



Jefferson Science Associates, LLC

# **300**

# **Scheduling and Budgeting**

**Project Control System Manual**  
**Revision 4**

## **300 Scheduling and Budgeting**

This chapter of the JSA Project Control System Manual describes the planning processes required to develop a practical project plan that can be implemented by the designated project team. The major goal of this planning effort is an integrated project schedule and budget. Schedule planning results in a schedule that describes the sequence of technical work and the task interdependencies necessary for a successful project outcome. Cost planning begins with the development of a cost estimate for all authorized work that eventually leads to the establishment of the project budget. Proper project planning ensures the amount of work to be accomplished, the time allotted to accomplish the project activities, and the resources required to complete the work scope are evenly balanced. Once the schedule and cost planning are concluded, the resultant plans can be merged to form a time-phased project budget that is seamlessly integrated with the network schedule. This resource loaded schedule and initial project budget are validated and approved as the Integrated Project Baseline which is endorsed by the project team as the Performance Measurement Baseline, a foundational element of earned value management. Meaningful earned value performance metrics enable better management insight and decision making to help keep the project on track.

## **301 Schedule Planning**

The objectives of schedule planning are to generate a reasonable schedule of work that leads to project completion, and to establish a schedule baseline that, when integrated with a cost baseline using resource loading techniques, will result in an Integrated Project Baseline for the project. The core of the schedule planning process is the Schedule Management System and its associated scheduling software. This system provides the requisite project management tools to plan and sequence project milestones and work activities, to assign resources to the activities, to monitor progress of activities toward project objectives, to forecast future schedule performance, and to provide the basis for earned value and performance calculations.

### **301.1 Schedule Management System**

- A. The Enterprise Suite consists of schedule and cost software packages that are part of the overall JSA Enterprise Project Structure. The central component to the Schedule Management System is the Enterprise Suite scheduling software. It is a powerful and flexible scheduling tool that is used to perform time analyses of logic network, maintain baseline and status information, prepare standard reports at regular intervals and special custom reports as needed, and provide the basis for earned value and performance calculations by seamless connectivity to the Cost Management System.



- Time analysis is the process of calculating the earliest start and finish dates and the latest start and finish dates of each activity, based on the duration of the activities, the logical relationships between them and the desired completion date of the project. In addition to these calculations, the scheduling software also determines free float (the amount of time an activity can be delayed without delaying subsequent activities), total float (the amount of time an activity can be delayed without delaying project completion as a whole), and the critical path (the longest path from the logic network start to finish and the sequence of activities with the least total float). Any delay in a critical path activity will extend the total project schedule.
  - For each work activity in the project schedule, the scheduling software maintains the early start, early finish, late start, late finish, and, after they occur, the actual start and the actual finish dates. Actual start and finish dates affect the remainder of the logic network by changing the early and late start and finishes of subsequent activities. Therefore, a time analysis is conducted after each status update. The scheduling software also maintains a separate file of baseline start dates, baseline finish dates and other baseline data in the schedule baseline. These baseline dates are not affected by actual starts and finishes. Instead they are retained for comparisons between planned and actual dates.
  - The scheduling software produces reports in three different formats (Gantt chart, logic diagram or in tabular format), and has flexible report generation routines. The use of relational databases and the manner in which the information is coded permit the creation of special reports. These are useful to assess the effects of various schedule alternatives, to extract portions of the project, or to select categories of milestones/activities for review.
- B. The scheduling group within the Project Management & Integration Division is responsible for administration of the Schedule Management System. This includes schedule preparation, horizontal and vertical integration of elements of the scheduling system, maintenance of schedule baselines, status reporting, and programming enhancements to the scheduling system. Information is obtained from all levels of project management in carrying out these responsibilities.



## **301.2 Schedule Development**

### **A. Baseline Milestones (Exhibit 6)**

The schedule planning process begins with the determination of the baseline milestones. These level 1 and 2 milestones with their planned dates form a master schedule for the project. This top-level schedule contains significant events and critical decision points that could affect the technical, schedule, and/or cost performance of the project. The baseline milestones and their associated definitions are mutually developed by the Jefferson Lab Project Manager and the Project Customer. They are re-examined and rescheduled, if necessary, during customer reviews. Based on the decisions by the Project Customer and the Project Manager, PM&I develops the baseline milestones schedule of planned and proposed dates for each milestone.

