Guide 1.8

Schedule Planning and Development (DRAFT Rev 3)

1.0 Purpose

This guidance describes various scheduling techniques used by WSRC to document, integrate and status project requirements and performance in support of the E11 Project Management Control System.

Implementation of this guidance document will provide the project team timely, pertinent, and objective management information to promote team understanding of, and commitment to, cost and schedule objectives and program baselines. Monitoring, statusing and facilitating analysis of the schedule will create awareness of potential problem areas and synergize solution development by facilitating team communications. The schedule is the project navigator to support informed management decision-making process. Project strategies and areas of concern are communicated to the project team through the schedule development and update process.

This guidance will also address the methodology to be utilized to issue schedules for review, approval, and implementation for controlling changes.

2.0 Scope

This guidance applies to all work scope as defined by the Project Management and Control process.

3.0 Terms/Definitions

(See Glossary of Terms, Definitions and Acronyms)

4.0 Scheduling Standards

The Project Management and Control process consist of interrelated processes and standards. These are as follows:

- standard scheduling software
- standard site-wide schedule code structure
- Project Work Breakdown Structure
- Schedule Networks (CPM scheduling technique and a single project database)

A. Use of a Standard Scheduling Software

Common standard scheduling software facilitates horizontal integration of project schedules by allowing separately maintained portions of a schedule (a single project scheduling database) for different responsible individuals or organizations to interface between the separate logic-legs and still maintain consistent schedule dates for those interfacing activities.

The use of standard scheduling software also facilitates vertical integration of the database by electronically summarizing and rolling-up scheduling details, dates and durations; and resource data for the lowest level of activity detail to the highest level.

The standard site approved scheduling software is Primavera Project Planner for Windows (P3), as described in the Site Controls Guidance Document 3.20, “Standardization”.

B. Use of Standard Site-wide Schedule Code Structure

Schedule coding structures are used to establish subdivisions and groupings of activities within the scheduling database. Different coding structures cannot be electronically merged (integrated). A standard site-wide schedule code structure allows horizontal and vertical schedule integration for site, business unit, and functional organization reporting. Separately maintained schedules can be electronically merged with minimal manual conversion or intervention.

C. Use of the Project Work Breakdown Structure (PWBS)

The PWBS is referencing the executable level of the WBS, below Level 3 of the Site WBS which is not controlled by DOE. It serves as the standard, hierarchical structure into which the scheduling database and its contents are to be organized, subdivided, and grouped. Each of the WBS elements may be contained in a single activity or multiple activities within the scheduling database.

The WBS provides the framework for identifying the project commodities and components. Each should be assigned to one element in the WBS. At the lower detail levels this will produce the first cut of the project schedule of activities, typically in or supported by a CPM network. Utilize this CPM network to validate commonality and interdependencies of the WBS elements. The project schedules should be built around the WBS, Cost Accounts and Work Packages. Schedule activities at the detail levels should not cross work packages or cost accounts. This allows for vertical roll up capabilities with Scope, Cost and Schedule.

The change control process must be followed to authorize any revisions, additions, or deletions to the Project WBS. The Project Execution Plan (PEP) will identify what level of change control approval is required before the CAM can implement the requested WBS change.

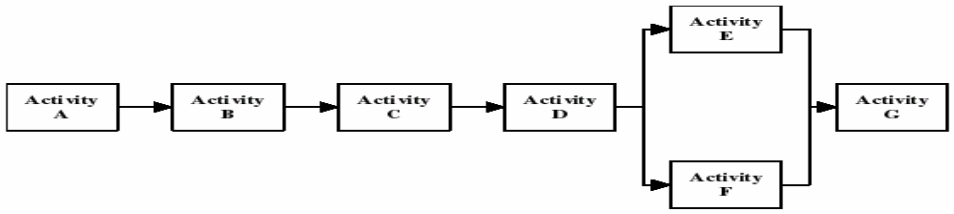
D. Use of Schedule Networks

The scheduling database is the logical representation of all the activities in a project showing their dependency relationships. It determines the timing of operations in the project. The Project Schedule will determine the specific start and completion dates for the project and all project activities. It is the prime tool used to communicate the status of the Project to the project team.

1) The importance of the scheduling database:
    a) Depicts the project's scope of work
    b) Improves the probability for the project team to meet its goals.
    c) Establishes overall schedule parameters.
    d) Aids in determining staffing requirements.
    e) Resource loading basis.
    f) Identifies long lead items
2) Scheduling Requirements include:
    a) Include logical ties for activities
    b) Include all key milestones and deliverables
    c) Reflect the agreed to project baseline
    d) Integrate with the cost baseline

3) Scheduling Technique

Precedence Diagramming Method (PDM) scheduling technique is the site-approved method of constructing a logic network using nodes to represent the activities and connecting them by lines that show logical relationships.



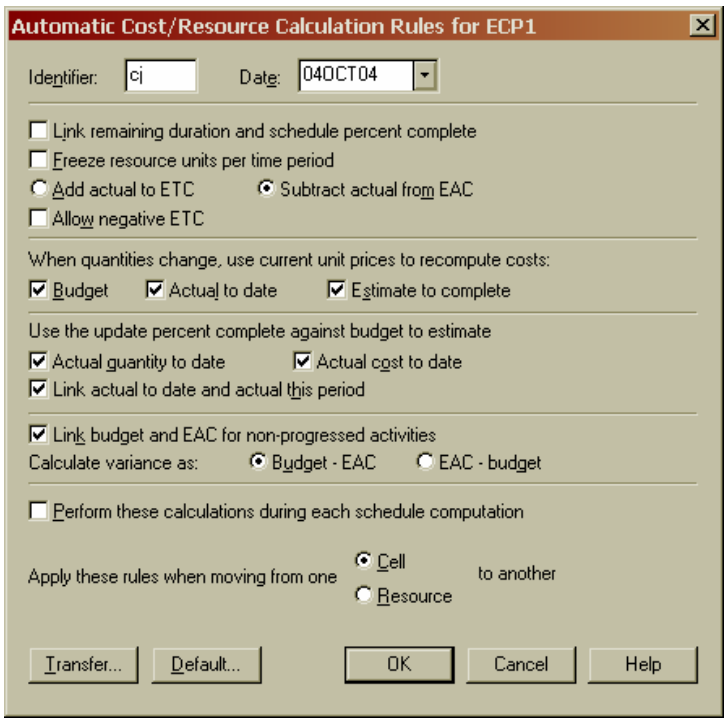
4) Critical Path Method (CPM) Analysis

The critical path is the longest continuous path of activities through a project that determines the project completion date. A delay in one activity delays other activities and the project as a whole. Any activity on the critical path is called a Critical Activity.

