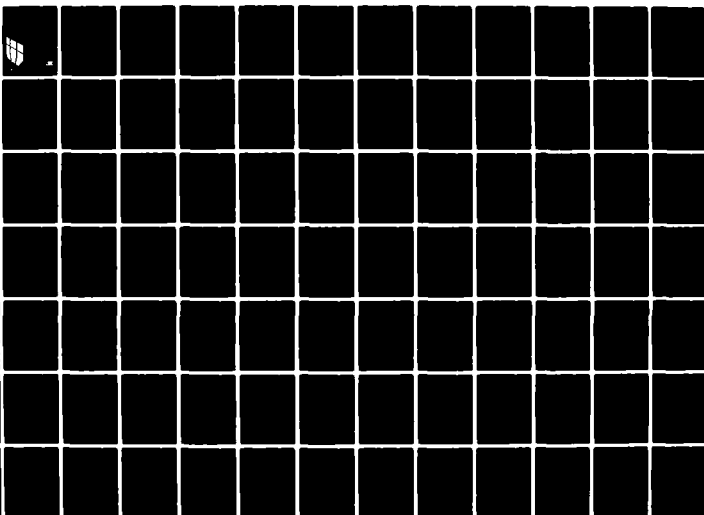


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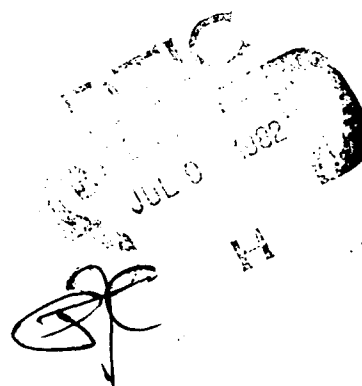
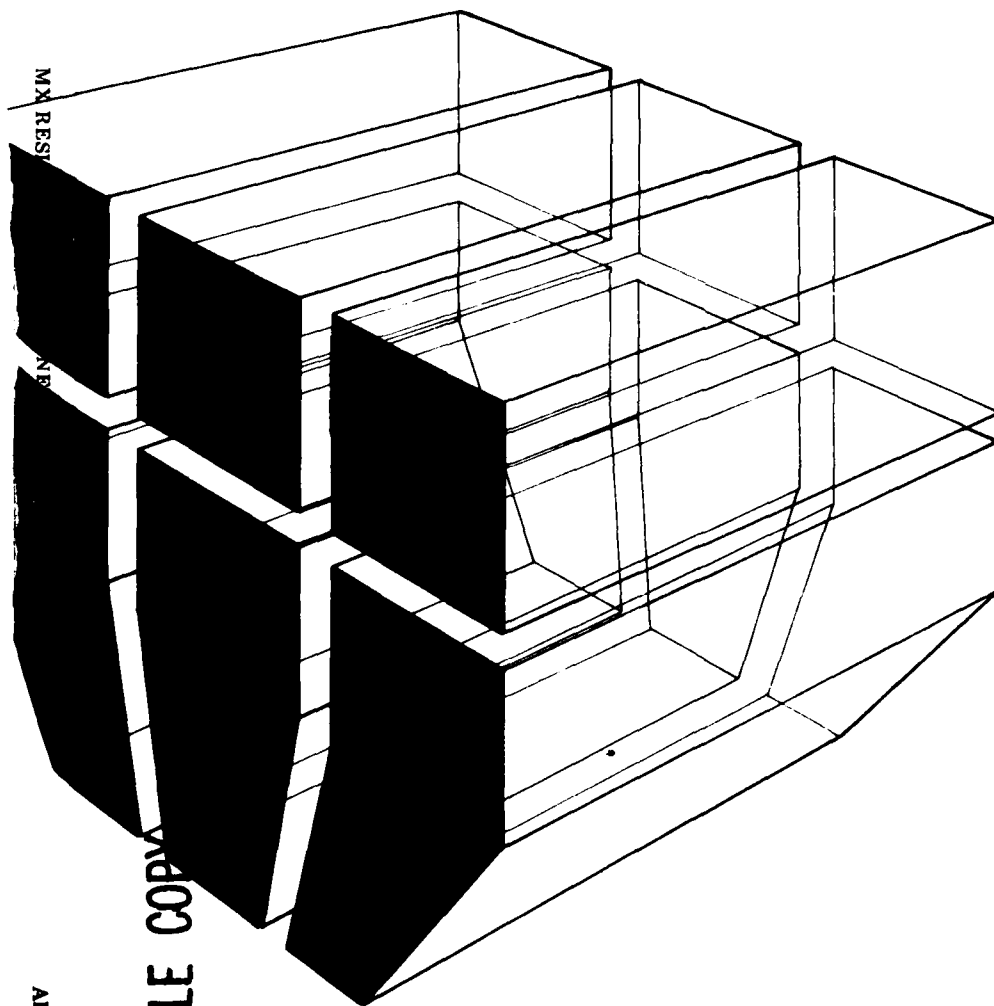


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TECHNICAL REPORT P-126
April, 1982

MX RESIDENT ENGINEER NETWORKING GUIDE

by
M. J. O'Connor
G. E. Colwell
R. D. Reynolds



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FOREWORD

This investigation was performed for the U.S. Army Corps of Engineers, Management Support Office, Corps of Engineers MX Program Agency (CEMXPA), under IAO No. E87-81-7151, "Integrated Hierarchical Networks for MX." The CEMXPA Technical Monitor was Mr. Richard Fraser.

The work was performed by the Facility Systems (FS) Division of the U.S. Army Construction Engineering Research Laboratory (CERL). Mr. E. A. Lotz is Chief of CERL-FS.

COL Louis J. Circeo is Commander and Director of CERL, and Dr. L. R. Shaffer is Technical Director.

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MX RESIDENT ENGINEER NETWORKING GUIDE

1 INTRODUCTION

Background

The Network Analysis System (NAS) is not a new planning method. It has been used for more than 20 years to record or graphically portray conventional planning. NAS demands much greater detail than such procedures as Ghant or bar charts. NAS displays the logic or order and interdependence of various activities so they can be analyzed, recalled, and applied to any eventuality as the project progresses. NAS considers planning as well as the time required to perform each task, the cost or value of the activities, the mathematical computations relevant to the system, and the evaluation of the results. Many variations of the basic NAS, designed to suit specific user needs, are available. Of these variations, the Critical Path Method (CPM) has been specified by the U.S. Army Corps of Engineers as best suited to the Corps' construction needs.

The Corps' past experience with NAS and CPM schedules has not lived up to expectations. This is probably because the CPM schedules used by the Corps depend on the construction contractor for computer support. Things happen rapidly on a construction project, so there must be a quick means of analyzing changing situations, and adjusting the plan accordingly. Without inhouse computer support at the field-office level, the Corps is at a disadvantage. All too often, the original progress schedule becomes outdated early in the job and stays that way. As a result, it is very difficult to evaluate the impact of change orders so their settlement is delayed; the incentives for the contractor to effectively manage the job deteriorate; and the Corps loses the ability to direct or even effectively influence positive action.

The question of computer support is critical given the Corps' responsibility for managing the huge MX program. It is generally recognized that NAS/CPM is the best construction management tool; it is imperative that it be used on the MX work and that the Corps obtain the computer capability to make it work successfully.

The development of solutions to the problem of providing necessary computer capability to Corps field personnel in an easy-to-use form was assigned to the U.S. Army Construction Engineering Research Laboratory (CERL) in March 1981. This report documents the results of one aspect of that total effort.

Approach

The automation of the project planning process began in the late 1950s and early 1960s when CPM scheduling was established as a valuable planning tool. The project planner identifies the project activities and their interdependencies. This information can be shown graphically on a network diagram. Once the network logic has been defined, the time and resources required to

perform each activity can be estimated. The use of computers for project scheduling and cost control has expanded the original network scheduling techniques and permits planners to control increasingly more complicated applications.

