Guidelines for Developing a Schedule

What These guidelines serve as reference information for use in developing a resource loaded project schedule.

Why Using these guidelines during the process of schedule development can improve the ease of use with EVMS.

1 Glossary of Terms and Acronyms

CA – Control Account
CAM – Control Account Manager
CD - Critical Decision
CTC - Chargeable Task Code
DOE – U.S. Department of Energy
DTI – Desk Top Instruction
EV – Earned Value
EVMS - Earned Value Management System
FPD – Federal Project Director
KPP - Key Performance Parameters
LOE - Level of Effort
MS - Milestone
M&S – Materials and Services
PCS – Project Controls Specialist
PEP - Project Execution Plan
PM – Project Manager
PMB – Performance Measurement Baseline
PMT – Performance Measurement Technique
PO – Purchase Order
SVT - Schedule Visibility Task
WBS – Work Breakdown Structure
WP – Work Package

Control Account (CA) - A key management control point located at the natural intersection point of the WBS and the OBS, where functional responsibility for work is assigned. It represents the point at which budgets (resource plans) and actual costs are accumulated and compared to earned value for management control purposes.

Control Account Manager (CAM) – The member of the project team responsible for the performance defined in a Control Account and for managing the resources authorized to accomplish the tasks.

Schedule Visibility Task (SVT) – Activities in the schedule that help maintain the logical sequence of events, but do not directly impact the budget i.e. they do not have budgeted resources assigned to them.

Work Breakdown Structure (WBS) - A product-oriented grouping of project elements that organizes and defines the total scope of the project. The WBS is a multilevel framework that organizes and graphically displays elements representing work to be accomplished in logical relationships. Each descending level represents an increasingly detailed definition of a project component. Project components may be products or services. It is the structure and code that integrates and relates all project work (technical, schedule, and cost) and is used throughout the life cycle of a project to identify and track specific work scopes.

Work Package (WP) –Commonly defined as “a task or set of tasks performed within a control account”. However, this term is often confusing due to its use in various tools. For example, in Cobra, a WP, and its ID refers to a P6 Task and its “Activity ID”. This usage is acceptable in Cobra because in EVMS terms a WP is any level of activity below the Control Account. However, in P6, a WP is sometimes referred to as an element of the Work Breakdown Structure (WBS). Throughout this document, WP, Task, and Activity are interchangeable, synonymous terms and do not refer to a particular level of the WBS.

2 Intent of Desk Top Instruction (DTI)

The intent of this DTI is to provide further clarification of intent and direction found in Fermi Research Alliance Earned Value Management System (EVMS) procedures. It is expected that all Project personnel are first familiar and compliant with the EVMS procedures, and then seek clarification from the DTI. Compliance with the procedures is expected; therefore, if there are conflicts between procedures and the DTI, the EVMS procedures are to be followed. Some schedule considerations may not be identified or clarified in the DTI because they are adequately addressed in the procedures.

3 General Considerations for Structuring Schedule Activities for EVMS Compatibility

3.1 Project file name convention

Due to various software integration and data retrieval needs, it is important that each project maintain a consistent naming convention. The P6 file naming convention is addressed in the Guidelines for P6 and Cobra Integration and Integrity Check DTI (12.PM-004.DT-06).

3.2 Schedules at stages/phases of a project

1. Schedule complexity, detail, and requirements are driven by practical necessity appropriate for different stages or phases of a project. For Projects that fall into DOE 413 requirements, schedule development follows the requirements of the Critical Decision (CD) process. Pre-CD-2, the schedule development and use is often driven by research and development, and exploratory processes resulting in large uncertainties in scope and cost. During these early phases, it makes sense that the schedule is more fluid and less defined. For example, early in the CD process it is acceptable to have planning and work package activities with longer durations, higher estimate uncertainties, or coding that does not meet all coding requirements found in various sections of this DTI including: 3.4-Activity Duration, 5-Scheduling Different Types of Work, and 14-Code Fields.
2. Schedule developers prior to the CD-2 should be aware of the schedule requirements found in this DTI, which are needed to comply with establishing a PMB. A project in the early phases of its life cycle should ensure that the schedule is developed in a way that minimizes changes needed to bring the schedule into compliance with CD-2 requirements. Pre-CD-2 schedules should be developed and organized so that they can easily evolve into CD-2 compliance.
3. As the project nears CD-2, the plan and scope of the project are more defined, which should result in a more defined schedule. As the project gets within six months, but no later than three months, of the CD-2 review, the project's plan, scope, and cost should be defined and compliant with FNAL EVMS policies. This DTI is written to address good scheduling practices that need to be in place prior to a project's CD-2 review and the project PMB being established.

3.3 Activity ID

Activity IDs are one of the key codes used in FNAL's EVMS tools. The Activity ID is integrated from P6 into Cobra's WP field. The Activity ID is the code field that links all codes, dates, resources, and progress between the two programs. Because of this relationship, the Activity ID must not change or be deleted in P6.

Activity ID Considerations:

1. Use caution in attempting to build "Smart" IDs
    a. Limit the intelligence in activity IDs
    b. Do not think of the ID as a means for sorting or grouping; other code fields are more appropriate
    c. "Smart" IDs can cause extra keystrokes when another coding field could be used

   d. Utilizing the ID as a quick link to WBS or other codes can quickly break down due to schedule evolutions
2. Avoid "." in the Activity ID because Cobra may treat the Activity ID as a hierarchical relationship. The use of periods can also cause issues with Excel export/import functions.
3. Use Capitalized Alphanumeric Coding
   a. Using Alphanumeric IDs reduces the likelihood of Excel treating the code as a number. When exporting schedule or information from P6 to excel, excel could treat the Activity ID as a number and not text, which may result in dropped leading or trailing digits, particularly when "." is used.
   b. Alpha characters must be capitalized. There have been issues of Cobra not recognizing non-capitalized characters in the P6 activity ID.
4. Cobra limits the Activity ID length. Do not use activity IDs longer than 23 digits.
5. Remember, once you establish a baseline in Cobra, the Activity ID must be maintained for the life of the project.
6. The Activity ID is only a reference number, make its use easy for everyone.

