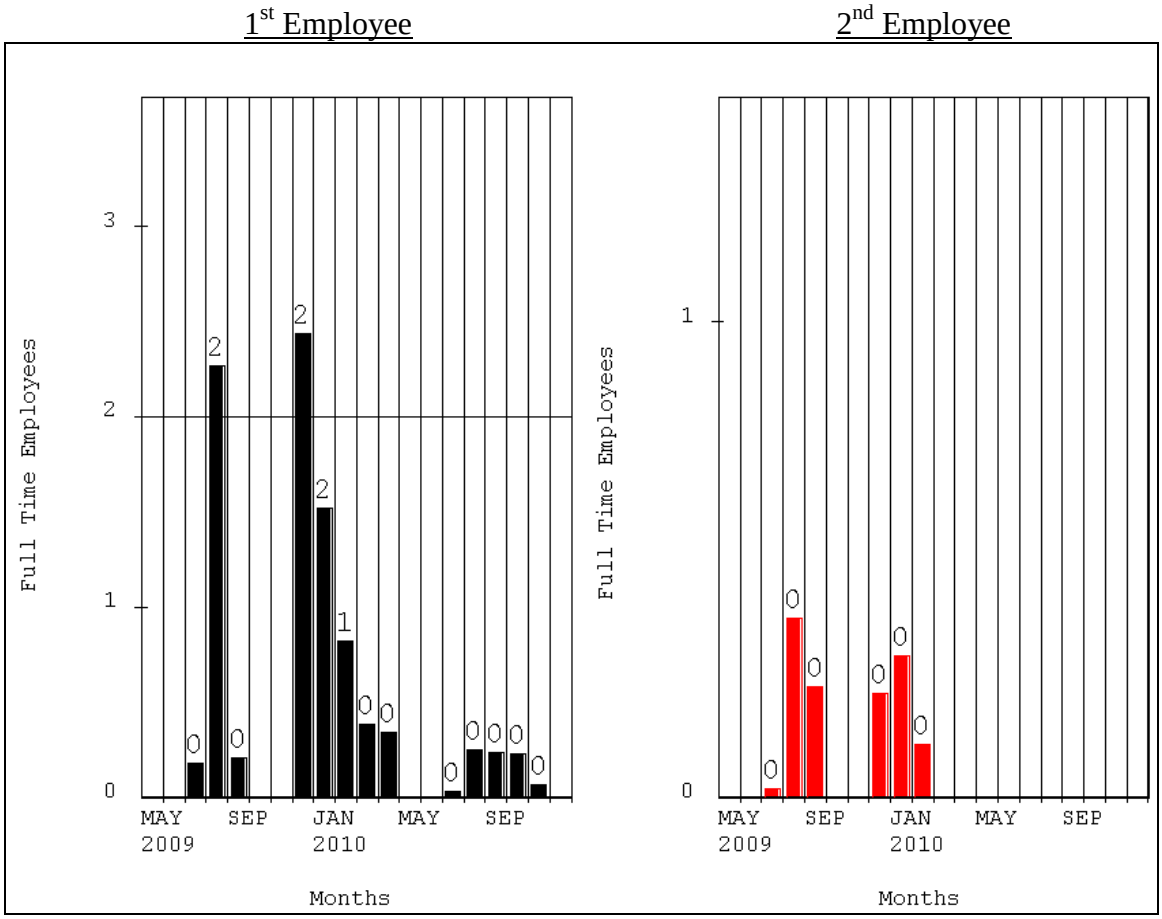
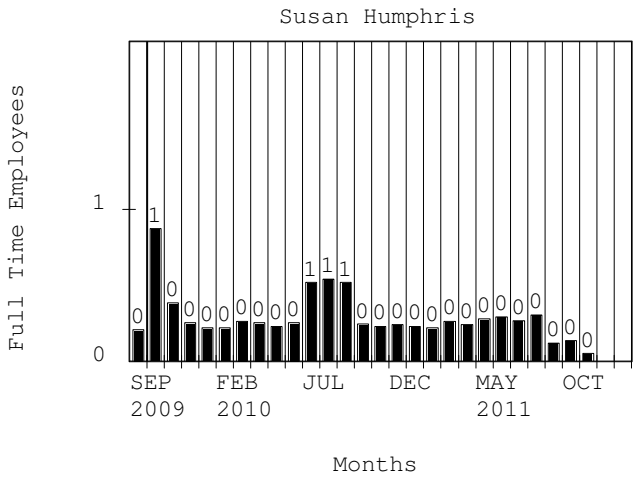
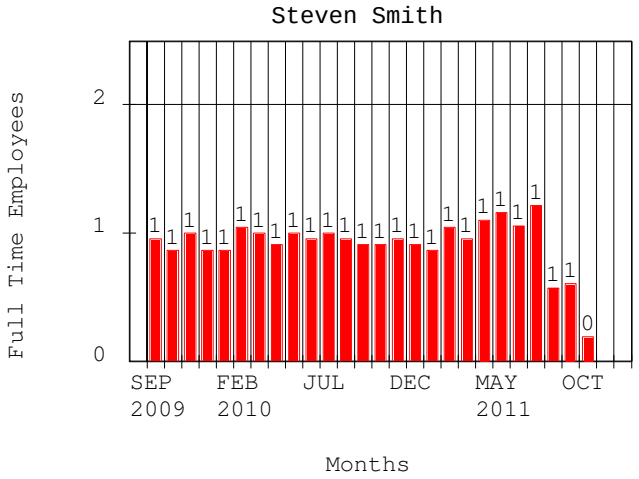
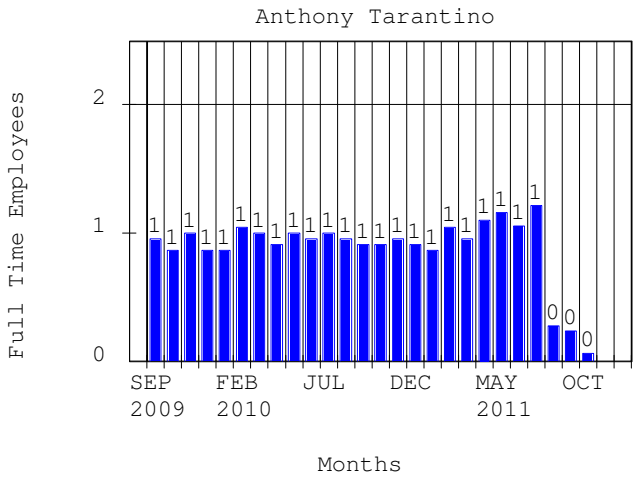


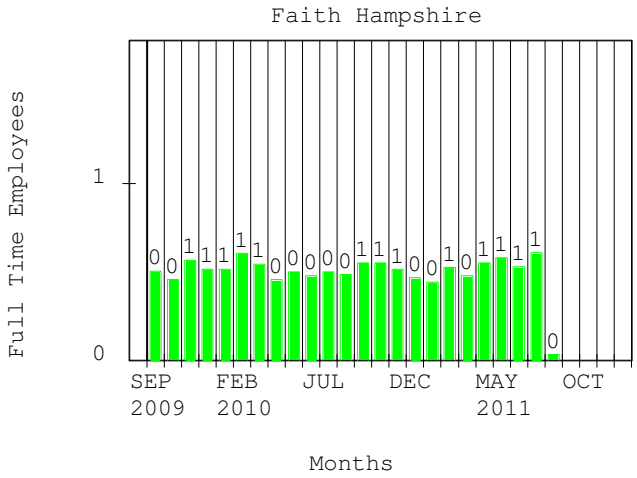
Figure 6. Example of Individual Staffing Plans

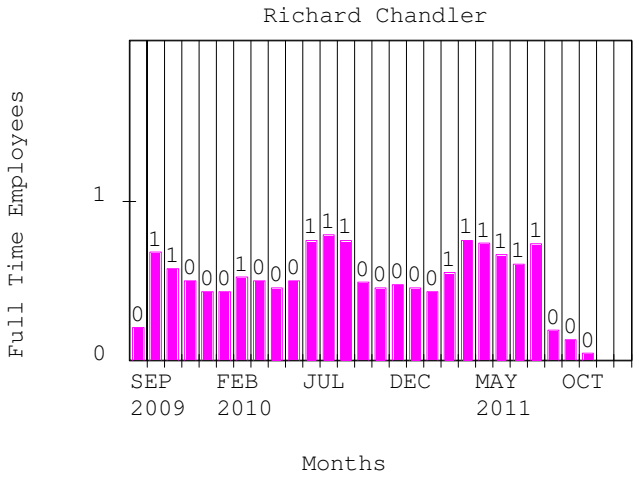
The example shown in Figure 6 demonstrates how the individual staffing plans will be used. Some work activities assigned to the 1st employee will be reassigned to the 2nd employee for the months of August and then again in December, January and February. The team will review opportunities to accelerate some of the work planned for December into the late fall months. Example individual staffing charts are provided in Figures 7-11.

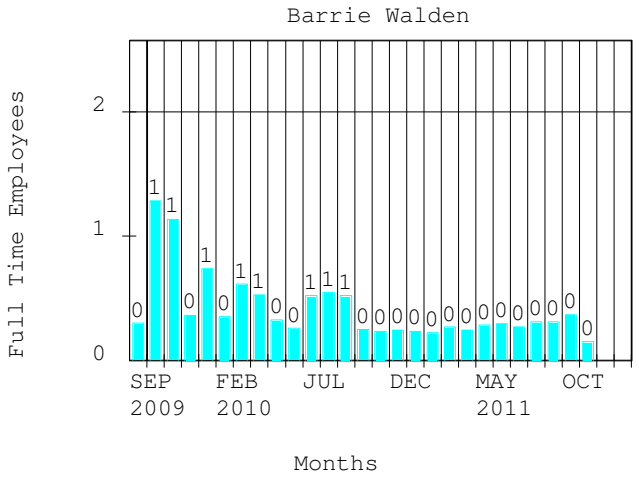

Susan Humphris
Full Time Employees
0
1
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months

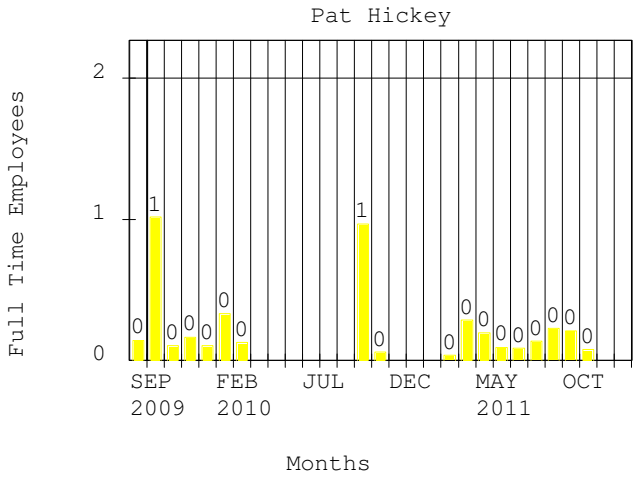

Steven Smith
Full Time Employees
0
1
2
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months

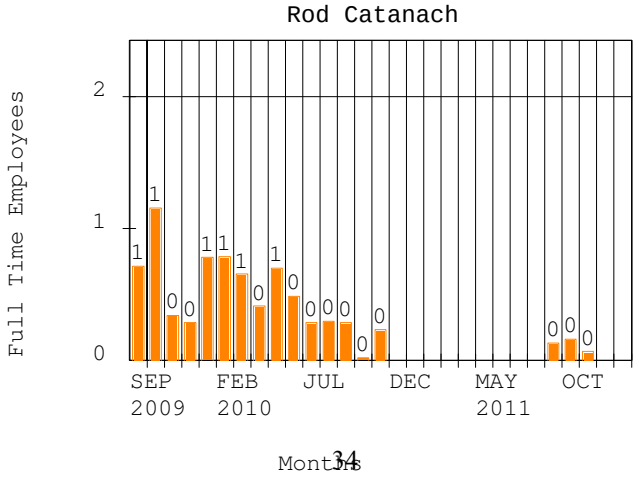

Anthony Tarantino
Full Time Employees
0
1
2
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


Faith Hampshire
Full Time Employees
0
1
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


Richard Chandler
Full Time Employees
0
1
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


Barrie Walden
Full Time Employees
0
1
2
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


Pat Hickey
Full Time Employees
0
1
2
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


Rod Catanach
Full Time Employees
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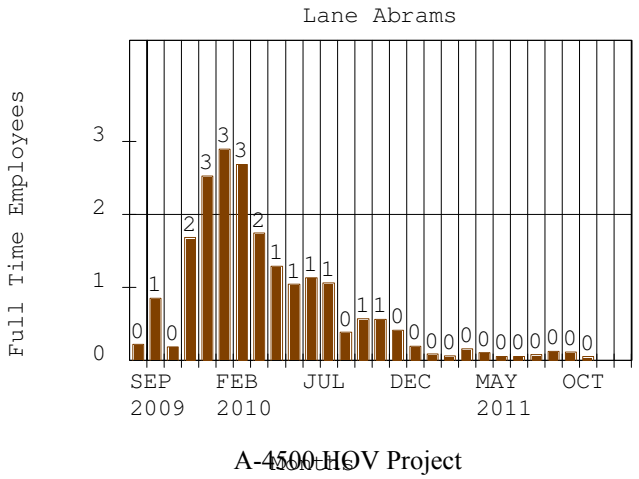
1
2
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


Lane Abrams
Full Time Employees
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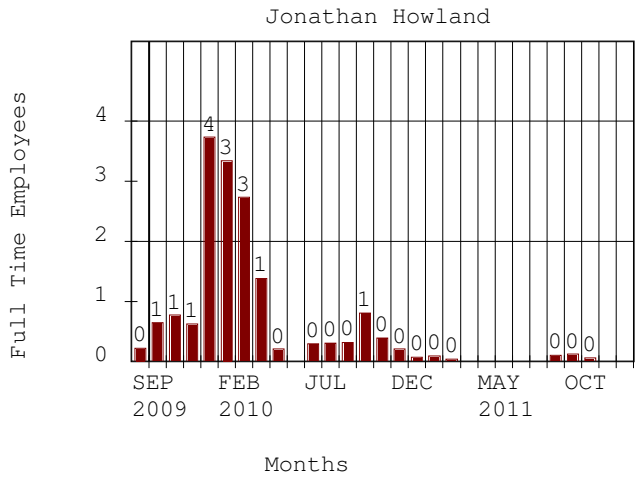
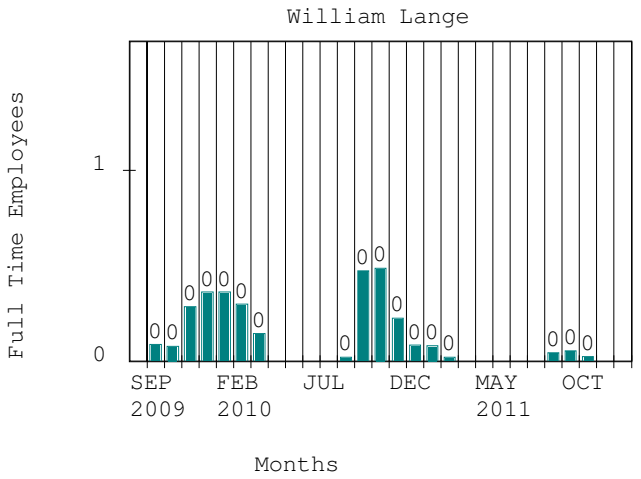
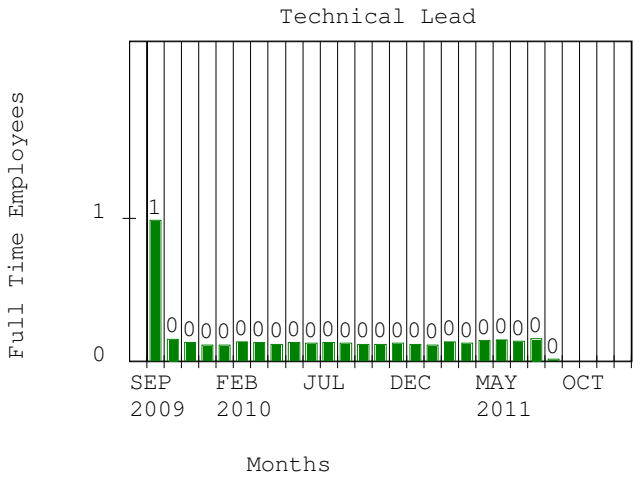
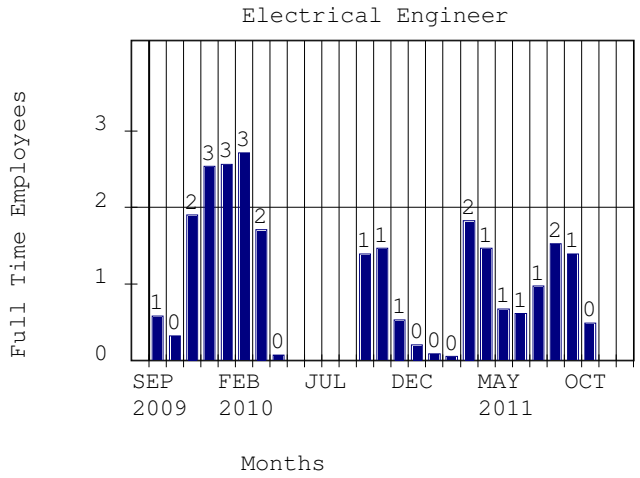
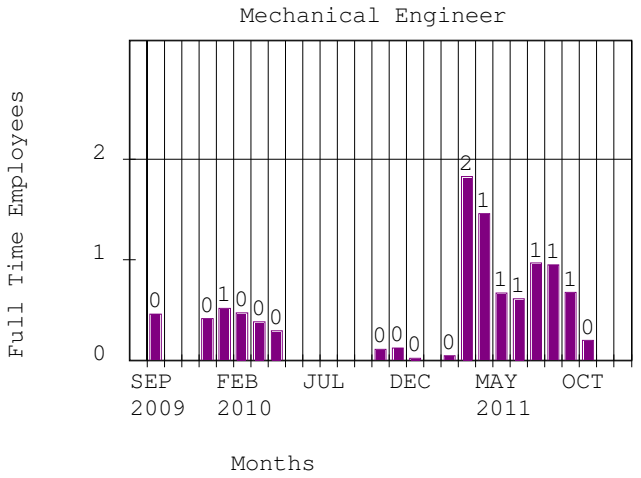
2
3
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months

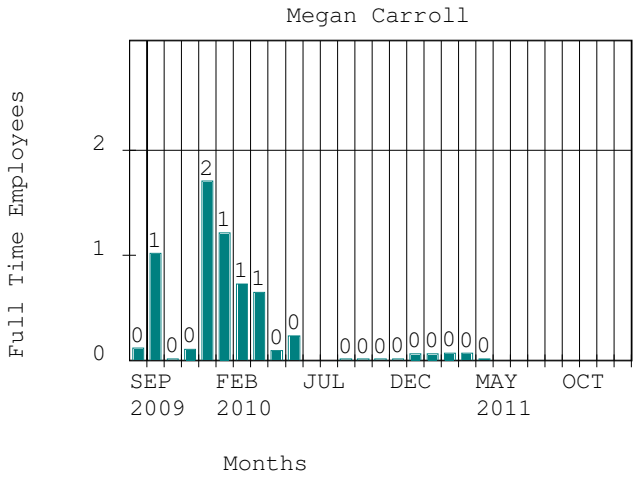

Jonathan Howland
Full Time Employees
Months
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT


William Lange
Full Time Employees
Months
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT


Technical Lead
Full Time Employees
Months
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT


Electrical Engineer
Full Time Employees
Months
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT


Mechanical Engineer
Full Time Employees
Months
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT


Megan Carroll
Full Time Employees
Months
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FEB 2010
JUL
DEC
MAY 2011
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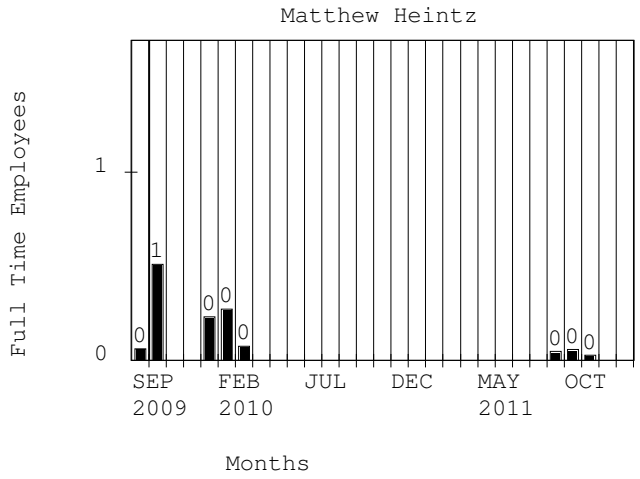
Matthew Heintz
Full Time Employees
Months
SEP 2009
FEB 2010
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DEC
MAY 2011
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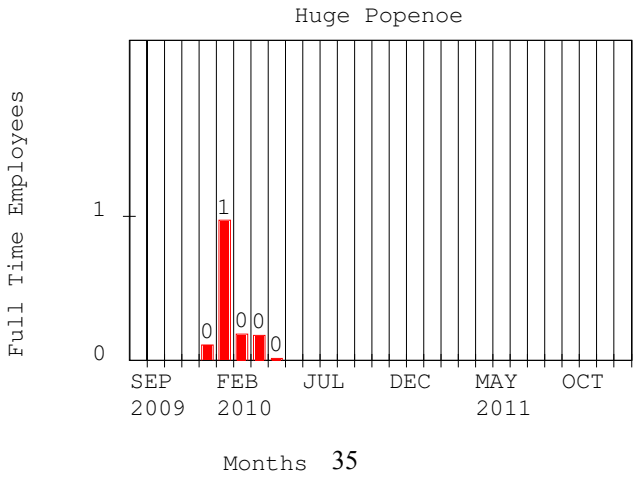
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Full Time Employees
Months
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FEB 2010
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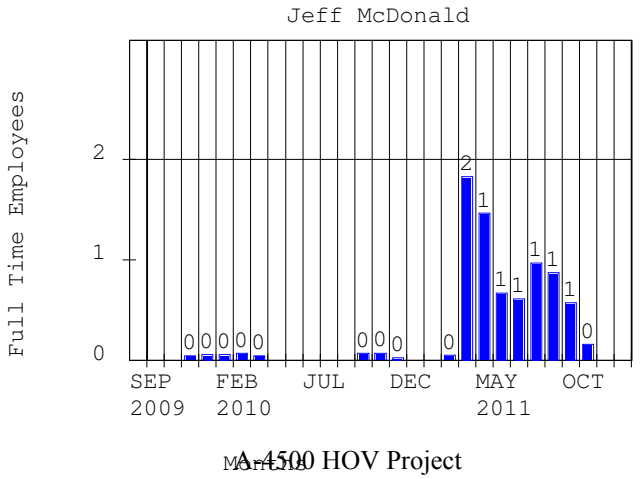
Jeff McDonald
Full Time Employees
Months
SEP 2009
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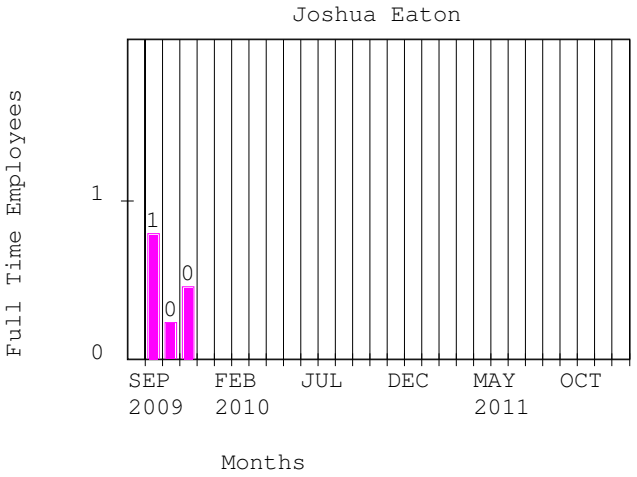
DEC
MAY 2011
OCT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Full Time Employees
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DEC
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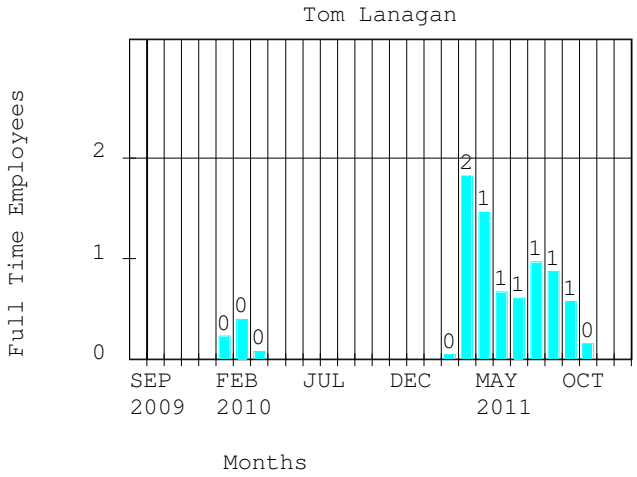
OCT
Months


Tom Lanagan
Full Time Employees
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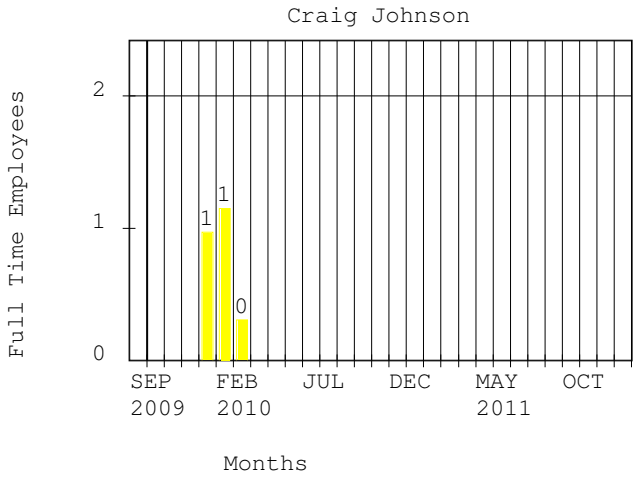
Months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Full Time Employees
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MAY 2011
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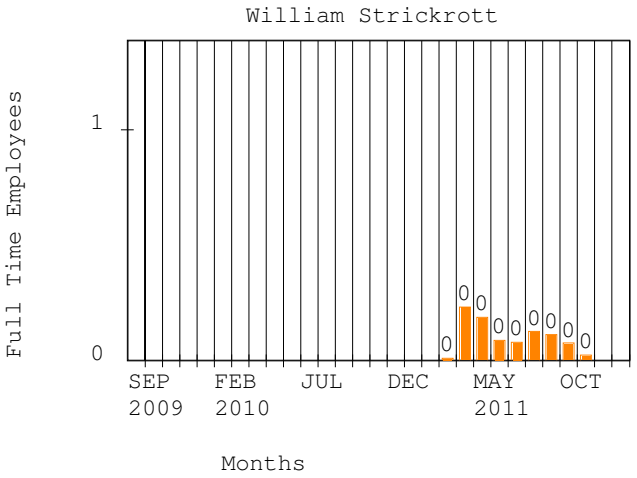
Months


William Strickrott
Full Time Employees
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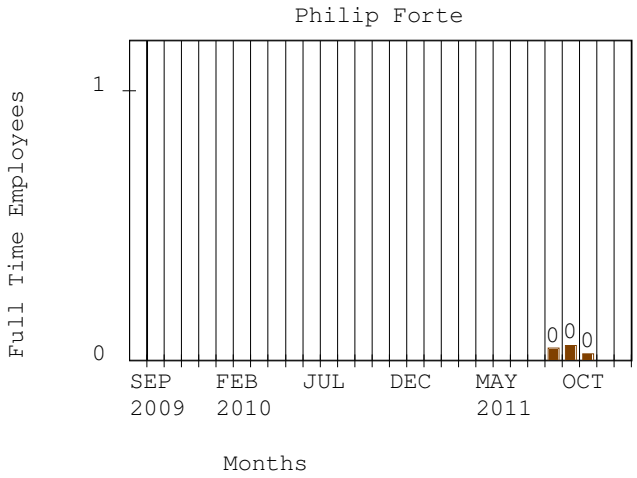
Months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Full Time Employees
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DEC
MAY 2011
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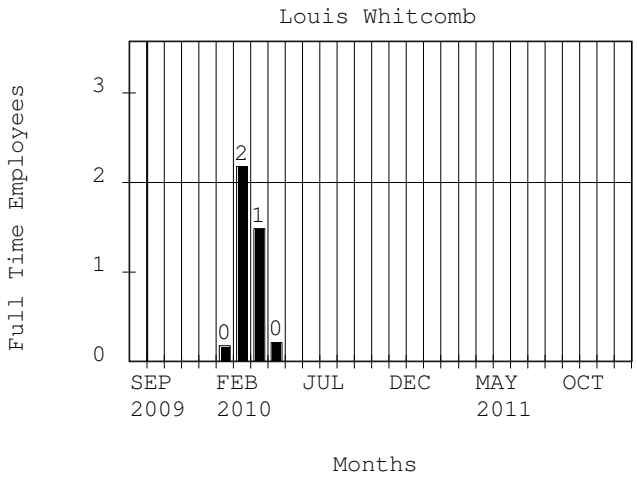
Months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Full Time Employees
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FEB 2010
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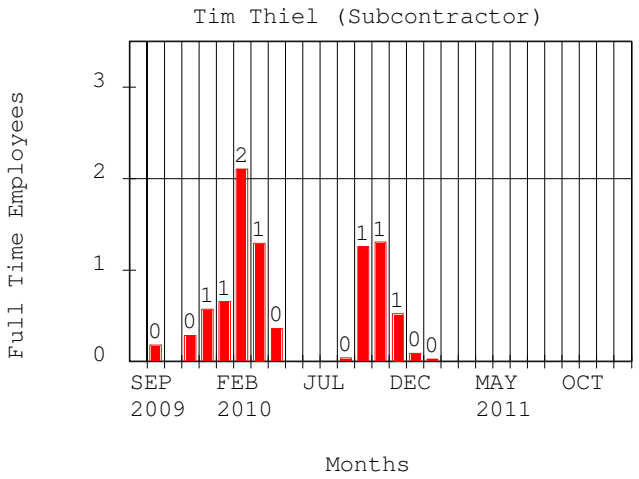
DEC
MAY 2011
OCT
Months


Tim Thiel (Subcontractor)
Full Time Employees
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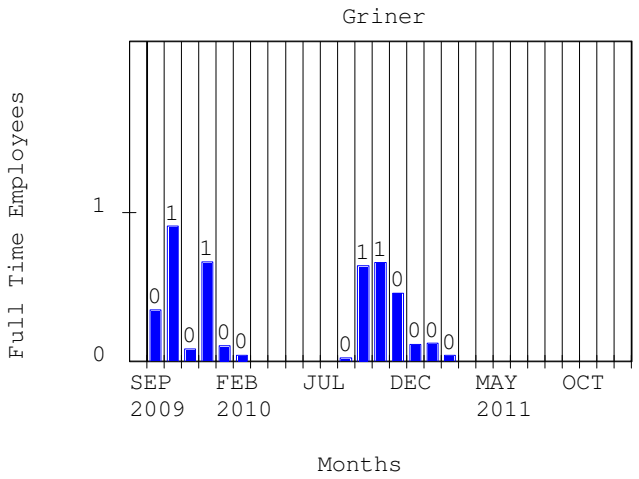
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


Griner
Full Time Employees
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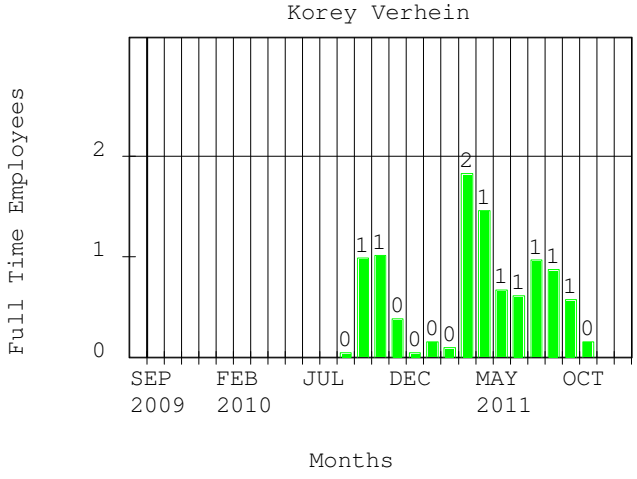
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


Korey Verhein
Full Time Employees
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1
2
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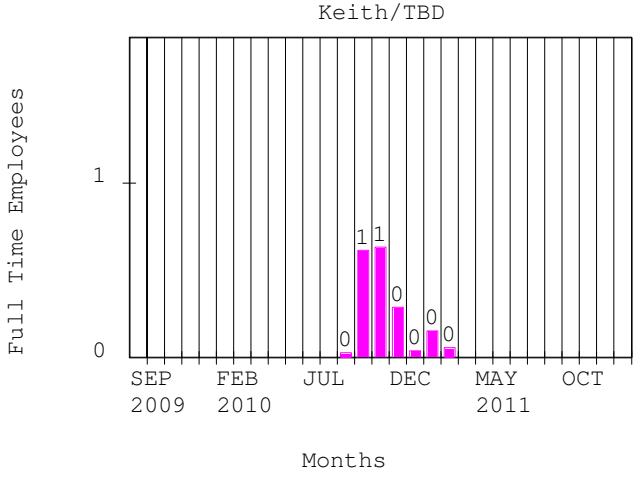
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


Keith/TBD
Full Time Employees
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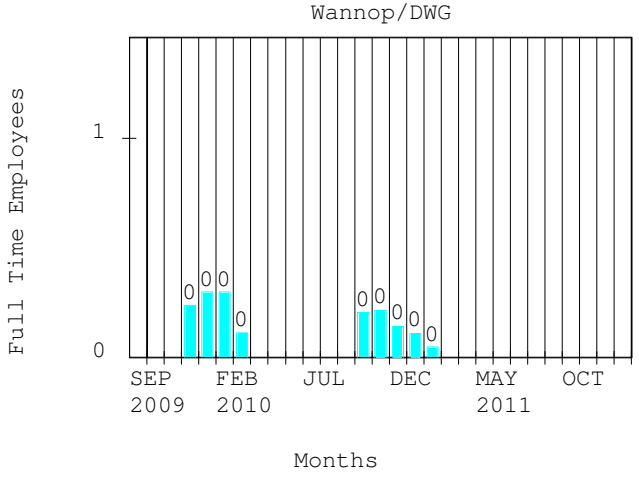
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


Wannop/DWG
Full Time Employees
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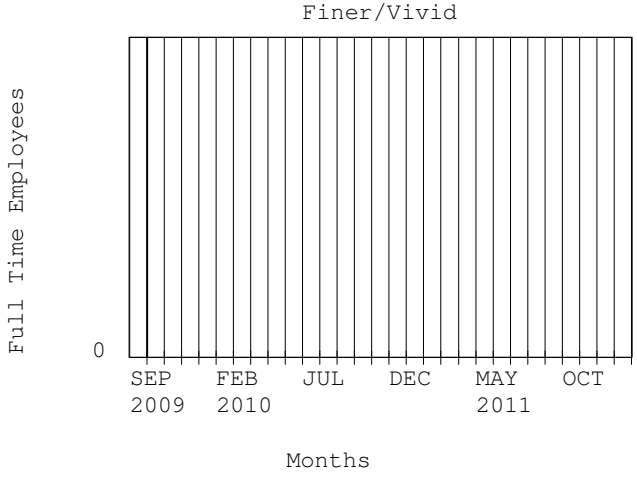
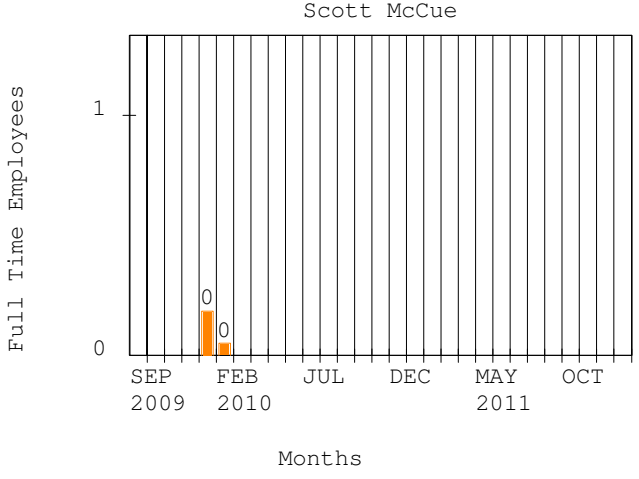
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


Finer/Vivid
Full Time Employees
0
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