Introduced by Project Software & Development, Inc. in 1968, PROJECT/2 was one of the first systems that used sophisticated computer techniques to handle the requirements posed by large-scale projects. The system uses CPM techniques to monitor and control schedules, and an earned value approach to monitor and control costs. Although cost and schedule processing can be integrated, PROJECT/2 allows the user complete flexibility in determining how much of the software is necessary for each application. PROJECT/2 is an English language, command-oriented system capable of operating in a totally interactive machine mode.

CERL determined that PROJECT/2 meets the Corps' MX networking needs better than anything else currently available. To use the capabilities of PROJECT/2 without requiring users to learn PROJECT/2 command language, CERL developed the MX Construction Planning Management System.

The main element of the MX Construction Planning Management System is the menu system. This is a software package designed to facilitate the user's interaction with PROJECT/2 in familiar contract administration terms. Figure 1 shows the relationship between the user, the menu system, PROJECT/2, and other elements of the integrated planning and control system.

Purpose

The purpose of this report is to describe the MX Construction Planning Management System, a computer-aided management and information system, and to provide field offices with guidance for its use.

Scope

The information in this report is intended for Resident/Area Engineers having MX contract administration responsibilities.

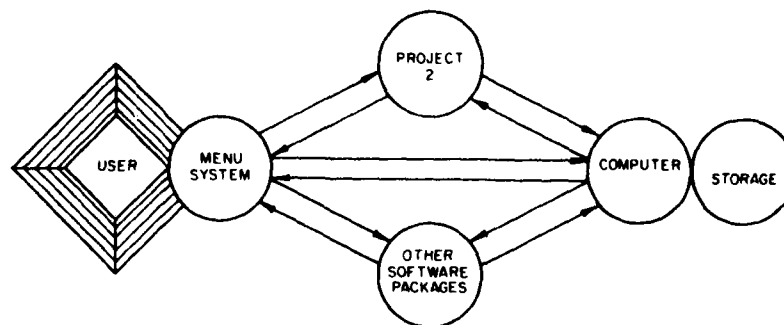


Figure 1. Schematic overview.

2 SYSTEM OVERVIEW

The MX Construction Planning Management System is designed for users with little or no computer experience, although a working knowledge of network-based management is expected since most system aspects are related, in some way, to a project network. The system is interactive, prompting users at every step, from system entry to exit. It links all major aspects of construction planning, then monitors progress and payments to contractors in support of the Government's construction management functions. The system was specifically tailored to make it easy to use while providing all the necessary functions; additional options are available through PROJECT/2 for those users familiar with PROJECT/2 command language.

System Modules

Figure 2 shows the major system modules:

o Module 1: The System Access and Control Module performs front-end system control. It ensures that all aspects of the system procedure are functioning, and monitors user input. User interaction with Module 1 is limited to LOGON, LOGOFF, and password input.

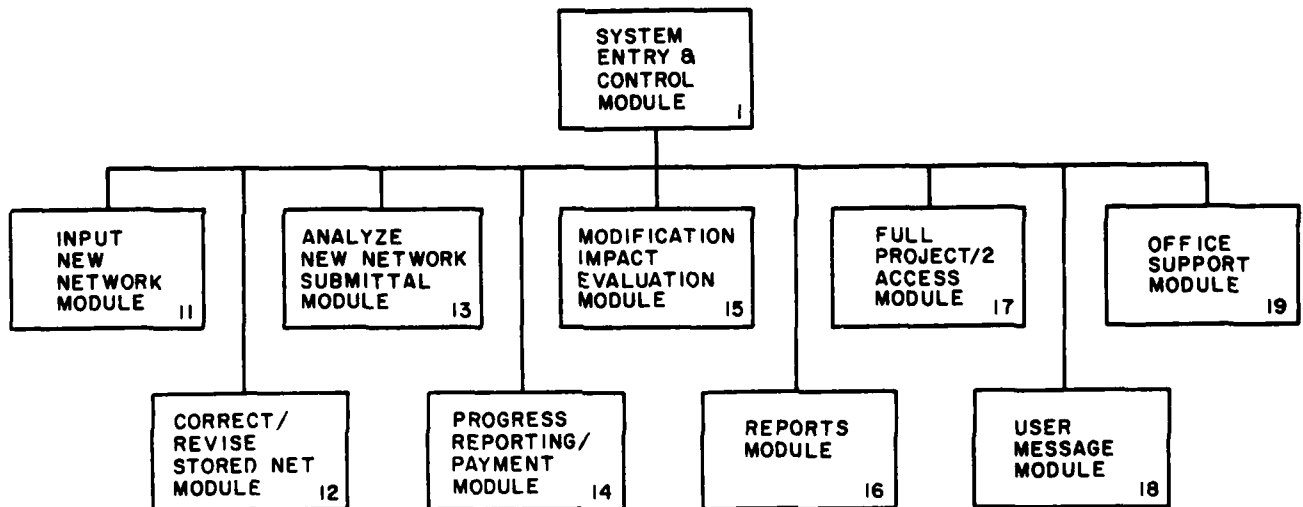


Figure 2. Major system modules.

o Module 11: The Input New Network Module has a number of options which let the user (1) create and edit an input file for PROJECT/2, (2) add a network to PROJECT/2, and (3) output a logical series of analysis reports (after the network is loaded). A network is only added via the STORE NEW NETWORK option. Thus, the user may build and then change an input file until a network is successfully loaded into PROJECT/2.

o Module 12: The Correct/Revise Stored Network Module is used to change a stored network. A network would change when errors are discovered in the new network input, changes are made to the contractor's work plan and sequence, the contract is modified, etc. Module 12 is the only module which can permanently change a stored network.

o Module 13: The Analyze New Network Submittal Module produces reports used to evaluate a new network submittal. After a new network is analyzed and approved, Module 13 releases it to the official file.

o Module 14: The Progress Reporting/Payment Request Module logically combines the functions needed to develop a payment request, including the development of actual progress, analysis of cost data, preparation of required forms, and tracking of payment actions.

o Module 15: The Modification Impact Evaluation Module lets the user predict the results of a number of "what if" scenarios to help determine the least disruptive and/or costly way to handle contract change orders. Module 15 also can evaluate the merit of claims. Module 15 cannot change the official file -- it is used only to develop change order options, which can then be implemented (placed in official file) using Module 12.

o Module 16: The Reports Module lets the user output PROJECT/2 reports, in a variety of customized formats, without having to know PROJECT/2 language. This module supplements the standard reports available through other modules. Information may be obtained in hard copy or on the screen.

o Module 17: The Full PROJECT/2 Access Module lets certain users access full PROJECT/2 operations; users must know PROJECT/2 job control language to use Module 17.

o Module 18: The User Message Module lets users communicate with one another. The message originator specifies which users are to receive a message; users are given messages when they logon to the system. Each user has an individual message set for holding messages from other system users. Each user can review or remove messages from his* message set at any time. However, the system will automatically delete any messages more than 15 days old.

o Module 19: The Office Support Module has a number of submodules to help the field office prepare correspondence, do cost estimates, keep payrolls, track various functions, ascertain latest policies and procedures, access information sources, etc. These submodules relieve the field office from time-consuming, nonengineering duties, so it can devote its attention to quality assurance and contract administration.

* The male pronoun is used throughout this report to refer to both genders.

Terminal Operation

System terminals are used to type in input data and obtain report printouts (Figure 3). The terminal's keys are the same as those on a standard typewriter or calculator. Special key functions are listed below.

The CURSOR is a blinking square on the terminal screen which indicates the user's position in the input sequence; the CURSOR prompts the user for information, as needed.

The RETURN key signals the system that an entry is complete. The user should tap the RETURN key after he finishes inputting a data sequence. When the user taps the RETURN key, the CURSOR will move to the next entry in the sequence; tapping the RETURN key in front of a blank entry will also prompt the CURSOR onto the next entry.

The BACKSPACE key lets the user correct an incorrect entry only if the RETURN key has not yet been struck. Tapping the BACKSPACE key will move the CURSOR one space from right to left; the user may then type over the incorrect entry. If the RETURN key has already been struck, the user must make the input correction using the system's EDIT/REVIEW mode.

Printer Operation

To print out screen information, the user depresses the SHIFT key and simultaneously strikes the PRINT key (see Figure 4). The terminal will not send information to the computer while the printer is in operation.