3.4 Activity Name

ANSI 748 EVMS Guideline 10, Create Work Packages, Planning Packages, states that "Work package descriptions must clearly distinguish one work package effort from another." In order to comply with this requirement and avoid debate with reviewers, the following applies to FNAL schedule Activity Names:

1. Resource Loaded activities must be unique. Don't use two activities with identical names. Differentiate similar work efforts by identifying what distinguishes each from other activities. For example, first lot, units 100-200, or FY15 PM.
2. Cobra is limited to 70 characters, so plan names carefully.
   a. Using Acronyms where practical will help meet the character limitation.
   b. Activities not integrated into Cobra can have longer names.
3. Should identify the scope of work being performed.
4. Should start with an action verb i.e. Perform, Complete, Install, etc.
5. Should be easily understood and convey enough information to the CAM and others to understand what the activity will deliver.

3.5 Activity Type

Activity types used in FNAL schedules are:

1. Start Milestone
2. Finish Milestones
3. Level of Effort - Not to be confused with the PMT. In previous versions of Primavera, this activity type was called a Hammock.
4. Task Dependent

Activity types NOT used in FNAL schedules are:

1. Resource Dependent
2. WBS Summary

3.6 Duration Type

Duration types used in schedules can affect how resources react to changes in duration, units or rates. Each of these duration types has a purpose, but caution should be exercised when selecting the duration type for activities. Here is a brief summary of the duration types. It is most appropriate to use Fixed Duration and Units or Fixed Duration and Units/Time in FNAL activities, based on FNAL not using Resource Dependent or WBS Summary activity Types.

1. Fixed Duration and Units - Choose Fixed Duration & Units if you want the activity duration to remain constant and the units/time to change. This type is used when the activity is to be completed within a fixed time period and the total amount of work is fixed. You most often choose this duration type when you are using task dependent activities.
2. Fixed Duration and Units/Time (Rate). Choose Fixed Duration & Units/Time if you want the activity duration to remain constant and the remaining units to change. This type is used when the activity is to be completed within a fixed time period regardless of the resources assigned. You most often choose this duration type when you are using task dependent activities.
3. Fixed Units - Choose Fixed Units if you want the activity units to remain constant when the duration or resource units per time change. This type is used when the total amount of work is fixed, and increasing the resources can decrease the activity duration. You most often choose this duration type when you are using resource dependent activities.
4. Fixed Units/Time (Rate) - Choose Fixed Units/Time if you want the resource units per time to remain constant when the activity duration or units change. This type is used when an activity has fixed resources with fixed productivity output per time period. You most often choose this duration type when you are using resource dependent activities.

3.7 % Complete Type

The Percent Complete type is very important in EVMS because it is directly tied to the Performance Measurement Technique (PMT) used.

1. Duration - To specify that the activity's percent complete be calculated from the original or planned and remaining durations, select Duration. In this case, Activity % Complete = Duration % Complete = (Original or Planned Duration – Remaining Duration) / Original or Planned Duration.
2. Physical - To indicate that the activity's percent complete will be entered by the user for this activity, select Physical. In this case, Activity % Complete = Physical % Complete.
3. Units - To specify that the activity's percent complete be calculated from the actual and remaining units, select Units. In this case, Activity % Complete = Units % Complete = (Actual Labor Units + Actual Nonlabor Units) / (Actual Labor Units + Actual Nonlabor Units +Remaining Labor Units + Remaining Nonlabor Units).
4. Note that when using P6 steps, each step will also generate a summation of predetermined weighted or entered % Complete.

3.8 Measurability

1. It is essential that schedule activities represent a measurable and quantifiable scope of work. That is, determination of the percent complete of any given activity should be straightforward and objective. For example, a given design activity might be measured by the number of drawing sheets completed versus the total number expected.
2. Despite the need and desire to identify measurable criteria for all work scope, some activities do not have measurable deliverables. Non-measurable activities are referred to as Level of Effort (LOE). Project Management support is an example of an LOE activity; not to be confused with Activity Type *Level of Effort*.
3. Understanding how to measure percent complete will be used to establish which PMT will be associated with the activity. For a further understanding of PMT see the EVMS procedures and PMT DTI (12.PM-004.DT-04).

3.9 Activity Duration

Discrete activities must have defined, objective means of measuring progress. Otherwise, activities should be limited to two months' duration, because EVM metrics are generated on a monthly basis. If an activity spans several months, and no progress criteria are defined for the intermediate months between start and

finish, then the activity relies on subjective criteria. Subjective progress status is unreliable, inaccurate, not defendable, and results in misleading data and poor decisions.

Use of resource loaded activities with durations less than a month should be minimized, due to the effort required to maintain versus the value added to management. Acceptable short duration activities include review tasks, uncosted procurement actions (e.g., Issue PO), obligations, milestones, and Schedule Visibility Task (SVT).

