MASTER

Techniques Handbook- Project Management

Milestone Planning Techniques

ERDA Handbook 0805.3 Part II

**U.S. Energy Research & Development
Administration**

Division Of Management Information
& Telecommunications

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PREFACE

The ERDA Handbook on project management techniques will consist of nine parts, each dealing with a specific technique. The parts are:

- o Part I : Work Breakdown Structure (WBS)
- o Part II : Milestone Planning Techniques
- o Part III : Network Techniques
- o Part IV : Line of Balance (LOB)
- o Part V : GANTT Charts
- o Part VI : Cost/Schedule Performance Measurement
- o Part VII : Technical Performance Measurement
- o Part VIII : Configuration/Data Management
- o Part IX : Design-to-Cost

Each part of the handbook provides a detailed description of the subject technique and methodology, together with information for the application and implementation of the technique at the project management level.

One purpose of the handbook is to provide the Project Manager with the essential information necessary

- o for a decision to implement a given technique on his project, and
- o for actual application of the technique after such decision has been made.

Part II, on Milestone Planning Techniques, follows this preface.

OVERVIEW

INTENT

☐ Milestone planning is a management planning and control technique oriented toward the sequential completion of significant actions necessary for the successful accomplishment of a project.

APPLICATION

☐ Milestone planning focuses the attention of the ERDA project manager, the contractor project manager, and their respective staffs, on the orderly completion of key decision events essential to achievement to the proper objectives.

SCOPE

☐ Milestone planning is used to: (1) quantify the project objectives, (2) define the significant events and activities which must be accomplished and which are decision points toward the achievement of the objectives, (3) determine the order or sequence in which the milestones must be accomplished and their relationship to each other, (4) establish a time-line schedule for accomplishment of the milestones, and, (5) through periodic updating of the time-line schedule to reflect current status, evaluate progress and arrive at decisions to continue, limit, accelerate, redirect, or otherwise control the project effort.

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A. BASIC INFORMATION

INTRODUCTION

□ This part of the ERDA Management Techniques Handbook provides detailed information on the milestone planning technique. The amount of material provided is somewhat greater than that for some of the other techniques presented in other parts of the handbook. There are a number of reasons for this. Among these is the popular usage of the term "milestone" under varying circumstances in a manner representing disparate and variegated interpretations of the term. The important connotation that a "milestone" is a decision point is not always clearly stated, or even implied. Rather, in its usage there appears to be an inference of understanding concerning its definition and application.

□ Since one purpose of this handbook is to provide a standard of technique definition and description for uniform application to the broad spectrum of ERDA programs, projects and activities, the collation and codification of the diverse understandings of and attitudes toward milestones as a management technique is required. For this reason, a greater than normal amount of expository material on the milestone planning technique, with emphasis on management decision and control, has been incorporated in this part of the handbook.

TERMINOLOGY

- Milestone: an important or critical event and/or activity that must occur in the project cycle in order to achieve the project objective(s).
- Major Milestones: The most significant milestones in the project cycle, representing major decision points, or the accomplishment of a group of important actions leading to an important project decision.

- ☐ Intermediate Milestones: the more detailed sequence of important events and activities whose prior completion are necessary for, and lead to, the completion of a major milestone.
- ☐ Milestone Network Program: A visual depiction, similar to a PERT network diagram, showing the logical sequence and dependency relationships among milestones for their completion (As opposed to a PERT network, the M/S network does not show constraints of time, cost, or resources). (See Figure II-3)
- ☐ Milestone Timeline Chart: A calendar grid chart showing the scheduled completion date for each milestone, with the status completed, delayed, rescheduled, etc.) of each milestone depicted by means of an appropriate symbol (See Figures II-4 and II-5).

TECHNIQUE SUMMARY

☐ Project milestone planning commences with the quantification of project objectives in terms of specific goals, products and/or anticipated results; and with the translation of these objectives into the initial detailed Work Breakdown Structure (WBS), or its equivalent,* for the project effort. The quantification of the objectives may already have been accomplished in the authorizing documentation of the work statement for the project. If this is not the case, the quantification should be accomplished in conjunction with the development of the initial WBS, or its equivalent.

*Projects which are basically simple in nature, not of long duration, nor calling for a large expenditure of effort and resources, may not require a detailed hierarchical WBS. This will depend upon the professional judgement of the Project Manager. Good management practice, however, would indicate that an equivalent definition of specific tasks to be accomplished would be developed to the extent necessary to ensure project success.