Scott McCue
Full Time Employees
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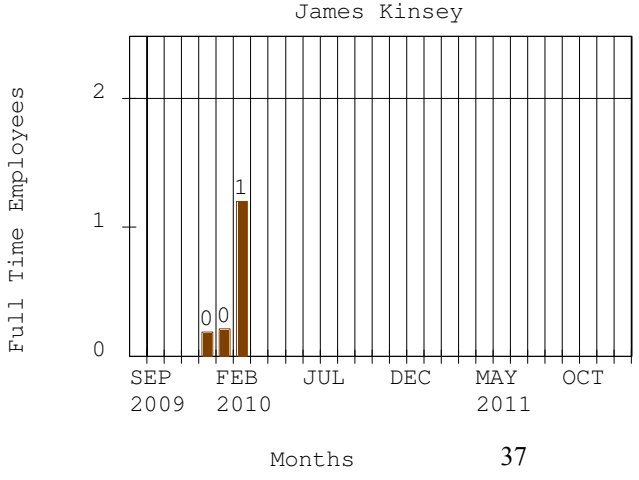
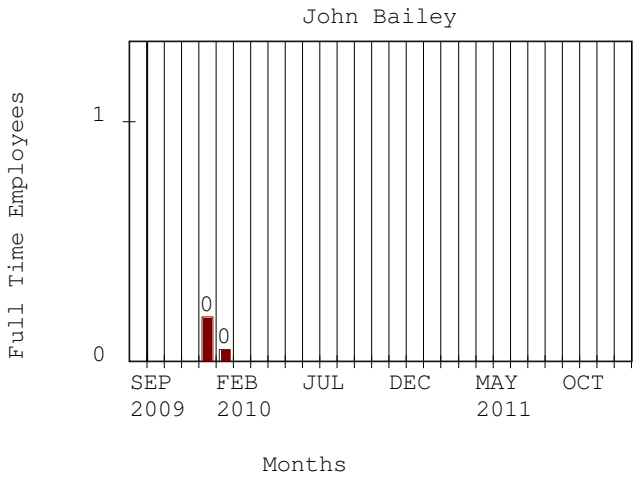
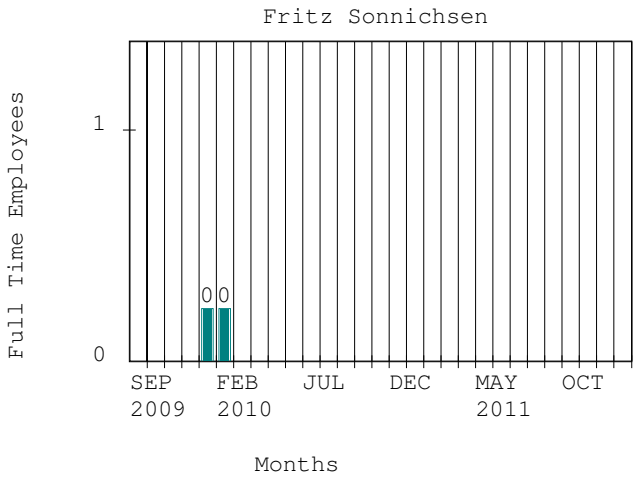
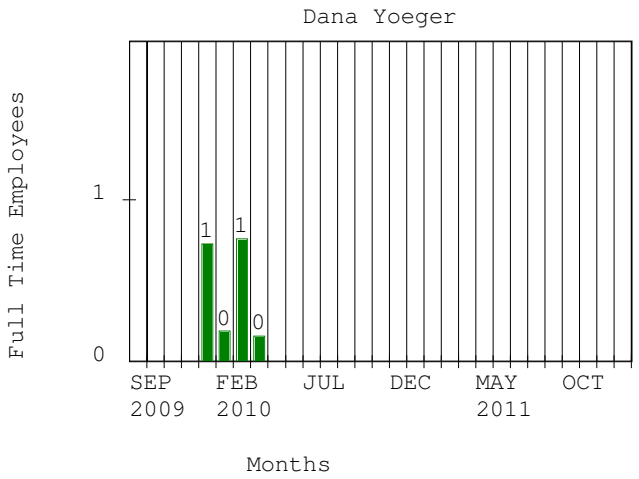
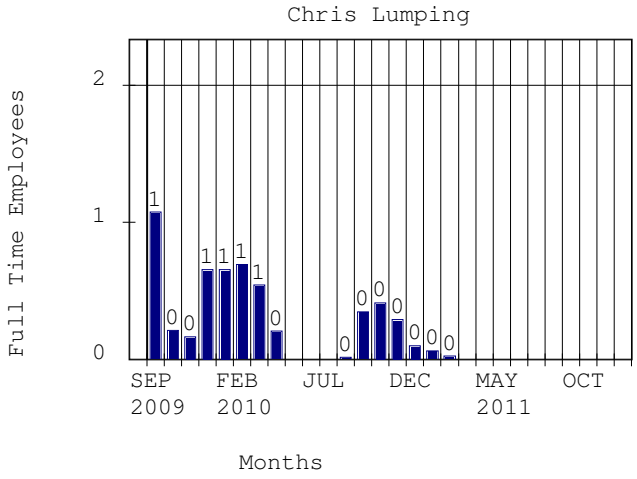
1
0 0
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


James Kinsey
Full Time Employees
0
1
2
0 0 1
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


John Bailey
Full Time Employees
1
0
0 0
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


Fritz Sonnichsen
Full Time Employees
1
0
0 0
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


Dana Yoeger
Full Time Employees
1
0
1 0 1 0
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


Chris Lumping
Full Time Employees
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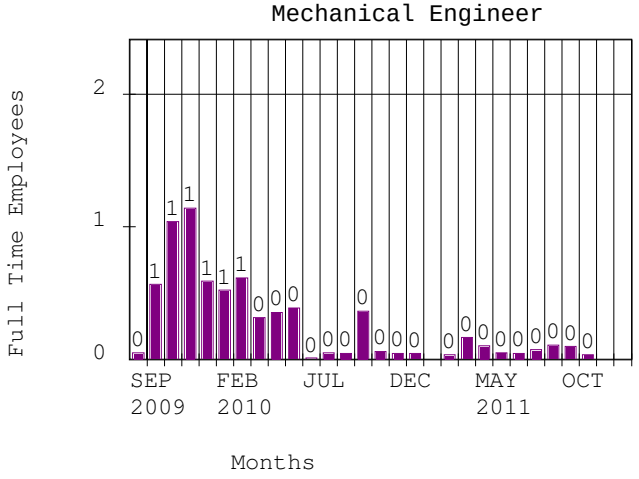
1
0
1 0 1 1 1 1 0 0 0 0 0 0 0
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


Mechanical Engineer
Full Time Employees
2
1
0
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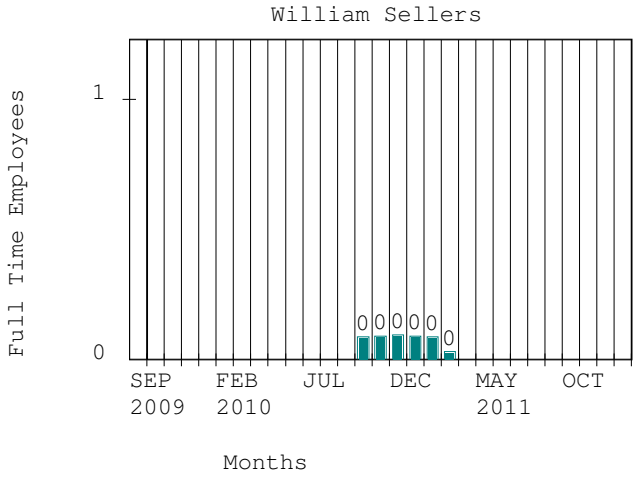
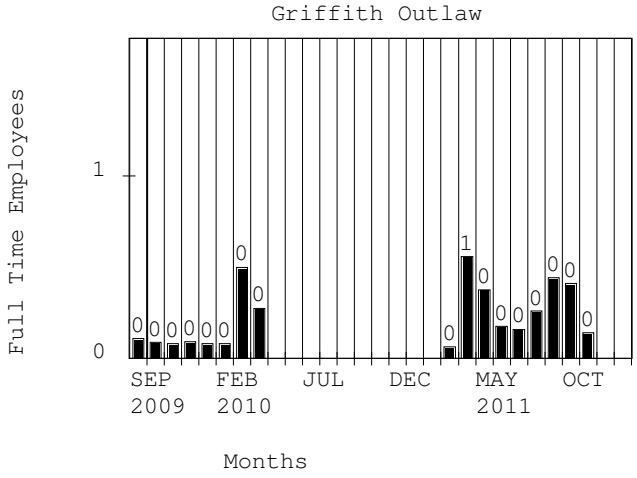
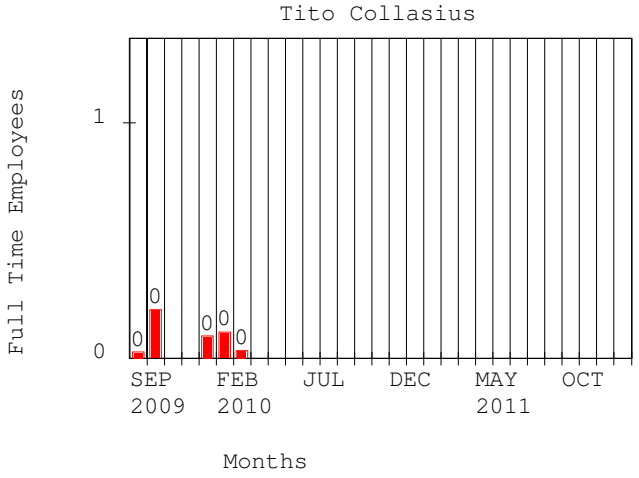
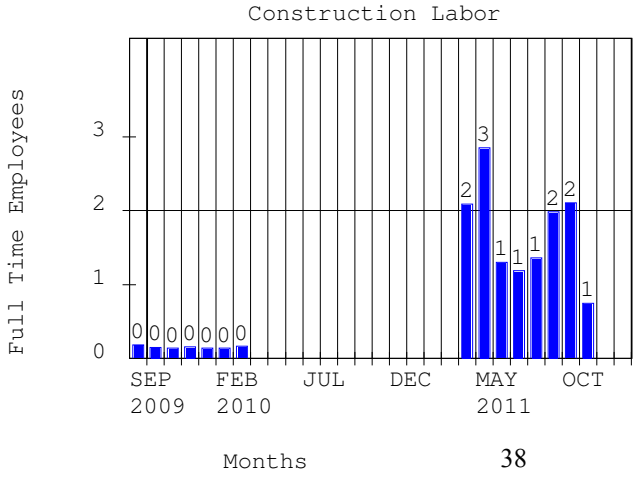
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


William Sellers
Full Time Employees
1
0
0 0 0 0 0 0
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


Griffith Outlaw
Full Time Employees
1
0
0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


Tito Collasius
Full Time Employees
1
0
0 0 0 0
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months


Construction Labor
Full Time Employees
3
2
1
0
0 0 0 0 0 0 0 2 3 1 1 1 2 2 1
SEP 2009
FEB 2010
JUL
DEC
MAY 2011
OCT
Months

6.0 Scheduled Values for Earned Value Management System

The scheduled value assigned to each activity is shown in Table 6. Activities that do not have a scheduled value have been filtered out of this table. The activities listed are horizontally traceable to the cost estimating worksheets. These values are the basis for earned value within the WBS

Table 6. Scheduled Value for Each Activity

Activity ID	Activity Description	Scheduled Value
Project Management		
+ Historical Information		
		15,586,441.16
Project Management		
0099	Prepare Preliminary Design	126,955.88
0107	Project Management during Preliminary Design	140,427.92
0237	Project Management Final Plans	212,884.04
0110	Project Management during Final Design	670,238.72
1998	Prepare Final Design	132,032.52
0160	Project Management during Procure & Fabrication	693,407.26
0190	Project Management during Construction	412,126.92
0192	Project Management during Sea Trials	18,147.40
Classification/Certification		
0115	ABS Certification during Preliminary Design	28,800.00
0120	ABS Certification during Final Design	218,157.04
0170	ABS Certification during Procure & Fabrication	224,781.73
0200	ABS Certification during Construction	167,874.84
Vehicle A-4500		
A00 General Information		
5682	Design Monitoring Alarm Interface to Battery Sys	8,874.36
5690	Build/Test EE Prototype: Command Structure	22,345.88
5693	Build/Test EE Prototype: Controls	45,744.64
5695	Build/Test EE Prototype: Propulsion	20,628.16
5698	Develop Hydraulic Control Architecture	48,007.44
5735	Complete Electrical Schematics and Specs	46,744.42
A01 Sphere and Attachments		
7270	Determine External Tabs and Lug Placement	22,688.64
7320	Determine Internal Arrangements	112,686.16
7330	Buildup Internal Sphere Mockup	62,794.19
7280	Prepare Prel Design Documents: Sphere & Attach	12,793.80

Start Date 01SEP05
Finish Date 28DEC11
Data Date 01OCT09
Run Date 06NOV09 02:11

AL28 Sheet 1 of 8

Woods Hole Oceanographic Institution
6500m HOV Project
Section 6.1 Scheduled Values

Appendix A – Cost Estimating Worksheets

	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		

Project: New Alvin: Design and Fab (83340908) **Work Package:** 002-01 Project Management **Technical Lead:** Susan Humphries

Description: This work package includes all work required to generate, administer and implement project control functions and reporting tasks including risk mitigation, scheduling, budgeting, earned value management and reporting for the duration of the project. This includes work required to maintain (but not develop and write) project documents i.e.: Project Execution Plan, Configuration Management Plan, Risk Management Plan, Quality Assurance Plan, etc. This work package also includes all efforts required to plan organize, administer and attend project meetings including all regularly scheduled team meetings.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	LOE Driving Duration	Most Likely (Days)					Comments
0107	PD	Project Management during Preliminary Design	8	40					10/01/09 through 11/30/09
0110	FD	Project Management	35.4	177					12/01/09 through 08/12/10
0160	FAB	Project Management	35.8	179					08/13/10 through 05/02/11
0190	OV	Project Management	20	100					05/03/11 through 09/22/11
	ST	Project Management	0	0					PM and assistant PM for 2 mths
				0					
		Subtotal:	**99.2**						

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost		Pricing Assumptions
labor	EE	Project Manager	99.2	3633.3	HR	$ 150.00	$ 544,995.00		full time 8 hrs per day each acty + 2 mths for sea trials
labor	EE	Susan Humphris	99.2	892.8	HR				assume 2 hrs per day each Acty
labor	EE	Anthony P. Tarantino	99.2	3633.426	HR				full time 8 hrs per day each acty + 2 mths for sea trials
labor	EE	Richard S. Chandler	99.2	1785.6	HR				assume 4 hrs per day each Acty
labor	EE	K. Faith Hampshire	99.2	1785.6	HR				assume 4 hrs per day each Acty
labor	EE	Barrie B. Walden	99.2	892.8	HR				assume 2 hrs per day each Acty
labor	EE	Tech Lead	99.2	446.4	HR				assume 1 hr per week for 5 people to attend team meetings
		Subtotal Labor:		**13,070**			**$ 1,733,326.91**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
travel - dom	EE	ARHOC meetings in DC		12	trip(s)	$ 1,500.00	$ 18,000.00		(2) people quarterly for 2 years
travel - dom	EE	DeSSC meeting in San Francisco		4	trip(s)	$ 1,500.00	$ 6,000.00		(2) people quarterly for 2 years
comm	EE	teleconferences		2	year(s)	$ 1,000.00	$ 2,000.00		
outside sv	EE	RHOC		1	LS	$ 81,057.00	$ 81,057.00		see attached
							$ -		
							$ -		
		Subtotal Expense:		19			$ 107,057.00		
						Total:	**$ 1,840,383.91**		

Notes: Assumes that atttendence by the tech leads (Don, Jon, Lane, Bill and Bob) are covered under project management. Other attendees are covered under the technical budgets. Pat, Chris and Andy are covered under their respective operations budget.

Project: New Alvin: Design and Fab (83340908) **Work Package:** 022-02 Project Management Plans (Option A,B,D) **Technical Lead:** Susan Humphries

Description: This work package includes activities to prepare and review project management plans. Activities include the draft and final for (9) PM plans for the Project Execution Plan, Vehicle Design Plan, Project Management Plan, Risk Management Plan, Contingency Management Plan, Acquisition Plan, Quality Control/Assurance Plan, Environmental Health and Safety Pan, and Transition to Operations Plan.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)					Comments
0236	PD	Prepare Draft Plans	0	0					includes: PEP, Vehicle Design, PMP, risk management plan, contingency plan, acquisition plan, QC/QA Plan, H&S plan, transition plan - COMPLETE
0237	PD	Prepare Final Plans	7	70					includes: PEP, Vehicle Design, PMP, risk management plan, contingency plan, acquisition plan, QC/QA Plan, H&S plan, transition plan
				0					
		Subtotal:	**7**						

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost		Pricing Assumptions
labor	EE	Tech Lead	4	144	HR				
labor	EE	Susan Humphris	2	72	HR				
labor	EE	Barrie B. Walden	1	36	HR				
				0	HR				
				0	HR				
		Subtotal Labor:		**252**			**$ 39,884.04**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
consulting sv	VQ	John Leadmon		1	LS	$ 91,000.00	$ 91,000.00		for 10/01/09-02/28/10
consulting sv	VQ	Scheduling Solutions		1	LS	$ 82,000.00	$ 82,000.00		for 10/01/09-12/09/09
							$ -		
							$ -		
		Subtotal Expense:		**2**			**$ 173,000.00**		
						Total:	**$ 212,884.04**		

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** 002-03 Preliminary Design Report (Option A,B,D) **Technical Lead:** Susan Humphries

Description: This work package is to prepare and review documents presentations and data for the Preliminary Design Review. Activities include engineering reviews, preparation of presentations, dry run sessions and revisions with the internal and external advisory boards.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)					Comments
0561	PD	Engineering Review	0.1	1					
0571	PD	Engineering Review Report	0.5	5					
0103	PD	Presentation preparation	1	10					
0104, 0108, 0122	PD	RR Dry Run sessions	0.6	6					(3) Team, internal & readiness review
0132	PD	PDR Presentation preparation	1	10					
0133, 0136	PD	PDR Dry Run sessions	0.6	6					
				0					
				0					
		Subtotal:	**3.8**						

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost		Pricing Assumptions
labor	EE	Susan Humphris	3.8	136.8	HR				
labor	EE	Richard S. Chandler	3.8	136.8	HR				
labor	EE	Barrie B. Walden	3.8	136.8	HR				
labor	EE	Jonathan C. Howland	3.8	136.8	HR				
labor	EE	Lane J. Abrams	3.8	136.8	HR				
labor	EE	Donald B. Peters	3.8	136.8	HR				
				0	HR				
				0	HR				
		Subtotal Labor:		**821**			**$ 126,955.87**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
							$ -		
							$ -		
							$ -		
		Subtotal Expense:		**0**			**$ -**		
						Total:	**$ 126,955.87**		

Notes: Team participants include: Susan, Barrie, Anthony, Don, Jon, and Lane. Participation by Andy and Pat is covered under their respective operations budgets. Assumes technical plans, specs, drawings are paid for under each disapline's preliminary design activities.