Activity Duration Considerations:

1. The preferred duration of each activity is one to two months.
2. If a maximum of a two-month duration cannot be achieved, then interim progress milestones, steps, or a progress tracking matrix should be specified for the activity.
3. Durations of less than a month on resource loaded activities should be minimized. They should be reconsidered and grouped with other logical working activities, when practical/appropriate.
4. CAMs should have 85% or higher confidence that the durations in the schedule can be accomplished in the time assigned and with the resources assigned. This makes the schedule slightly aggressive but still realistic. The 85% confidence in duration can be determined by creating a 3 point estimate for the activities (optimistic, pessimistic and likely durations), and then running a Monte Carlo analysis.

3.10 Responsibilities

If different groups handle a certain scope of work, separate activities for each group should be created so the progress of the individual groups can be monitored and managed. Different groups may consist of differently funded entities, universities, companies, and laboratories. Different groups do not refer to different FNAL departments.

3.11 Funding Source

Though the concept of funding is technically independent of EVMS, FNAL's accounting system requires each Chargeable Task Code (CTC) to have a single funding source. Therefore, there must be separate activities for work scope funded by more than one source.

4 Work Breakdown Structure (WBS) and Dictionary

1. The WBS provides the high-level framework for organizing the schedule. A WBS is hierarchical in nature and is organized following the scope of work to be performed in each level and area of the WBS, which is described in the WBS dictionary. The WBS must extend at least as low as the Control Account level. The activities in the schedule should represent the complete scope of work and typically exist within the most discrete (i.e., "lowest") level of the WBS. Because of parent/child accounting system limitations, a WBS category that is associated with a particular CTC may not contain any WBS sub-categories that are associated with any other CTC. See Project WBS, OBS, RAM 12.PM-001 for more details.
2. The WBS Dictionary description must be at each level down to the Control Account, at a minimum.
3. The WBS Dictionary description contains a brief description of the scope or statement of work and defined deliverable(s). Some projects may include the scope assumptions and exclusions.
4. The WBS Dictionary description can exist in a notes field in the schedule file or a separate file, depending on the PM's preference. Regardless, the WBS structure must be defined as a code in Cobra to allow various reports to be produced.
5. The WBS in P6 and Cobra need to match to ensure accurate integration of data.

5 Scheduling Different Types of Work

5.1 Design

1. An individual design activity may be used if its duration spans two reporting periods or less. If the design work is expected to take longer than two reporting periods, the design activities should be divided into separate activities that have measurable deliverables (such as design requirements, models, drawings sets, specifications, etc.). An alternative method is to have a single activity for design with steps for the interim design deliverables. These steps would each be weighted according to the difficulty, complexity, etc.
2. Include activities or milestones for all internal and external reviews. The set of reviews is to be defined by project management or Engineering/Design procedures.

5.2 Procurement Activities

There are templates for various sorts of procurements, with a decision tree available to tell the CAM/PCS which template should be employed. However, templates must not be used without the CAM thinking through and adjusting each task regarding the particular item being procured, or without consultation with the Procurement Department. Regardless, procurement activities should follow the guidelines below.

1. Consult with the Procurement Department when defining procurement schedules.
2. Define the criteria that trigger the start of the procurement process. For example, triggers could be the completion of a design, a design verification test, or a review.
3. Ensure that adequate time is allocated in the schedule to prepare a bid package, organize a source selection process (if applicable), process the requisition, prepare the purchase order, solicit and analyze bids/proposals, award the contract, and include all the approval steps.
4. Determine whether procurement personnel will charge to the project budget or recieve funding from another source.
5. Structure activities such that both an Obligations Profile and budget/cost profile for EV can be established.
6. Activities should reflect if progress payments are required or if phased shipments/receipts are part of the PO. The goal is for the budget to match the contract payment schedule, and for earned value to align with actual costs when the contractual event has been achieved. This will avoid timing related EVMS variances. It will also help make good accrual decisions during monthly status/costing cycles.
7. If applicable, include reviews such as procurement reviews and production readiness reviews as activities or milestones in the schedule.
8. Prior to the completion of schedule development, the procurement department (e.g. project procurement liaison) should complete a review of the schedule to validate procurement durations.

5.3 Fabrication/Assembly

1. If the activity describes production of multiples of the same item, e.g., 70 boards or 1000 PMT boxes, then one activity per product can be used, provided other good scheduling practices are used (i.e., proper duration and logic). In this case, status progress as a % complete, based on the number of units complete divided by total number of units.
2. As an alternative to having unit-based activities, activities can be split into batches.
3. Unit or Batch Production activities should have enough defined sequencing and appropriate durations, to allow successor actions to occur following a defined and logical time frame. For example, rather than wait for a full production cycle to complete, plan for small one month batches to complete then start successor actions (such as testing shipping, assembly etc.) . Using properly defined durations and logical sequencing will avoid the less desirable, but too often used, Start to Start relationship with a lag off of production to successor action activities.
4. Scheduled shipping activities must be considered for units or batches that need to be shipped to another location for the next step, such as testing.

5. Accrual/cost considerations must be made for Fabrication/Assembly activities to align with the status/costing cycle.

5.4 Testing Activities

1. If testing of a component or system is required for acceptance, a separate activity should be added to track and progress the testing, especially if there are multiple items that require testing.
2. Account for the probability of rework in the testing plan and risk register. Rework can be planned as separate activities or built into the test activities, depending on the anticipated testing success rate.

5.5 Reviews

Project Management should outline a series of reviews specific to their project. Below are examples of review sequences that can be part of a complete project schedule. Although the examples below are very specific, the principles should be considered and applied to various review activities the project may plan for.