The Critical Path Method uses activity durations and relationships to calculate schedule dates. This calculation requires two passes over the activities within a project; forward and backward pass. Once this calculation is performed the total float and free float for each activity is calculated. Generally, the first, second and third paths are analyzed for potential project impacts.

5.0 Software Conventions

A. Automatic Cost/Resource Calculation Rules (AutoCost)



The Project Management Control System's AutoCost Rules are established to import data into various schedules for the purpose of integration. The autocost rules control units and costs when editing or importing data into the project.

There are 2 rules that must be strictly enforced for each project, otherwise use the best rules to fit your scheduling needs. Those 2 rules are:

- Do not link remaining duration and schedule percent

  By keeping this selection clear, this indicates that the activity's remaining duration does not accurately reflect its percent complete. P3 calculates the finish date using remaining duration, ignoring percent complete. The earned value and actuals are calculated by P3 using percent complete, ignoring remaining duration.

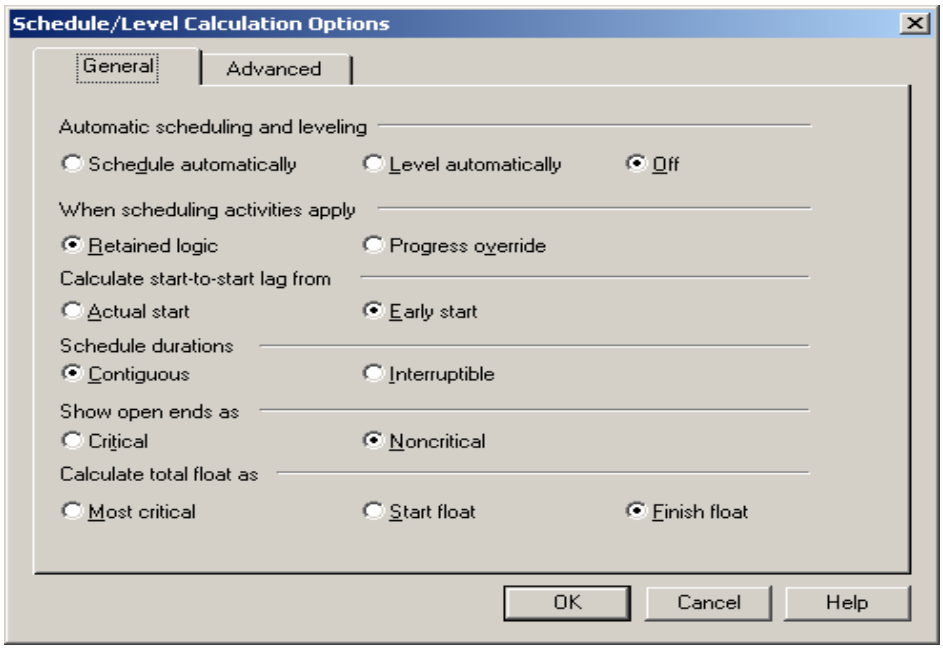
- Link budget and EAC for non-progressed activities

  A nonprogressed activity is any activity that does not have an activity percent complete, resource percent complete, actual to date, or actual start date. By selecting this rule, the budget is set equal to the EAC as long as the activity has no progress. To change the EAC and the budget before work begins, change either of the two variables; P3 will automatically change the other to match the edited value.

Once your set the Autocost rules at the start of a project, you should not change them. These calculations are sensitive to the variables you update. Remember; if you must change the rules, you must recalculate using the new rules, especially those activities you have already updated will not immediately reflect the new rules. Mark 'Perform These Calculations During Each Schedule Computation' checkbox and calculate the schedule. Upon completion of recalculation the schedule, clear the checkbox.

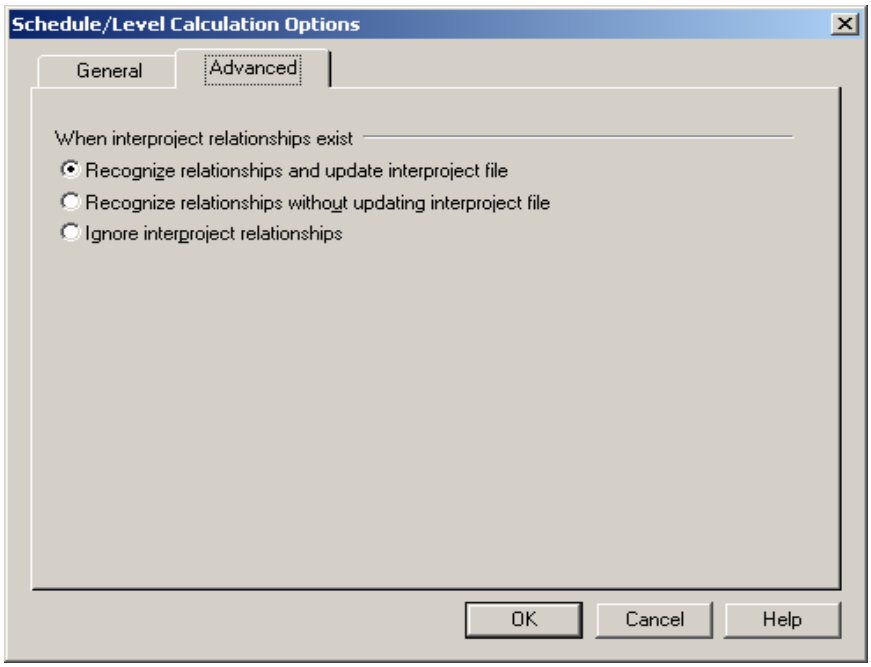
B. Schedule Calculation Options

On item #2 – Select Retained Logic



Retained logic or progress override logic affects a schedule only if one or more activities show out-of-sequence progress. Retained logic requires that an out-of sequence activity cannot resume unit all predecessors finish.