Project: New Alvin: Design and Fab (83340908) **Work Package:** 002-04 Final Design Report (Option A,B,D) **Technical Lead:** Susan Humphries

Description: This work package is to prepare and review documents presentations and data for the Final Design Review. Activities include engineering reviews, preparation of presentations, dry run sessions and revisions with the internal and external advisory boards.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)					Comments
0561	FD	Engineering Review	0.1	1					
0571	FD	Engineering Review Report	0.5	5					
0103	FD	Presentation preparation	1	10					
0104, 0108, 0122	FD	RR Dry Run sessions	0.6	6					(3) Team, internal & readiness review
0132	FD	PDR Presentation preparation	1	10					
0133, 0136	FD	PDR Dry Run sessions	0.6	6					
				0					
				0					
		Subtotal:	**3.8**						

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost		Pricing Assumptions
labor	EE	Susan Humphris	3.8	136.8	HR				
labor	EE	Richard S. Chandler	3.8	136.8	HR				
labor	EE	Barrie B. Walden	3.8	136.8	HR				
labor	EE	Jonathan C. Howland	3.8	136.8	HR				
labor	EE	Lane J. Abrams	3.8	136.8	HR				
labor	EE	Donald B. Peters	3.8	136.8	HR				
				0	HR				
				0	HR				
		Subtotal Labor:		**821**			**$ 126,955.87**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
							$ -		
							$ -		
							$ -		
		Subtotal Expense:		**0**			**$ -**		
						Total:	**$ 126,955.87**		

Notes: Team participants include: Susan, Barrie, Anthony, Don, Jon, and Lane. Participation by Andy and Pat is covered under their respective operations budgets. Assumes technical plans, specs, drawings are paid for under each disapline's final design activities.

Project: New Alvin: Design and Fab (83340908) **Work Package:** 003 ABS Certification (Option A,B,D) **Technical Lead:** Anthony P. Tarantino

Description: This work package includes all work required to support vehicle classification during the preliminary design, final design, procurement & overhaul phases of the project. This includes meetings with ABS and effort required to generate all reports and information required by the ABS Classification Plan including all drafts and final submissions. This task includes any billing by ABS engineering and surveying groups and any WHOI labor required to Classify the vehicle.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)					Comments	
0125	PD	Draft/Final ABS Certification Plan		40					ABS Approval needed by: 1 May 2010	A,B,D
0140	FD	Draft/Final Existing Equip Group		40					ABS Approval needed by: 1 Sep 10	
9000	FD	Draft/Final General Group		40					ABS Approval needed by: 1 Sep 10	
9040	FD	Draft/Final Mech Equip Group		40					ABS Approval needed by: 1 March 10	
9080	FD	Draft/Final Pressure Vessel Group, Power Bottle		40					ABS Approval needed by: 1 Sep 10	
?	FD	Draft/Final Pressure Vessel Group, Data Bottle		40					ABS Approval needed by: 1 Sep 10	
?	FD	Draft/Final Pressure Vessel Group, Motor Control Bottle		40					ABS Approval needed by: 1 Sep 10	
?	FD	Draft/Final Pressure Vessel Group, Implodable Volumes		40					ABS Approval needed by: 1 Sep 10	
9120	FD	Draft/Final Ballast Group, Variable Ballast System		40					ABS Approval needed by: 1 March 10	
9120	FD	Draft/Final Ballast Group, Main Balast System		40					ABS Approval needed by: 1 March 10	
9120	FD	Draft/Final Ballast Group, Syntactic Foam		40					ABS Approval needed by: 1 March 10	
9160	FD	Draft/Final Elec Installation Group		40					ABS Approval needed by: 1 March 10	
9200	FD	Draft/Final Emergency Sys Group		40					ABS Approval needed by: 1 Sep 10	
9320	FD	Draft/Final Life Support Group		40					ABS Approval needed by: 1 Sep 10	
9360	FD	Draft/Final Procedure & Test Group		40					ABS Approval needed by: 1 Sep 10	
9400	FD	Draft/Final Manuals Group		120					ABS Approval needed by: 1 Sep 10	
				0						
		Subtotal:	**0**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost		Pricing Assumptions
labor	EE	Systems Engineer	446.4	3571.2	HR	$ 100.00	$ 357,120.00		8 hr/day
				0	HR		$ -		
		Subtotal Labor:		**3,571**			**$ 357,120.00**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
subcontracts	EE	ABS Certification Agency		1	LS	$ 200,000.00	$ 200,000.00		from LM estimate
subcontracts	EE	Gloston		1	LS	$ 50,000.00	$ 50,000.00		reduce with addition of system engineer
		Subtotal Expense:		**2**			**$ 250,000.00**		
						Total:	**$ 607,120.00**		

Notes: Compiling data, writing report, submitting it and resolving issues (submittal process with ABS).

Work **Technical**

Project: New Alvin: Design and Fab (83340908) **Package:** A00 General Info/System Engineering(Option B) **Lead:** Lane J. Abrams

Description: This work package includes all electrical engineering, planning, prototyping and documentation required to generate a top level electrical system design. This WP effort covers design and build of the pilots joystick, control hardware, submarine specific controls and any testing and analysis required to develop a system architecture including data, high and low power distribution system with circuit protection analysis and component selection. This WP includes all efforts required to maintain instrument list, I/O list, wire list, cable and connector list and vehicle wiring schematic and design of ground and leak detection systems, emergency power plan and junction box allocation. The work package includes work required to generate ABS support documentation to be included in ABS classification submission. This will include any procurement costs and fabrication effort required to build and test all components of functional system and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	LOE Driving Duration	Duration (Days)					Comments	
5670	PD	Develop Prelim Elec Architecture	0	0					Minor feature changes. (COMPLETE)	A
5670	PD	Develop Prelim Elec Architecture	0	50					Minor feature changes. (COMPLETE)	B, C, D
5697	PD	Propulsion Control Architecture	0	10					COMPLETE	B, C, D
5730	PD	Complete Elec Architecture	0	1					COMPLETE	B, C, D
5682	FD	Monitoring Alarm Interface	0.5	5						B, C, D
5690	FD	Prototype Command Structure	4	40					Smooth interface development	B, C, D
5693	FD	Prototype Controls	4	40					Smooth interface development	B, C, D
5695	FD	Prototype Propulsion	1	10					In-shop. 1 week remaining effort	B, C, D
5698	FD	Hydraulic control Architecture	4	40						B, C, D
5735	FD	Complete Schematics & Specs	9	90						A
7285	FD	Weight & Balance	0	0						A
				0						
		Subtotal:	**22.5**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost		Pricing Assumptions	
labor	EE	Lane J. Abrams	23.6	849.6	HR					
labor	EE	Tom Lanagan	3	108	HR			5693		
labor	EE	Joshua A. Eaton	2	72	HR			5682		
labor	EE	Donald B. Peters	5	180	HR			7285		
				0	HR					
		Subtotal Labor:		**1,210**			**$ 150,837.55**			
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.										
Supplies	EE	Misc. Prototyping Bits		2	EA	$ 2,000.00	$ 4,000.00	5693		B
Supplies	HD	Misc. Prototyping Bits		0	EA	$ 5,000.00	$ -	5690	(2) at $5,000 - already purchased	B
Subcontracts	EE	Louis Whitcomb	160		HR	$ 144.05	$ 23,048.00	5697	Subcontractor @ 4 man wks	B
Repair	EE	Pressure Tests		0	ea	$ 1,200.00	$ -			A
							$ -			
		Subtotal Expense:	**160**	**2**			**$ 27,048.00**			
						Total:	**$ 177,885.55**			

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** A02 Sphere & Attachment (Options A,B,D) **Technic** Donald B. Peters

Description: This work package includes all engineering, planning, prototyping and documentation required to support the SwRI sphere fabrication process including all interface and integration required to generate an interface document indicating size and placement of external lugs and hull to frame attachment points on the personnel sphere. This budget includes SwRI sphere costs and all outside services required to support the project.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)					Comments	
7270	PD	Determine External Tabs & Lug Placement	4	40						A,B,D
7280	PD	Prepare Preliminary Design Documentation	1	10					assume work for PDR is complete	A,B,D
7290	PD	Compile Mech PDR Documents	1	10						A,B,D
1002	FD	Prepare Final Design Documentation	1	20						A,B,D
5410	FAB	Construct Sphere	0	316						A,B,D
5447	FAB	Procure Attachments for Sphere	1	10						A,B,D
5440	FAB	Install Penetrator and Test Sphere	1	84						A,B,D
5470	FAB	Complete & Deliver Hull	0	54						A,B,D
				0						
		Subtotal:	**9**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	ACTY ID	Pricing Assumptions
labor	EE	Donald B. Peters	9	324	HR				
labor	EE	Megan M. Carroll	3	108	HR			7280, 1002	2 wk = 80/1wk=40
				0	HR				
				0	HR				
				0	HR				
				0	HR				
		Subtotal Labor:		**432**			**$ 63,414.36**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
Subcontracts	HD	SwRI		0	EA	$ 6,762,041.21	$ -		$6,672,041 actual cost as of 09/30/09
Subcontracts	VQ	SwRI		1	EA	$ 1,536,958.79	$ 1,536,958.79		Balance of current contract
Subcontracts	EE	SwRI		1	EA	$ 1,287,779.00	$ 1,287,779.00		Vendor Provided Estimate
Subcontracts	HD	Perot Systems		0	LS	$ 567,527.00	$ -		$567,527 actual cost as of 09/30/09
Subcontracts	VQ	Perot Systems		1	LS		$ -		
Subcontracts	EE	Perot Systems		1	LS	$ 198,874.76	$ 198,874.76		Vendor Provided Estimate
Subcontracts	VQ	Control Solution: Ed Slate		1	EA	$ 9,450.00	$ 9,450.00		
travel -dom	EE	Trip to Hydro Test Facility		1	EA	$ 3,000.00	$ 3,000.00		San Antonio, TX
							$ -		
		Subtotal Expense:		**6**			**$ 3,036,062.55**		
						Total:	**$ 3,099,476.91**		

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** A02-03 Penetrators (Option B and D) **Technical Lead:** Barrie B. Walden

Description: This work package includes all engineering, planning, and documentation required to develop a purchase specification and define a final test procedure for verification of production units. The WP included vendor site visits, procurement of vendor quotations and selection of a penetrator vendor. This WP includes procurement of prototype copper and fiber penetrators and production units and effort to complete final testing to be performed by WHOI.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)					Comments	
1090	FD	Prepare Final Design and Specs	4.9	49					Includes ABS Comments	A,B,D
1160	FAB	Issue Purchase Order	1	10						A,B,D
1170	FAB	Vendor Evaluate Penetrators	0	20						A,B,D
1180	FAB	Vendor Manufacture Penetrator	0	88						A,B,D
	FAB	Testing NRE	1	10						
	FAB	Testing Fiber	0.5	5						
	FAB	Testing Copper	1.5	15						
				0						
		Subtotal:	**8.9**					**0**		

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions	
labor	EE	Barrie B. Walden	3	108	HR					
labor	EE	Lane J. Abrams	1.4	50.4	HR			1090, NRE		
labor	EE	Joshua A. Eaton	4.5	162	HR			Fiber, Copper		
				0	HR		$ -			
				0	HR		$ -			
				0	HR		$ -			
		Subtotal Labor:		**320**			**$ 41,267.27**			
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.										
supplies	VQ	copper base, 1st article		1	EA	$ 16,887.00	$ 16,887.00		Kemlon	A
supplies	VQ	fiber base, 1st article		1	EA	$ 23,236.00	$ 23,236.00		Lancer	A
supplies	VQ	copper base		18	EA	$ 8,231.95	$ 148,175.10		Kemlon assumes (14) with (4) spare	B,D
supplies	VQ	fiber base		5	EA	$ 12,600.00	$ 63,000.00		Lancer (2) installed with (3) spare	B,D
supplies	EE	end caps		23	EA	$ 500.00	$ 11,500.00			B,D
supplies	VQ	SwRi		1	LS	$ 11,889.00	$ 11,889.00		Penetrator Housing Structural Analysis	B,D
		Subtotal Expense:		**49**			**$ 274,687.10**			
						Total:	**$ 315,954.37**			

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** A02-06 Internal Arrangements (Options A,B,D) **Technical Lead:** Barrie B. Walden

Description: This work package includes all engineering, planning, prototyping and documentation required to design an ergonomically correct internal arrangement. This includes all LM contract services and any WHOI costs required to generate internal mock-ups of sphere internal hardware and components. Also included are WHOI maintenance of a master equipment list (MEL), switch list and panel list and all efforts needed to generate an interface document for SwRI indicating the placement of personnel sphere mounting studs that are needed to attach internal structure. This will include all WHOI procurement costs and fabrication effort required to build and test the mock-up and actual birdcage and internal arrangement components and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)					Comments	
7320	PD	Evaluate LM CAD Designs	5	50					Work with LM expert to incorporate initial designs, provide feedback and make changes based on feedback	A,B,D
7330	PD	Construct Mock-up Components	14	140					Construct initial mockup layout design and modify based on LM and science user input to final configuration	A,B,D
1050	FD	Provide Feedback	3	30						A,B,D
3100	FAB	Procure Internal Arrangement	1	10					Procure final internal arrangement material and provide construction oversight	A,B,D
3100	FAB	Fabricate Internal Arrangement	6	60					Fabricate final 6500m hull internal arrangement	A,B,D
				0						
		Subtotal:	**29**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Barrie B. Walden	2	72	HR				Technical Lead
labor	EE	Griffith Outlaw	6	216	HR				WHOI mockup modeling in conjunction with LM, mockup build assistance
labor	EE	J. Pat Hickey	8	288	HR				Primary interaction with LM ergonomics expert, initial mockup build
labor	EE	Rodney M. Catanach	3	108	HR				Construction lead for 6500M hull build
labor	EE	Donald B. Peters	2	72	HR				Structural evaluation of internal tab locations working in conjunction with SWRI
labor	EE	ALOPS	5	180	HR				Construction lead for 6500M hull build
		Subtotal Labor:		**936**			**$ 119,136.24**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
Supplies	HD	Internal parts - design & fabrication		0	LS	$ 14,090.00	$ -		Lockheed Martin design $181,315 (PO# D100126-0001 00122-001)
Supplies	VQ	Internal parts - design & fabrication		1	LS	$ 107,014.00	$ 107,014.00		Remainder of Lockheed Martin design $181,315
repair	EE	WHOI machine shop		240	hrs	$ 55.00	$ 13,200.00		
Supplies	EE	materials		1	ea	$ 10,000.00	$ 10,000.00		aluminum, angles, plastic, cushions
stockroom	EE	stock room		1	ea	$ 2,000.00	$ 2,000.00		
							$ -		
							$ -		
		Subtotal Expense:		**243**			**$ 132,214.00**		
						Total:	**$ 251,350.24**		

Notes: This design work includes 2 complete bird cages, benches and racks for the sphere mockup and 6500M hull. Internal components such as panels, wiring harnesses, life support equipment, video and navigation systems, computer systems etc will be fit to the mockup and transfered to the 6500M hull during construction. The mockup will be stored and utilized during future maintenance overhaul periods follow construction.

Project: New Alvin: Design and Fab (83340908) **Work Package:** A02-06E Internal Arrangements (Option B,D) **Technical Lead:** Lane J. Abrams

Description: This work package includes all engineering, planning, prototyping and documentation required to design internal panels, penetrator enclosures and wiring harness. This will include all WHOI procurement costs and fabrication effort required to build and test components and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	LOE Driving Duration	Most Likely (Days)					Comments	
1057	FD	Prepare Panel Schematic	4	40						A,B,D
1058	FD	Design Panels	4	40						A,B,D
1059	FD	Design Penetrator Enclosure	1	10						A,B,D
0162	FAB	Procure/Fabricate Wire Harness	3	30						A,B,D
				0						
		Subtotal:	**12**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Lane J. Abrams	4	144	HR				
labor	EE	Mechanical Engineer	4	144	HR				estimate 6 panels @ 3 days each
labor	EE	Mechanical Engineer	1	36	HR				
labor	EE	Electrical Engineer	3	108	HR				
				0	HR				
		Subtotal Labor:		**432**			**$ 46,925.28**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
equip	EE	Panels		6	EA	$ 500.00	$ 3,000.00		
equip	EE	Penetrator Enclosures		2	EA	$ 1,000.00	$ 2,000.00		
Supplies	EE	Wires & Connection		1	EA	$ 2,000.00	$ 2,000.00		
Supplies	EE	Power Supply		25	EA	$ 2,500.00	$ 62,500.00		B,D
							$ -		
		Subtotal Expense:	**0**	**34**			**$ 69,500.00**		
						Total:	**$ 116,425.28**		

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** A04 Frame & Structure (Options A,B,D) **Technical Lead:** Donald B. Peters

Description: This work package includes all engineering, planning, prototyping and documentation required to design the vehicle frame including modifications to the existing frame and design of new structure required to attach the new personnel sphere and all subsystems. The work package includes structural analysis and verification of compliance with ABS rules and guidelines. All detail design, external services, fabrication cost and unit testing is included. Vendor site visits, development of purchase specifications and procurement of vendor quotations required to identify and select a fabrication and weld shop are included in this WP.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)					Comments	
7340	PD	Prepare Design & Calculations for Frame Mods	1	10						A,B,D
7350	PD	Prepare Preliminary Design Documentation	1	10					assume work for PDR is complete	A,B,D
0310	FD	Prepare Final Design Documentation	2	20						A,B,D
0320	FAB	Procure Frame & Components	1	10						A,B,D
5500	OV	Inspect, Modify and Weld Frame	0	10						A,B,D
				0						
				0						
				0						
		Subtotal:	**5**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions	
labor	EE	Donald B. Peters	5	180	HR					
					HR					
				0	HR					
		Subtotal Labor:		**180**			**$ 28,360.80**			
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.										
subcontracts	VQ	frame modifications		1	EA	$ 116,000.00	$ 116,000.00		TiFab - material & fabrication	A,B,D
subcontracts	VQ	fabrication plan		1	EA	$ 4,000.00	$ 4,000.00		TiFab - if ABS requires	A,B,D
supplies	EE	misc mounting brackets		1	EA	$ 2,500.00	$ 2,500.00			A,B,D
repair	EE	WHOI machine shop		80	hrs	$ 55.00	$ 4,400.00			A,B,D
							$ -			
		Subtotal Expense:		**83**			**$ 126,900.00**			
						Total:	**$ 155,260.80**			

Notes: TiFab - based on preliminary design only. material & fabrication ($116K), fabrication plan ($4K) if ABS requires.

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

Description: This work package includes all engineering, planning, and documentation required to develop a syntactic foam purchase specification. This includes efforts to determine minimum foam density requirements, foam qualification test procedures and accurate estimates of quantity needed. Foam block size, shape, placement and attachment method should be determined as well as identification of shaping facility. The work package includes work required to generate ABS support documentation to be included in ABS classification submission. This will include any procurement costs and fabrication effort required to build and test all components of functional system and spares.