1. **Design Review** - (This may be a separate activity or included as part of a Readiness Review.)
    a. Internal – Reviewers from Project/Collaboration
    b. External – Reviewers are not part of the Project/Collaborations, but reviewers may be from internal and external to the Lab.
2. **Pre-production Review** – activity(s) should be added for when parts/components/systems are transitioning from an R&D prototype phase to the fabrication of the pre-production version of the part/component/system. This activity is to ensure all the lessons learned during the prototyping phase are incorporated into the design specs and drawings used to fabricate the preproduction version. Also, if the fabrications are being done internally or by another institution, activities should include verification that the shop or factory is properly setup and managed prior to the pre-production of the part/component/system. A separate milestone can be added to track the completion of the review.
3. **Production Review** – activity(s) should be added for when parts/components/systems are transitioning from a pre-production phase to the fabrication of the production version of the part/component/system. This activity is to ensure all the lessons learned during the pre-production phase have been incorporated into the design specs and drawings used to fabricate the production version. Again, if the fabrications are being done internally or by another institution, activities should include verification that the shop or factory is properly setup and managed prior to the production of the part/component/system. A separate milestone can be added to track the completion of the review.
4. **Construction/assembly Review** – activity(s) should be added for when parts/components/systems are transitioning from a production phase to the Construction/assembly phase. This activity is to ensure all the lessons learned during the production phase has been incorporated into the design specs and drawings used to construct the deliverable version. Again, if the constructions/assemblies are being done internally or by another institution, activities should include verification that the shop or factory is properly setup and managed prior to the final product construction/assembly. A separate milestone can be added to track the completion of the review.
5. **Operational Review** – activity(s) should be added for when final product transitions from the construction/assembly phase of the project to the operational phase, where the product is operated and maintained by the pre-agreed Division/Department. This activity is to ensure all the lessons learned and documentation during the construction/assembly phase have been incorporated into the final specifications, drawings (as built), and operations manuals, and that these documents are ready to or have been turned over to the operating organization. A separate milestone can be added to track the completion of the review. The output of this review is a package that contains a checklist of the documentation to be turned over to the operating organization, with all the documents attached or the document #s stored for retrieval in a document control system.

5.6 Installation and Commissioning Activities

Often the degree of required commissioning is defined by the project's Key Performance Parameters (KPPs) in the Project Execution Plan (PEP) developed in conjunction with DOE. The project schedule will, at a minimum, represent those installation and commissioning activities required to achieve the KPPs.

5.7 Closeout/Turnover Activities

Activities associated with the Closeout Phase of the project should be included in the schedule. Some closeout scope will be defined in a project's Transition to Operations plan document. Other activities include closing out project accounts and producing final documentation.

5.8 Documentation Activities

Activities related to completion documentation should be included in the schedule (e.g. software/firmware final documentation, as built drawings, maintenance requirements, and procedures, etc.)

6 Schedule Integrity

6.1 General

The guidelines for schedule integrity below are viewed as good scheduling practice. Though they may seem difficult to accommodate at first, they are essential for maintaining the schedule integrity, performing what-if analysis, and risk analysis.

6.2 Network Logic

Since a project schedule must have a continuous flow of activities from the start of the project through the end, it is important to consider what events will trigger the start of each activity. Logically driven schedules improve the visibility of issues, critical path analysis, risk analysis, and provide a better management tool.

Network Logic Considerations:

1. All activities must have predecessors except for the very first task (project start milestone). All activities must have at least one successor, except the very last task (project complete milestone).
2. WBS Summary tasks are not to be used in FNAL EVMS schedules because they have no logical predecessors and successors but are driven by their sub-WBS tasks. They add no value to an EVMS schedule, generally clutter the schedule, and create surveillance fodder.
3. Types of relationships include Finish to Start (FS), Finish to Finish (FF), Start to Start (SS), and Start to Finish (SF). Normally 90%+ are FS, if tasks have been discretely-enough defined.
4. Activities that help maintain the logical sequence of events, but do not directly impact the cost (i.e. do not have budgeted resources) are allowed in the schedule. These activities are referred to as Schedule Visibility Tasks (SVT).

6.3 Activity Constraint Dates

While the number of constraints should be kept to a minimum and mainly used for external milestones, customer requirements, and the start and end date of the project, there are instances where the project may need to add additional constraints to more accurately reflect the scheduled work. In circumstances where the project uses constraints on activities or milestones, the Project Controls Specialist (PCS) should review the constraints and document a written justification for the use of each constraint in the P6 notebook. Acceptable additional uses of constraints can be:

1. Manual scheduling adjustments to activity start dates to assist in the most optimal use of critical resources. This assumes the schedule float is large enough to accommodate the changes (delays) in the start of the activity with no negative impact on the project schedule.
2. Identification of external constraints for events outside the scope of the project that have an impact on the progression of the project and are required before the project activities can start/finish.
3. BCR approval or another constraint to hold a specific baseline date.

Other constraint considerations are:

1. Hard constraints are Mandatory Start, Mandatory Finish, Start on, and Finish on. The use of hard constraints should be extremely limited (generally no more than 2, for project start and project completion).
2. Examples of soft constraints are Finish On or After, Finish On or Before, Start On or After, Start On or Before, and As Late As Possible. The Number of activities with soft constraint dates should be minimized.
3. Provide documented justification for the use of each constraint in the P6 Notebook "Constraints and Assumptions".