Modem

Figure 4 shows the Racal-Vadic modem controls and indicators. Two switches are on the front of the modem: FA and HS. Both should lean toward the back of the modem. The rear of the modem also has two switches; both should be turned to the left and set at DLB/IRT and NORMAL. The user will not change the position of the modem switches during normal system operation.

Figure 5 shows a rear view of the terminal and a typical modem hook-up configuration.

LOGON and LOGOFF Procedure

The user begins and ends terminal operation using the LOGON and LOGOFF commands.

After making the proper telephone-modem connection to the computer service system, the terminal will ask the user a series of questions before

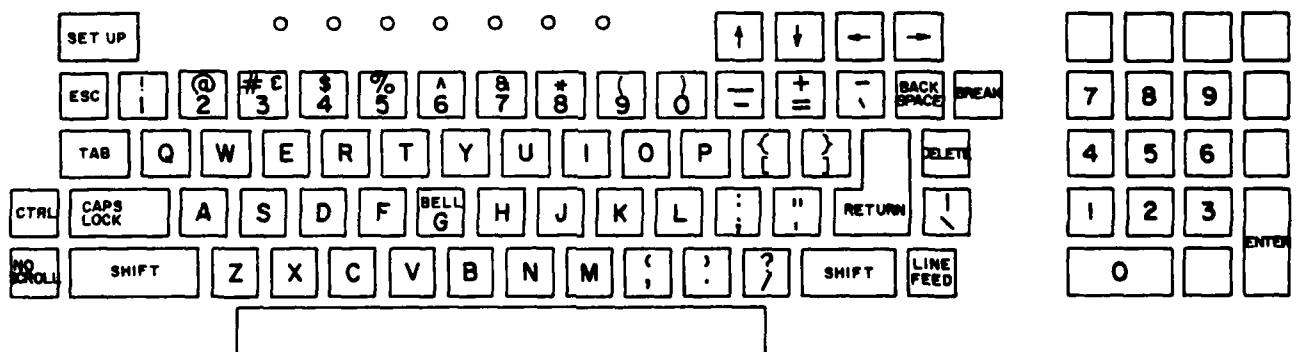
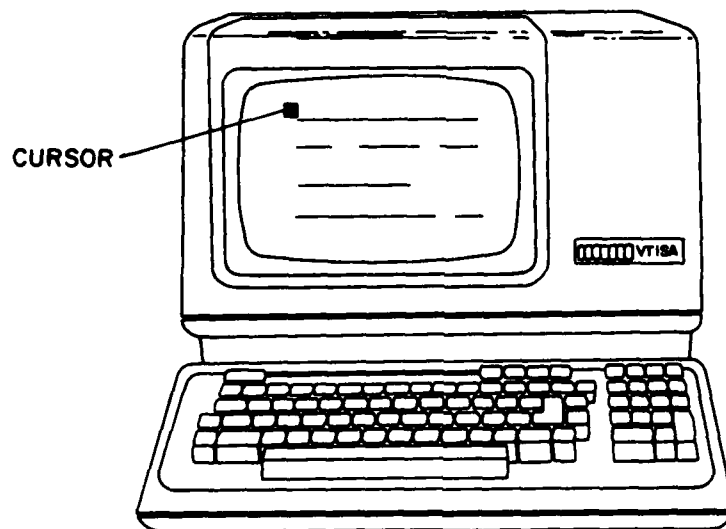
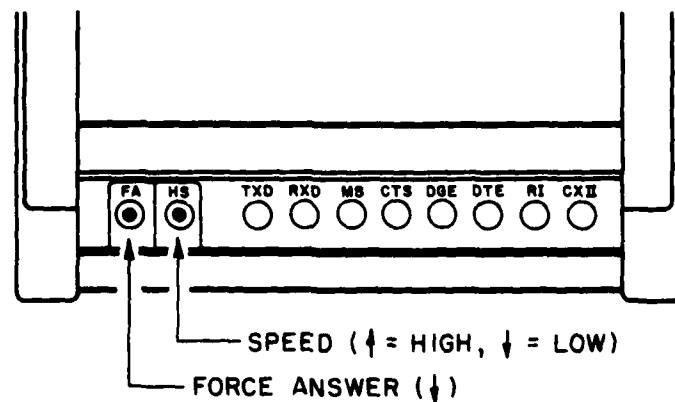
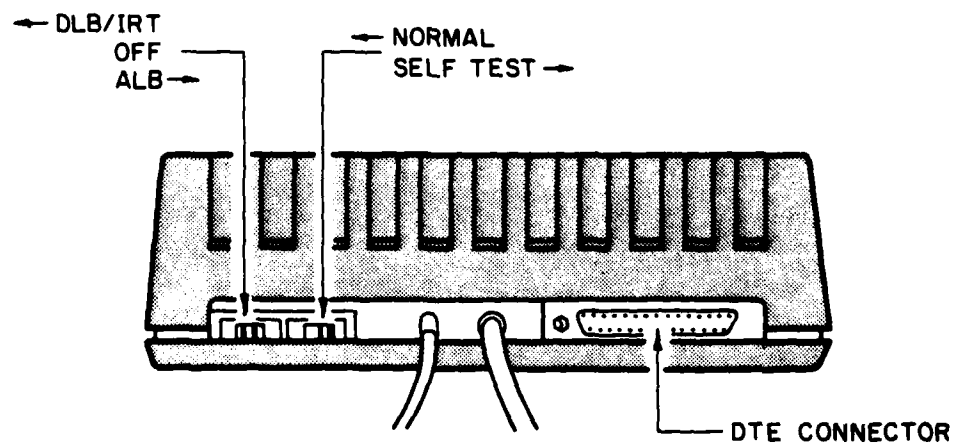


Figure 3. Terminal and keyboard.



FRONT VIEW



REAR VIEW

Figure 4. Modem controls and indicators.