### **B. Intermediate Milestones (Exhibit 7)**

Once the baseline milestones schedule has been created, the next level of detail can be incorporated by designating the project's intermediate milestones. The intermediate milestones are level 3 and 4 elements and provide a secondary level of scheduling. These intermediate milestones are selected by the Project Manager and the Associate Project Managers.

### **C. Detail Milestones**

To complete the milestone schedule development, the Control Account Managers generate level 5 and 6 detail milestones, as needed.

### **D. Detail Schedule (Exhibit 8)**

The baseline milestones schedule, populated with the intermediate and detail milestones, serves as the framework to add work activities to the project schedule. The detail schedule is developed from the Control Account Plans created by the Control Account Managers (see section 303 Integrated Project Baseline Development). PM&I incorporates the schedule information contained in the Control Account Plans and builds a comprehensive schedule logic sequence within the Schedule Management System that includes the sequence, start and finish dates and duration of every work activity required to complete the project. The resulting detail schedule contains all project milestones, the work activities, and the logical ties between the various schedule elements. After subsequent refinement, this then becomes the schedule baseline of the project.

#### E. Working Detail Schedule

While the schedule baseline constitutes the performance standard against which actual progress is compared, the Working Detail Schedule is a working tool for evaluating schedule plans and projecting future progress. In order to preserve its value as a baseline, changes to the schedule baseline are carefully controlled and documented. On the other hand, the Working Detail Schedule is continuously revised as actual work activity status and completion dates are entered and their effects on future scheduled work activities are calculated. Consequently, this results in changes to early and late, start and finish dates that may no longer be consistent with the schedule baseline. These revised dates are used to forecast when detail, intermediate and baseline milestones will actually be accomplished, and to guide management corrective action.

### **302 Cost Planning**

- A. Cost planning is the other major planning activity required to develop an Integrated Project Baseline. The purpose of cost planning is to identify the resources needed to accomplish the scope of work and estimate the associated costs. Cost represents the dollar value required to accomplish the technical work scope within schedule and programmatic constraints. A preliminary cost estimate can be started after an initial Work Breakdown Structure is developed. Cost estimate integration with the WBS occurs when the work scope in each project work and planning package has a definitive cost/resource estimate associated with it. Once the cost estimate is approved at all management levels, it becomes the cost baseline, i.e., the project's budget.
- B. Elements of the cost estimate include both direct charges and indirect charges. Direct charges are costs applicable to, and identified specifically with, the project work scope. Examples of these types of costs include labor, travel, material, subcontractor costs, etc. Indirect charges are costs that cannot be consistently or economically identified against a specific Jefferson Lab project and are spread over the total laboratory project portfolio based on the JSA/JLab Cost Accounting Standards Disclosure Statement.

#### **302.1 Cost Management System**

The Cost Management System is an integral element of the Enterprise Suite software package used at Jefferson Lab. Initial budget data enters the Cost Management System via its link to the Schedule Management System. Direct and indirect actual costs are imported from the Lab's financial system. The Cost Management System, together with the Schedule Management System, forms an



integrated cost/schedule database that enables the project management team to understand a project's costs at the transaction level.

### **302.2 Funding Guidance**

At the start of project cost planning, the Project Customer may provide funding guidance to the Project Manager that may include a fiscal year breakout. The Project Manager can use the funding guidance to establish a project budget profile across the WBS Level 2. Target budgets are developed and distributed to the Associate Project Managers and Control Account Managers. This represents the Project Manager's guidance to Associate Project Managers and Control Account Managers when they develop the details of the cost estimate for their portion of the project. The Project Customer may elect to hold in reserve some funding from the total project cost as contingency funds. The Project Manager may withhold management reserve funds at the project level to account for any risk uncertainty that may arise during the execution of the project plan.

### **302.3 Cost Estimating**

A disciplined and systematic cost estimating process will promote integrity in a new project. As project performance will be measured against the project baselines, it is important that an accurate cost estimate be determined prior to the establishment of the cost baseline. This necessitates an extensive project management evaluation of the proposed project cost be accomplished. Multi-level dialogue among the Project Manager, the Project Management & Integration Division, Associate Project Managers, and the Control Account Managers will be required to reach consensus on a final cost estimate for the project. Areas can be identified where actions must be taken to restructure work scope or reassess resource requirements to meet anticipated fiscal year and total project funding constraints. Through validation of the cost estimate, a cost baseline can be established for the project. However, cost estimating is a continuous process conducted throughout project execution for refining future work costs.