Select Item #1 on Advanced Window – select Recognize relationships and update interproject file.



Using this selection, P3 will recognize relationships between activities from different project groups when scheduling and updates activities in the current project as well as in the project group.

6.0 Planning

A. The major components of a plan will:

1) Identify the Project GOALS
2) Encompass the Scope of Work.
3) Define the Project Execution Plan (PEP)
4) Incorporate decisions that can influence the future.
5) Form a sequence of activities with which the Project Goals can be accomplished.

B. The first steps in the planning process are the development of the work breakdown structure (WBS), and the organizational breakdown structure (OBS). The integration of WBS and OBS is the creation of the responsibility assignment matrix (RAM).

C. Elements of Planning

1) Scope Definition
2) Execution strategy
3) Regulatory Requirements

4) Identifying / Defining the activities & milestones necessary
5) Level of detail
6) Discipline integration
7) Identifies the resources required and cost.

D. Source Documents for Project

1) Statement of Mission Need
2) Project Execution Plan (PEP) and/or Team Execution Plan (TEP)
3) KASE Plan
4) Risk and Opportunity Management Plan
5) Estimate (BDER and Single Value)

7.0 Introduction

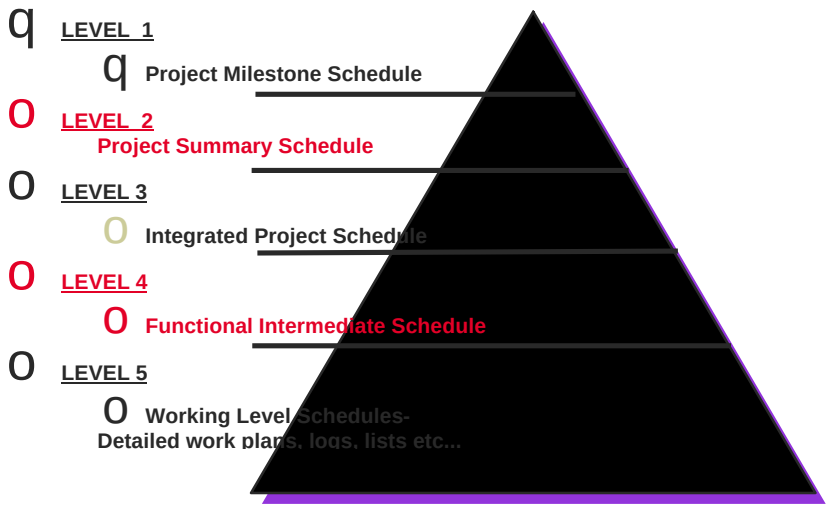
A project maintains a scheduling database which is a logical sequence from the project level of the WBS to working level tasks. All schedules support baseline dates. Detail and working level schedules are to be used for internal use only. At a minimum, a project should contain a Project Milestone and Project Summary Schedule for monitoring and reporting project status.

The scheduling system should provide current status and forecast of completion dates for scheduled work. As work progresses, forecast dates different than baseline dates for milestones are expected and generate variances that are a key element of performance measurement and analysis. In addition, completion of activities and milestones must be objectively determinable.

A. Schedule Hierarchy

Schedules are organized in a supportive hierarchy to satisfy the various levels of planning and scheduling detail that are required at each level of the organization for monitoring and control of activities during the different phases of the project. The schedule hierarchy becomes the basis for planning and scheduling work activities, monitoring, evaluating deviations, and exercising schedule controls. Monitoring and updating the most detailed schedules are performed first and then summarized upwards to the higher level schedules.

It is essential that the hierarchy of schedules relate to each other. Schedule traceability (vertical integration) and schedule interaction (horizontal integration) are achieved through selected milestones which appear on all schedules downward through the hierarchy from the Milestone Schedule to the working level. In addition, the incorporation of the Work Breakdown Structure also ensures that horizontal and vertical integration is attained within the scheduling database.



LEVEL I – Project Milestone Schedule

The Project Milestone Schedule is a list of the major milestones of a project with their corresponding scheduled dates which portrays the total project scope. The major milestones include Project related Control milestones, KASE milestones and support milestones recommended by the Project Team. This is normally illustrated in a time phased Bar Chart format (logic relationships not displayed) and is usually one page.

The entire project scope is defined in this scheduling level. Typically, this will be used for client and senior management reviews.

LEVEL II –Project Summary Schedule

A Project Summary Schedule identifies the major activities, interface points, and duration estimates for the completion of the project. It shows all interfaces as defined by the Project Milestone Schedule by the vertical integration of the schedule hierarchy and includes all major milestones. The entire project scope is defined as it supports the Project Milestone Schedule. This level schedule usually consists of approximately 50 activities.

LEVEL III – Integrated Project Schedule (IPS)

The Integrated Project Schedule expands the Level II schedule to specifically identify project activities and their associated logic ties. This intermediate level schedule provides a comprehensive plan and schedule for each functional organization. It reflects interrelationships between disciplines as well as schedule relationships to other organizations associated with the project. It shows all interfaces relative to the functional organization as defined in the Project Summary Schedule by vertical integration of the schedule hierarchy. It includes all Major and Other Functional Organization Milestones to be completed for the entire project's scope. This level schedule usually consists of approximately 250 activities.

LEVEL IV – Functional Intermediate Schedules

The Functional Intermediate Schedules are an expansion of the Level III schedule representing details at the deliverable level. These detailed schedules are the working level schedules, prepared by the functional organizations for the scheduling of individual work packages and tasks. Vertical integration of the schedule hierarchy provides traceability to more summary levels

of the hierarchy. The schedules reflect Interrelationships between internal disciplines as well as schedule interfaces and constraints with other organizations, contractors and subcontractors associated with the project. The schedules also show all milestones for which the organization is responsible, and the activities shown on the schedules relate to specific control accounts except where the close interactions between activities are better represented as a single activity, e.g., pulling wire for different systems through a common raceway or cable tray.

Major engineered components or items selected by the Project Manager as warranting special schedule attention are individually scheduled in the Functional Intermediate Schedules. Procurement activities for other components and materials may be summarized on the Functional Intermediate Schedules based on the Procurement Detail Schedules.