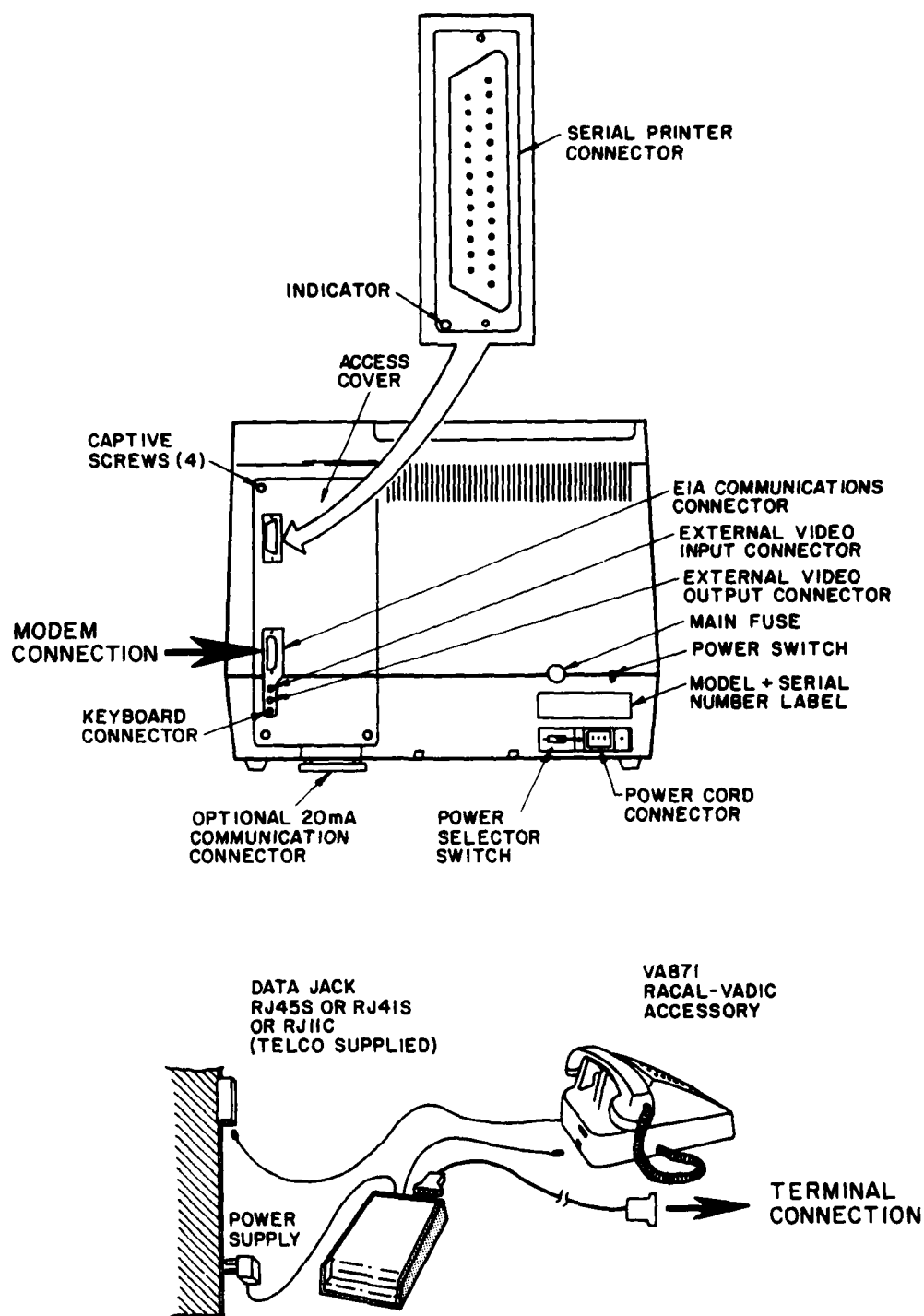


Figure 5. Rear view of terminal and modem configuration.

allowing the user access to the MX Construction Planning Management System (see Figure 6):

1. The system asks: SELECT DESIRED SERVICE
2. The user enters: TSO (hit RETURN key)
3. The system shows: MAINSTREAM-TSO
4. The user enters: LOGON CHP n n n/(password) NON (hit RETURN key)

(Note: n n n is a three-digit ID number for the user; a password will be given by the system manager)

5. The system asks: ENTER PROCEDURE NAME
6. The user enters: CEMX (hit RETURN key)

The user may exit (LOGOFF) the system by selecting the EXIT SYSTEM option and striking the RETURN key. This option is available on many screens strategically phased throughout the system.

MX CONSTRUCTION MANAGEMENT SYSTEM

Welcome to the bcs network
Your access port is scy 072

Select desired service: tso

MAINSTREAM-TSO
logon chp001/xxxxxx non
ENTER PROCEDURE NAME -
cemx
CHP001 LOGON IN PROGRESS AT 13:05:29 ON JULY 10, 1981
NO BROADCAST MESSAGES
NO "ACTIVE" DATA SETS

Figure 6. LOGON procedure.

Menu Selection

After the user successfully completes the LOGON procedure, Screen 1, the Message Notice and Module Selection will appear (Figure 7). At this time, the user will be shown any message entered into the system. Options 1 through 9 allow the user to enter any system module, assuming the user has the proper security classification. Option 10 will effect a LOGOFF.

Options 1 through 9 directly correspond to Modules 11 through 19.

MX CONSTRUCTION MANAGEMENT SYSTEM

SYSTEM ENTRY AND CONTROL MODULE

(Message notices will appear here)

System options:

1. Input new network
2. Correct/revise stored network
3. Analyze new network submittal
4. Report progress/payment
5. Evaluate modification impact
6. Produce reports
7. Use full PROJECT 2
8. Send messages
9. Office support module
10. Exit system

Enter option or help: _____

1

Figure 7. Screen 1 -- Message Notice and Module Selection.

3 ORIGINAL SUBMITTAL

This chapter describes how Modules 11 and 13 are used to input, analyze, and evaluate a contractor's original submittal data. (Module screens are presented in Appendix A.)

Input

The contractor's construction schedule responsibilities are defined in the contract's General and Special Provisions. Appendix B is an example Special Provision compatible with the MX Construction Planning Management System. The contractor's network submittal should be formatted so it can be electronically copied into the Government's automated data processing (ADP) files; the Special Provision should require this for the original submittal. Later, however, the contractor may wish to change only a few pieces of network data; this can be done manually. The Resident Engineer also may wish to manually input a network for his own use. Consequently, Module 11, the Input a New Network module, allows both manual and automatic input of network data. Figure 8 is a Module 11 flowchart. The screens supporting Module 11 are shown in Appendix A, Figures A1 through A13.

Module 11 inputs the network to PROJECT/2, where it may be processed and stored.

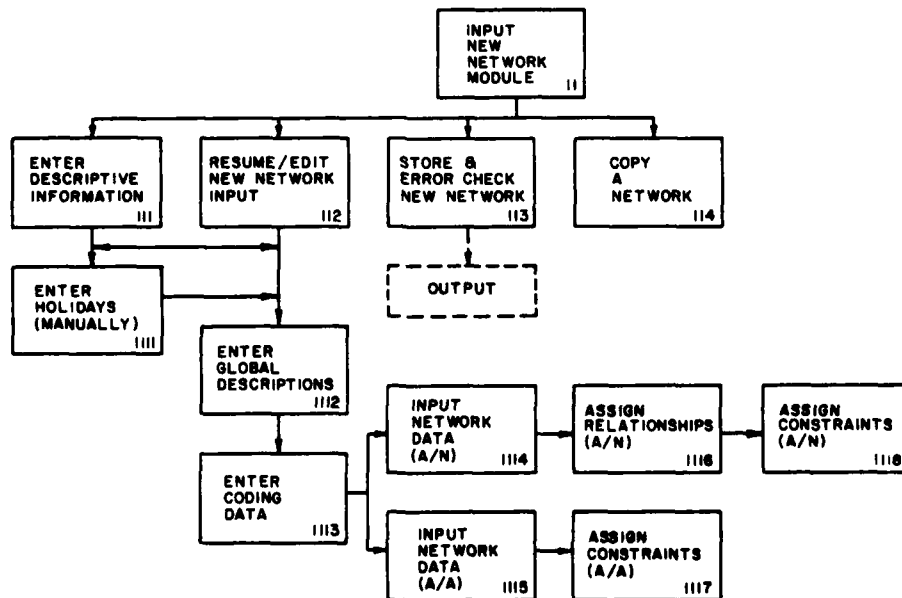


Figure 8. Module 11 -- flowchart.

Analysis

Module 13, Analyze New Network Submittal, allows the user to print out reports he can use to evaluate the contractor's work plan. A Module 13 flowchart is shown in Figure 9. The screens supporting Module 13 are shown in Appendix A, Figures A14 through A17. In the event Module 13's standard reports do not entirely fulfill the users' needs, other reports are available from Module 16 or Module 17.

Module 13 lets the user release the approved schedule to the official file. In the official file, data are available to others in the organizational structure served by the system. All other files are working files, accessible only to those who created them.

NAS General Requirement Checklist

The checklist in Table 1 can be used to systematically analyze a contractor's initial network submittal. The checklist is arranged so each item references a system module that can provide the information needed to answer the question. Since some computer aids answer more than one question, there is some duplication; however, when performing a complete analysis, duplicate copies of a particular report are not needed. To intelligently judge the validity of a contractor's proposed schedule, the user must know the scope and details of the work and the requirements affecting it.

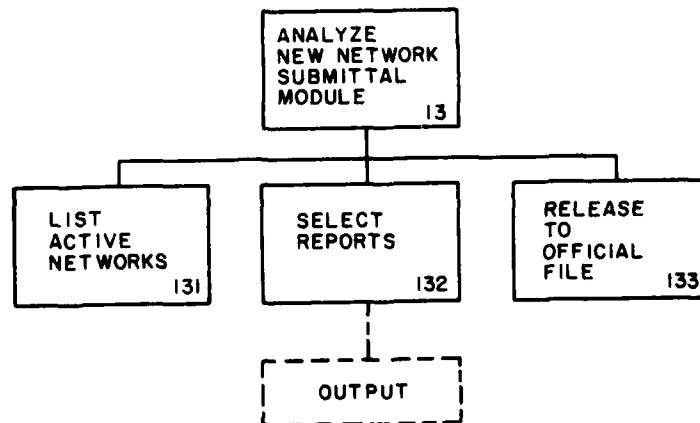


Figure 9. Module 13 -- flowchart.