## **303 Integrated Project Baseline Development**

- A. With any budget targets provided by the Project Manager, the Control Account Manager can start to develop his/her Control Account Plan. While the initial cost estimate for the control account may be a rough order of magnitude, the Control Account Manager will eventually make use of the Control Account Plan (CAP) sheet (Exhibit 9) to refine his schedule and cost estimate. As a control account will normally consist of multiple work packages, the Control Account Manager will use the CAP sheet to produce a



detailed plan for the work packages. Once completed, these series of CAP sheets will form the initial Control Account Plan.

- B. The Control Account Manager develops work activities to divide the work package into discrete manageable and measurable segments of work for the purpose of developing plans and determining progress. Each activity is sequenced in a manner that provides logical support for the project schedule. Work activities are at or below the reporting requirements such that earned value performance measurement takes place at the control account level.
- C. With the work activities identified in the Control Account Plan, the Control Account Manager estimates the resources (labor, expenses, and procurements) and the quantity (hours, dollars) required to accomplish the work activities. Labor resources are estimated according to various cost element categories, such as Plant Engineer, Mechanical Engineer, and Scientist, etc. Expense estimates are prepared for such items as supplies and materials, travel, and consulting. Labor and expense estimates are assigned to the month/fiscal year during which they will be used or expended. Estimates for procurements are also made and are assigned to the month/fiscal year in which payment is anticipated to occur. Dollar amounts for all cost estimates are entered in current year direct dollars. Once the resources have been identified and their costs estimated, a schedule of the work activities is developed with start dates, activity durations, and activity predecessors. Data from the Control Account Plan sheet is used to develop the initial Detail Schedule within the Schedule Management System as discussed in section 301.2 Schedule Development. Once this initial resource-loaded Detail Schedule is created using the Control Account Plan sheets, the Detail Schedule then becomes the basis for future development of the Control Account Plans.
- D. One essential product of the Control Account Plan is the identification of the types and levels of labor resources that must be provided by each functional organization supplying labor to the project. Summary reports showing labor requirements in support of work scope as documented in the Control Account Plans are prepared by Project Management & Integration and used by senior project management to assure the availability of such personnel when needed.
- E. At this stage in the planning process, three project baselines have been established: the technical baseline, the schedule baseline, and the cost baseline. The technical baseline, organized around a WBS framework, describes the desired configuration, performance, and characteristics of the project and establishes the project's mission, technical objectives, and functional requirements. The required work activities to satisfy the project's mission need are logically linked in a schedule baseline integrating the entire work scope while reflecting all programmatic constraints. The cost baseline is based on validated cost estimates developed for the project work scope and



ensures resources for labor, services, subcontracts, and materials are established at the requisite levels. In total, these three baselines produce the Integrated Project Baseline. The approved Control Account Plans that form the Integrated Project Baseline represent the life-cycle budget plan for accomplishing all of the project work scope.

- F. The Integrated Project Baseline lays the foundation through which project objectives can be achieved and progress can be managed and monitored during project execution. Data that form the Integrated Project Baseline are recorded in an integrated cost/schedule database using the Cost and Schedule Management Systems. These systems share the data to produce a resource-loaded schedule and time-phased budget plan.

### **303.1 Performance Measurement Baseline**

- A. After an in-depth review, the project management team validates the Integrated Project Baseline thereby establishing the Performance Measurement Baseline. This time-phased budget plan encompasses all the individual work activities of the control accounts with the dollars and resources necessary to accomplish them. Within the Performance Measurement Baseline, any budget not yet specifically identified with a control account may be held in the short term holding account Undistributed Budget. Undistributed Budget is a transient amount and should be allocated in a reasonably timely manner. The Performance Measurement Baseline sets the criteria against which actual performance is measured during project execution. This comparison process helps identify problem areas early and aids the development of a recovery plan.
- B. Earned Value Management employs three sets of project data to provide project management with insight into the progress of the project. From the Performance Measurement Baseline, the Budgeted Cost of Work Scheduled (BCWS) can be established. This metric represents the sum of the time-phased budgets established for all effort scheduled to be accomplished within a given time period. BCWS can be called “Planned Value.” At the project completion time point, the BCWS should equal the Budget At Completion (BAC). BAC is the budgetary goal for accomplishing all of the authorized work contained in the control accounts. While BCWS is derived from project planning, Budgeted Cost of Work Performed (BCWP, the second set of data) is determined during project execution. BCWP, or “Earned Value,” is the sum of the time-phased budgets for work completed during a specified time period; i.e., the value of the work accomplished. The third set of data, also collected during project execution, is Actual Cost of Work Performed (ACWP) or “Actual Costs.” Actual Costs are the project costs incurred and recorded in accomplishing the work performed (i.e., Earned Value) within a given time period. With these three earned value metrics, project