□ The first step in the technique is the identification and definition of the major project milestones. These are the activities or events that must be accomplished, and indicate the essential and controlling decision points necessary to maintain continuity of the project, and to ensure project success. They may be composed of:

- elements from the top levels of the WBS,
- official decision points imposed by upper management, or
- decision points defined by the knowledge and professional judgement of the project manager as peculiar to, or necessary for, the control of the project (this is not a "catch-all" category, but may include items which are implicit in the project charter documents, directives, plans, or premises, which need explication for the focusing of management attention and decision, such as in-process reviews, facility acquisition, budget reviews and approval).

□ After the definition of the major milestones, intermediate milestones are identified and defined, if appropriate for the project. These are a more detailed sequence of events and/or activities whose prior completion are necessary for completion of the major milestones. Intermediate milestones are primarily of use:

- to subordinate project managers in the management and control of their areas of relegated project responsibility,
- for incorporation in the project network techniques, such as PERT (if employed),
- for insuring that no important project control and decision element has been overlooked, and
- for providing further checkpoints on the continuity of the project effort.

□ Subsequent to the definition of the milestones, their sequence is established in the order of their accomplishment. This is the critical element of the technique, since each major milestone represents a decision point which must be successfully passed. Thus, activities or events that should ensue from the completion of a major milestone will be held in abeyance until a decision is reached that the preceding milestone has been successfully accomplished. If ensuing activities are initiated, or those in progress are continued prior to such decision, much project effort may be wasted should an adverse decision be reached or the milestone be rescheduled.

□ When the milestone sequence has been established, the milestone network and the time-line chart are determined (See Section B, Figures II-2, 3, and 4). This is accomplished by establishment of a schedule in which the time span required for completion of those activities leading up to the milestone event is planned and estimated, and the schedule date of the milestone is determined therefrom. In the process, the specific preceding milestone upon whose completion each milestone depends is identified, and the milestone network schedule is depicted together with an appropriate time-line schedule. If a PERT or other network technique is employed by the project, then this effort is in conjunction with, and may be supported by the development of the network technique.

□ Upon completion of the milestone schedule, project procedures for periodic reporting and updating of the status and progress toward the milestones are established. These should provide for the noting of slippages and other discrepancies between planned and actual accomplishment and the reasons therefor.

□ As each milestone control point is reached in the schedule, the project manager reviews the status of the effort represented by the milestone. Based upon the review, a decision is made as to whether or not the milestone has been achieved. If the decision is affirmative, the project schedule of effort can continue. If the decision is negative, further decisions must be made; such

as to redirect effort, to reallocate resources, to limit other scheduled effort, or, in the extreme, to recommend cancellation of the project. In all cases, except the decision to cancel, the milestone must be rescheduled. This may also necessitate the rescheduling of subsequent milestones. Figure II-1 shows the decision logic of the milestone control point.

RELATIONSHIP TO OTHER MANAGEMENT TECHNIQUES

□ The foregoing paragraphs have touched upon the relationship between milestone planning and other management techniques. The foremost of these techniques is the WBS. Of all of the techniques, the WBS and milestone planning are the two which are recommended for application, in a lesser or greater degree, to all projects. A project WBS, at an hierarchical level dependent upon the project scope and complexity, can be used for the proper definition of the work to be accomplished in the achievement of the project objectives. The upper levels of the WBS will, in themselves, help in the identification of many of the major milestones, and the lower levels will also identify intermediate milestones. Milestone planning is, therefore, related to the WBS, but is not subordinate to it. Milestone planning provides the schedule and sequential dependency relationships among major elements of the project effort which the WBS does not. Milestone planning also includes events which are not a part of the WBS, such as: in-process reviews, management schedule approval reviews, budget approval, and facility and support acquisition. Finally, milestone planning is a part of the management decision process for the execution of the project.

□ Network techniques, such as PERT or CPM, can be of assistance to milestone planning in the determination of the schedule and sequence relationships of the milestones, and in the initial identification of time, cost, or resource critical activities which lie on the PERT or CPM network critical path are not,

Figure II-1 Simplified Milestone Decision Logic

per se, milestone events; for example, they may merely represent long lead items of a routine nature which are not of major criticality to the continuity of the project. Many projects will not require the application of network techniques, or will require their application to a limited extent only.