Table 1

Checklist for NAS General Requirements

<u>ACTIVITY</u>	<u>COMPUTER AID</u>
1. Are I-J numbers unique, ascending with sufficient skipping?	-Network Listing Sort IJ
2. Is each activity described and coded?	-Network Listing Sort IJ
3. Are the activity descriptions specific enough?	-Network Listing Sort IJ Ejected and Sorted by BSI/CSI
4. Is the coding correct?	-Network Listing Ejected and Sorted by BSI/CSI
5. Are those Government activities which affect job progress included?	-Network Listing Sort IJ -Planning Schedule Eject and Sort on General Requirements (BSI DIV 90)
6. Have local conditions such as climate, site access, services, water table, etc., been factored into the plan?	-Planning Schedule (Print) Eject and Sort on CSI ES -Planning Schedule (Plot) Eject and Sort on CSI ES
7. Is there any evidence that major subcontractors have not participated in the formulation of the plan?	-Planning Schedule Eject and Sort on BSI/CSI

TIME

<u>ACTIVITY</u>	<u>COMPUTER AID</u>
1. Does the overall completion date comply with contract requirements?	-Planning Schedule (Print) TF Sort IJ ES
2. Are BOD and any other contractual dates indicated and met?	-Planning Schedule (Print and Plot) TF Sort ES IJ
3. Are the network milestone identifiers in accordance with contract specifications?	-Network Listing Sort IJ
4. Are the durations assigned to Government activities in accordance with the contract or, in the absence of specification, reasonably workable?	-Network Listing Sort by BSI Div
5. Are the durations assigned to contractor activities within contract requirement and/or reasonable?	-Network Listing Sort by Duration
6. Are the durations assigned to procurement activities consistent with existing product lead times?	-Network Listing Sort IJ
7. Is there a reasonable range of total float?	-Planning Schedule TF Sort TF
8. Is the critical path reasonable (without excessive parallel critical paths)?	-Planning Schedule TF Sort TF -Network Diagrams

Table 1 (Cont'd)

LOGIC

<u>ACTIVITY</u>	<u>COMPUTER AID</u>
1. Is the entire scope of work reflected in the network activities?	-Network Listing Ejected and Sorted by BSI/CSI
2. Does the network include all required submittal activities?	-Network Listing (Sort by General Requirements, BSI Div 90)
3. Does the network include required procurement activities?	-Network Listings (Sort by CSI Broad Scope, IJ)
4. Do the submittal approval and procurement activities constrain the appropriate construction operations?	-Planning Schedule TF Sort CSI with Successors -Network Diagrams
5. Does the sequencing and inter-dependencies of the activities represent a logical and reasonable plan for accomplishing the work?	-Planning Schedule (Print and Plot) Eject and Sort by BSI/CSI with Successors -Network Diagrams
6. Are constraints realistic?	-Planning Schedule (Print) Sort ES IJ

MONEY

<u>ACTIVITY</u>	<u>COMPUTER AID</u>
1. Does the total value equal the total contract amount?	-Network Listing Sort by Costs Print COSTS ES/LS
2. Is the monetary value assigned to each activity within the range specified in the contract?	-Network Listing Sort by Costs
3. Is the monetary value assigned to each activity reasonable for the work?	-Network Listing Sort by Costs
4. Are zero monetary values assigned to administrative functions, such as preparation of submittals, materials procurement and delivery, Government activities, etc.	-Network Listing Sort by Costs and CSI Div
5. Is there evidence of excessive front-end-loading of payment items?	-Network Listing Sort by Costs

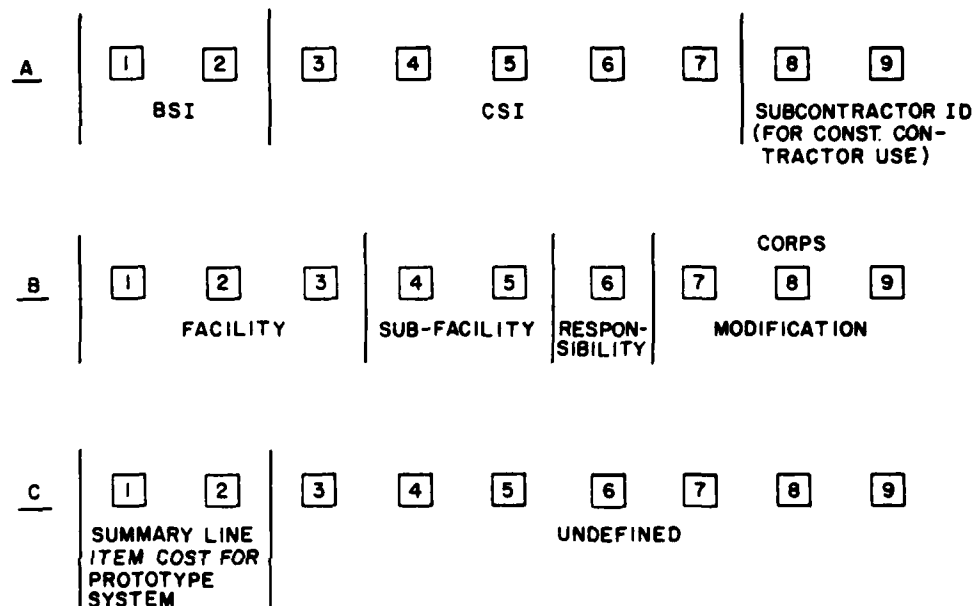
A detailed explanation of each checklist item is given below.

General Requirements

1. I-J numbers. The user should skip enough numbers to allow revision without disrupting the scheme of ascending numbers. (Although the networking computer program allows I numbers to be higher than J numbers, it is still considered good technique to keep such occurrences to the minimum.)
2. Description and codes. Each activity must be coded and include a description of the work involved (Figure 10). Codes and descriptions should match the work breakdown structure (WBS) specified for the contract. (Dummies are not further described or coded as they do not represent work, only precedence.)
3. Activity Descriptions must be written so anyone familiar with the construction work can understand them. Each description should be unique and nonstandard abbreviations should be avoided.
4. Coding must be complete, correct, and reflect the nature of the work. Information retrieval by related groups of activities, etc. depends on properly coded input. (Also see Item 2 above.)
5. Government activities which affect construction progress should be included in the network. Durations, either specified or reasonable, should be assigned by the contractor and approved. A dollar value must not be placed on these activities, e.g., Government action on submittals, Government-furnished items (GFI), work area access, etc.
6. Local conditions that may affect the work should be accounted for in the plan. For example, built-up roofing should not be scheduled in January if normal temperatures usually are below specified minimums.
7. Participation of major subcontractors. Any subcontractor performing 10 percent or more of the total contract work is considered a major subcontractor, and should participate in the contractor's development plan. (All major subcontractors may not have been identified at the time the contractor prepares and submits his schedule, but those who have should have been involved in its preparation.)

Time

1. Overall completion date. This date must comply with the contract's requirements. The contract specifications will define the time period within which the work is to be completed (in calendar days) from Notice to Proceed. A schedule consuming more than the specified number of days is not acceptable. However, a schedule showing early completion is acceptable, provided unreasonable time constraints are not placed on Government activities.
2. BOD and other contractual dates must be met in the proposed schedule. Early completion is usually acceptable as long as it is compatible with related activities.



FACILITY: EXAMPLE = HSS -ITF BLDG -

SUB-FACILITY: EXAMPLE = ROSEM -AREA W -

RESPONSIBILITY:

0 = UNSPECIFIED

1 = CONTRACTOR

2 = GOVERNMENT

MODIFICATION: FOR FIELD USE DURING CONSTRUCTION

NOTE: See MX cross-referenced building systems index
for BSI and CSI coding information.

Figure 10. Coding for MX Construction.