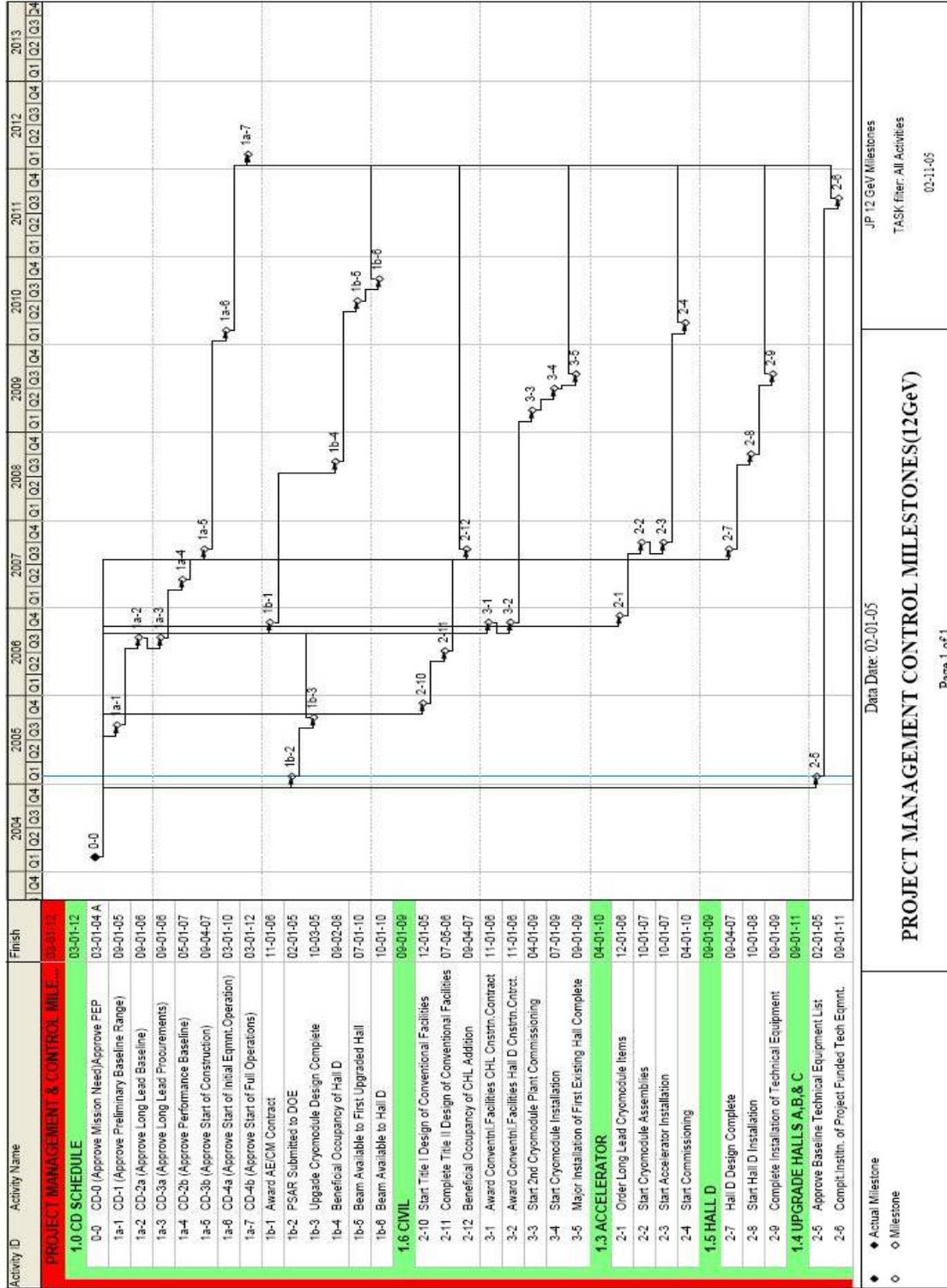
management can evaluate the status of the project in relation to the technical, schedule, and cost baselines established for the project. An Estimate At Completion (EAC) can be calculated that sums the actual costs incurred to date plus the estimate of costs for all authorized work remaining. Additional detail on Earned Value Management is provided in chapters 600 Progress Status and 700 Analysis and Reporting of the JSA Project Control System Manual.