Each functional group has the option to resource load their portion of the schedule. Generally, this is done to identify critical project resources only; specifically for identifying specific skill-mix requirements for successfully completing upcoming project commitments.

Typically this level schedule has detail activities for approximately 6 months with or without summary level activities for the remaining functional organization's scope of work.

LEVEL V – Working Level Schedules - Detailed work plans, logs, lists, etc.

Working Level Schedules are prepared when necessary. This level schedule is an extremely detailed schedule that identifies specific daily activities and/or the individual(s) who will perform them. As schedule deviations occur, this schedule incorporates the corrective action decisions and results. The corresponding activities are summarized and evaluated against the baseline reflected in the Functional Intermediate Schedules. These detail schedules may also be generated for support unique situations or to provide specific information for management planning or control, called 'Specialty Schedules'.

Engineering typically use control logs to monitor design work and equipment procurement activities. Several distinct, task-oriented logs may be used to list and schedule products (e.g., drawings, specifications, equipment procurements).

Construction Detail Schedules are field generated and contain work activities expanded from the Construction Intermediate Schedule. These schedules are normally generated for a "window" of time covering a rolling two-to four-week period. Construction Detail Schedules also include construction/startup punchlists used to identify, schedule, and monitor remaining or corrective work items. For example, the content of the 4 Week Lookahead Schedule reflects 2 weeks of history, the current work week, and 3 weeks ahead. This scheduling level maybe manually created and maintained; the use of scheduling software is optional.

Procurement Detail Schedules are developed by the Engineering CAM for engineered components and by the Construction CAM for the field and bulk material items. Procurement Detail Schedules are prepared consistent with installation dates established by the construction baseline schedule.

B. Milestone Traceability

Milestone traceability is provided through the used of coded milestone numbers which are applied to Control Milestones and WSRC selected major milestones. These code numbers allow the milestone to be traced vertically to the next upper or lower level schedule on which it appears. As a minimum, each project should have a Project Milestone Dictionary that lists all control milestones pertinent to the project. The Standard Project Milestone Dictionary is a generic listing of milestones common to all projects within the applicability of the E11 Manual. These milestones

are recognized by the Department of Energy at SRS (DOE-SR) and should be selected for use by the project when applicable. Horizontal traceability is achieved through the logic network in the Project Master and Intermediate Schedule. (See Attachment Milestone Guidance within this manual).

C. Capital Project Line-Item Overview

Various levels of schedules are created at different project phases, the scheduling details are directly associated with the available project details. The risk and complexity of the project are the determining factors as to how the project team will depict details. As a project progresses and strategies and scope are better defined so are the details within the various scheduling levels. The following is a guidance indicating when these various scheduling levels are developed and the maintenance required for Line-Item Projects only.

1) Before Key Decision CD-0, “Approve Mission Need”

The Project Milestone Schedule (Level I) and the Project Summary Schedule Level II are the only 2 schedules used during the project phases for Up-front Planning and Pre-Conceptual. Generally the Project Summary Schedule is the first schedule developed by the team in support of early project key decisions. During the early project phases, each activity for this schedule level will be resource allocated to reflect the project budget, excluding all contingencies. A Credible Low Case and Credible High Case Project Summary Schedule are developed and submitted for CD-0. However, the Credible Low Case Schedule is the schedule controlled by the project team for trending and change control purposes. This baseline schedule is for internal use only. A schedule contingency is run for each credible case and incorporated into both the BDER and the schedule.

During the Pre-Conceptual Phase, the Detail Conceptual Design schedule is developed to support Key Decision, CD-1 Approve Preliminary Baseline Range. Activities are to be developed to identify all steps required to support the development of the Conceptual Design Business Decision Estimate.

Once the lower level schedules are developed the upper tiered schedules are revised to incorporate any changes; becoming summary versions of the detail schedules.

2) Before Key Decision CD-1 “Approve Preliminary Baseline Range”

The Integrated Project Schedule (Level III) is developed during this project phase using the low credible case. The WBS is incorporated into the activity definition, therefore, allowing for resource allocation by the Control Account Managers. Schedule contingency analysis is performed at this level. This scheduling level is summarized, to the Project Summary Schedule, to provide the credible low case schedule for the TPC BDER schedule submittal of CD-1. The credible high case schedule is also submitted.

At this point in time, the Engineering Intermediate Schedule and the Procurement Intermediate Schedule are developed and ready for implementation when CD-1 is approved.

3) Before Key Decision CD-2 “Approve Performance Baseline”

The activities detailing the scope of work for the functional organizations are developed during this project phase. A single schedule is developed and readied for submittal for CD-2. This schedule will establish the project schedule baseline. All the higher tiered schedules are revised to reflect the project commitment dates established by this scheduling level. The CD-2 package also contains the Level III schedule.

4) After Key Decision CD-2 “Approve Performance Baseline”

After the approval of CD-2 is received, the baseline schedule is controlled using the change control/trending process from this point on. The current schedule is updated routinely and scheduling impacts evaluated for corrective actions. The rolling wave concept is completely adopted depicting extensive detailed-activities for the short-term work scope and less details for future work scope. In addition, areas of concern, particularly critical path activities should provide enough detail for the Control Account Managers routine assessments. In short, this scheduling level will contain varying levels of detail, as needed by the project team for appropriate monitoring.

Level V schedules, may also be required, and are developed after CD-2. These schedules may reflect detail activities from the Level IV, for specific team meetings. Or it may reflect the detail activities for a particular functional organization to support their organizational meetings. This schedule will support a concentrated scope of work for corrective actions, resource requirements and other decision-making elements for the project team and management.

D. GPP Overview

1) For project's over $250K

It is recommended that the scheduling level of detail should coincide with the control account/work package. This scheduling level of detail will depend on the project's level of risk, complexity and co-occupancy issues. CPM scheduling and analysis should be employed by the Project Team to discern potential project impacts.

2) For Project's under $250K

It is recommended that CPM scheduling be employed for these projects. The level of scheduling detail should coincide with the level of Construction and/or Maintenance work package development. Allowing the project team to easily discern potential project problems based on this common reporting level. The Project Team should be aware of the Project's level of risk, complexity and co-occupancy issues when developing the schedule details. It maybe advised to develop less or more scheduling details when those 3 critical issues are analyzed.