3. Network milestone identifiers must be as specified in the contract. Contract milestones are entered automatically into the MX master plan. Each milestone must be assigned a unique identifier.

4. Durations for Government activities must be reasonable. The contract specifications should advise the contractor on such things as how long the Government will require to act on submittals, and when any GFI are scheduled to be delivered. In the absence of advice in the specifications, a reasonable submittal review time (14 days) and (if possible) a GFI delivery compatible with contractor needs should be established.

5. Durations for contractor activities should be reasonable and conform to the limits specified in the contract. Activity duration limits usually range from 1 to 30 calendar days. Generally, only a few 1-day durations are needed for activities of a significant nature. Long-term activities (more than 30 days) of continuous duration should be broken into parts not exceeding 30 days each. Activities of more than 30 days duration may be acceptable if they do not lend themselves to further breakdown, or if their dollar value is small enough to allow accurate progress reporting and payment.

6. Durations for procurement activities should reflect market conditions. Procurement lead time must be an integral part of the construction schedule.

7. Float range should be broad enough to support the premise that it has not been manipulated. Some cases have occurred where schedules were submitted having an inordinate number of critical (0 float) activities and most of the remaining activities with small amounts of float. Some contractors have resorted to such practices in an attempt to counteract the use of float by the owner (Corps), without compensation, in the change order process. The old philosophy was that "the float belongs to the one who gets to it first." The Corps has processed many change orders without granting additional time because enough float existed to absorb the additional work duration, and the contract alerted the contractor of the practice. However, this is not completely in keeping with another philosophy which says that (after finalizing a change order) "the contractor should neither be better off nor worse off than he was immediately before the change order became effective." In cases where the change order work consumed some float, it would appear that the contractor was actually worse off because there remained less room for miscalculation on his part without incurring costs for which the Corps would not provide reimbursement.

If there is no float, every change order will either cause a time extension or acceleration costs. Essentially a situation has been created where the contractor owns the float. In such a situation, at least the contractor is no better off nor no worse off after a change order. It would appear, however, that the Corps is now worse off since it must either grant time or buy it back.

Zero floating a network defeats its fundamental purpose. One must know which activities are critical and which are not in order to effectively manage the work. Float is a significant element of the honestly developed network. Float belongs to no one; it may be used as necessary by the contractor (without change to the contract price, although the contractor has probably

incurred some additional cost in so doing). When the Corps wishes to use float to absorb change order work, it must negotiate an equitable price for the amount used.

The solution lies in a policy that says, "float has value to the contractor and must be treated as any other resource when pricing a change order." It appears reasonable that the value of float is not constant: (a) overall, it is generally of more value early in the life of the job than when the job approaches completion, because as the job progresses, the remaining risk factors diminish; and (b) for a given activity, it increases in value inversely to its quality, because uncontrollable events are more likely to happen to cause small periods of delay than those producing longer delays.

8. The critical path usually is a relatively few activities that form a path from the start to the finish of the network. If many parallel paths and/or a large number of critical activities exists, it is likely that some durations will be overstated for the purpose of eliminating float (see Item 7, above).

Logic

1. The scope of work should be reflected in the network. The network must contain all the work activities (with clear descriptions) to be performed under the contract. Any misunderstandings in the scope of work should be resolved as quickly as possible.

2. Submittal activities. These activities include the contractor's preparation and submittal of shop drawings, catalog cuts, samples, etc., and the Corps' review and approval actions. These time-consuming activities must precede nearly all of the construction-producing activities; thus, all materials and/or methods requiring prior approval must be represented in the network.

3. Procurement activities generally occur after the proposed material is approved, but before the construction activity using that material occurs. As in Item 2 above, all materials requiring approval should have their procurement lead-time activities represented in the network. (For durations, see *Time*, Item 6.)

4. Submittal and procurement activities must precede, and therefore constrain, the start of construction activities. Multiple procurements or deliveries of the same material should be shown separately. For example, if Buildings A, B, and C all require structural steel, each of the three structural steel erection activities should be preceded by its own structural steel procurement and delivery activity.

5. Sequencing and interdependencies must be logical. While it is the contractor's responsibility to plan and accomplish the work, many conventions can limit his options. For example, foundations will have to be completed before the roof is constructed, etc. The Corps reviews the contractor's proposed NAS/CPM to: (a) confirm it represents a reasonable plan for accomplishing the work, (b) ensure the work is broken down and identified well enough to permit accurate monitoring and reporting of progress, and (c) ensure that monetary values are correct for payment purposes.

6. Constraint. External constraints should be considered, including site access, work of other contractors, local climatic and environmental conditions, working schedules of local suppliers, contract-specified dates, etc.

Money

1. The monetary value assigned to individual activities must total to the contract amount.

2. The monetary value of each activity should conform to the range stipulated in the contract. The usual range is between 0.1 and 2.5 percent of the total contract amount. As discussed under *Time*, Item 5, ranges are given only as a guide to the desired level of work breakdown. Most breakdowns should fall within the range, some may fall outside. Judgement should be applied to see if the exceptions need changing.

3. The monetary value of each activity should represent a reasonable amount for that work. This analysis is subjective, based on the reviewer's experience, his knowledge of the work to be accomplished, and the cost of similar work completed recently.

4. The monetary value of administrative activities should be zero. The cost of preparing submittals is considered part of the overhead the contractor must distribute to other activities. Government activities such as submittal reviews, GFI deliveries, etc., represent no cost to the contractor. A monetary value should not be placed on procurement and delivery activities, since the cost of materials is included in the price for the construction activity using them. Payment for onsite materials (when allowed) is handled outside the network framework.

5. Front-end loading is the practice of placing an excessively high monetary value on activities scheduled for completion early in the project. This is the contractor's way of overcoming the effect of retainage on his payments, and obtaining working capital. However, this can result in prohibited overpayments or advance payments. The MX program allows payments in full, without retainage, as long as satisfactory work is performed by the contractor; thus, front-end loading is not necessary.

Planning Revisions

The need for network analysis does not end with approval of the contractor's initial submittal. There are many reasons why the network must be changed during the prosecution of the work. For example, production may fall behind that anticipated, equipment may unexpectedly break down, material deliveries may not be made on schedule, subcontractors and/or suppliers may fail to perform as promised, etc. A few such delays can cause the contractor's progress to fall behind the original schedule. Such delays do not, however, constitute justification for a time extension. So, when a network no longer realistically reflects how the work can be completed on schedule, the remaining work must be rescheduled. The contractor must also

replan the ways resources are applied to ensure timely completion at no additional cost to the Government. The contractor will be requested (or he may initiate the action) to reschedule the remaining work, and will submit his new network proposal for Government review and approval.

When the contractor's revised network is received, the Corps should evaluate it in the same way as the original submittal, except many of the checklist items will no longer be applicable.

For a discussion of plan revisions caused by contract modifications, see Chapter 5.

4 PROGRESS REPORTING AND PAYMENT ESTIMATES

Progress Reporting

The contractor's most recent approved NAS/CPM schedule is the basis for evaluating and reporting progress and for making payments. The reporting frequency and payment interval are established in the contract.

The importance of maintaining an up-to-date schedule cannot be overemphasized. Only from an up-to-date schedule can two of the most important management questions be answered accurately:

1. What is the scheduled status of the work?
2. What is the actual status of the work?

An up-to-date schedule must be used to accurately evaluate and price the effect of change orders. Without an up-to-date schedule, it is impossible to determine the work's current status, its future status, when it is scheduled for completion, or what it will cost.

Only the contractor or the Corps Contracting Officer can revise a project's progress schedule. The contractor may ask to revise the schedule when it no longer represents his plan for completing the remaining work; if the contractor does not ask to revise an outdated schedule, the Corps must ask the contractor to reschedule the remaining work and to apply the resources needed to complete the job on schedule.

The Corps, under the terms of the contract, is responsible for certain "excusable" delays as well as for its own contractual actions (or inactions). Change order revisions to a network should be incorporated immediately so the network analysis for the next change order will be accurate.

Field-office-level computer support will let the Corps, for the first time, rapidly analyze large networks. The Corps will be able to quickly update actual progress data, determine contractor earnings, evaluate the impact of change orders, and answer other management questions.