☐ The Line of Balance (LOB) technique application is restricted to projects involving production processes. The LOB may provide identification of milestones associated with progress of production toward the accomplishment of timely deliveries.

☐ Gantt charts are derived primarily from the project work statement and the WBS. The depiction of task progress on the charts can provide inputs to the periodic milestone reporting process. The elements of the Gantt charts, however, do not represent milestone events.

☐ Other advanced techniques, such as Configuration/Data Management, Cost/Schedule Performance Measurement, Technical Performance Measurement, and Design-to-Cost, are supplementary management methods which emphasize control of specific project elements, i.e.: schedule, cost, product identification, technical performance. For many projects, some or all of these techniques will be either inapplicable or unnecessary. If employed, they may provide inputs to milestone planning in identifying management decision points for incorporation in the milestone network.

MANAGEMENT CONSIDERATIONS

☐ Any project, other than those extremely limited to scope and duration, will benefit from the application of the milestone technique. The technique is aimed at the management decision process in the achievement of quantified project objectives. Milestone planning provides an orderly approach to the

management of extended phases of the project. By defining meaningful activities, standards, and progress criteria in advance, the project effort and the management decision process are made "result-oriented."

□ Milestone checkpoints assist in reducing the risk on the part of management that the project objectives will not be achieved, or that significant program elements will be overlooked. The progress review entailed for each milestone of the project provides an opportunity for careful analysis of the project in the light of current funding, the operational environment, and the magnitude of known or anticipated technical problems. The focusing of management attention at these key points allows judicious decisions to be made as to

- continuation of the planned project effort,
- limitation of the effort,
- acceleration of the effort,
- redirection or rescheduling,
- reallocation of resources, or
- in the extreme, cancellation of the project, before significant amounts of resources have been committed.

□ Thus, if the milestones are defined to evaluate the proper project activities and objectives, the supporting data will result in a progressive risk reduction, and will indicate actual, not just planned, accomplishments. Decisions that commit funds and resources will be based upon actual events and achievement, and not on arbitrary calendar dates. Since time, including the initial operational capability schedule, is made a variable, the project planning and schedule can be continuously developed to provide flexibility in attaining the project objectives in the event milestones are not met.

□ The initial implementation of milestone planning requires detailed effort on the part of the project manager, and the concerted support of staff and subordinate management personnel. Care must be exercised that no significant or critical event is overlooked in the definition of the major milestones. At the same time, the project manager's level of milestone attention should not be burdened with an overabundance of detailed milestones which are intermediate and not major in nature. In practice, an hierarchy of milestones can be developed:

- those pertaining to upper management review decision,
- those pertaining to the project manager level of review and decision,
- those pertaining to subordinate project manager levels, and
- those pertaining to contractor management, if the project involves contractor participation.

In this hierarchy, all of those in the first two categories would be identified as major milestones, together with a select few from the latter categories. The remainder of the latter categories would be intermediate milestones at the project management level of attention. These would provide a basis for evaluation of major milestones by project management.

□ Reporting requirements for progress review and evaluation should be on a periodic basis, with provisions for special "flag" reports on unusual or decision-critical circumstances. To conserve resources, reports should be of a summary nature, providing indication of progress along a time span and/or percent of activity actually completed. Slippage or other discrepancies between planned and actual accomplishment should be noted with a brief narrative discussion of causes. Recommendations for rescheduling should be included, with a brief discussion of the reasons therefor.

□ In selecting and implementing milestone planning, the project manager must keep continually in mind that a milestone event is a decision point which must be completed before ongoing project activities are continued, or dependent scheduled activities are initiated. A milestone event is to be considered as completed, only when a decision on the event has been reached. This implies that arbitrary calendar data schedules are subordinate to the accomplishment of scheduled sequence of events. Adherence to this principle throughout the project phases will ensure that appropriately significant milestones are identified and established, and that risk of non-accomplishment of the project objectives is continually reduced as the project progresses.