E. CE Overview

1) For project's over $250K

It is recommended that the scheduling level of detail should coincide with the control account/work package. This scheduling level of detail will depend on the project's level of risk, complexity and co-occupancy issues. CPM scheduling and analysis should be employed by the Project Team to discern potential project impacts.

2) For Project's under $250K

It is recommended that CPM scheduling be employed for these projects. The level of scheduling detail should coincide with the level of Construction and/or Maintenance work package development. Allowing the project team to easily discern potential project problems based on the common reporting level. The Project Team should be aware of the Project's level of risk, level of complexity and co-occupancy issues when developing the schedule details. It maybe advised to develop less or more scheduling details when those 3 critical issues are analyzed.

F. Schedule Development

A schedule is the logical representation of all the activities in a project showing their dependency relationships.

Scheduling determines the timing of operations in the project. The schedule will determine the specific start and completion dates for the project and all project activities.

The process steps are:

- Develop the list of project activities
- Sequence the list of project activities
- Determine the relationships between activities
- Establish the duration for each activities
- Determine the project duration (start and completion dates)

1) Activity Definition

Identify the specific activities that must be performed to produce the various project deliverables.

Information or inputs to accomplish this are the following:

a) WBS is the primary input to activity definition. For more details seen WBS Development and Maintenance guide in this manual.

b) Scope statement contains project justification and the project objectives.

c) Strategic plan should be supportive of the performing organization's strategic goals.

d) Historical information is activities which were actually required on previous, similar projects.

e) Constraints are factors that will limit the project team's options. For example, a predefined budget is a constraint that is highly likely to limit the team's options regarding scope, staffing, and schedule.

f) Assumptions are factors that, for planning purposes, are considered to be true, real, or certain. Assumptions affect all aspects of project planning, and are part of the progressive elaboration of the project. Project teams frequently identify, document and validate assumptions as part of their planning process. Assumptions generally involve a degree of risk. Scheduling assumptions are documented in the PEP/TEP, estimate and other project documents.

g) Expert Judgment will often be required to assess the inputs to this process. Such expertise may be provided by any group or individual which specialized knowledge or training, and is available from many sources, including:

(1) Other units within the performing organization.

(2) Consultants.

(3) Stakeholders, including customers.

(4) Profession and technical associations.

(5) Industry groups.

2) Activity Sequencing

Activity Sequencing involves identifying and documenting interactivity logical relationships. Activities must be sequenced accurately to support later development of a realistic and achievable schedule.

Information or inputs to accomplish this are the following:

a) Activity list must include all activities that will be performed on the project. It should be organized as an extension to the WBS to help ensure that it is complete, and that it does not include any activities that are not required as part of the project scope. As with the WBS, the activity list should include descriptions of each activity to ensure that the project team members will understand how the work is to be completed.

b) Product description documents the characteristics of the product or service that the project was undertaken to create. The product description will generally have less detail in early phases and more detail in later ones as the product characteristics are progressively elaborated.

   The product description should also document the relationship between the product or service being created and the business need or other stimulus that gave rise to the project. While the form and substance of the product description will vary, it should always be detailed enough to support later project planning.

c) Discretionary dependencies are those that are defined by the project team. They should be used with care and fully documented, since they may limit scheduling options. Discretionary dependencies are usually defined based on knowledge of:

   (1) "Best practices" within a particular application area.

   (2) Some unusual aspect of the project where a specific sequence is desired, even though there are other acceptable sequences. Often they are called preferred logic, preferential logic, or soft logic.

d) External dependencies are those that involve a relationship between project activities and nonproject activities. For example, environmental hearings may need to be held before the site preparation can begin in the construction phase of a project.

e) Milestones events should be identified to ensure that the requirements for meeting the milestone(s) are met.

3) Relationships Between Activities

Identifying direct relationships provides greater understanding to the project tasks and schedule. By identifying the relationships between activities in scheduling, you identify the sequence plus dependencies of tasks. There are 4 types of scheduling dependencies:

a) FS – Finish to Start - the initiation of the work of the successor depends upon the completion of the work of the predecessor.

b) SS – Start to Start – the initiation of the successor depends upon the initiation of the work of the predecessor.

c) FF – Finish to Finish – the completion of the work of the successor depends upon the completion of the work of the predecessor.

d) SF – Start to Finish

Using the relationships, described above, the activities and the logical relationships among them is formally known as a Network Diagram.

4) Activity Duration

Activity duration is estimating the number of work periods required to complete an activity will often require consideration of elapsed time as well. It involves determining which day of the week it begins, and whether or not weekend days are treated as work periods.

Information or inputs to accomplish this are the following:

a) Activity list

b) Constraints

c) Assumptions

d) Resource requirements are a description of what types of resources are required and in what quantities for each element at the lowest level of the WBS. Resource requirements for higher-levels within the WBS can be calculated based on the lower-level values. If additional resources are added, projects can experience communication overload, which reduces productivity and causes production to improve proportionally less than the increase in resource.

e) Resource capabilities – the duration of most activities will be influenced by the capabilities of the human and material resources assigned to them.

f) Historical information

g) Identified risks –the project team considers information on identified risks when producing estimates of activity durations, since risks can have a significant influence on duration. The project team considers the extent to which the effect of risks is included in the baseline duration estimate for each activity, including risks with high probabilities or impact.

5) Techniques for Estimating Activity Duration

a) Expert Judgment – durations are often difficult to estimate because of the number of factors that can influence them. Expert judgment and historical information should be used whenever possible. If such expertise is not available, the estimates are inherently uncertain and risky,

b) Analogous estimating, also called top-down estimating, means using the actual duration of a previous, similar activity as the basis for estimating the duration of a future activity. It is frequently used to estimate the project duration when there is a limited amount of detailed information about the project. This is a form of expert judgment.

Analogous estimating is most reliable when 1) the previous activities are similar in fact and not just in appearance, 2) the individuals preparing the estimates have the needed expertise.

c) Quantitatively based durations – the quantities to be performed for each specific work category defined by engineering/design effort and the construction effort, when multiplied by the productivity unit rate can be used to estimate activity durations.

d) Schedule contingency – Project teams should incorporate an additional time frame that can be added to the activity duration or elsewhere in the schedule as recognition of schedule risk. This reserve time can be a percentage of the

estimated duration, or a fixed number of work periods. The reserve time can later be reduced or eliminated, as more precise information about the project becomes available. Schedule contingency should be well document along with other data and assumptions. See Scheduled Contingency Guide 1.6 of this manual.