The little time needed to learn the effective use of the computer support system can mean the difference between keeping on top of the job or being buried by it.

Input

Module 14 lets the user input data on job progress, compare actual progress to scheduled progress, and produce partial payment documents. Figure 11 is a flowchart for Module 14. The screens supporting Module 14 are shown in Appendix A, Figures A18 through A26. The first step in gathering progress data is to generate an Update Input Report. This is done by selecting Option 1, Screen 14 (Figure A18). The Update Input Report is designed to be used by the field representative to report actual progress (Figure 12).

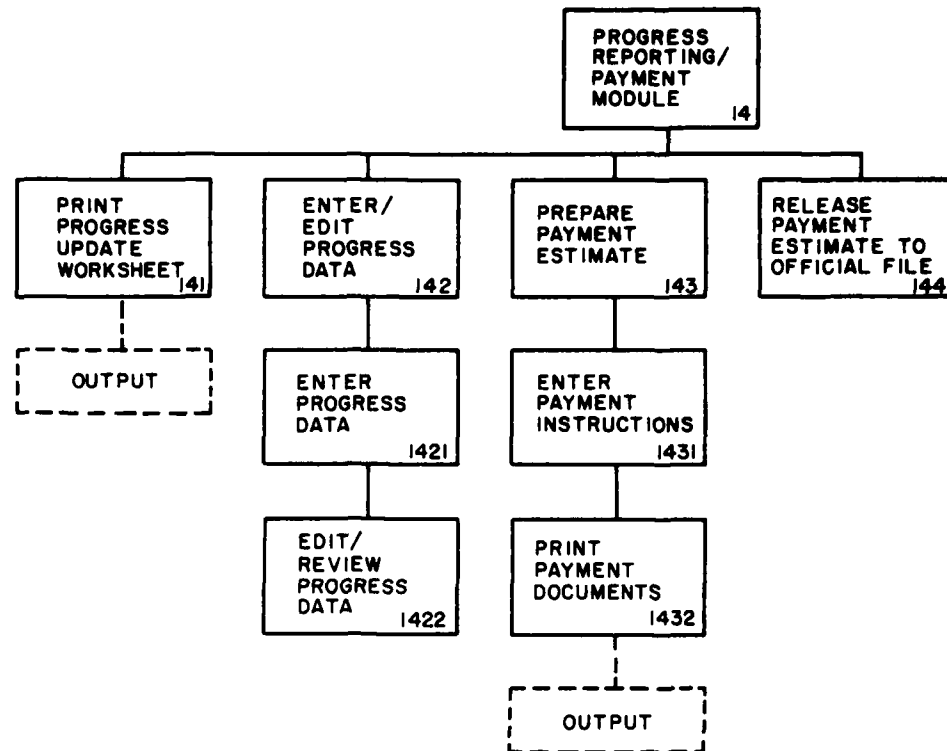


Figure 11. Module 14 -- flowchart.

For each network activity, the Update Input Report will show:

I-J numbers

Description

Start date (estimated start per schedule)

Days complete (0 before first update)

Percent complete (0 before first update)

Remaining duration: (scheduled duration before first update)

Finish date (estimating finish per schedule).

The inspector must input the following data for each activity whose status has changed:

1. Start date: an actual start date (DDMMYY) is mandatory whenever a percentage complete is shown.

2. Percentage complete: a percentage complete value is mandatory whenever an actual start date is shown. Percentage complete pertains to the dollar value of acceptable, in-place work as a percentage of the dollar value assigned to the activity.

```

RUN DATE 20MAY81 1437MRS      PROJECT START 2JAN81
PROJECT NET2                   CURRENT COMPL. 19MAR81
                                DATA DATE 23JAN81 PAGE 1
                                SORT  NODES
                                FINISH
MODE=C/F      START      DAYS PERCENT  PERM
ACTIVITY NUMBER  COMPL. COMPL.  DUR
-----
100  200 ISSUE NTP
      STA ..... DC ..... PC ... RD .... FIN .....
      .....COMPLETE  A  2JAN81  1  100  0  A  2JAN81
      1
200  300 MOBILIZE
      STA ..... DC ..... PC ... RD .... FIN .....
      .....COMPLETE  A  5JAN81  2  100  0  A  16JAN81
      11
300  300 BEGIN PROCUREMENT
      OCC .....
      .....COMPLETE  A  16JAN81  2
400  400 LAYOUT SITE
      STA ..... DC ..... PC ... RD .... FIN .....
      .....COMPLETE  A  19JAN81  12  100  0  A  20JAN81
      13
500  500 EXCAVATE FOUNDATION
      STA ..... DC ..... PC ... RD .... FIN .....
      .....COMPLETE  A  26JAN81  17  100  0  A  30JAN81
      21
600  600 BUILD FORMWORK
      STA ..... DC ..... PC ... RD .... FIN .....
      .....COMPLETE  A  2FEB81  22  100  0  A  13FEB81
      31
700  700 BEGIN CONCRETE POUR
      OCC .....
      .....COMPLETE  A  13FEB81  22

```

Figure 12. Sample Update Input report.

3. Remaining duration: under most circumstances, a remaining duration should not be assigned by the inspector. When a remaining duration is not assigned, the computer will calculate one by applying the percentage remaining of the dollar value of the activity to the scheduled duration of the activity. These data then will be used to reschedule the remaining work. Only when the inspector knows of events that would override the logic of the computer-calculated remaining duration should a remaining duration value be entered. The computer will then use this assigned duration to schedule the remaining work instead of the planned remaining duration.

4. Finish date: a finish date must be supplied by the inspector at the time an activity is shown as 100 percent complete (actual finish date DDDMMYY). For activities started, but not yet finished, the computer will project an early finish date. The inspector also must enter a "data date" in the upper right-hand corner on the first page of the Update Input report. The data date is the effective date of all the individual activity progress data.

After an activity initially is reported on, the Update Input report for the next period will show the previously input or computed information, instead of information based on the original schedule. The Update Input report is kept current by entering a new data date and progress information. If the status of an activity remains unchanged, no new progress entries are made, and the computer will calculate a new early finish date based on the new data date.

Progress data from the Update Input report are input to the computer using Menu 142 (Figure A20).

Output

After the computer is given input data which reflect the actual progress of the work as of a specific date, the computer will:

1. Produce reports showing current job status compared to the schedule (with respect to both time and money).
2. Use current trends to forecast the degree of success or failure to be expected in meeting future contractual milestones.
3. Show contractor earnings (past, current period, and total to date).

Module 16 lets the user select from several different kinds of reports. Figure 13 is a flowchart of Module 16. The screens supporting Module 16 are shown in Appendix A, Figure A27 through A40. These screens show the available report module menus. These reports let the user identify areas that need remedial action while there is still time for such action to produce a positive effect.

Figure 14, the Planning Schedule report, is obtained through Option 3 of Screen 162. It shows the schedule of the remaining work, based on current status and the logic of the current approved network (Figures A29 and A31, respectively). At any given time, there can be only one official schedule. This is the schedule approved by the Corps; it shows how the proposed plan will produce results on or before contractual dates, it is the one against