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 Fc	4	40					
7370	PD	Calculate adjustable fixed ballast we	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

Project: New Alvin: Design and Fab (83340908) **Work Package:** A08 Skins, Fairings and Sail (Option B) **Technical Lead:** Rodney M. Catanach

Description: This work package includes all engineering, planning, and documentation required to develop skin, bathtub and sail designs. Efforts to select a fabrication shop are included in this WP including vendor site visits, development of purchase specifications and procurement of vendor quotations. All design, external labor and services, fabrication costs, unit testing and WHOI rework is included.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)					Comments	
7390	PD	Determine Shape of Skins, Fairings & Sails	3	30						A,B,D
7660	PD	Prepare Preliminary Design Documentation	1	10						A,B,D
1200	FD	Prepare Final Design Documentation	4	40						A,B,D
3400	FAB	Procure	1	10						A,B,D
	FAB	Fabricate	0	60						A,B,D
	OV	Assemble and Fit-up Skins, sail & bathtub	4	40						A,B,D
				0						
		Subtotal:	**13**							

Object Code	Type of Etima	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions	
labor	EE	Rodney M. Catanach	10	360	HR					A,B,D
labor	EE	Donald B. Peters	3	108	HR			7390		
				0	HR					
				0	HR					
		Subtotal Labor:		**468**			**$ 57,142.08**			
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.										
Supplies	EE	materials & manufacture: sail		1	ea	$ 33,000.00	$ 33,000.00		Green VE based on current sail Oct 14, 2009	A,B,D
Supplies	EE	materials & manufacture: bath tub		1	ea	$ 8,000.00	$ 8,000.00		assumes simple configuration	A,B,D
Supplies	EE	materials & manufacture: skins		0	ea	$ 8,000.00	$ -		2 skin pieces includes molds at $8k each, fabrication, and painting. Assumes (2) transition skins and all foam forward fairings. Aft stays the same.	A
Supplies	EE	materials & manufacture: skins		7	ea	$ 8,000.00	$ 56,000.00		7 skin pieces includes molds at $8k each, fabrication, and painting. Mid body foam will be replaced. Aft stays the same. Includes (1) for the rescue buoy.	B
Supplies	EE	materials & manufacture: skins		0	ea	$ 8,000.00	$ -		20 skin pieces includes molds at $8k each, fabrication, and painting. Mid body foam will be replaced. Lower aft skins change.	D
							$ -			
		Subtotal Expense:		**9**			**$ 97,000.00**			
						Total:	**$ 154,142.08**			

Notes: Potential vendors include NE boatworks, Greene Marine. Assumes aft skins remain the same. Current Alvin has approximately 24 skins in total.

Project: New Alvin: Design and Fab (83340908) **Work Package:** A10 - Lead Acid Batteries (Option A, B) **Technical Lead:** Joshua A. Eaton

Description: This work package includes all electrical engineering, planning, prototyping and documentation required to cross deck the existing lead acid main battery design. Activities include the procurement of replacement cells.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)					Comments	
6485	FAB	Procure New Battery Cells	0.1	1						A,B
6487	FAB	Fab & Deliver Battery Cells	0	30						A,B
				0						
				0						
				0						
		Subtotal:	**0.1**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions	
labor	EE	Richard S. Chandler	0.1	3.6	HR					
				0	HR					
				0	HR					
				0	HR					
				0	HR					
				0	HR					
		Subtotal Labor:		**4**			**$ 361.30**			

Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.

supplies	HD	Battery Cells		200	EA	$ 164.00	$ 32,800.00		replacement for 3 batteries and 20 spares	A,B
							$ -		price based on most recent purchase 01/09	
							$ -			
		Subtotal Expense:		**200**			**$ 32,800.00**			
						Total:	**$ 33,161.30**			

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** A12-01 Junction Boxes (Option B,D) **Technical Lead:** Donald B. Peters

Description: This work package includes all engineering, planning, prototyping and documentation required to generate new mechanical designs for four (4) new electrical junction boxes. This task includes any procurement costs and fabrication effort required to build and test the mechanical boxes, covers and gaskets only. Electrical stuffing tubes and internal hardware will be covered by the electrical effort.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)					Comments	
1595	PD	Determine jbox requirements	1	10					location, wire count (need vehicle wiring plan from Lane and jbox layout)	B,D
1595	PD	Prepare Preliminary Design Documentation	1	10						
1600	FD	Prepare Final Design Documentation	4	40						
3800	FAB	Procure, Fabricate & Oversite	2	20					2 week spread over 60 days	
				0						
				0						
		Subtotal:	**8**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Chris Lumping	6	216	HR				
labor	EE	Megan M. Carroll	2	72	HR			7285, 7690	oversight
				0	HR				
				0	HR				
		Subtotal Labor:		**288**			**$ 29,627.28**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
Supplies	EE	all stock & supplies		1	EA	$ 15,000.00	$ 15,000.00		
repair	EE	WHOI machine shop		160	hrs	$ 55.00	$ 8,800.00		
							$ -		
							$ -		
		Subtotal Expense:		**161**			**$ 23,800.00**		
						Total:	**$ 53,427.28**		

Notes: NOT REQUIRED for Base Configuration.

Project: New Alvin: Design and Fab (83340908) **Work Package:** A12-01 Electrical Junction Boxes (Option B,D) **Technical Lead:** Lane J. Abrams

Description: This work package includes all engineering, planning, prototyping and documentation required to determine the number of junction boxes the new vehicle will need and determine the physical requirements of each. This work will also determine if any existing boxes will be reused. This effort includes the design and build of any new internal assemblies for reused and new external electrical junction boxes. This will include any procurement costs and fabrication effort required to build and test the necessary components required to assemble fully functional units and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	LOE Driving Duration	Most Likely (Days)					Comments	
1595	FD	New Desion for Penetration Configuration	1	10						B,D
1600	FD	New Box Design	2	20						B,D
3800	FAB	Build Box	4	40					prior to Alvin construction	B,D
				0						
				0						
				0						
		Subtotal:	**7**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Mechanical Engineer	2	72	HR				
labor	EE	Electrical Engineer	2	72	HR				
labor	EE	Lane J. Abrams	1	36	HR				
labor	EE	Mechanical Engineer	2	72	HR				
				0	HR				
				0	HR				
		Subtotal Labor:		**252**			**$ 26,266.32**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
Supplies	EE	Fabrication		2	EA	$ 5,000.00	$ 10,000.00		
							$ -		
							$ -		
		Subtotal Expense:		**2**			**$ 10,000.00**		
						Total:	**$ 36,266.32**		

Notes: NOT REQUIRED for Base Configuration. - This work includes all internal fab, stuffing and OPS installed. Assumes OPS group will install on vehicle and wire.

Project: New Alvin: Design and Fab (83340908) **Work Package:** A12-03 Power Bottle (Option B,D) **Technical Lead:** Donald B. Peters

Description: This work package includes all engineering, planning, prototyping and documentation required to design the power pressure vessels. Component layout, chassis design and thermal analysis is included. The work package includes structural analysis and generation of ABS support documentation to be included in ABS classification submission. All detail design, external labor and services, fabrication costs and unit testing is included.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)					Comments	
7670	PD	Determine Overall Dimensions & Specs	1	10						B,D
7680	PD	Prepare Preliminary Design Documentation	2	20					assume work for PDR is complete	
1400	FD	Prepare Final Design Analysis and Documentation	2	20					includes thermal and FE analysis as required.	
5860	FD	Design Chassis	2	20						
3600	FAB	Procure	1	60						
	OV	Assemble (2) Power Bottles	0	10					1 per week (2) bottles	
				0						
				0						
		Subtotal:	**8**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Megan M. Carroll	8	288	HR				possibly McDonald effort
				0	HR				
				0	HR				
		Subtotal Labor:		**288**			**$ 32,973.12**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
Supplies	EE	materials & manufacture							vessels, welding, end caps, ….
Supplies	EE	titanium (2) @ 288		576	lbs	$ 30.00	$ 17,280.00		includes end cap stock
Supplies	EE	treepaning & machining		2	housings	$ 4,000.00	$ 8,000.00		
repair	EE	WHOI machine shop		160	hrs	$ 55.00	$ 8,800.00		
Supplies	EE	pressure test (shop & labor)		1	test	$ 1,200.00	$ 1,200.00		
							$ -		
		Subtotal Expense:		**739**			**$ 35,280.00**		
						Total:	**$ 68,253.12**		

Notes: assumes no camera vessels. See bill's estimate.

Project: New Alvin: Design and Fab (83340908) **Work Package:** A12-03 Power Bottle (Option B,D) **Technical Lead:** Lane J. Abrams

Description: This work package includes all engineering, planning, and documentation required to develop a detailed power bottle schematic. This WP includes procurement of prototypes for validating designs and development of test procedures for functional units. This will include any procurement costs and fabrication effort required to build and test all components of three functional systems and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	LOE Driving Duration	Most Likely (Days)					Comments	
5770	FD	Identify Requirements	1	10						B,D
5780	FD	Prototype Selected Components	3	30						B,D
5790	FD	Develop Prel Schematic	2	20						B,D
5850	FD	Purchase Components	1	10						B,D
5865	FD	Revise Schematic	1	10						B,D
5772	FD	Design Lanecon Software	1	10						B,D
5305	OV	Assemble and Test	2	20					(2) bottles 1 per week	B,D
				0						B,D
		Subtotal:	**11**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions	
labor	EE	Lane J. Abrams	7	252	HR					
labor	EE	Hugh Popenoe	2	72	HR			5780	40 hrs for 3wks = 120 hrs	
labor	EE	Jonathan C. Howland	1	36	HR			5780	40 hrs for 3wks = 120 hrs	
				0	HR					
		Subtotal Labor:		**360**			**$ 43,433.64**			
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.										
Supplies	EE	Prototype Components		1	EA	$ 4,000.00	$ 4,000.00			
Supplies	EE	Power Supply		8	EA	$ 200.00	$ 1,600.00			B,D
Supplies	EE	Power Supply		8	EA	$ 90.00	$ 720.00			B,D
Supplies	EE	Power Supply		8	EA	$ 200.00	$ 1,600.00			Increment from B to D
Supplies	EE	Power Supply		8	EA	$ 90.00	$ 720.00			Increment from B to D
Supplies	EE	Contractor		30	EA	$ 160.00	$ 4,800.00		GX12TAA Price.pdf	B,D
Supplies	CP	SSR Relay		80	EA	$ 100.00	$ 8,000.00		S60DC40 Price.pdf	B,D
Supplies	EE	Network		3	EA	$ 1,500.00	$ 4,500.00			B,D
Supplies	EE	Fiber		3	EA	$ 1,600.00	$ 4,800.00			B,D
Supplies	EE	Serial		6	EA	$ 2,000.00	$ 12,000.00			B,D
Supplies	CP	RS485 Convert		12	EA	$ 75.00	$ 900.00		485PBTR Price.pdf	B,D
Supplies	EE	Other		1	EA	$ 3,000.00	$ 3,000.00		Chassis components but not their design	B,D
Supplies	EE	Lanecon		1	EA	$ 1,000.00	$ 1,000.00	5772	Before PDR	B,D
Supplies	EE	Lanecon		10	EA	$ 1,000.00	$ 10,000.00	5772	After FDR	B,D
Supplies	CP	Fiber Equipment		1	EA	$ 35,000.00	$ 35,000.00		3-splicer, 2 tester, 2-VFL	
supplies	EE	Penetrators NRE		1	EA	$ 1,700.00	$ 1,700.00			
supplies	EE	Penetrators		4	EA	$ 3,000.00	$ 12,000.00			
supplies	EE	Blindmate Tools		4	EA	$ 500.00	$ 2,000.00			
							$ -			
		Subtotal Expense:		**189**			**$ 108,340.00**			
						Total:	**$ 151,773.64**			

Project: New Alvin: Design and Fab (83340908) **Work Package:** A12-03 Data Bottle (Option B,D) **Technical Lead:** Donald B. Peters

Description: This work package includes all engineering, planning, prototyping and documentation required to design the data bottle pressure vessels. Component layout, chassis design and thermal analysis is included. The work package includes structural analysis and generation of ABS support documentation to be included in ABS classification submission. All detail design, external labor and services, fabrication costs and unit testing is included.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)				Hrs per Key Emp	Comments	
1500	FD	Prepare Final Design Documentation	3	30				108	assume work for PDR is complete. Includes thermo and FE analysis as needed	B,D
5930	FD	Design Chassis	2	20				72		
3700	FAB	Procure, Fabricate and Oversight	1	10				36		
5310	OV	Fabricate (2) Data Bottles	0	10				0	1 bottle per week	
				0				0		
				0				0		
		Subtotal:	**6**					**216**		

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions	
labor	EE	Megan M. Carroll	6	216	HR				possibly McDonald Effort	
				0	HR					
				0	HR					
		Subtotal Labor:		**216**			**$ 24,729.84**			
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.										
Supplies	EE	materials & manufacture							vessels, welding, end caps, ….	
Supplies	EE	titanium (2) @ 558		1116	lbs	$ 30.00	$ 33,480.00		includes end cap stock	B,D
Supplies	EE	treepaning & machining		2	housings	$ 6,000.00	$ 12,000.00			B,D
repair	EE	WHOI machine shop		200	hrs	$ 55.00	$ 11,000.00		housing and end caps	B,D
repair	EE	WHOI machine shop		80	hrs	$ 55.00	$ 4,400.00		chassie components	B,D
repair	EE	pressure test (shop & labor)		1	test	$ 1,200.00	$ 1,200.00			B,D
							$ -			
		Subtotal Expense:		**1399**			**$ 62,080.00**			
						Total:	**$ 86,809.84**			

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** A12-03 Electrical Data Bottle (Option B) **Technical Lead:** Lane J. Abrams

Description: This work package includes all engineering, planning, and documentation required to develop a detailed data bottle schematic. This WP includes procurement of prototypes for validating designs and development of test procedures for functional units. This will include any procurement costs and fabrication effort required to build and test all components of three functional systems and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	LOE Driving Duration	Most Likely (Days)					Comments	
5870	FD	Identify Requirements	1	10						B,D
5880	FD	Prototype Selected Components	3	30						B,D
5890	FD	Develop Prel Schematic	2	20						B,D
5920	FD	Purchase Components	1	10						B,D
5935	FD	Revise Schematic	1	10						B,D
	FAB	Assemble/Test	1	10						B,D
				0						
		Subtotal:	**9**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions	
labor	EE	Lane J. Abrams	6	216	HR					
labor	EE	Donald B. Peters	2	72	HR			5880	required for heat transfer issues	
labor	EE	Jonathan C. Howland	1	36	HR			5880		
				0	HR					
		Subtotal Labor:		**324**			**$ 43,432.20**			
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.										
supplies	EE	Prototype components		1	EA	$ 4,000.00	$ 4,000.00			B,D
supplies	EE	Power Supply		40	EA	$ 90.00	$ 3,600.00			B,D
supplies	EE	Power Supply		10	EA	$ 200.00	$ 2,000.00			B,D
supplies	EE	Power Supply		0	EA	$ 90.00	$ -			Increment from B to D
supplies	EE	Power Supply		0	EA	$ 200.00	$ -			Increment from B to D
supplies	EE	Network		3	EA	$ 1,500.00	$ 4,500.00			B,D
supplies	EE	Fiber		3	EA	$ 1,600.00	$ 4,800.00			B,D
supplies	EE	Serial		6	EA	$ 2,000.00	$ 12,000.00			B,D
supplies	EE	Other		1	EA	$ 3,100.00	$ 3,100.00			B,D
supplies	EE	Lancon		10	EA	$ 1,000.00	$ 10,000.00		after FDR	B,D
supplies	EE	Penetraters		6	EA	$ 3,000.00	$ 18,000.00			
supplies	EE	Blindmale Tools		6	EA	$ 500.00	$ 3,000.00			
supplies	EE	Blindmale Tools		1	EA	$ 500.00	$ 500.00			
							$ -			
		Subtotal Expense:		**87**			**$ 65,500.00**			
						Total:	**$ 108,932.20**			

Project: New Alvin: Design and Fab (83340908) **Work Package:** A14 - Main Ballast System (Option A,B) **Technical Lead:** Rodney M. Catanach

Description: This work package includes all engineering planning, prototyping and documentation required to design the main ballast system. This includes a study to determine the buoyancy requirements of the vehicle and the design of new soft ballast tanks. This WP will also include any effort required to modify hard and soft piping. The work package includes ABS support documentation to be included in ABS classification submission. This will include any procurement costs and fabrication effort required to build and test all components of the system.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)					Comments	
7285	PD	Prepare Weight & Balance Analysis	5	50						A,B.D
7690	PD	Determine Overall Requirements & Specs	1	10						A,B.D
7700	PD	Prepare Preliminary Design Documentation	1	10						A,B.D
1700	FD	Prepare Final Design Documentation	5	50					1 week for Don	A,B.D
3900	FAB	Procure & Oversee Fabrication	1	10						A,B.D
3900	FAB	Fabricate	0	66						
5590	OV	Fit Main Ballast	2	20					assume fit check and TE work	A,B.D
		Subtotal:	**15**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions	
labor	EE	Rodney M. Catanach	14	504	HR					
labor	EE	Donald B. Peters	1	36	HR			7285, 7690		
				0	HR					
				0	HR					
		Subtotal Labor:		**540**			**$ 61,848.00**			
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.										
Supplies	EE	fiberglass tanks		1	lot	$ 37,000.00	$ 37,000.00		Green Marine quoted (4) Tanks for 37k completed at same time as sail (3mon) VE 14 Oct 09	A,B,D
Supplies	EE	fiberglass tanks		1	ea	$ 18,000.00	$ 18,000.00		aft tank	A,B,D
							$ -			
		Subtotal Expense:		**2**			**$ 55,000.00**			
						Total:	**$ 116,848.00**			

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** A14 Main Ballast Systems (Option B,D) **Technical Lead:** Lane J. Abrams

Description: This work package includes all electrical engineering planning, prototyping and documentation required to cross deck the Alvin Main Ballast system and design the electrical interface schematic and electronics. The work package includes work required to generate ABS support documentation to be included in ABS classification submission. This will include any procurement costs and fabrication effort required to build and test all components of functional system and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	LOE Driving Duration	Most Likely (Days)				Hrs per Key Emp	Comments	
5950	FD	Prepare Schematic - Main Ballast	0.5	5				18		B,D
				0				0		
				0				0		
				0				0		
				0				0		
				0				0		
				0				0		
				0				0		
				0				0		
				0				0		
				0				0		
				0				0		
		Subtotal:	**0.5**					**18**		

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Lane J. Abrams	0.5	18	HR				
				0	HR				
				0	HR				
				0	HR				
		Subtotal Labor:		**18**			**$ 2,225.16**		

Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.

							$ -		
							$ -		
		Subtotal Expense:		**0**			**$ -**		
						Total:	**$ 2,225.16**		

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** A16 Variable Ballast Systems (Options B,D) **Technical Lead:** Lane J. Abrams

Description: This work package includes all engineering planning, prototyping and documentation required to cross deck the Alvin VB system and construct the electrical interface schematic and electronics. The work package includes work required to generate ABS support documentation to be included in ABS classification submission. This will include any procurement costs and fabrication effort required to build and test all components of functional system and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	LOE Driving Duration	Most Likely (Days)					Comments	
5990	FD	Prepare Schematic - Variable Ballast	0.5	5						B,D
6010	FD	Prototype - Variable Ballast	0.5	5						
6020	FD	Revise Schematic - Variable Ballast	0.5	5						
				0						
				0						
				0						
				0						
				0						
		Subtotal:	**1.5**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Lane J. Abrams	1.5	54	HR				
				0	HR				
				0	HR				
				0	HR				
		Subtotal Labor:		**54**			**$ 6,675.48**		

Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.