6) Rolling Wave Concept

The Rolling Wave concept is a continual expansion of scheduling details as time progresses increasing planning for near-term work. This continual review should further define activities with the most current available information, and is not to be confused with schedule change resulting in delay or acceleration of work. As a minimum, schedules should reflect detail planning for at least a six month period of work which is in progress or near-term. The near-term work should be evaluated quarterly to provide an additional three months of expanded detail; hence the term “Rolling Wave”.

8.0 Baseline Schedule

Schedules are established by the generation of the Critical Path Method (CPM) network representative of the total project scope for all functional organizations in accordance with the WBS for the project.

Resources are loaded at the Control Account Level and CPM schedule calculations performed to determine early and late schedule dates, total float, and network critical path based on a resource leveled schedule. Any resource over-allocation is resolved before the schedule baseline is targeted. It is recommended for resource loading to use manhours for scheduling databases using hourly planning units or FTEs/mandays for scheduling databases using daily planning units. Direct manhours, subcontract manhours, and equipment dollars are the cost elements to be resource loaded. This is the resource level that the CAM can control. (See resource loading and leveling section of this document for more details).

The Control Account Level varies among projects, ranging from Level III to Level IV details. If in accordance to the E11 Manual, the project is not required to provide these lower level schedules, the resource loading should occur at the Project Summary Schedule level. In either case, once the schedule is approved by the Project Team, the Project Manager, the Functional Organization Management and the appropriate Senior Management, the resource-leveled early schedule will become the baseline schedule. This baseline schedule becomes the basis for determining project impacts.

The Project Baseline Schedule is revised in the beginning of each project phase. In addition, it is recommended that the baseline be revised at least every six-month period and/or when the project performs a “Bottoms-Up” EAC. All scheduling baseline changes require the project to follow the Procedures 2.61 “Change Control” and 2.31 “Trending Process”.

9.0 Schedule Status

Schedules will be updated on a periodic basis to measure performance and to provide management pertinent information. This involves ascertaining the amount of progress for all in-progress activities and determining whether or not an activity or milestone has been started and/or completed. The actual status is recorded and graphically depicted on appropriate schedules. Schedules used for performance measurement and reporting are updated on a monthly basis, concurrent with cost accumulation and reporting.

Current schedule progress will be analyzed in relation to the baseline schedule. This is accomplished by setting the baseline schedule as the target in the current schedule. The Total Float Variance is determined by measuring the Early Start/Finish of the Target Schedule against

the Early Start/Finish of the Current Schedule. This comparison will be implemented in all project phases throughout the project's life.

Total float for those activities which affect milestone dates or cross control accounts will be controlled by the Project Manager; otherwise it will be managed by the responsible organization.

Schedule status is reported in Project Team meetings on a weekly basis utilizing the Working Level Schedule (Level IV). While Project Review Meetings report schedule status monthly utilizing the Project Summary Schedule (Level II). For project's supporting daily meetings (i.e. Operations Plan of the Day – POD), the working level schedule is the document utilized and manually updated. However, the scheduling database is routinely progressed and published on a weekly basis.

A. Updating Terms and Definitions

1) Data date -The date used as the starting point for schedule calculations. Change the data date to the reporting date when you record progress.

2) Actual dates-The dates you record for an activity that identifies when it actually started and finished. Actual start and finish dates should be recorded for all activities that have been started and/or completed by the data date before you calculate a schedule. Actual dates replace early and late dates in all reports.

3) Early dates - The earliest dates an activity can begin after its predecessors have completed, and can finish based on the completion of its predecessors in a conventional relationship. For a newly added activity, the early dates appear only when the schedule is calculated. To impose an early start or finish date, assign an early start or early finish constraint to the activity.

4) Percent complete - The proportion of an activity that has been completed.

5) Remaining duration - The number of work periods required to complete an activity. Duration is measured in the project's planning unit, such as months, weeks, days, hours.

B. Updating Steps

There are 3 types of activities to be reviewed for updating; they are Completed Activities, In-Progress Activities, and Not Started Activities.

1) Determine the Data Date and the set the data date to the new reporting periods (as of report date)

2) Status Completed activities

   a) Set the actual finish date, percent complete of 100% and the remaining duration to zero

   b) Status the next activity in the chain (if the activity has started)

3) Status In-progress activities

   a) Set the actual start date

   b) Status the percent complete and remaining duration. The Percent Complete and the Remaining Duration are not linked (See Autocost Rule section). Both must be updated appropriately.

   c) If the activity was due to complete before the current reporting period – assess the impact by evaluating the total float.

4) Not Started activities – no action is required.

During the updating process, Project Controls will be in constant communication with the appropriate individuals to validate and inform them of any early indication of schedule impacts or potential problems. Early resolutions are incorporated into the schedule immediately, if appropriate, with verbal authorization from the responsible person(s).

10.0 Schedule Analysis

The Critical Path Method (CPM) analysis technique is used to determine the criticality of an activity or milestone based upon the amount of time that activity/milestone can slip without impacting the project completion. The number of working days which an activity can slip without impacting the project completion is total float. The Project Controls group is responsible for performing this analysis with input provided by the Control Account Manager (CAM).

The Baseline schedule reflects all authorized scope and schedule changes. The Current Schedule reflects the baseline plus actual progress to-date and forecast progress from that date forward. A comparison between the Current Schedule and the Baseline Schedule, a review of the resultant changes in total float for each activity will indicate the criticality of the activity/sequence of activities in the timely completion of the milestone to which they are related. Late activities with a total float of twenty working days or less should be placed on a Critical Items List. It is important to remember that schedule analysis should be performed in conjunction with schedule performance measurement analysis. Only through schedule analysis (CPM analysis) can one determine if work is progressing on the critical path. In other words, the SV, SV% and SPI may indicate a positive schedule performance, while the CPM analysis may indicate that work was not performed on the critical path activities indicating negative float. The positive schedule performance occurs when activities are completed ahead of schedule while the critical path activities are not worked. This can lead the project into a false-sense of security.