6.4 Lags

The use of lags is often an indication of not understanding the required logic needed to complete work or a hopeful or reactive attitude of management. For example, a manufacturer or subcontractor has given assurance that a product will be ready 60 days after the purchase order has been placed. The CAM may be tempted to use a 60 day lag between placing order and receiving goods. However, this action appears to take the oversight opportunity away from the CAM and places it on the hope the supplier will deliver. In this case a SVT for the CAM to ensure supplier is on schedule to deliver the product would be more appropriate. To encourage management action, removal of hidden activities is encouraged and lags are discouraged in FNAL schedules. However, proper use of lags is allowed. An example of proper lag use is predetermined automated or inherent processes such as concrete cure time. Even in this case the cure time can be represented by a SVT, which is preferred. When using lags follow these guidelines.

1. Most lags are better represented with an SVT that describes the reason for the lag, such as "vendor fabricates devices." Take careful thought on how to show proactive management of desired lags and replace them with SVTs when appropriate.
2. If a CAM requests SS lag between tasks, it is likely the predecessor task should be split, into that part of the task which must occur before the potentially lagged activity can start, and that part which can occur contemporaneously with the potentially lagged activity.
3. When applicable, use positive (+) Lags, and only when an SVT is not appropriate.
4. Negative (-) Lags, a.k.a. "Leads" should not be used except for unique circumstances. Leads are usually indications of not giving the necessary sequence of events proper consideration. This poor scheduling technique is obvious when we look at the activity with lead on the successor, which generally does not have an appropriate logic tie. The lead activity is often tied arbitrarily to unassociated activities or milestones simply to tie loose ends or prevent logic loops. Leads also have increased potential for false critical paths and other inappropriate logic-driven issues.
5. Provide documented justification for any activities with leads/lags in P6 Notebook "Constraints and Assumptions."

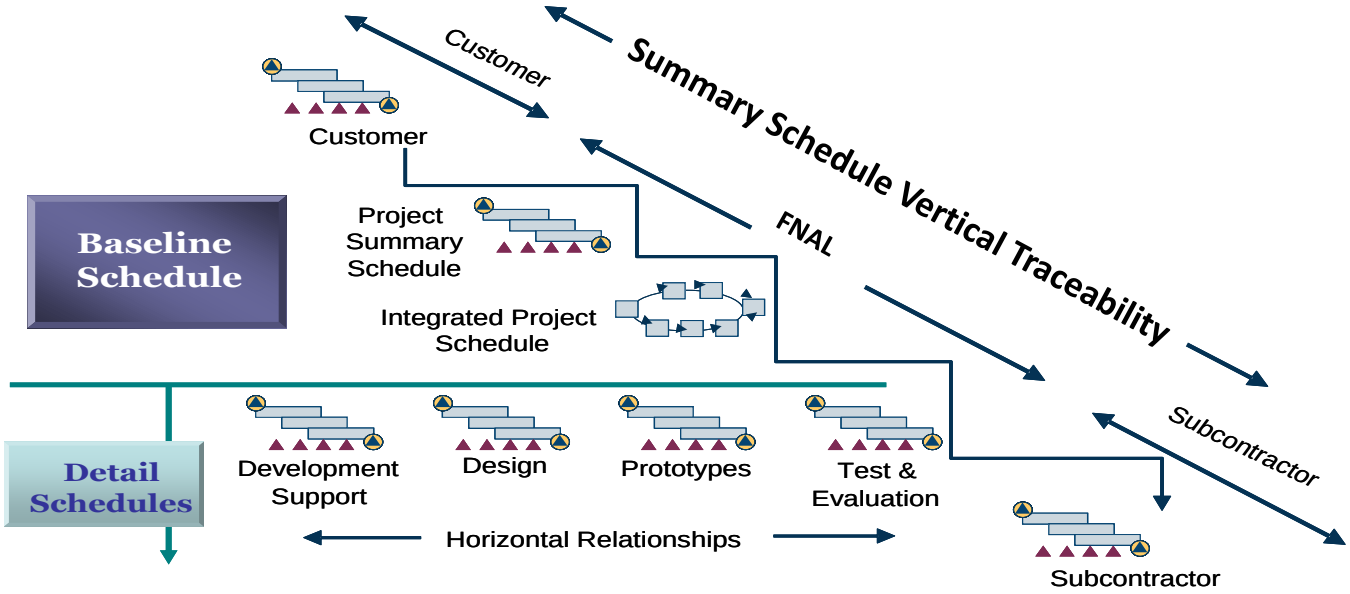
6.5 Work Calendars

Except for special cases, use the standard OPSS calendar, which is a five day work week (M-F) and includes Fermilab holidays as non-working days (Name: Standard 5 Day Workweek w/Basic Holidays).

6.6 Horizontal and Vertical Traceability

All activities necessary to complete the project's work scope must be scheduled. Some scheduled activities may be outside of the project's P6 schedule; however, this scope must have appropriate milestones or activities that reflect efforts and dependencies provided by others. Once all scope is scheduled, activities must be traceable to the source plan such as customer, subcontractor, or FNAL schedules.

1. Vertical traceability ensures the client, project, control account, work packages schedules are in sync.
2. Horizontal traceability ensures interdependencies between control accounts and work packages are accounted for.



7 Resource Loading

1. The Fermilab Standard Resource list should be used.
2. Labor resources should be assigned in increments of hours.
3. If equipment is a limited resource (e.g. bonding machine), then equipment resources can be assigned in the schedule to ensure over allocation of the equipment does not occur.
4. When known, and at the appropriate level of commitment, the individual performing the resource's work can be identified in the P6 "Role" field on the resource assignment.
5. To prevent issues with Cobra, once a resource has been integrated into Cobra and the baseline established, the resource should not be deleted. Consult with FNAL Project Controls Manager or Cobra administrator if further direction is needed.