							$ -		
							$ -		
		Subtotal Expense:		**0**			**$ -**		
						Total:	**$ 6,675.48**		

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** A16 Variable Ballast System (Option B) **Technical Lead:** Donald B. Peters

Description: This work package includes all engineering planning, prototyping and documentation required to make any high pressure piping modifications to the VB system to accommodate the new sphere design. The work package includes work required to generate ABS support documentation to be included in ABS classification submission. This will include any procurement costs and fabrication effort required to build and test all components of functional system and sparesThis work package includes all engineering planning, prototyping and documentation required to make any high pressure piping modifications to the VB system to accommodate the new sphere design. The work package includes work required to generate ABS support documentation to be included in ABS classification submission. This will include any procurement costs and fabrication effort required to build and test all components of functional system and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)					Comments
	PD	prepare modified piping diagram	1	10					B
	FD	Prepare Final Design	1	10					
	FAB	Procure	1	30					
				0					
				0					
				0					
				0					
				0					
		Subtotal:	**3**						

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Philip E. Forte	3	108	HR				
				0	HR				
				0	HR				
		Subtotal Labor:		**108**			**$ 11,201.76**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
Supplies	EE	piping & fittings		1	EA	$ 3,000.00	$ 3,000.00		
							$ -		
							$ -		
							$ -		
		Subtotal Expense:		**1**			**$ 3,000.00**		
						Total:	**$ 14,201.76**		

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** A16 Variable Ballast System (Option B,D) **Technical Lead:** Donald B. Peters

Description: This work package includes all engineering planning, prototyping and documentation required to design and integrate new Variable Ballast Spheres into the existing system. The work package includes work required to generate ABS support documentation to be included in ABS classification submission. This will include procurement costs for 2 new spheres. Replacement of VB Hydraulic system is not included in the scope of this task.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)					Comments	
1795	PD	Prepare Preliminary Design	1	10						B,D
1795	PD	Generate RFP	1	10						
1795	PD	Review RFP Reponses	1	10						
1800	FD	Prepare Final Design	3	30						
4000	FAB	Procure	2	200						
4000	FAB	Fabrication		0						
4000	FAB	Acceptance Testing	1	10						
				0						
		Subtotal:	**9**							

Object Code	Type of Estimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Barrie B. Walden	9	324	HR				
labor	EE	Donald B. Peters	2	72	HR			7285, 7690	
labor	EE	J. Pat Hickey	2	72	HR				
labor	EE	Chris Lumping	2	72	HR				
				0	HR				
				0	HR				
		Subtotal Labor:		**540**			**$ 89,679.96**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
Supplies	VQ	tanks		2	tanks	$ 135,000.00	$ 270,000.00		vendor estimate
Supplies	VQ	design, analysis & engineering		1	lot	$ 350,000.00	$ 350,000.00		vendor estimate
Supplies	VQ	tooling		1	lot	$ 250,000.00	$ 250,000.00		vendor estimate
Supplies	VQ	weld qualification		1	lot	$ 120,000.00	$ 120,000.00		vendor estimate
Supplies	VQ	qual testing		1	lot	$ 120,000.00	$ 120,000.00		vendor estimate
Supplies	VQ	qual tank		2	ea	$ 135,000.00	$ 270,000.00		vendor estimate
							$ -		
		Subtotal Expense:		**8**			**$ 1,380,000.00**		
						Total:	**$ 1,469,679.96**		

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** A18 Propulsion (Option B) **Technical Lead:** Lane J. Abrams

Description: This work package includes all engineering, planning, prototyping and documentation required to design the propulsion system electrical interface schematic and electronics. All detail design, external labor and services, fabrication costs and unit testing is included. The work package includes generation of ABS support documentation to be included in ABS classification submission. This will include any procurement costs and fabrication effort required to build and test all components of functional system and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	LOE Driving Duration	Most Likely (Days)					Comments	
6030	FD	Identify Motors	0	0						D
6035	FD	Identify Controllers	0	0						D
6040	FD	Prepare Schematic	1	10						B,D
6050	FD	Build/Test Prototype	0	0						D
6060	FD	Revise Schematic	1	10						B,D
				0						
				0						
				0						
		Subtotal:	**2**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions	
labor	EE	Lane J. Abrams	2	72	HR					
labor	EE	Hugh Popenoe		0	HR			6050	1wk proto/1wk test	
labor	EE	Tom Lanagan		0	HR					
labor	EE	Mechanical Engineer		0	HR					increment from B to D
				0	HR					
				0	HR					
		Subtotal Labor:		**72**			**$ 8,900.64**			
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.										
supplies	HD	Motors		0	EA	$ 1,500.00	$ -	6030		D
supplies	HD	Controllers		0	EA	$ 2,000.00	$ -	6035		D
supplies	EE	Motor Inner Space		0	EA	$ 8,000.00	$ -	6050	estimate provided by vendor	D
supplies	EE	Inner space modify housing		0	EA	$ 1,000.00	$ -	6050		D
subcontracts	EE	Tim Thiel test support		40	hr	$ 110.00	$ 4,400.00		40 hrs @ 110	
							$ -			
		Subtotal Expense:		**40**			**$ 4,400.00**			
						Total:	**$ 13,300.64**			

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** A20 Main Hydraulic System (Option B,D) **Technical Lead:** Lane J. Abrams

Description: This work package includes all engineering, planning, prototyping and documentation required to cross deck the Alvin Main Hydraulic system and construct the electrical interface schematic and electronics. This will include any procurement costs and fabrication effort required to build and test all components of functional system and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	LOE Driving Duration	Most Likely (Days)					Comments	
6080	FD	Prepare Schematic - Hydraulic	0.5	5						B,D
6090	FD	Prototype - Hydraulic	0.5	5						B,D
6150	FD	Revise Schematic - Hydraulic	0.5	5						B,D
6152	FD	C&C Integration	1	10						
				0						
				0						
				0						
				0						
				0						
		Subtotal:	**2.5**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Lane J. Abrams	2.5	90	HR				
labor	EE	Jonathan C. Howland	1	36	HR				C&C support and intergration
				0	HR				
				0	HR				
		Subtotal Labor:		**126**			**$ 16,511.76**		

Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.

							$ -		
							$ -		
		Subtotal Expense:		**0**			**$ -**		
						Total:	**$ 16,511.76**		

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** A22 Mercury Trim (Option B,D) **Technical Lead:** Lane J. Abrams

Description: This work package includes all engineering, planning, prototyping and documentation required to cross deck the Alvin Mercury Trim system and develop the electrical interface schematic and electronics. This will include any procurement costs and fabrication effort required to build and test all components of functional system and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	LOE Driving Duration	Most Likely (Days)				Hrs per Key Emp	Comments	
5940	FD	Prepare Schematic - Mercury Trim	0.5	5				18		B,D
				0				0		
				0				0		
				0				0		
				0				0		
				0				0		
				0				0		
		Subtotal:	**0.5**					**18**		

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Lane J. Abrams	0.5	18	HR				
				0	HR				
				0	HR				
				0	HR				
		Subtotal Labor:		**18**			**$ 2,225.16**		

Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.

Supplies	EE						$ -		
							$ -		
							$ -		
		Subtotal Expense:		**0**			**$ -**		
						Total:	**$ 2,225.16**		

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** A24 Life Support & Habitability (Option A,B,D) **Technical Lead:** Lane J. Abrams

Description: This work package includes all engineering, planning, prototyping and documentation required to design the life support system. This includes all outsourced work to the LM corporation and all WHOI efforts to support outsourced work and complete the ABS submission. This will include any procurement costs and fabrication effort required to build and test all components of functional system and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	LOE Driving Duration	Most Likely (Days)					Comments	
6170	FD	Prepare Electric Schematic - Life Support	0.5	5						A,B,D
b		Component selection	1	10						
c		Prepare Mech Diagram	0.5	5						
d		Design Support	3	30						
e		Final Installation	3	30					possibly Al OPS tech effort	
				0						
		Subtotal:	**8**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Lane J. Abrams	8	288	HR			a	
labor	EE	Barrie B. Walden	3	108	HR			d	
labor	EE	J. Pat Hickey	4.5	162	HR			b,c,e	
				0	HR				
		Subtotal Labor:		**558**			**$ 80,382.06**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
subcontracts	VQ	PO D100126-0002		1	LS	$ 180,354.00	$ 180,354.00		Locheed Martin - specification
equip	EE	Components		1	LS	$ 28,000.00	$ 28,000.00		O2 bottles, values, regs flowmeters, O2 & CO2 monitors, piping, fitting, gauges, & cleaning
							$ -		
		Subtotal Expense:		**2**			**$ 208,354.00**		
						Total:	**$ 288,736.06**		

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** A28 Service Releases (Option B,D) **Technical Lead:** Donald B. Peters

Description: This work package includes all engineering, planning, prototyping and documentation required to cross deck the Alvin Service Weight Release System electrical components. This includes a system schematic and effort required to generate ABS support documentation to be included in ABS classification submission. This will include any procurement costs and fabrication effort required to build and test all components of functional system and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)				Hrs per Key Emp	Comments	
2395	PD	Determine requirements	1	10				31	mount plates & droppers	A,B,D
2395	PD	Prepare Plate preliminary design	1	10				31	mount plates	A,B,D
2400	FD	Prepare Plate Final Design	1	10				31	mount plates	A,B,D
4600	FAB	Procure, Fab & Oversight	1	10				31	mount plates	A,B,D
	PD	Prepare Dropper preliminary design	1	10				31	droppers - assumes same location	B,D
	FD	Prepare Dropper Final Design	2	20				62	droppers - assumes same location	B, D
				0				0		
		Subtotal:	**7**					**216**		

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Chris Lumping	6	216	HR			Key Emp	
labor	EE	Megan M. Carroll	1	36	HR				
				0	HR				
				0	HR				
		Subtotal Labor:		**252**			**$ 25,505.64**		

Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.

Supplies	EE	materials & manufacture		1	Lot	$ 5,000.00	$ 5,000.00		
							$ -		
							$ -		
							$ -		
		Subtotal Expense:		**1**			**$ 5,000.00**		
						Total:	**$ 30,505.64**		

Notes: assumes release plates to be bolted to frame foundations. Assumes resue of most major components.

Project: New Alvin: Design and Fab (83340908) **Work Package:** A28 Service Releases (Option A,B,D) **Technical Lead:** Lane J. Abrams

Description: This work package includes all engineering, planning, prototyping and documentation required to cross deck the Alvin Service Weight Release System. This includes analysis to determine placement based on weight and balance criteria and designs for dropper mounting plate. The work package includes work required to generate ABS support documentation to be included in ABS classification submission. This will include any procurement costs and fabrication effort required to build and test all components of functional system and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	LOE Driving Duration	Most Likely (Days)					Comments	
	FD	Prepare Schematic - Service Releases	0.5	5						A,B,D
				0						
				0						
				0						
		Subtotal:	**0.5**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Lane J. Abrams	0.5	18	HR				
				0	HR				
				0	HR				
				0	HR				
		Subtotal Labor:		**18**			**$ 2,225.16**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
							$ -		
							$ -		
							$ -		
		Subtotal Expense:		**0**			**$ -**		
						Total:	**$ 2,225.16**		

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** Emergency Releases (Option A,B,D) **Technical Lead:** Lane J. Abrams

Description: This work package includes all engineering, planning, prototyping and documentation required to cross deck the Alvin Emergency Release System electrical components. The work package includes work required to generate ABS support documentation to be included in ABS classification submission. This will include any procurement costs and fabrication effort required to build and test all components of functional system and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	LOE Driving Duration	Most Likely (Days)					Comments	
6465	FD	Prepare Schematic - Emergency Releases	0.5	5						A,B,D
				0						
				0						
				0						
				0						
				0						
				0						
				0						
		Subtotal:	**0.5**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Lane J. Abrams	0.5	18	HR				
				0	HR				
				0	HR				
				0	HR				
		Subtotal Labor:		**18**			**$ 2,225.16**		

Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.

							$ -		
							$ -		
							$ -		
		Subtotal Expense:		**0**			**$ -**		
						Total:	**$ 2,225.16**		

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** Emergency Releases (Option B,D) **Technical Lead:** Donald B. Peters

Description: This work package includes all engineering, planning, prototyping and documentation required to design the Emergency Release and Hydraulic Disconnect system. This includes all work required to design a new basket and manipulator electrical, mechanical and hydraulic release mechanism. The work package includes work required to generate ABS support documentation to be included in ABS classification submission. This will include any procurement costs and fabrication effort required to build and test all components of functional system and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)					Comments	
2495	PD	Determine requirements	1	10						
2495	PD	Prepare preliminary design	1	10					assume no work is required for PDR	
2500	FD	FD (basket, manipulators, aux weight)	2	20						A,B,D
2505	FD	FD (rescue buoy)	1	10						B,D
4700	FAB	Procure & Oversight	1	10						
4700	FAB	Fabrication	1	60						
				0						
		Subtotal:	**7**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions	
labor	EE	Chris Lumping	5	180	HR					
labor	EE	Donald B. Peters	1	36	HR				oversight	
				0	HR					
				0	HR					
		Subtotal Labor:		**216**			**$ 23,492.16**			
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.										
repair	EE	WHOI machine shop		72	hrs				basket, manipulators, aux weight	A,B,D
repair	EE	WHOI machine shop		36	hrs				rescue buoy	B,D
Supplies	HD	materials (frangi bolts & other stock)		0.9	ea				basket (actualtor $4,300; bolt $250)	A,B,D
Supplies	EE	materials		0.9	ea				rescue buoy	B,D
		Subtotal Expense:		**109.8**			**$ 10,935.00**			
						Total:	**$ 34,427.16**			

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** A30 Manipulators (Option B,D) **Technical Lead:** Lane J. Abrams

Description: This work package includes all engineering, planning, prototyping and documentation required to cross deck the Alvin Manipulator system and construct a four wire interface system schematic and electronics. This will include any procurement costs and fabrication effort required to build and test all components of functional system and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	LOE Driving Duration	Most Likely (Days)					Comments	
2600	FD	Final Design 4- Wire Telemetry	3	30						B,D
				0						
				0						
				0						
				0						
				0						
		Subtotal:	**3**							

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Lane J. Abrams	3	108	HR				
				0	HR				
				0	HR				
				0	HR				
		Subtotal Labor:		**108**			**$ 13,350.96**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
Supplies	EE	4- Wire Telemetry		1	EA	$ 1,000.00	$ 1,000.00		
							$ -		
							$ -		
		Subtotal Expense:		**1**			**$ 1,000.00**		
						Total:	**$ 14,350.96**		

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** A32 Operational Instruments & Equipment (Option B,D) **Technical Lead:** Jonathan C. Howland

Description: This work package covers design, development, and building of the equipment the pilot and observers use to control the submarine and evaluate its real-time performance. Specifically, it includes the pilots joystick/hand box, the head-down display, and other submarine specific controls and indicators.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)					Comments
17	PD	Prepare Preliminary Design	0.4	4					note in many of these tasks, others (not jch) are the duration pacer
6470	FD	refine HDD design and provide input to drawings	1	10					
6480	FD	write HDD purchase spec and obtain quotes	1	10					
6490	FD	refine handbox design and provide input to drawings	1	10					
7210	FD	write purchase spec and obtain quotes for handbox	1	10					
6510	FD	refine design for remainder of controls and indicators	0.4	4					
7220	FAB	build handbox	0.2	2					
7230	FAB	integrate handbox	0.2	2					
7240	FAB	build HDD	0.2	2					
7250	FAB	integrate HDD	0.2	2					
4900	FAB	test handbox	0.2	2					
7004	FAB	test HDD	0.2	2					
				0					
		Subtotal:	**6**						

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Jonathan C. Howland	6	216	HR				
labor	EE	J. Pat Hickey	0.2	7.2	HR			17	
labor	EE	Lane J. Abrams	0.5	18	HR			17	
labor	EE	Lane J. Abrams	0.5	18	HR			6470	
labor	EE	J. Pat Hickey	1	36	HR			6490	
labor	EE	Lane J. Abrams	2	72	HR			6510	
labor	EE	Lane J. Abrams	1	36	HR			7220	
labor	EE	Hugh Popenoe	0.5	18	HR			7230	
labor	EE	Lane J. Abrams	0.5	18	HR			7240	
labor	EE	Hugh Popenoe	0.5	18	HR			7240	
labor	EE	Hugh Popenoe	0.5	18	HR			7250	
labor	EE	Hugh Popenoe	0.4	14.4	HR			4900	
labor	EE	Hugh Popenoe	0.4	14.4	HR			7004	
		Subtotal Labor:		**457**			**$ 66,859.52**		

Project: New Alvin: Design and Fab (83340908) **Work Package:** A32 Operational Instruments & Equipment (Option B,D) **Technical Lead:** Jonathan C. Howland

Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
subcontracts	EE	Tim Thiel		112	hrs	$ 110.00	$ 12,320.00		
							$ -		
							$ -		
		Subtotal Expense:		**112**			**$ 12,320.00**		
						Total:	**$ 79,179.52**		

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** A34 Science Instrument & Equipment (Option B,D) **Technical Lead:** Lane J. Abrams

Description: This work package includes all engineering, planning, prototyping and documentation of the science interface system required to provide power and through hull communications to science gear located outside the vehicle. This effort includes science basket electrical, hydraulic and optical fiber interface and disconnect system. This WP includes a pressure bottle to house all electronics. This will include any procurement costs and fabrication effort required to build and test all components of functional system and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	LOE Driving Duration	Most Likely (Days)				Hrs per Key Emp	Comments	
6520	FD	Schematic	2	20				24		B,D
6530	FD	Science Panel	1	10				12		B,D
6540	FD	Outside Bottle Schematic	1	10				12		B,D
6550	FD	Bottle Design & Chassis	2	20				24		B,D
				0				0		
				0				0		
		Subtotal:	**6**					**72**		

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Lane J. Abrams	2	72	HR			6520	
labor	EE	Mechanical Engineer	1	36	HR			6530	
labor	EE	Lane J. Abrams	1	36	HR			6540	
labor	EE	Mechanical Engineer	2	72	HR			6550	
labor				0	HR				
		Subtotal Labor:		**216**			**$ 24,150.96**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
Supplies	EE	bottle		1	LS	$ 50,000.00	$ 50,000.00		assumes labor & 1/2 materials from power bottle (mech)
							$ -		
							$ -		
		Subtotal Expense:		**1**			**$ 50,000.00**		
						Total:	**$ 74,150.96**		

Notes: NOT REQUIRED for Base Configuration.