B. METHODOLOGY

PROJECT APPLICABILITY

□ The Milestone planning technique is applicable to all types of projects, whether they be Basic Research, Research & Development, Production, Construction, Software Development Technology and/or Management Study projects, or others. However, the kind and number of milestones will differ for each project. The major difference will be for research projects and, possibly, technology studies, where specific end results cannot always be known, and a specific calendar date for completion cannot be scheduled. Nevertheless, milestones peculiar to the research environment can be established which are related to quantified research objectives, and define an orderly decision process for the research effort. For example, review and approval checkpoints concerning:

- formal definition of anticipated end results,
- completion of the detailed experimental plan,
- completion of the experimental design,
- completion of the design and specification of experimental test facilities,

- completion of experimental test procedures and evaluation criteria,
- Completion of experimental tests,
- accomplishment of scientifically significant results,

represent possible, but not all-inclusive, milestones for the research project. Other milestones, common to all projects, or imposed by upper management levels, would also apply, such as: project budget review and approval, WBS development and approval, and periodic in-process reviews and approval. A tabulation of generic milestones applicable to ERDA projects in varying degrees, depending upon the type of project, is provided in Section E of this part of the manual.

MILESTONE IDENTIFICATION

☐ The identification of project milestones proceeds as follows:

- Develop quantified project objectives, if these do not already exist in the project authorization documentation, statement, and/or program master plans.
- Examine upper management directives, instructions, and formal guidelines and identify activities and events, whose completion call for specific upper level management review and approval. List these as major milestone checkpoints.
- If used, examine the WBS in detail, and identify those tasks whose accomplishment are critical to, and which must be completed for achievement of the project objectives. List the completion of these as milestones.

- Analyze the project plan and the plans and schedules for other management techniques to be employed (e.g.: Configuration Management, Technical Performance Measurement, Design-to-Cost, etc.) to identify other activities and events whose completion are necessary for achievement of the project objectives, and which are not contained in the WBS. These may include, for example: in-process reviews, periodic budget and schedule reviews, baseline configuration establishment, design characteristics reviews, etc. List the completion of these as milestones.
- Evaluate the latter two lists and determine those for which no alternative activity is possible. Add these to the list of major milestones. The remainder are listed as intermediate milestones, although some may be designated, in the judgement of the project manager, as major milestones.

MILESTONE NETWORK

□ The milestone network (which shows the logical inter-relationships and dependencies of the milestones, but -- as opposed to a PERT network -- does not show time, cost, or resource constraints) is developed as follows:

- The identified milestones (major and intermediate) are ordered in a combined list in the proper sequence for their completion. The first major milestone is listed first, (unless it is preceded by intermediate milestones) followed by a listing of those intermediate milestones leading to the second major milestone, then the second milestone is listed, followed by the next intermediate milestone. This is continued until all milestones are arranged in sequence. If two or more milestones can logically be completed at the same time, their sequence relative to each other can be arbitrary, if other factors (such as time, cost, and prior or subsequently dependent milestones) are equal. This effort can be greatly assisted by evaluation of the WBS, and preliminary data from the PERT network, if this technique is implemented for the project.

- Each of the milestones in the sequenced list is assigned an identifying number. A four-digit numeric designator is recommended; with the last two digits of the major milestones as zeros (i.e.: 0100, 0200, ..., 4700, etc.). The numeric designator for intermediate milestones would use the first two digits of the preceeding major milestone, and the last two digits would be the sequence order of the intermediate milestone (i.e.: 3301, 3302, ... 3310, etc.). An example is shown in Figure II-2.
- Using the developed milestone sequence, a milestone network diagram similar in appearance to a PERT network is developed (See Figure II-3). The network diagram shows the milestone event as a node (depicted by a circle and identified by its numeric designator), and the interrelationship and dependency of each milestone on predecessor milestones is depicted by a line connecting the predecessor node to the dependent node. The milestone network development is facilitated, if a PERT-type network technique is being developed concurrently. However, the milestone network should in no way be as complex as the PERT network.
- For large and complex projects, with relatively extensive milestone network, summary networks should be prepared for:
 - o Upper management levels, showing those major milestones imposed by, or of significant interest to, those levels;
 - o project manager level, showing all major milestones, and selected intermediate milestones judged to be of significant interest for continuity of project control and decision;
 - o subordinate project management levels, showing those major milestones and related intermediate milestones relating to the delegated areas of responsibility.