8 Milestones

Since Milestone are a critical element of the EVMS schedule and may include client and management visibility through tiers and PEP requirements, a more in-depth guidance has been written on the subject (see Desktop Instruction #12.PM-004.DT-03). However, minimal guidance includes:

1. Each major deliverable should have at least one "completion" milestone
2. Milestones should be zero duration, zero work, and zero cost
3. Like any other activity, milestones should have at least one predecessor and at least one successor, with the exception of Project Start and End milestones.
4. Specify the milestone type appropriately (i.e. "Start "or "Finish "milestone). Note: While the present version of P6 will allow inappropriate relationships to a milestone (e.g., a FS predecessor to a Finish Milestone), reviewers and the P6 schedule log may identify such relationships as concerns.

5. Assign an appropriate milestone tier code value to each milestone.

9 Milestone (MS) Dictionary

1. Verify a MS dictionary entry exists for each milestone in the schedule.
2. The MS Dictionary is a description of the requirements that define the completion of each milestone. (Example: 100 prototype ASICs have been tested and accepted for use.)
3. The MS dictionary should contain information regarding tier level, requirements, and agreements per FPD and PM, such as original float between tiers, which MS are PEP/PMP required.
4. The MS Dictionary may exist in a note field or UDF (Milestone Description, Milestone Description Continuation) in the schedule file, or a separate file may be used to track the Milestone Dictionary. It is the PM's decision to pick the preferred tool used to create and maintain the Milestone Dictionary.

10 BOE (Basis of Estimate)

BOEs are a critical element of the RLS development, and in-depth guidance has been written on the subject (see Guidelines for Cost Estimation and BOE development DTI 12.PM-003.DT-01). However, minimal guidance relating to the schedule includes:

1. The EVMS schedule should include the appropriate BOE files or references to the controlled BOE documents using hyperlinks, UDFs, or Notebook entries.
2. Verify that the BOE exists at the appropriate level. The BOE should be documented at the lowest level of the schedule (work package). However, this does not mean separate BOE files need to be generated for each task/WP (i.e. multiple tasks can roll into one BOE).
3. Verify Resources loaded into the schedule are traceable to BOE documentation and match the labor hours and non-labor dollars specified in the BOE.

11 Float

1. **Total Float** is the amount of time an activity can be delayed or lengthened before it affects the Project Finish Date
2. **Free Float** is the amount of time an activity can be delayed or lengthened before it affects the next activity that follows it.
3. By definition, activities on the critical path have zero (or negative) total float. Note: negative float is not allowed in the baseline schedule.
4. It is important to continuously monitor available float, especially total float of the project and free float on milestones and high risk activities.

12 Resource Leveling and Total Float reduction

1. Often the first pass at developing a RLS will result in periods having over allocation of human resources, high obligation periods, or budget profiles that cannot be met by the available funding. Resource leveling is the process of adjusting the schedule to balance demand for resources and budget with the available supply. Resource leveling is to be performed using informed judgment rather than automated resource leveling by a scheduling tool. Total float reduction is the process of ensuring the schedule is not too optimistic and provides freedom to CAMs to prioritize work efforts.
2. Activities default to start as early as possible (a.k.a. Early Start dates) in P6. This results in some activities with large amounts of float. Cobra uses early dates to establish baseline dates for WPs. If activities with large float are left at their earliest start dates, they will likely not start as scheduled resulting in EVMS schedule variances.
3. Tools used to analyze the need for resource leveling include
    a. FTE histograms by month to determine if the FTE count from month to month is fairly flat or at least is without abrupt and unrealistic increases or decreases each month.

   b. Total Float analysis to identify activity sequences with potentially unrealistic start dates. Activities with total float over 3 reporting periods will receive less attention from a CAM as they focus on more critical activities. Float analysis coupled with FTE histograms will help determine potential activities for resource leveling.

4. The following resource leveling and total float reduction process can help establish a more realistic estimate of the project completion date and help prevent unnecessary schedule variances.
   a. Start by looking for missing or incorrect logic and fix any errors.
   b. Run the project schedule risk analysis prior to resource leveling or total float reduction, which may introduce constraints into the schedule that will skew the risk analysis results.
   c. Identify activities contributing to high FTE spikes to determine work that cannot be accomplished due to over extention of that resource. Determine if the work scope is related and missing logical ties, and correct as appropriate. If the work could proceed in parallel, determine what the logical priority is and ensure the sequence reflect the priority (priority can be determined by amount of float or other factors).
   d. Add appropriate logic ties that move activities, but do not add new predecessor relationships to fiscal year pegs, or relationships to other work, when there is no logical relationship required by the nature of the tasks. Making false relationships will only complicate the schedule and cause work to move with the unrelated work.
   e. Add SVTs as needed to move activity sequences. The SVTs should have enough information in the description to identify the reason for their addition. Good descriptions will aid in their status and control.
   f. Add a constrained milestone to move activity sequences. Like SVTs the MS should have enough information in the description to identify the reason for its addition. Good descriptions will aid in status and control. The activities could be constrained without the MS, but there is less visibility with notes than descriptions. Although, any constraint should be documented as described earlier.
   g. Ensure efforts in step d-f did not inadvertently, unintentionally, or adversely affect other areas of the schedule. Then repeat steps c-g until desired results are obtained
   h. After resources have been appropriately leveled, look for activities with float greater than three reporting period. These activities are candidates for further refinement by following steps d-g.
5. As desired, remove the constraints and SVTs applied in resource leveling and total float reductions in the working version of the schedule. Removing the constraints will allow the CAMs to see what work they can perform if resources allow. Ensure CAMs can differentiate which activities must be done and which are discretionary by displaying float and dates between PMB target and working schedules.