Project: New Alvin: Design and Fab (83340908) **Work Package:** A34 External Arrangement - Workspace Design (Option A, B, D) **Technical Lead:** Donald B. Peters

Description: This work package includes all engineering, planning, prototyping and documentation required to design an efficient pilot and observer workspace layout including the design and build of the manipulator mounting system, sample basket, and light/camera mounting system. This includes a kinematic analysis of the manipulator and must consider the emergency release system and hydraulic and electrical disconnect system. This includes any procurement costs and fabrication effort required to build and test the manipulator mounting system, sample basket and light/camera mounting system.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)				Hrs per Key Emp	Comments	
7325	PD	Determine requirements	1	10						A,B,D
7326	PD	Prepare PD Inventor modeling	6	60						A,B,D
7327	PD	Prepare PD Studio Max	3	30						A,B,D
1055	FD	Prepare FD	4	40						A,B,D
3105	FAB	Procure material	1	10						A,B,D
3105	FAB	Oversee shop fabrication	2	20						A,B,D
3105	FAB	Fabrication	0	25						A,B,D
3105	FAB	Test	5	50						A,B,D
				0						
		Subtotal:	**22**					**0**		

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Matthew C. Heintz	5	180	HR				
labor	EE	Megan M. Carroll	3	108	HR				
labor	EE	Will Sellers	2	72	HR				assist with testing
labor	EE	Tito Collasius	2	72	HR				assist with testing
labor				0	HR				
		Subtotal Labor:		**432**			**$ 51,052.32**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
Supplies	EE	WHOI machine shop	5	200	hrs	$ 55.00	$ 11,000.00		basket, manipulators, aux weight
Supplies	EE	materials		1	ea	$ 20,000.00	$ 20,000.00		basket & manipulator mounts
Supplies	EE	materials		1	ea	$ 5,000.00	$ 5,000.00		light bar
subcontracts	VQ	Craig Johnson	2.67	500	HR	$ 60.00	$ 30,000.00		CJ Designs
							$ -		
							$ -		
		Subtotal Expense:		**702**			**$ 66,000.00**		
						Total:	**$ 117,052.32**		

Notes:

Project: New Alvin: Design and Fab (83340908) **Work Package:** A34 Science Interface System - Imaging (Option B) **Technical Lead:** William N. Lange

Description: This work package includes all engineering, planning, prototyping and documentation required to design the vehicle's lighting plant. This includes high intensity (ramped and strobed) LED lighting. This will include any procurement and fabrication effort required to build and test all components of functional system and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Offload Data System	LOE Driving Duration	Most Likely (Days)					Comments	
	FD	**DESIGN & FABRICATION**	5.8	58						B,D
	FD	Situational Camera System	0	0						B,D
	FD	Panoramic/Down Looking Camera System	0	0						B,D
	FD	Science Utiltity Camera System	4.5	45						B,D
	FD	Science HDTV Camera System	2.9	29						B,D
	FD	Primary Science Camera System	0	0						B,D
	FD	Camera Interface & Telemetry System	6.9	69						B,D
	FD	Acquisition System (External)	3.7	37						B,D
	FD	Still Image Acquistion Module	4.3	43						B,D
	FD	Motion Image Buffering System	3.9	39						B,D
	FD	Interior Hull Systems	3	30						B,D
	FD	Internal Camera Interface & Telemetry System	3.9	39						B,D
	FD	Internal Acquisition System	4.9	49						B,D
	FD	Control/Display/Monitoring Distribution System	3.8	38						B,D
	FD	Control Systems - Camera	1.2	12						B,D
	FD	Control Systems - Still Acquistion	1.2	12						B,D
	FD	Control Systems - Video Monitoring	1.2	12						B,D
	FD	Control Systems - PATS	1.2	12						B,D
	FD	Control Systems - Video Record	1.2	12						B,D
	FD	Monitoring Display System	3.3	33						B,D
	FD	Video Distribution System	4.5	45						B,D
	FD	Science Image Data Distribution	3.5	35						B,D
	FD	Offload Data System	2.4	24						B,D
	FD	Alvin Data Duplication System	3.1	31						B,D
	FD	Science Data Processing System	3.5	35						B,D
	Fabrication/Procurement/Assemble		0	0						
	FAB	Situational Camera System	0	0						
	FAB	Panoramic/Down Looking Camera System	0	0						
	FAB	Science Utiltity Camera System	8.3	83						
	FAB	Science HDTV Camera System	4.7	47						
	FAB	Primary Science Camera System	0	0						
	FAB	Camera Interface & Telemetry System - External	7.1	71						
	FAB	Camera Interface & Telemetry System	5.3	53						
	FAB	Acquisition System (External)	11.9	119						

Project: New Alvin: Design and Fab (83340908) **Work Package:** A34 Science Interface System - Imaging (Option B) **Technical Lead:** William N. Lange

	FAB	Control System	4.7	47					
	FAB	Control Systems - Camera	4	40					
	FAB	Control Systems - Still Acquistion	3.6	36					
	FAB	Control Systems - Video Monitoring	4.8	48					
	FAB	Control Systems - PATS	2.6	26					
	FAB	Control Systems - Video Record	3	30					
	FAB	Monitoring Display System	7.8	78					
	FAB	image Data offload System	6.7	67					
	FAB	Image Data duplication System	8.3	83					
	FAB	science image Data processing System	9.5	95					
	FAB	science image data duplication system	7.1	71					
	FAB	ext. camera positioning system	3.9	39					
	FAB	ext. lighting positioning system	3.9	39					
	FAB	ext mechanical interfaces	2.1	21					
	FAB	ext electrical interfaces	6.7	67					
	FAB	ext fiber optic interfaces	4.3	43					
	INTGR	Integration Plan	3.8	38					
	INTGR	Imaging System Integration	8.8	88					
	INTGR	Imaging System Calibration	8.6	86					
				0					
		Subtotal:	**215.4**						

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost		Pricing Assumptions
labor	EE	William N. Lange	8.7	313.2	HR				
labor	EE	Lane J. Abrams	3	108	HR				
labor	EE	Jonathan C. Howland	1.8	64.8	HR				
labor	EE	Tim Thiel - SUBC	2.8	100.8	HR				
labor	EE	Electrical Engineer	8.5	306	HR				
labor	EE	Electrical Engineer	3.7	133.2	HR				
labor	EE	Electrical Engineer	1.3	46.8	HR				
labor	EE	K. Faith Hampshire	0.9	32.4	HR				
labor	EE	Wannop/DWG	2.1	75.6	HR				
labor	EE	Donald B. Peters	0.2	7.2	HR				
labor	EE	Megan M. Carroll	1.1	39.6	HR				
labor	EE	Chris Lumping	3.1	111.6	HR				
labor	EE	Electrical Engineer	0	0	HR				
labor	EE	Glen McDonald	0.6	21.6	HR				
labor	EE	William N. Lange	7.3	262.8	HR				
labor	EE	Lane J. Abrams	6.3	226.8	HR				

	Project: New Alvin: Design and Fab (83340908)				**Work Package:** A34 Science Interface System - Imaging (Option B)					**Technical Lead:** William N. Lange	
82	labor	EE	Jonathan C. Howland	4.5	162	HR					
83	labor	EE	Tim Thiel - SUBC	12.4	446.4	HR					
84	labor	EE	Electrical Engineer	10.7	385.2	HR					
85	labor	EE	Electrical Engineer	5.3	190.8	HR					
86	labor	EE	Electrical Engineer	3.3	118.8	HR					
87	labor	EE	K. Faith Hampshire	1.1	39.6	HR					
88	labor	EE	Electrical Engineer	12.6	453.6	HR					
89	labor	EE	Donald B. Peters	0	0	HR					
90	labor	EE	Megan M. Carroll	0.2	7.842996	HR					
91	labor	EE	Chris Lumping	1.8	64.8	HR					
92	labor	EE	Griner	6.9	248.4	HR					
93	labor	EE	Glen McDonald	0	0	HR					
94					0	HR					
95			**Subtotal Labor:**		**3,968**			**$ 432,857.70**			
96	Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.										
97	Supplies	EE	Infrastructure Hardware		1	LS	$ 245,920.00	$ 245,920.00			D
98	Supplies	EE	Camera System - reuse most existing		1	LS	$ 153,000.00	$ 153,000.00			NO
99	Supplies	EE	Camera System		1	LS	$ 184,533.00	$ 184,533.00			NO
100	Supplies	EE	SSSG Duping Station		1	LS	$ 120,500.00	$ 120,500.00			NO
101	Supplies	EE	Science Processing Station		1	LS	$ 60,250.00	$ 60,250.00			D
102								$ -			
103			**Subtotal Expense:**		**5**			**$ 764,203.00**			
104											
105							**Total:**	**$ 1,197,060.70**			
106	**Notes:**										
107											

Project: A-4500 HOV **Work Package:** A34 Illumination **Technical Lead:** Bill Lange

Description: This work package includes all engineering, planning, prototyping and documentation required to design the vehicle's imaging and recording plant. This includes high intensity (ramped and strobed) LED lighting. New internal Infrastructure hardware including camera displays, Pan Tilt Zoom and Focus control, video routing and switching, audio, data and time code integration. Cross decking of several existing Alvin cameras, an upgrade to the existing HD camera from Analog to Digital output and replacement of imager with new. Addition of second HD Camera and external still image storage capability. Digital Upgrade to the Shipboard Science Support Group duplication station. Retooling of the Science Processing Station tools and addition of Non-Linear Editing capabilities to allow HD conversion to PC or Mac format. To include the integration of these new tools and functions with the existing SDTV conversion tools. This will include any procurement and fabrication effort required to build and test all components of functional system and spares.

Basis of Estimate

Activity ID	Project Phase	Description	LOE Driving Duration	Most Likely (Days)				Hrs per Key Emp	Comments
	DESIGN		4.7	47				14	
	FD	Illumination Field Design	6.3	63				19	
	FD	Light Head Design Specification	5.7	57				18	
	FD	Power and Modulation System	8.1	81				25	
	FD	Lighting Control System Design	3.9	39				12	
	FABRICATION								
	FAB	Light Heads	6.1	61				19	
	FAB	Power Control and Modulation	7.7	77				24	
	FAB	Lighting Control	5.1	51				16	
	FD	Lighting System Integration	8.6	86				26	
				0				0	
		Subtotal:	**56.2**					**172.8**	

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Research Specialist	4.8	172.8	HR				
labor	EE	Research Engineer (4)	3.7	133.2	HR				
labor	EE	Senior Engineer (2)	0.9	32.4	HR				
labor	EE	Outside Services (3)	0.8	28.8	HR				
labor	EE	Electrical Engineer	11.25	405.0	HR				
labor	EE	Electrical Engineer	2.5	90	HR				
labor	EE	Electrical Engineer	0.4	14.4	HR				
labor	EE	Center Administrator	0.7	25.2	HR				
labor	EE	Sr Engineering Asst I	7.1	255.6	HR				
labor	EE	Senior Engineer (1)	0.1	3.6	HR				
labor	EE	Research Engineer (6)	1.6	57.6	HR				
labor	EE	Engineer II (1)	1.1	39.6	HR				
labor	EE	Engineering Asst III (6)	2.5	90	HR				
labor	EE	Research Engineer (2)	0	0	HR				
				0	HR				
		Subtotal Labor:		**1,348**			**$ 144,288.00**		

	Project: A-4500 HOV			**Work Package:** A34 Illumination					**Technical Lead:** Bill Lange		
	Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.										
	Supplies	EE	Lighting and Illuminataion Material		1	LS	$ 287,975.00	$ 287,975.00			B,D
								$ -			
			Subtotal Expense:		**1**			**$ 287,975.00**			
							Total:	**$ 432,263.00**			
	Notes:										

Project: New Alvin: Design and Fab (83340908) **Work Package:** A36 Software & Computers (Option B,D) **Technical Lead:** Jonathan C. Howland

Description: This work package includes all engineering, planning, prototyping and documentation required to design the vehicle's imaging and recording plant. This includes high intensity (ramped and strobed) LED lighting. New internal Infrastructure hardware including camera displays, Pan Tilt Zoom and Focus control, video routing and switching, audio, data and time code integration. Cross decking of several existing Alvin cameras, an upgrade to the existing HD camera from Analog to Digital output and replacement of imager with new. Addition of second HD Camera and external still image storage capability. Digital Upgrade to the Shipboard Science Support Group duplication station. Retooling of the Science Processing Station tools and addition of Non-Linear Editing capabilities to allow HD conversion to PC or Mac format. To include the integration of these new tools and functions with the existing SDTV conversion tools. This will include any procurement and fabrication effort required to build and test all components of functional system and spares.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Wks	Most Likely (Days)					Comments	
29	PD	specify system architecture	0.6	6						B,D
30	PD	develop interface descriptions	1	10						
31	PD	complete preliminary design	1	10						
32	PD	complete costing and estimating	2	20						
33	PD	specify computing needs of COTS/legacy equipment	0.6	6						
1740	FD	identify and design interfaces for legacy navigation, sonar and communication equipment	2	20						
34	FD	complete software spec and design for real time controller	1	10						
7470	FD	complete software spec and design for pilot GUI	2	20						
7480	FD	complete software spec and design for navigation engine	1	10						
37	FD	complete software spec and design for navigation GUI	1	10						
7510	FD	complete software spec and design for data system	0.6	6						
7550	FD	complete hardware spec for other computing needs	1	10						
7590	FD	evaluate and specify computers for purchase	1	10						
7600	FD	design network and evaluate hardware for network system	0.6	6						
7610	FD	evaluate approaches and specify A/D, D/A, and DIO approach	1	10						
7620	FD	produce reference development platform	1	10						
7630	FD	commission version control platform	1	10						
7650	FD	write final software test plan	1	10						
7490	FAB	purchase computer and network systems	1	10						
7520	FAB	integrate and test computer and network systems in T&D System	1	10						
7560	FAB	move computer and network systems to birdcage/sphere	0.2	2						
7640	FAB	develop and test code for A/D, D/A. and DIO	1	10						
7530	FAB	develop submarine simulators	0.5	5						
7570	FAB	develop navigation simulators	1	10						
7540	FAB	produce beta version of RTC	5	50						
7580	FAB	produce beta version of Naveng	4	40						
7582	FAB	produce beta version of GUI	5	50						
7584	FAB	produce beta version of Nav GUI	5	50						
7586	FAB	integrate and test new software systems on hardware	4	40						

Project: New Alvin: Design and Fab (83340908) **Work Package:** A36 Software & Computers (Option B,D) **Technical Lead:** Jonathan C. Howland

				0					
		Subtotal:	**47.1**						

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Jonathan C. Howland	47.1	1695.6	HR				
labor	EE	Lane J. Abrams	0.2	7.2	HR			30	
labor	EE	Lane J. Abrams	0.4	14.4	HR			33	
labor	EE	Barrie B. Walden	0.4	14.4	HR			33	
labor	EE	James Kinsey	1	36	HR			7480	
labor	EE	Dana Yoerger	1	36	HR			7480	
labor	EE	James Kinsey	1	36	HR			37	
labor	EE	Dana Yoerger	1	36	HR			37	
labor	EE	Scott McCue	1	36	HR			7510	
labor	EE	Fritz Sonnichsen	1	36	HR			7600	
labor	EE	Lane J. Abrams	1	36	HR			7610	
labor	EE	John Bailey	1	36	HR			7610	
labor	EE	Fritz Sonnichsen	1	36	HR			7600	
labor	EE	Hugh Popenoe	2	72	HR			7560	
labor	EE	Lane J. Abrams	0.4	14.4	HR			7640	
labor	EE	James Kinsey	1	36	HR			7570	
labor	EE	James Kinsey	5	180	HR			7580	
labor	EE	Dana Yoerger	2	72	HR			7580	
labor	EE	Dana Yoerger	2	72	HR			7584	
		Subtotal Labor:		**2,502**			**$ 354,516.01**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
subcontracts	EE	Louis Whitcomb		480	hrs	$ 200.00	$ 96,000.00		
subcontracts	EE	Tim Thiel		540	hrs	$ 110.00	$ 59,400.00		
supplies	EE	materials		1	LS	$ 88,088.00	$ 88,088.00		
		Subtotal Expense:		**1021**			**$ 243,488.00**		
						Total:	**$ 598,004.01**		

Notes:

Project: A-4500: Construction & Test **Work Package:** Preconstruction **Technical Lead:** Pat Hickey

Description: Activities include, but are not limited to: High Bay overhead crane load testing, general area cleanup, additional lighting installation, shop and office van installations, shop and office van decking and stairway installation, outside storage van setup, outside van decking and stairway installation, area work bench assembly and setup, temporary wall structure setup, fabrication of old sphere transport and storage fixture, WHOI safety office inspections, etc. This task also includes design and fabrication of a sphere storage and transport fixture for old ALVIN 4500M personnel sphere.

Basis of Estimate

Activity ID	Project Phase	Description	LOE Driving Duration	Most Likely (Days)					Comments
	FAB	Preparation for ship arrival	5	50					Activities include, but are not limited to: High Bay overhead crane load testing, general area cleanup, additional lighting installation, shop and office van installations, shop and office van decking and stairway installation, outside storage van setup, outside van decking and stairway installation, area work bench assembly and setup, temporary wall structure setup, fabrication of old sphere transport and storage fixture, WHOI safety office inspections, etc
	FAB	Fixture design	1	10					Design sphere storage and transport fixture for old ALVIN 4500M personnel sphere
		Subtotal:	**6**						

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost		Pricing Assumptions
labor	EE	Barrie B. Walden	0	0	HR				
labor	EE	Donald B. Peters	0	0	HR				
labor	EE	Electrical Engineer	0	0	HR				
labor	EE	Griffith Outlaw	1	18	HR				
labor	EE	J. Pat Hickey	1	9	HR				
labor	EE	Richard S. Chandler	1	9	HR				
labor	EE	Jonathan C. Howland	0	0	HR				
labor	EE	Lane J. Abrams	1	4.5	HR				
labor	EE	Matthew C. Heintz	0	0	HR				
labor	EE	Mechanical Engineer	0	0	HR				
labor	EE	Philip E. Forte	0	0	HR				
labor	EE	Rodney M. Catanach	2	9	HR				
labor	EE	William N. Lange	0	0	HR				
		Subtotal Expense:	**6**	**50**			**$ 5,539.50**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
Supplies	EE	WHOI Shop Services (Mech)		160	hr	$ 55	$ 8,800		Old sphere storage and transport fixture fabrication
Supplies	HD	WHOI Shop Services (Carpentry)		80	hr	$ 55	$ 4,400		High Bay & storage van misc carpentry, new benches
Supplies	HD	WHOI Shop Services (Electrical)		40	hr	$ 55	$ 2,200		High Bay & storage van wiring, High Bay lighting
Supplies	EE	Old sphere storage and transport fixture materials		1	lot		$ 10,000		
Supplies	EE	Misc carpentry supplies		1	lot		$ 2,500		High Bay & storage van misc carpentry, new benches
Supplies	EE	Misc electrical supplies		1	lot		$ 2,500		High Bay & storage van wiring, High Bay lighting
Supplies	EE	Stockroom		1	ea	$ 2,000	$ 2,000		Misc supplies, brooms, barrels, etc

1											
2		**Project:** A-4500: Construction & Test			**Work Package:** Preconstruction					**Technical Lead:** Pat Hickey	
3											
36									$ -		
37				Subtotal Non Labor		284			$ 32,400.00		
38								**Total:**	**$ 37,939.50**		
39											
40											

Project: A-4500: Construction & Test **Work Package:** Support Ship Demob and Submersible Disassembly **Technical Lead:** Pat Hickey

Description: Activities include, but are not limited to, relocation and set up of support equipment and system spares into temporary work vans in Islen High Bay and the complete disassembly of the existing vehicle and final disposition of all components and systems. This also includes cleaning of the existing vehicle frame and preparations for transport to vendor service facility and all work package control documentation.