<u>Milestone Number</u>	<u>MILESTONE IDENTIFICATION</u>
0500	Research Plan prepared
0501	Research Study I, completed
0502	Research Study II, completed
0503	Research Study III, completed
0600	Research Studies evaluated
0700	Experimental Test Requirements established
0701	Alternative A: Experimental Design, completed
0702	Alternative A: Test Procedures and Criteria, completed
0703	Alternative B: Experimental Design, completed
0704	Alternative B: Test Procedures and Criteria, completed
0705	Test Facility Acquisition, initiated
0706	Preliminary Test Facility Design and Specifications, completed
0800	Test Plan, completed
0900	Test Facility Design and Specifications, completed
1000	Test Facility, completed
1001	Alternative A: First In-process Test Review
1002	Alternative A: Second In-process Test Review
1003	Alternative B: In-process Test Review
1100	Experimental Tests completed

Milestone Tabulation

Figure II-2

Sample Milestone Network

Figure II-3

MILESTONE TIMELINE CHART

☐ Concurrently with the development of the milestone network, the milestone timeline chart is developed.

- Starting with the activities or events leading to the first milestone, and continuing in sequence for each milestone thereafter, estimate the time to complete each activity. The cumulative time for the activities leading from one milestone to the next represents the time span between each milestone. Again, if a PERT-type network technique is being implemented, time estimate inputs, and calculated time outputs from the PERT network will facilitate this effort.
- Using the scheduled project starting date and the between-milestone time span estimates, establish the scheduled calendar dates for each milestone.
- For each of the summary networks prepare a milestone time-line schedule chart which lists the numeric designator and descriptive nomenclature of each milestone in columns at the left, and the scheduled completion date by an appropriate symbol on the corresponding line of a calendar grid to the right. A typical chart is shown in Figure II-4.

CONTROL OF THE MILESTONE PLANNING PROCESS

☐ For its employment by the project, the milestone planning process will, in itself, require management control. The control is achieved through: (a) the establishment by the project manager of procedures for periodic reporting on progress toward each milestone, and (b) project management review and evaluation of the reported progress, together with the updating of the milestone network and time-line chart. To this end:

- Develop a standard form for reporting, together with instructions for preparation. The report should be of summary nature, to include the following information
 - percent of activity actually completed along the milestone time span,

Milestone Time-Line Chart

Figure II-4

- o discrepancies between planned and actual accomplishment,
 - o anticipated or actual slippages,
 - o recommended reschedule dates,
 - o brief narrative discussion of causes and reasons for recommendation.
- Establish the schedule for periodic reporting.
- Review the progress reports at project manager level and update the milestone time-line chart. Typical progress symbols which can be used for such display are shown in Figure II-5.

C. IMPLEMENTATION

□ The foregoing section provides a comprehensive methodology for the application of the milestone planning technique in project management. As such, it covers a wide scope of activities, not all of which may be applicable to any given project. It is not intended to set forth a formalized set of procedures to be rigidly followed in all implementations of the technique. Knowledgeable project managers will exercise their professional judgement in adapting the methodology for implementation in their projects. In the actual implementation, the project manager's efforts will be directed to the three areas of

- Planning
- Control, and
- Review and Decision.

Management attention in these areas, throughout the phases of the project, is essential, and will provide the greatest payoff in the implementation of the technique.

TYPICAL MILESTONE SYMBOLS

BASIC SYMBOL	MEANING
Scheduled Completion
Actual Completion
Previous Scheduled Completion - Still in future
Previous Scheduled Completion - Date passed
REPRESENTATIVE USES	MEANING
Anticipated Slip - Rescheduled Completion
Actual Slip - Rescheduled Completion
Actual Slip - Actual Completion
Actual Completion Ahead of Schedule
Time Span Action
Progress Along Time Span
Continuous Action

Figure II-5

□ In practice, the project manager will find that the major milestone network need not be as massive as the methodology would imply. Not all of the milestones tabulated in Section E will be applicable to a given project, and, subject to milestones imposed by higher authority, the project manager has flexibility in identification of those milestones which best fit the needs of his project. In the initial planning phases, however, it is well to develop a detailed preliminary milestone network, following the methodology. This will provide a more profound understanding of the interrelationships and magnitude of the various areas of the project effort, and assure that significant activities are not inadvertently overlooked. At the same time, it will provide a more thorough grasp of the overall scope of resources involved in the achievement of the project objectives, and a better understanding of the total schedule, including possible constraints and potential conflicts.