13 Schedule Contingency

The method of building overall project contingency into the schedule:

1. First the schedule developers build a reasonable schedule using the criteria outline in this DTI and EVMS procedures.
2. Ensure 85% or higher confidence that the durations in the schedule can be accomplished in the time assigned and with the resources assigned.
3. Ensure DOE and Project tier milestones reflect float per agreement between FPD and PM, such as float between CD-4 Fed tier MS, FPD MS, and Project MS.
4. After the schedule is verified and calculated, the difference between the Federal tier CD-4 MS and Project CD-4 MS establishes the overall project contingency.

The method of building other schedule contingency or margin into the schedule:

1. Ensure overall project contingency has been established and critical path is known.

2. Ensure resource leveling and total float reduction has been performed.
3. Analyze areas of the project with high float and determine if these areas should have the float reduced to allow increased focus on more critical activities. The activities that meet this criteria are targeted areas.
4. Reduce float in one targeted area by using constraints on milestones or lead activities to set start dates. Note that prudent reduction of float must be used by maintaining some amount of float and not simply scheduling to late dates.
5. Ensure efforts in step 4 did not inadvertently, unintentionally, or adversely affect other areas of the schedule. Then repeat steps 3, 4, and 5 until desired results are obtained.

Working with and monitoring schedule contingency:

6. As desired, remove the constraints applied in creating contingency float in the working version of the schedule. Removing the constraints will allow the CAMs to see what work they can perform if resources allow. Ensure CAMs can differentiate which activities must be done and which are discretionary by displaying float and dates between PMB target and working schedules.
7. Monitor the date variance between the key milestone (as determined by the PM) dates in the baseline vs. the dates in the working schedule. The change in date variance is then monitored from one reporting period to the next to determine if the project is generating or using schedule contingency.

14 Code Fields

There are several Activity and User Defined Fields (UDF) available in P6. Some code fields must be populated for EVMS purposes while others are not.

1. Required Coding: The Coding Requirements table below guides EVMS coding. Note that any fields that are fed to Cobra are controlled and can only be changed upon approval, using the Baseline Change Request process.

2. Other Coding
   - i) Activity Codes not mentioned in the Coding Requirements table are discretionary and used for reporting purposes only.
   - ii) UDFs are created for the sole purpose of sorting and reporting different aspects of the schedule and are created and maintained at the discretion of the PM or lead Project Controls Specialist (PCS).