Basis of Estimate

Activity ID	Project Phase	Description	Man Weeks					Hrs per Key Emp	Comments
	ST	Ship demobilization	14					38	Activities include, but are not limited to: relocation of support ship shops to temp work vans in High Bay, relocation of all system spares to storage vans and High Bay, setup of temp shops, etc.
	ST	Submersible disassembly	28					75	Activities include, but are not limited to: removal of all skins and fairings, removal of all syntatic foam, strip out all internal sphere components, removal of all battery systems, removal of all VB system components, removal of all hydraulic system components, removal of all mercury and mercury trim components, removal of all pressure housings and cabling, removal of all j-boxes and cabling, removal of all propulsion system components, removal of all science sensors, removal and storage of old personnel sphere, removal of all other associated materials and fixtures to the bare frame, cleaning of the frame in preparations for transport to vendor service facility, work
		Safety training	5					13	WHOI mandatory safety training for operations crew: forklift operator, general shop safety, enclosed space entry, cranes and rigging, hazmat material handling, etc.
		Subtotal:	**47**					**126**	

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Korey Verhein	3.5	126	HR				
labor	EE	Susan Humphris	0	0	HR				
labor	EE	Electrical Engineer	3.5	126	HR				
labor	EE	Mechanical Engineer	3.5	126	HR				
labor	EE	Mark Spear	3.5	126	HR				
labor	EE	Jeffery McDonald	3.5	126	HR				
labor	EE	Casual 1/2 Time	0	0	HR				
labor	EE	Griffith Outlaw	2	36	HR				
labor	EE	J. Pat Hickey	2	18	HR				
labor	EE	Richard S. Chandler	2	18	HR				
labor	EE	Michael Skowronski	3.5	15.75	HR				
labor	EE	Lane J. Abrams	2	9	HR				
labor	EE	Sean Kelley	3.5	15.75	HR				
labor	EE	David Walter	3.5	15.75	HR				
labor	EE	Anton Zafereo	3.5	15.75	HR				
labor	EE	Rodney M. Catanach	2	9	HR				
labor	EE	William Strickrott	3.5	15.75	HR				
labor	EE	Andrew S. Billings	2	9	HR				
labor	EE	Andy Bowen	0	0	HR				

Project: A-4500: Construction & Test **Work Package:** Support Ship Demob and Submersible Disassembly **Technical Lead:** Pat Hickey

labor	EE	Chris German	0	0	HR					
		Subtotal Labor:	**47**	**808**			**$ 69,731.87**			
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.										
Supplies	HD	WHOI Shop Services (Mech/Elec/Carp)		160	hr	$ 55	$ 8,800	Misc shop services		
Supplies	HD	Submersible & shop offload		1	lot		$ 4,000	Mobile crane for sub lift		
Supplies	EE	Old sphere storage materials		1	lot		$ 2,500	Tarps, load binders, penetrator and window hole covers		
Supplies	EE	Misc carpentry supplies		1	lot		$ 1,500	Misc jigs and fixtures needed for disassembly		
Supplies	EE	Misc electrical supplies		1	lot		$ 1,000	Battery chargers and HP air compressor cabling and connectors		
Supplies	HD	Stockroom		1	ea	$ 2,000	$ 2,000	Misc supplies, rigging		
		Subtotal Expense:		160			$ 19,800.00			
						Total:	**$ 89,531.87**			

Project: A-4500: Construction & Test **Work Package:** Refurbishment & Integration **Technical Lead:** Pat Hickey

Description: This work package includes all work required to teardown, service and reassemble all vehicle subsystems and components to be reused for the A-4500 HOV and includes unmodified frame inspection and repair, lifting tee inspection and repair, and life support system inspection and cleaning. The task also includes new hull bird cage component fabrication and installation, new skin fit ups, new foam fit ups, new main ballast system component fit up, new sphere to frame modification fit up, support of ABS survey inspections and testing as required, etc.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	LOE Driving Duration	Most Likely (Days)				Hrs per Key Emp	Comments
	FAB	Existing system refurbishment	75	750				180	Activities include, but are not limited to: teardown, servicing and reassembly of VB system, hydraulic system, Hg trim system, main battery tanks and cells, main ballast system components to be reused, unmodified frame inspection and repair, lifting tee inspection and repair, life support system inspection and cleaning, service and emergency system releases, Schilling manipulator service, ISE manipulator service, misc frame fixtures and bracket inspections and repairs, propulsion system teardown, servicing and reassembly, major system components testing, periodic ABS survey inspections and testing as required, etc.
	FAB	Integration	75	750				180	Activities include, but are not limited to: new hull bird cage fabrication and installation, new skin fitups, new foam fitups, new main ballast system component fitup, new sphere to frame modification fitup, ABS survey inspections and testing as required, etc.
	FAB	Training	4	40				10	WHOI ALOPS mandatory training for operations crew & SEOG personnel: new systems intergration and operation, existing systems modification and operations, existing systems review, general safety reviews, etc.
		Subtotal:	**154**					**369**	

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Korey Verhein	10.25	369	HR				
labor	EE	Donald B. Peters	0	0	HR				
labor	EE	Electrical Engineer	10.25	369	HR				
labor	EE	Mechanical Engineer	10.25	369	HR				
labor	EE	Mark Spear	10.25	369	HR				
labor	EE	Jeffery McDonald	10.25	369	HR				
labor	EE	Casual 1/2 Time	20	720	HR				
labor	EE	Griffith Outlaw	5.25	94.5	HR				
labor	EE	J. Pat Hickey	5.25	47.25	HR				
labor	EE	Richard S. Chandler	5.25	47.25	HR				
labor	EE	Michael Skowronski	10.25	46.125	HR				
labor	EE	Lane J. Abrams	5.25	23.625	HR				
labor	EE	Sean Kelley	10.25	46.125	HR				
labor	EE	David Walter	10.25	46.125	HR				
labor	EE	Anton Zafereo	10.25	46.125	HR				
labor	EE	Rodney M. Catanach	5.25	23.625	HR				
labor	EE	William Strickrott	10.25	46.125	HR				
labor	EE	Andrew S. Billings	5.25	23.625	HR				

Project: A-4500: Construction & Test **Work Package:** Refurbishment & Integration **Technical Lead:** Pat Hickey

		Subtotal Labor:	**154**	**3,056**			**$ 228,399.44**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
Supplies	HD	WHOI Shop Services (Mech/Elec/Carp)		250	hr	$ 55	$ 13,750	Misc shop services	
Supplies	HD	Outside services		1	lot		$ 378,112	Activities include but are not limited to: transportation of frame to New Jersey and additional frame inspections and repairs not included with frame modification, VB sphere NDT inspection services, VB sphere hydro testing, Schilling manipulator vendor servicing, fiberglass skin repair and painting, etc.	
Supplies	HD	Stockroom		1	ea		$ 2,000	Misc supplies, rigging	
Supplies	HD	Repair Parts and Equipment		1	lot		$ 5,000	Cabling, wire, compensation and hydraulic hose, piping and fittings, etc.	
Supplies	HD	Graphic Services and duplication		1	lot		$ 1,000	Services associated with work packages and documentation	
		Subtotal Expense:		254			$ 399,862.00		
						Total:	**$ 628,261.44**		

Project: A-4500: Construction & Test **Work Package:** Assembly **Technical Lead:** Pat Hickey

Description: This work package includes all efforts, planning, and documentation required to reassemble all components of the A-4500 vehicle and support periodic ABS survey inspections and testing as required. This task also includes completion and closure of all work package control documentation.

Basis of Estimate

Activity ID	Project Phase	Description	LOE Driving Duration	Most Likely (Days)				Hrs per Key Emp	Comments
	ST	Submersible Assembly	150	1500				359	Activities include, but are not limited to: install all skins and fairings, install all syntactic foam, install all internal sphere components, install main battery systems, install all VB system components, install all hydraulic system components, install mercury and mercury trim components, install all pressure housings and cabling, install all J-boxes and cabling, install all propulsion system components, install all science and submersible sensors, install new personnel sphere, install all other associated materials and fixtures to the bare frame, install manipulators, install viewports, install penetrators, periodic ABS survey inspections and testing as required, completion and closure of work package control documentation
		Training	4	40				10	WHOI ALOPS mandatory training for operations crew & SEOG personnel: new systems integration and operation, existing systems modification and operations, existing systems review, general safety reviews, etc.
		Subtotal:	**154**					**369**	

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Korey Verhein	10.25	369	HR				
labor	EE	Donald B. Peters	0	0	HR				
labor	EE	Electrical Engineer	10.25	369	HR				
labor	EE	Mechanical Engineer	10.25	369	HR				
labor	EE	Mark Spear	10.25	369	HR				
labor	EE	Jeffery McDonald	10.25	369	HR				
labor	EE	Casual 1/2 Time	20	720	HR				
labor	EE	Griffith Outlaw	5.25	94.5	HR				
labor	EE	J. Pat Hickey	5.25	47.25	HR				
labor	EE	Richard S. Chandler	5.25	47.25	HR				
labor	EE	Michael Skowronski	10.25	46.125	HR				
labor	EE	Lane J. Abrams	5.25	23.625	HR				
labor	EE	Sean Kelley	10.25	46.125	HR				
labor	EE	David Walter	10.25	46.125	HR				
labor	EE	Anton Zafereo	10.25	46.125	HR				
labor	EE	Rodney M. Catanach	5.25	23.625	HR				
labor	EE	William Strickrott	10.25	46.125	HR				
labor	EE	Andrew S. Billings	5.25	23.625	HR				

Project: A-4500: Construction & Test **Work Package:** Assembly **Technical Lead:** Pat Hickey

		Subtotal Labor:		**3,056**			**$ 228,399.44**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
Supplies	HD	WHOI Shop Services (Mech/Elec/Carp)		250	hr	$ 55	$ 13,750	Misc shop services	
Supplies	HD	Outside services		1	lot		$ 20,000	Activities include but are not limited to: transportation of frame to Woods Hole, oxygen cleaning services for life support system, mechanical and electrical calibration services	
Supplies	HD	Stockroom		1	ea		$ 2,000	Misc supplies, rigging	
Supplies	HD	Repair parts and equipment		1	lot		$ 5,000	Cabling, wire, compensation and hydraulic hose, piping and fittings, etc.	
Supplies	HD	Graphic Services and duplication		1	lot		$ 1,000	Services associated with work packages and documentation	
		Subtotal Expense:		254			$ 41,750.00		
						Total:	**$ 270,149.44**		

Project: A-4500: Construction & Test

Work Package: Hangar Test and Ship Mobilization

Technical Lead: Pat Hickey

Description: This work package includes all engineering, planning and documentation required to perform all post assembly hangar (dry) testing including complete end-to-end submersible systems ring out with fully-powered test (POELCO), closed-boat unoccupied habitability test, closed-boat occupied habitability test, and support of ABS survey and inspections as required. This task also includes return of support equipment and system spares from the temporary work and storage vans in High Bay to the support ship, setup of shops and stowage of system spares, and return tested submersible to support ship.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Weeks					Hrs per Key Emp	Comments
1	FAB	Hangar testing	14					42	Activities include, but are not limited to: complete end-to-end submersible systems ring out with fully-powered test (POELCO), closed-boat unoccupied habitability test, closed-boat occupied habitability test, ABS survey and inspections as required
2	FAB	System mobilization	28					83	Activities include, but are not limited to: return of shops from temp work vans in High Bay to support ship, return of all system spares from storage vans and High Bay to support ship, setup of shops and stowage of system spares, return tested submersible to support ship, etc.
3		Training	5					15	WHOI ALOPS mandatory training for operations crew & SEOG personnel: new systems integration and operation, at sea operations procedures review, requalifications as required, support ship general safety reviews, etc.
		Subtotal:	**47**					**140**	

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Korey Verhein	3.5	126	HR				
labor	EE	Susan Humphris	0	0	HR				
labor	EE	Electrical Engineer	3.5	126	HR				
labor	EE	Mechanical Engineer	3.5	126	HR				
labor	EE	Mark Spear	3.5	126	HR				
labor	EE	Jeffery McDonald	3.5	126	HR				
labor	EE	Casual 1/2 Time	0	0	HR				
labor	EE	Griffith Outlaw	2	36	HR				
labor	EE	J. Pat Hickey	2	18	HR				
labor	EE	Richard S. Chandler	2	18	HR				
labor	EE	Michael Skowronski	3.5	15.75	HR				
labor	EE	Lane J. Abrams	2	9	HR				
labor	EE	Sean Kelley	3.5	15.75	HR				
labor	EE	David Walter	3.5	15.75	HR				
labor	EE	Anton Zafereo	3.5	15.75	HR				
labor	EE	Rodney M. Catanach	2	9	HR				
labor	EE	William Strickrott	3.5	15.75	HR				
labor	EE	Andrew S. Billings	2	9	HR				
labor	EE	Andy Bowen	0	0	HR				
labor	EE	Chris German	0	0	HR				

Project: A-4500: Construction & Test **Work Package:** Hangar Test and Ship Mobilization **Technical Lead:** Pat Hickey

		Subtotal Labor:	**47**	**808**			**$ 69,731.87**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
Supplies	HD	WHOI Shop Services (Mech/Elec/Carp)		160	hr	$ 55	$ 8,800	Misc shop services following vacation of High Bay to return hangar to ready status	
Supplies	HD	Submersible & shop load		1	lot		$ 4,000	Mobile crane for sub lift	
Supplies	HD	Stockroom		1	ea		$ 5,000	Misc supplies, consumables	
		Subtotal Expense:		162			$ 17,800.00		
						Total:	**$ 87,531.87**		

Project: A-4500: Construction & Test

Work Package: Dockside Testing and Sea Trials

Technical Lead: Pat Hickey

Description: This work package includes all engineering, planning and documentation required to perform all tests leading to the acceptance and commissioning of the vehicle by the National Science Foundation for regular deep sea operations. This includes all dockside testing activities including, but not limited to: A-frame fit up, tethered powered system testing, inclination and stability tests, untethered surface propulsion testing, and departure and transit to Bermuda. This also includes all sea trial tests including continuation of shallow water test program, initial shallow water harbor dives, communications and obstacle avoidance testing, open water slope dive program to increasing depths, open water deep dive program to full service depth, culminating with ABS survey and inspections and certification class approval and certification of remaining pilots by test pilots.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	Man Weeks					Hrs per Key Emp	Comments
	ST	Dockside testing - Woods Hole	24					36	Activities include, but are not limited to: A-frame fitup, tethered powered system testing, inclination and stability tests, untethered surface propulsion testing, ABS survey and inspections as required, departure and transit to Bermuda
	ST	Sea trials - Bermuda	72					108	Activities include, but are not limited to: continuation of shallow water test program, initial shallow water harbor dives, communications and obstacle avoidance testing, open water slope dive program to increasing depths, open water deep dive program to full service depth, culminating with ABS survey and inspections and certification class approval. Certification of remaining pilots by test pilots.
		Subtotal:	**96**					**144**	

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Korey Verhein	4	144	HR				
labor	EE	Susan Humphris	4	36	HR				
labor	EE	Electrical Engineer	4	144	HR				
labor	EE	Mechanical Engineer	4	144	HR				
labor	EE	Mark Spear	4	144	HR				
labor	EE	Jeffery McDonald	4	144	HR				
labor	EE	Project Manager	4	144	HR				
labor	EE	Griffith Outlaw	4	72	HR				
labor	EE	J. Pat Hickey	4	36	HR				
labor	EE	Richard S. Chandler	4	36	HR				
labor	EE	Michael Skowronski	4	18	HR				
labor	EE	Lane J. Abrams	4	18	HR				
labor	EE	Sean Kelley	4	18	HR				
labor	EE	David Walter	4	18	HR				
labor	EE	Anton Zafereo	4	18	HR				
labor	EE	Rodney M. Catanach	4	18	HR				
labor	EE	William Strickrott	4	18	HR				
labor	EE	Andrew S. Billings	4	18	HR				
labor	EE	Andy Bowen	4	18	HR				
labor	EE	Chris German	4	18	HR				

Project: A-4500: Construction & Test **Work Package:** Dockside Testing and Sea Trials **Technical Lead:** Pat Hickey

labor	EE	Anthony Tarantino	4	18	HR				
labor	EE	Barrie Walden	4	18	HR				
labor	EE	Jonathan Howland	4	18	HR				
labor	EE	Don Peters	4	18	HR				
		Subtotal Labor:	**96**	**1,296**			**$ 135,931.68**		
Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.									
Supplies	HD	Various vendors		1	ea		$ 20,000	At-sea consumables	
		Subtotal Expense:		1			$ 20,000.00		
						Total:	**$ 155,931.68**		

Project: A-4500: Construction & Test **Work Package:** Sea Trials - Shoreside Labor (Options A,B,D) **Technical Lead:** Susan Humphries

Description: This work package is for shoreside team support during sea trials.

Basis of Estimate

*assumes 1/2 time

Activity ID	Project Phase	Description	LOE Driving Duration	Most Likely (Days)				Hrs per Key Emp	Comments
	ST	Sea Trials	4	40				108	
				0				0	
		Subtotal:	**4**					**108**	

Object Code	Type of Etimate	Item	Man Wks	Qty	Unit	Unit Rate	Cost	Apply to ACTY ID	Pricing Assumptions
labor	EE	Barrie B. Walden	3	108	HR				assumes 1 wk covered under typical overhaul budget
labor	EE	Donald B. Peters	4	36	HR				
labor	EE	Electrical Engineer	8	288	HR				
labor	EE	Griffith Outlaw	3	54	HR				assumes 1 wk covered under typical overhaul budget
labor	EE	J. Pat Hickey	3	27	HR				assumes 1 wk covered under typical overhaul budget
labor	EE	Jonathan C. Howland	4	18	HR				
labor	EE	Lane J. Abrams	3	13.5	HR				assumes 1 wk covered under typical overhaul budget
labor	EE	Matthew C. Heintz	4	18	HR				
labor	EE	Mechanical Engineer	8	36	HR				
labor	EE	Philip E. Forte	4	18	HR				
labor	EE	Rodney M. Catanach	2	9	HR				assumes 1 wk covered under typical overhaul budget
labor	EE	William N. Lange	4	18	HR				
labor	EE	Cruise leave adjustment					$ 33,237.00		see attached backup from Faith
		Subtotal Expense:		**644**			**$ 113,120.82**		

Expenses: Meals, Travel Domestic/International, Equipment, Supplies, Stockroom Supplies, Outside Services, Consulting Services, Shipping & Postage, Subcontracts, Computer Software, Repair & Maintenance, Communication.

							$ -		
							$ -		
							$ -		
		Subtotal Non Labor		0			$ -		
						Total:	**$ 113,120.82**		

Notes: this estimate assumes that a typical 2-week sea trial for 6 people will be covered by the overhaul budget. Therefore, this estimate included time beyond the 2-week period and those people who would ordinarily not participate in the sea trials.