□ With this preliminary detailed information at hand, the project manager is in a position to identify, on a selected basis, the network of those major milestones whose completion, in his judgement, provide a vital contribution to the success of the project. Candidates for selection would include those decision points with the potential for causing

- major delay in the execution of the planned project effort and schedule,
- drastic expenditures and allocation of resources,
- extensive redirection of the project effort,
- major revision of the subsequent milestone network,
- cancellation (failure) of the project.

At the same time, the selection process allows consideration to be given to reducing to a practical level the reporting burden imposed on the management staff and subordinate managers.

☐ Of importance to the practical control of the milestone implementation is the timeliness of the reporting process in providing information on the milestone time-line status, and, in particular, in providing ample forecasting of potential changes in the time-line schedule for completion of the milestone event. In most cases, periodic summary reports on progress of activities leading to a milestone will suffice. A common practice is reporting on a monthly basis. However, this may vary for different milestones. In fact, there should be no requirement for reporting on milestones for which no activities have been initiated; unless the initiation of the activities has been impacted by achieved experience toward predecessor milestones.

☐ One method of achieving timeliness and control of the reporting process, and at the same reducing the reporting burden at the lower management levels, is for project management to issue a three-to-six month schedule of milestones on which activity progress is to be reported during the period. This milestone report schedule can then be revised periodically on the basis of reported progress, and the initiation of scheduled activities leading to future milestones. In effect, a running update of the milestone report schedule is maintained, and in the process the project manager is provided with an additional focus on potential problem milestones and on the advent of emerging milestones in the project schedule. This can be of importance to the project manager, since he is at the node of a reporting network. He not only receives, evaluates, and acts on milestone summary reports received from lower management levels, but he also prepares milestone summary reports for upper management levels. For the latter activity, maintenance of a running milestone report schedule alerts the project manager to upper management milestone review and decision requirements.

☐ Review and decision activity is discussed in the next section.

D. REVIEW AND DECISION

□ The gist of the milestone planning implementation lies in the review and decision process as each milestone is reached. If they have been properly identified, each milestone represents an activity or event that must occur in the project cycle for the project objectives to be achieved. It follows that each milestone must be completed, if the success of the project is to be assured. Thus, each milestone is a decision point at which management must reach a decision either that the scheduled milestone has been successfully passed, or that the milestone has not been achieved as scheduled, and must be rescheduled. In the latter instance, additional decisions must be reached concerning alternatives with regard to project effort, schedule, cost, and allocation of resources. The milestone review and decision process can be considered as a continuing audit, in the most general sense, of the progress of the project toward its defined objectives.

□ For most projects, the milestone review and decision process will not reside entirely at the level of the project manager. Certain milestones may have been directly imposed by various levels of upper management, while others, identified by the project manager, may have been selected by upper management for their attention. In either case, review and decision for these milestones will be made at the upper management level, as well as at the project manager level. In addition, certain circumstances can arise in which a milestone decision, normally to be made at the project manager level, must be deferred to upper management. This, of course, does represent a project manager decision. In either case, the necessary information and supporting data will be prepared by the project manager and provided to upper management for review and use in their decision process.

☐ The goals of the milestone review and decision process are to assure that

- The full technical, schedule, and economic risks and consequences are evaluated before the milestone completion is approved and a decision is made for the continuation of effort in process, or the initiation of planned and scheduled effort,
- The premises and essential details upon which the decision is based are defined and recorded, and
- substantial changes which may have occurred in premises or information, upon which previous decisions have been based, are identified, recorded, and reported to appropriate management levels.

☐ In practice, it is well for the project manager to develop evaluation criteria for use in the review and decision process. One form of criteria could involve the establishment of thresholds in certain areas which must be met for an approval decision. These thresholds would be quantitative in nature, involving for example, such items as:

- technical and engineering progress,
- production and construction progress,
- system performance,
- cost (incremental and cumulative),
- resource commitment,
- schedule impact.

Threshold criteria provide a means for ensuring that the project effort remains on track throughout all the project phases.

☐ Another form of criteria could be developed to evaluate responses elicited by questions, such as:

- have the technical/engineering/production/construction requirements been well defined?
- has the best technical approach been selected?
- have trade-off selections of alternatives been optimized?
- are cost, resources, and schedule estimates credible and realistic?
- what methodology has been employed? is it appropriate or valid?
- what are the information and data sources? what has been observed and/or selected? are the data adequate and/or valid?
- against what have results been measured?
- what changes have occurred in prior premises, assumptions, and/or information?
- what potential problems are foreseen?
- what decision options and alternatives exist?