### **304 Exhibits**

6. Baseline Milestones Example
7. Intermediate Milestones Example
8. Detail Schedule Example
9. Control Account Plan Sheet



Exhibit 6. Baseline Milestones Schedule Example



JP 12 GeV Milestones  
TASK Filter: All Activities  
02-11-05

Data Date: 02-01-05  
Page 1 of 1

PROJECT MANAGEMENT CONTROL MILESTONES(12GeV)

◆ Actual Milestone  
○ Milestone



Exhibit 7. Intermediate Milestones Schedule Example

Activity ID	Activity Name	Year																								
		2001			2002			2003			2004			2005												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
<b>SNS LAB Intermediate Milestones</b>																										
<b>Spallation Neutron Source Project</b>																										
1.1 Research and Development																										
1.1.1.1 Superconducting Linac R&D																										
1.1.1.1.1 Medium Beta Cryomodule R&D																										
SL1101RD16	M-B CM Procurement Package Complete																									
SL1101SC10	M-B SC - Design Complete SC10 Finish																									
SL1101SC21	Initiate Testing of Proto Cryomodule SC21 Finish																									
1.1.1.1.2 High Beta Cryomodule R&D																										
SL1101RD25	H-B CM Procurement Package Complete																									
1.1.1.1.3 RF Skid R&D																										
SL1101RD40	IPL - 10 kW RF Skid																									
SL1101RD41	IPL - 1 MW RF Skid Operational																									
1.4 Linac Systems																										
1.4.10 Medium Beta Cryomodule																										
1.4.10.4 Cavity/Cryomodule Assembly Labor																										
SL10040007	START PRODUCTION Mech/Beta CM																									
1.4.12 Cryogenic System																										
SL1200SC22	IPL - BOD Cryo Building																									
SL1200SC36	IPL - Cryosystem Cooldown (SC35 Finish)																									
SL1200SC86	IPL - BOD 600 MeV Linac Tunnel																									
SL1205CRFE	IPL - RFE Cryo Building																									
1.4.12.3 Control, Refrigerator & Cryomodule																										
SL12030006	IPL - Refrig Controls Operational																									
SL12030008	IPL - CM Controls Operational																									
1.4.13 SC Assembly Facility																										
SL1300SC40	IPL - BOD SRF Assembly Bldg SC40 Finish																									
SL1300SC66	IPL - SRF Facility Operational SC65 Finish																									
1.4.15 High Gradient																										
1.4.15.6 Process Development																										
SL15060100	805MHz Cavity Electropolishing Sys Operational...																									