The review and approval process follows after the analytical process has been completed. More than one alternative work around plan (different logic scenarios) and associated schedule impact may be identified, as impacts to the next higher schedule level are identified. This could require higher level management involvement. Any impacts as a result of the CPM analysis will be reported on the Critical Items List Report and addressed in the Project Review Meeting for resolution. In addition, after the Project Controls Lead's evaluation he may recommend to the Project Manager (PM) to issue an Early Warning, if he deems necessary.

A. Analysis Techniques

1) Compare Project Completion date – the current schedule early finish date to the baseline early finish date.

2) Focus on critical path activities – for complex projects the first 3 critical paths should be analyzed and evaluated.

3) Gather relevant data:

a) Detailed activity data – validate the current activities and activity sequencing reflects the intended steps for the responsible group to meet their commitment.

b) Network logic – validate that the internal and external requirements portrayed by the logic ties are still the current strategy for completing the task(s).

c) Resource availability – validate that the resource requirements are available to support the completion of the tasks as scheduled.

B. Critical Items List Report (CAIR)

The Critical Items List is used to focus project team and management attention on problem activities that may have significant impact on the project schedule. It should be the subject of the Project Team Meetings to discuss corrective actions or alternatives to eliminate or alleviate the schedule impact.

Only critical activities that are affecting the schedule or have the potential to do so should appear on the list. Two categories of activities will be reflected, critical activities and potential critical activities.

Those late activities with a total float of ten working days or less which may directly or indirectly impact a project milestone should be categorized as a critical activity. Those late activities with a total float of eleven to twenty working days should be categorized as a potential critical activity. Unless the trend of schedule slippage is reversed, a potential critical activity may become critical.

11.0 Schedule Revisions and Changes

Revisions to the schedule emanate from three sources:

- When progress reflects a schedule slip which may potentially impact project completion, appropriate analysis is required to develop an acceptable recovery plan.
- Revisions necessitated by the limitation of planning insight into the future. This usually involves assimilation of more details into the lower level schedules and may involve logic and duration changes to reflect a current work plan.
- Revisions resulting from customer or project management redirection or change.

12.0 Methods of shortening the schedule

- Focus on critical activities
- Add resources to reduce durations
- Use relationships to overlap activities
- Reevaluate relationships
- Break down long activities
- Apply/modify constraints
- Change calendar assignments
- Put critical activities on a longer workweek
- Add exceptions to non-worktime

13.0 Duration Compression

Duration compressions uses ways to shorten the project schedule without changing the project scope (e.g., to meet imposed dates or other schedule objectives). The techniques for using duration compression are: Crashing and Fast Tracking.

- Technique 1 – Crashing or Crunching (Duration Reduction)

In which cost and schedule tradeoffs are analyzed to determine how, if at all, to obtain the greatest amount of compression for the least incremental cost. Crashing does not always produce a viable alternative and often results in increased costs.

- Technique 2 – Fast Tracking

Doing activities in parallel that would normally be done in sequence (e.g., starting to write code on a software project before the design is complete, or starting to build the foundation for a petroleum processing plant before the 25 percent engineering point is reached). Fast tracking often results in rework and usually increases risk.

14.0 Trending and Change Control

The schedule baseline is approved through the change control process, which sets schedule dates for major tasks and commitments. The Project Milestone Schedule is attached to the original BCP; which sets the cost and schedule baseline.

A. Project performance is measured against the schedule baseline.

B. Corrective action plans are developed to ensure project commitments are met.

C. Approved change control is utilized authorizing schedule baseline changes.

The schedule baseline should be evaluated periodically to ensure that current project strategies, current project internal and external commitments are incorporated.

The Project Manager executes the change control process as is written in the Project Execution Plan. The Project Manager determines which level of the change control process is appropriated by reviewing and evaluating each project change. The Trend Process is administered and coincides in the total process.

15.0 Resource Scheduling and Leveling

A. Resource Loading

Resources are people (manhours/FTEs), equipment, costs, space, material bulks, etc. It is recommended that direct hours, subcontract hours and equipment costs be utilized for resource loading. The manhours/mandays are further subdivided by the resource types; Design Engineering, Quality Assurance, Project Controls, Project Management, Construction Crafts (Boilermakers, Pipefitters, Carpenters, etc), Engineering, Operations, etc. Project Controls works closely with the Estimator during the process of developing an estimate. Once the schedule is resource leveled and approved by the Project Team, Project Controls provides the manhours by resource type and by month/year to the Estimator. The Estimator computes the Direct Labor and Subcontract dollars, along with the indirect costs for Outyear Wage Adjustments, ESS and G&A dollars.

B. Resource Scheduling

Good resource scheduling is the basis for maximizing the productivity of people and equipment while minimizing their cost. It defines which resources should be utilized on specific tasks, between which dates.

1) Resource definition
2) The advantages of Resource Scheduling are:
    a) Analytically manage and use schedule float
    b) Analyze staffing requirements
    c) Evaluate effects of limited staffing
    d) Avoid wide fluctuations in daily need for various resources (leveling)

C. Resource Leveling

Scheduling without resource consideration often produces preliminary early-start schedule that requires more resources during certain time periods than are available, or requires changes in resource levels that are not manageable.

Resource leveling often results in a project duration that is longer than the preliminary schedule. This technique is sometimes called the resource-based method, especially when implemented with computerized optimization.

1) Advantages

   a) Optimizes resource use

   b) Helps maximize utilization of resources

   c) Produces realistic start/finish dates

   d) Avoids peaks and valleys in staff

2) Resource Over-Allocation

   Resource Over-Allocation occurs when activities/tasks are competing for the same resource at the same time. There are several means which can be used together or independently to eliminate and/or reduce the over-allocation of a resource. Resource reallocation from non- critical to critical activities is a common way to bring the schedule back, or as close as possible, to its originally intended overall duration. Other methods should also be considered in order to reduce duration of critical activities, such as; the utilization of extended hours, weekends, or multiple shifts and the Use of different technologies and/or machinery (i.e., automatic welding, electrical pipe cutters, etc.) are other methods used to shorten durations that have extended the preliminary schedule. Incorporation of the later method, will increase productivity and have a compounded improvement of the activity's duration.

   a) The steps to resolve over-allocation are:

      (1) Increase the resource's workweek

      (2) Increase the resource's workday.