☐ The above forms of criteria and questions are not all-inclusive, nor will they apply to all milestone reviews and decisions. However, development of such criteria and questions by the project manager will prove of great assistance to his own review and decision on milestone accomplishment, and in the preparation of information and material for upper management milestone review and decision.

E. EXAMPLES OF PROJECT MILESTONES

☐ The following tabulation indicates typical milestones which may apply to ERDA projects. The milestones are listed by a number of categories: general category which pertains to all projects, and other categories which pertain to particular project types or phases.

☐ The tabulation is not all-inclusive; and by no means are all of the tabulated milestones applicable to a given project. It is not the intent of the tabulation to impose a specific milestone structure on the project manager. Rather, the tabulation is provided as information and guidance to the project manager in the development of milestones which, in his judgement, best fit the needs of his project.

☐ The nomenclature of the milestone in the tabulation is to be considered in the light that events culminate in a management review and decision process. It is only when an approval decision has been reached that the milestone event is considered to be completed.

☐ GENERAL

- Project Management Plan prepared
- Project Technical Plan prepared
- Definitive Project Schedule established
- Definitive Total Cost Estimate established
- Work Breakdown Structure prepared
-
-
-

☐ RESEARCH/VALIDATION

- Anticipated End Results and Criteria established
- Research Technical Plan prepared
- Research Studies defined
- Research Studies completed
- Experimental Design completed
- Test Facility Design and Specifications prepared
- Test Procedures and Criteria prepared
- In-process Reviews (variable in number), completed
- Experimental Tests, completed
- Scientifically Significant Events, accomplished
- Pilot Model Design and Specification, prepared
- Pilot Model Construction, completed
- Pilot Model Tests completed
- End Results evaluated
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☐ DEVELOPMENT

- Technical Development Plan prepared
- Technical Characteristics In-process Reviews, completed
- Definition Baseline established
- Engineering Design Concept In-process Reviews, completed
- Development Baseline established
- Engineering Design In-process Reviews, completed
- Development Test Plan prepared
- Breadboard/Mockup Model(s), completed
- Engineering Tests, completed
- Critical Design Review, completed
- Configuration Baseline, established
- Prototype/Development Model, completed
- Development Tests, completed
- Draft Technical Manuals, completed
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☐ PRODUCTION/CONSTRUCTION

- Technical Production Plan, prepared
- Production Test Plan and Criteria, prepared
- Advanced Production Engineering, completed
- In-process Production Design Reviews, completed
- Production Baseline, established
- Production Design and Specifications, completed
- Production Schedule, prepared
- Production Contracts, awarded
- LOB Technique implemented
- First Article Configuration Review, completed
- First Production Item delivered
- Technical Publications, completed
- Confirmatory Tests, completed
- Production Deliveries, completed
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F. SELECTED REFERENCES

□ The following selected references are listed as sources of background management information relevant to the milestone planning technique. A number of the references do not deal directly with the technique, per se, but are illustrative of the variety of project elements, activities, and events that may be considered in the identification of project milestones, and in the implementation of the milestone planning technique.

- AFSCM/AFLCM 310-1: "Management of Contractor Data and Reports," Data Item M103: Program Schedule, and Data Item M105: Program Milestones, Air Force Systems Command/Air Force Logistics Command Manual, August 1969.
- AFSCP 800-3: "A Guide for Program Management," Air Force Systems Command Pamphlet, May 1971.
- AMA Management Report #74: "PERT, A New Management Planning and Control Technique," J.W. Blood, Ed. American Management Ass'n, N.Y. 1962
- AMCR 11-27: "Army Programs, AMC Milestones," Army Material Command Regulation, August 1965.
- AR 70-17: "Research and Development: System/Project Management," U.S. Army Regulation, January 1968.
- MIL-STD-499A (USAF): "Military Standard, Engineering Management," May 1974.
- MIL-STD-1521 (USAF): "Military Standard, Technical Reviews and Audits for Systems, Equipment, and Computer Programs," September 1972.
- NASA NHB 7121.4: "Guidelines for Project Planning," National Aeronautics and Space Administration, July 1972.