Coding Requirements

P6 Code Name	Cobra Code Name	P6 Code Type	Description	Finish/Start Milestones	Activities with Resources	Obligations	Activities without Resources	Notes	
Chargeable Task Code	CTC	Global Activity Code	The lowest level at which work will be charged.	No	Yes	Yes	No	All activities assigned a specific CTC can have only one control account and fund type. However, there can be multiple CTCs under a specific control account; minimally, one for each fund type.	Cobra Required Minimium / Cobra Imported
Cobra PMT Code	EVT	Global Activity Code	Earned Value Method that will be used to take performance.	No	Yes	No	No	Examples include A = LOE, C = % complete, K = planning package, etc.	
Control Account	CntrlAcct	Global Activity Code	WBS level identified as the control account by the project.	No	Yes	Yes	No	It must be established in the Cobra *CntrlAcct.BDN* code table. This code is the **key code field** to integrate data from P6 to Cobra and is used for PARSII CA fields.	
Control Account Manager	CAM	Global Activity Code	Control Account Manager ID	Yes	Yes	Yes	Yes	Assigned to every activity, except Obligations. It is optional on obligation tasks. It is used for OBS in PARSII.	
Cost Class 1	*Classes*	Global Activity Code	Budget code, primarily used to separate Obligation/commitment required on purchase order items.	No	Yes	Yes	No	It categorizes base estimate costs for reporting purposes in Cobra.	
Cost Class 2	*Classes*	Global Activity Code	Contingency code associated with Cost Class 1	No	Yes	Yes	No		
Cost Class 3	*Classes*	Global Activity Code	Forecast code associated with Cost Class 1.	No	Yes - See Notes	Yes - See Notes	No	It is required if forecast is manually integrated from P6 to Cobra.	
Estimate Type	Est Type	Global Activity Code	Used to determine estimate quality or maturity.	No	Yes	No	No	It is assigned based on the estimating procedure.	
Funding Type	Fund Type	Global Activity Code	identifies the type of funding associated with the specific tasks	No	Yes	Yes	No	All tasks within a chargeable task code must have the same funding type.	
WBS	WBS		Work Breakdown Structure	Yes	Yes	Yes	Yes		
BCR #	BCR Number	Global Activity Code	Used in conjunction with the BCR Change Type when an activity is touched by a BCR.	Yes	Yes	Yes	Yes	It identifies any activity affected by the BCR being prepared. This field is blank except when processing a BCR.	BCR Only
BCR Change Type		Global Activity Code	Used in conjunction with the "BCR #" code. It identifies the type of change that's occurring on a specific activity.	Yes	Yes	Yes	Yes	Assigned to all activities affected by a BCR. This field is blank except when processing a BCR. It does not go into Cobra	
Change Note		UDF	Log change specifics; prefaced by the BCR#	Yes	Yes	Yes	Yes	OPTIONAL use in conjunction with BCR# and BCR Change Type	
Duration Uncertainty		Global Activity Code	used by Primavera Risk Analysis (PRA) tool	No	Yes	No	No		Risk Codes
Maximum Duration		Activity UDF	used by PRA	No	Yes	No	No		
Minimum Duration		Activity UDF	used by PRA	No	Yes	No	No		
Max. Resource Quantity		Resource UDF	used by PRA for units of Materials & Services	No	Yes	No	No		
Min. Resource Quantity		Resource UDF	used by PRA for units of Materials & Services	No	Yes	No	No		
Procurement Activity		Global Activity Code	The code "Y" is used on obligation and purchase order cost (delivery) activities	No	Yes	Yes	No	The code allows activities to be filtered for Gantt charts and reports for the procurement office, and so Cobra can produce reports of M&S items filtered or ordered by any of the procurement characteristics.	Procurement
Procurement #		Activity UDF	Record purchase order #, FY, or Fund Type associated with a specific procurement	No	Yes	Yes	No		
Procurement Type		Activity UDF	Record the type of procurement	No	Yes	Yes	No	See 12.PM-004.DT-03 for more information	
Milestone Tier		Global Activity Code	assigned to all milestones and will identify which tier the milestone is associated with.	Yes	No		No		Milestone Only
Cobra_WBS		Activity UDF	temporarily holds the control account code for activities which are not integrated into Cobra (milestones and zero resource activities)	Yes	No	No	Yes	Prior to upload into PARSII this code is copied into the Control Account code field.	PARS II Only
Agency-Funded Laboratory		Global Activity Code	Identifies the recipient of funding from the funding agency	No	Yes	Yes	No		Special Coding
Performing Institution	Perform Lab/In	Global Activity Code	The laboratory or university performing the work.	No	Yes	Yes	No	This code is used, in part, to identify scope for MOUs and annual Statements of Work. Note: Resources from multiple institutions can be assigned to a task; the Performing Institution is that which is actually performing the work--either the Funded Institution or one which has received an MOU or Purchase Order for the work.	
Responsible Institution	Resp Lab/In	Global Activity Code	The laboratory or university responsible for performing the work or procuring the work from a vendor.	No	Yes	Yes	No	This code is used, in part, to identify scope for MOUs and annual Statements of Work. Note: Resources from multiple institutions can be assigned to a task; the Performing Institution is that which is responsible for the work--either the Funded Institution or one which has received an MOU or Purchase Order for the work.	
LOE Anchors & Major Milestones		Global Activity Code	used by Mu2e to identify activities that are the starting point for the Driving Critical Path/Major Milestone report	Yes	No	No	No		
Project Phase/Operational State		Global Activity Code	used to classify activities by phase, relative (typically) to DOE Order 413 Critical Decisions.	No	No	No	No		
Responsible Person	Resp Person	Global Activity Code	used for the name of a person, other than the CAM, who has direct management responsibility for an activity.	No	Yes -See Notes	No	Yes - See Notes	Optional code	
EDIA Reporting Category	EDIA	Global Activity Code	Used for annual DOE report, according to categories on DOE "EDIA Survey 2."	No	Yes	No	No	The EDIA Survey 2 report categorizes Engineering (which includes scientific effort), Management, ES&H and Construction/Fabrication. Note: "EDIA" used by FESS is a division by engineering, design, inspection and administration.	Annual Update or as Requested
BCR History		Activity UDF	A place to record all BCRs that affected the activity						Optional User Defined Fields
BOE Docdb #		Activity UDF	Reference the project DocDB or other depository for the Basis of Estimate						
BOE Ver #		Activity UDF	Reference the project Basis of Estimate version						
Milestone Description / Milestone Description Continuation		Activity UDF	Milestone description					In conjunction with a Milestone Dictionary layout, provides a quick report versus the P6 Notebook	
PMT		Activity UDF	Description of the Cobra PMT code					No longer needed since PMT Code legend can be applied to header	
Resource Information		Activity UDF	May be used to report back resource IDs and the quantity for each						

15 Schedule Analysis Techniques

Analysis of working and baseline schedule is important to ensure schedule integrity and proper data flow form P6 and Cobra. This section covers general considerations of schedule analysis techniques. For an in-depth EVMS analysis including P6 and Cobra tools please refer to Guidelines for P6 and Cobra Integration and Integrity Check DTI # PM.12-004-DT-06.

1. During Schedule Development:
   - View the critical activities (with zero float) to verify that the critical path represented in the schedule is sound.
   - Perform a Float Analysis looking for negative float. If negative float exists, then it is probably caused by a constraint date on an activity. A baseline schedule should not have any negative float.
   - Run reports that show the number of missing relationships, lags, and constraints. Ensure that all schedule activities have predecessors and successors, except project start and project finish. Ensure that activities with constraints and lags have proper and documented justification.
   - Analyze the number of open activities per reporting period by Level 2 manager or CAM to determine if the number is something that seems to be manageable. The appropriate number will be based on the individual manager and the nature of the work.
2. During Schedule Status:
   - Trend baseline schedule changes over time. This can be accomplished by making backups/copies of the original baseline schedule file and each revised baseline schedule (i.e., BCR) file. These files should be saved in a repository that is under configuration management.
   - Perform an analysis of float on the key milestones, as defined by the PM. For each reporting period, compare the float for key milestones to the prior month. A threshold should be established by the PM which identifies the trigger point of float change (i.e. increase or decrease in the number of days or % change) that would trigger a written explanation for the change.
   - Perform analysis of completion dates of key milestones. For each reporting period, compare the difference between the baseline completion date and the forecast completion date for the key milestones. A change in the forecast completion date from the last reporting period should be highlighted and explained.
   - Trends over several reporting periods can be analyzed to give PM “heads up” about potential critical path issue, etc.

16 Document Revision History

Date	Version	Author	Description
06/01/2006	1.0	Dean.A.Hoffer	This is the initial release of this document.
10/27/2015	2.0	Rich Marcum	General updates to every section