      (3) Increase the resource amount by assigning additional resources to the activity.

         (a) Switch or replace the over allocated resource with an available resource.

3) Resource Scheduling Techniques

   a) Fast Tracking, if feasible is another way to reduce the overall project duration.

   b) Some project may have a finite and critical project resource, requiring that the resource be scheduled in reverse from the project ending date; this is known as reverse resource allocation scheduling - Backward Resource Leveling.

   c) Critical chain is a technique that modifies the project schedule to account for limited resources.

4) Resource Smoothing Techniques

   The automatic approach to resource leveling is accomplished by scheduling each activity when all resource requirements can be met for the entire, continuous duration of the activity. If this condition cannot be met, the entire activity is delayed until the condition

can be met. The splitting, stretching or crunching technique can be specified as a leveling technique.

a) Splitting

The nature of some activities dictates that the work, once it begins, must continue every working day until it completes. Work on other activities, however, can occur during any work-periods when sufficient resources are available, even if the work-periods are not contiguous on the activity or resource calendar.

This technique schedules a task to begin when the required resources are available, suspends work if the resource supply becomes too low, and resumes work when sufficient resources are available again.

b) Resource Stretching

Natures of some activities require a constant supply of resources for their entire duration. Others tolerate a reduced supply, allowing them to continue working through periods of low resource availability.

This technique, stretching, increases the duration of the activity by increasing the duration of the resources.

c) Crunching

Some activities cannot speed the completion by increasing their resource supply; these activities are not crunchable.

Crunchable activities can complete in less time if the resource supply is increased. The duration of a crunchable activity is decreased by taking advantage of additional available resources.

16.0 Schedule Risk Assessment and Contingency

"The application of contingency shall be considered in all scope, schedule, and cost baselines as being both prudent and necessary. Contingency is most often derived through a risk analysis of scope, cost, schedule, and technical, risks, underscoring the uncertainties existing in each element". DOE Order 413.3 – DOE Program and Project Management Manual, 10/00 – per page 6 of "Schedule Risk Analysis & Schedule Contingency Overview". (See the Guide 1.6 Schedule Contingency, IM-95-20)

A. Risk Management

Uncertainty and risk are intrinsic aspects of every project. These risks are often dealt with by allocating extra resources – time, labor, materials, and/or funds – to cover performance uncertainty. This type of contingency planning is adequate for some activities; however, it usually ignores important information.

As a rule your confidence level increases when you carefully examine the range of possibilities from "pessimistic" to "optimistic".

Simulation involves calculating multiple project durations with different sets of activity assumptions. The most common technique is Monte Carlo Analysis, in which a distribution of probable results is defined for each activity and used to calculate a distribution of probable results for the total project. In addition, what-if analyses can be made using the logic network to simulate different scenarios. The outcome of the what-if simulations can be used to asses the feasibility of the schedule under adverse conditions, and in preparing contingency/response plans to overcome or mitigate the impact of unexpected situations.

1) Schedule Risk Analysis is a structured process of identifying and quantifying potential/possible impacts to a schedule and combining that information to determine the probability of schedule success.
2) Schedule Contingency is a duration of time-based on the schedule risk analysis – added to or subtracted from selected schedule events to achieve the desired probability of completing those events on or before the date scheduled.
3) Risk Management Techniques:
    a) Experience judgment
    b) Monte Carlo analysis
    c) Combination of judgment and Monte Carlo analysis – this is the preferred method
    d) Targets 80% probability of meeting customer-commitment milestones.

B. Range of Possible Times

Rather than accept a single-point estimate of the amount of time required to perform a particular task, you want to consider the range of possible durations-each activity in the project has its own rand and pattern of duration possibilities.

Using a single value cost estimate of time, you can identify which activities are critical to the project completion schedule.

However, running a simulation of the range estimates, you can identify the activities that appear on the critical path in nearly every instance, and those that appear on the critical path less often. This information can help you focus on “criticality”-the likelihood that an activity will be critical to project completion.

1) Optimistic – the shortest reasonable time for performing the activity.
2) Most likely – the most reasonable time for performing the activity.
3) Pessimistic - the longest reasonable time for performing the activity.

This information enables you to predict, with a high degree of confidence, that the project will be finished by a certain date.

C. Incorporation of schedule contingency

1) Schedule risk/contingency will typically be evaluated for the risks “Included in Risk Assessment”. DOE will add their requirements (if any) for risks not typically included. It will be applied only to customer-commitment milestones and not to the schedule detail.
2) Authorized schedule contingency is to be shown as the difference between the customer-approved target milestone date(s) and the Project Team’s target milestone date(s) for the same event
3) An activity, called “Schedule Contingency”, may be added between these two milestones (recommended)
4) Any baseline budget spread “BCWS” for schedule contingency activities would normally be limited to the cost increase caused by the schedule contingency duration
5) Schedule contingency is “used” by changing the current/forecast schedule contingency duration and/or milestone completion. No BCP required to do perform a schedule risk analysis; however it should be incorporated into the estimate for any re-

baseline effort. The Project Team should perform a schedule risk analysis, for each "bottoms-up" EAC preparation, at a minimum.

D. Schedule Preparation for using Schedule Contingency

See Guide 1.6, Schedule Contingency, IM-95-20, for details.

17.0 Attachments

A. Milestone Guide
http://shrine01.srs.gov/ProjectWeb/operations/e11/guidance/Milestones/MSGuide.pdf

18.0 References

A. Site Controls Guidance Documents

http://shrine.srs.gov/html/psc_council/guidancedoc.htm

B. E11 Manual, Conduct of Project Management and Control

http://shrine01.srs.gov/ProjectWeb/operations/e11/home.htm

C. Site and Division Coding Structures for Integrating Division Schedules in P3 Schedules and Parade Cost Account Plans,"Code-8 Coding Dictionary", Rev 7a, October 1, 2001

http://shrine01.srs.gov/ProjectWeb/controls/p3/code8.pdf

D. A Guide to the Project Management Body of Knowledge (PMbok Guide) 2000 Edition