Intermediate Milestones

- ◆ Actual Milestone
- ◇ Milestone

JP SNS Intermediate Milestones  
TASK filter: Milestone Level X.  
03-23-05



Exhibit 8. Detail Schedule Example

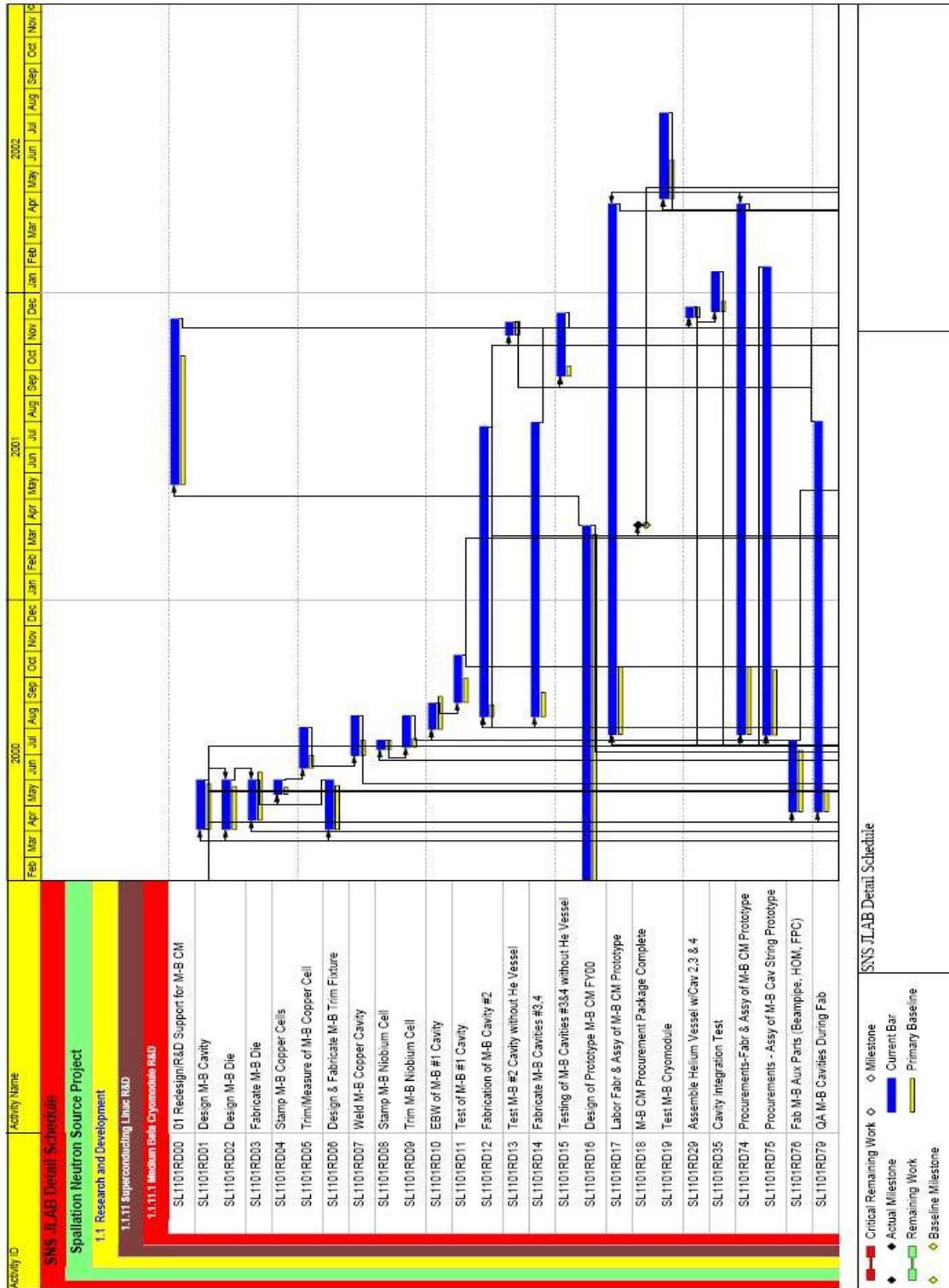




Exhibit 9. Control Account Plan Sheet

A	B	C	D	E	F	G	H	I	J	K	L	M	
Control Account Plan (CAP)												SAVE Buttons	
1	Project											SAVE CAP	
2	WBS	Cost Account Manager										SAVE / SUBMIT CAP	
3	CAM	Uploaded to Schedule										SAVE OFF NETWORK	
4	Description:	Cost Sheet / CAP Sheet Comparison Area											
5		Cost Sheet Total \$: Budgeted For	Labor	Expenditures	Procurement < \$50K	Procurement > \$50K	Cost Sheet Minus CAP Difference	CAP Total \$: Budgeted For	Labor	Expenditures	Procurement < \$50K	Procurement > \$50K	CAP Grand Total Cost
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37	STEP #1 Activity Description To read attached note, place cursor over this field (read note)	STEP #2 Enter Duration in Calendar Weeks (read note)	STEP #3 Select Resources Use multiple rows for multiple resources (read note)	STEP #4 Budgeted Labor Person Weeks (read note)	STEP #5 Budgeted Expenses / Procurement \$ (read note)	STEP #6 Predecessor Start Date (read note)	STEP #7 Planned Start Date (read note)	STEP #8 Meet Finish By Date (read note)	STEP #9 External Predecessor Link (read note)	STEP #10			
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CALCULATE Planned Start Date

VIEW Gantt Chart

EXPORT to Primavera