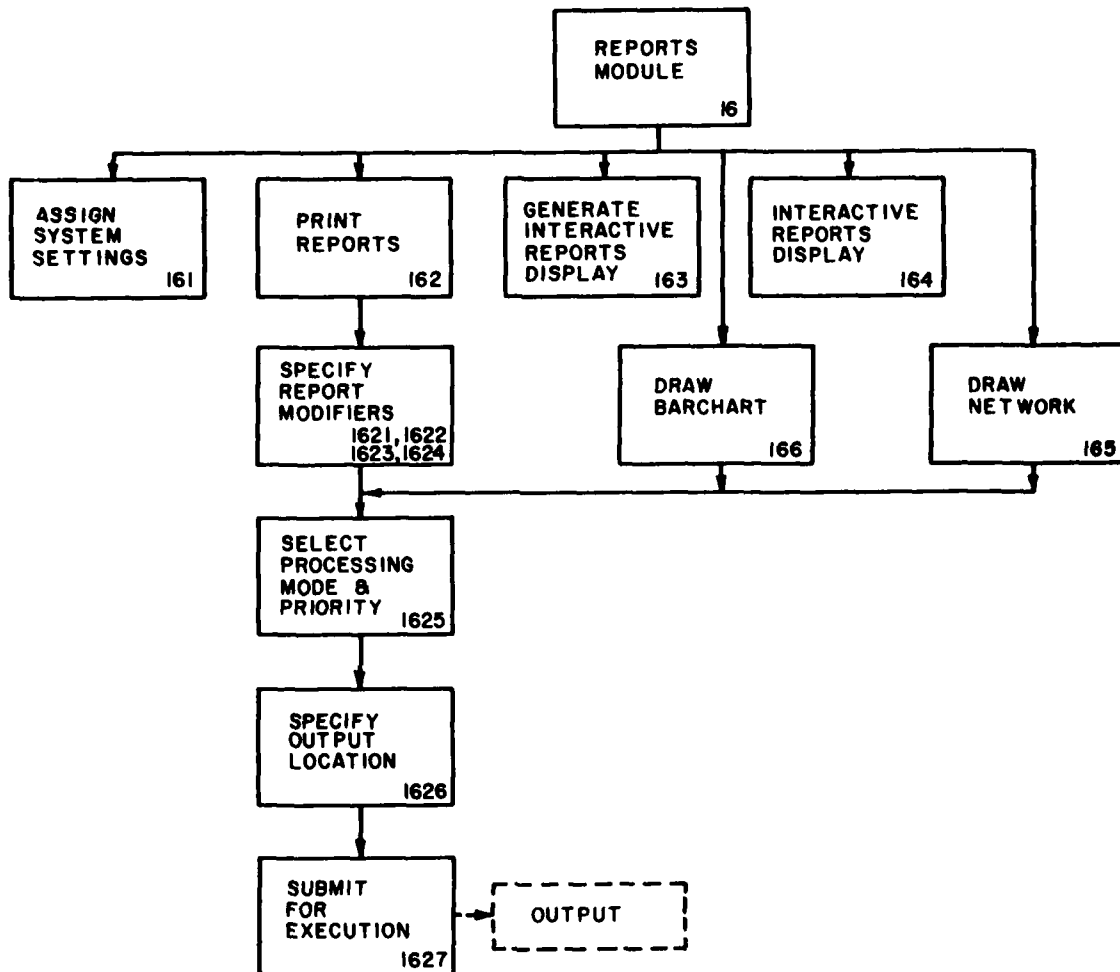


Figure 13. Module 16 -- flowchart.

which actual progress is evaluated, and it remains in force until replaced. Planning schedules (or target schedules) are not part of the official schedule, but projections based on what has happened and what was planned. When actual progress data are input to the computer, the planning schedule module predicts any significant deviations from the official schedule.

The Payments Estimate report (Figure 15) is obtained by selecting Option 3 of Screen 1432 (Figure A25). This report shows the overall percentage complete (dollar value) for the project. This figure can be compared with the scheduled percentage complete to determine the project's status. The percentage complete is based on the value of acceptable, in-place work. It is

QIN DATE 30JUN81 1400RS		P A Y M E N T S E S T I M A T E			PROJECT START 2JAN81				
PROJECT #12		CURRENT COMPLETION 13MAR81			DATA DATE 23JAN81 PAGE 1				
D E S C R I P T I O N		S O R T		M O D E S					
		P A Y M E N T		P E R C E N T C O M P L E T E					
		V A L U E		P A S T P E R I O D T O T A L					
				P A S T P E R I O D					
				T O T A L					
100 ISSUE MIP	200	0	100.00	0.0	100.00	0	0	0	0
200 MOBILIZE	300	1000	100.00	0.0	100.00	1000	0	0	1000
300 BEGIN PROCUREMENT	300	0	100.00	0.0	100.00	0	0	0	0
300 LAYOUT SITE	400	500	100.00	0.0	100.00	500	0	0	500
400 EXCAVATE FOUNDATION	500	2000	60.00	0.0	60.00	1200	0	0	1200
500 BUILD FORMWORK	600	3000	0.0	0.0	0.0	0	0	0	0
600 BEGIN CONCRETE POUR	600	0	0.0	0.0	0.0	0	0	0	0
600 POUR CONCRETE FOUNDATION	700	2000	0.0	0.0	0.0	0	0	0	0
700 CURB ADJUST	800	500	0.0	0.0	0.0	0	0	0	0
800 STRIP FORMWORK	900	1000	0.0	0.0	0.0	0	0	0	0
900 FOUNDATION COMPLETE	900	0	0.0	0.0	0.0	0	0	0	0
Grand Total		10000	27.00	0.0	27.00	2700	0	0	2700

Figure 15. Sample Payment Estimates report.

generally the response expected by someone inquiring about project status. Unless this figure is augmented by a progress allowance for materials onsite, it is the percentage complete reported upward.

The percentage complete becomes more meaningful when compared to the percentage complete scheduled, or more accurately, the range within which progress was scheduled. The percentage scheduled to be complete, calculated weekly, for both early and late finish is available from a report generated during the network approval analysis of the contractor's submittal. A new copy of this report will be required each time the approved schedule is revised. If the contractor does not furnish a scheduled percentage, the late finish percentage will be used as the scheduled percentage complete from which the actual percentage complete is evaluated. The late finish schedule is used instead of the early finish schedule because the contract usually only requires progress equal to or exceeding that represented by the late finish schedule.

The Working Schedule report (Figure 16) is obtained by selecting Option 4 of Screen 162 (Figure A29). The Working Schedule report can be sorted by either early or late finish; Figure 16 is an example of a Working Schedule report sorted by early finish. This report can be used to plan manpower requirements for the Corps staff, review phased safety plans and other prerequisite submittals for upcoming phases of the work, and to quickly check whether the anticipated work activities are compatible with normal, seasonal weather conditions.

The sample output reports shown in Figures 15 and 16 represent only parts of each full report and one type of its information. The data shown on these reports, as well as data on all other output reports, may be listed or grouped according to the user's needs. The system is designed to allow the user to retrieve and display only those data really needed at any given time.

Electronic Transfer

After data on the actual status of job progress have been input and the user is satisfied that the reports output by the system accurately portray the work, the user is ready to pass the schedule up the chain of command.

When the user originally approved the contractor's network, he electronically placed one copy in an official file and one copy in his own working file. Although other authorized users have electronic access to the official file (so they can monitor progress information), the original user is the only one who can access his working file. The working file is used to massage the data until they are ready to be placed in the official file. (Users who ask for a report from the official file may ask for data to be formatted in any way they choose.) Official data are updated on a predetermined schedule (e.g., weekly, biweekly, or monthly). A progress update input should coincide with each partial payment action. Logic revisions to the official schedule that are approved by the Corps will be input to the official file as soon as they occur.

The originally approved progress schedule and (any subsequently approved revisions) are electronically transferred from the user's working file to the official file by Module 14, via Screen 142, Option 3.

A similar process is activated via Screen 14, Option 4 to release payment estimate data for further processing.

Record Copies

Generally, the computer will store only current data. As the user updates or revises data, old data files are destroyed. If a historical record of the project is desired, it must be created by generating hard copies of pertinent reports as the job progresses.

The Resident Office is responsible for maintaining the record files for its contracts. Among other things, this includes collecting and filing copies of reports showing job status at the end of each reporting period.

Payment Estimates

General

Partial payments to contractors will be processed at about 15-day intervals. Payment cutoff dates will be established at the preconstruction conferences. To level their workload, Resident Engineers probably will want to use a different cutoff date for each contract.

The job status information needed to calculate earnings will be input as previously described; note that the data date for the progress data must be the same as the cutoff date for the partial payment.

Input

Screen 14, Option 3 is used to prepare partial payments. Screen 143 prompts the user to supply information needed to produce a payment. Normally retainage will not be withheld. If retainage is withheld, the user must provide information on the percentage applied. If the contract includes more than one facility and there are different completion dates, retainage may be applied to some, but not to others. The system allows the user to specify what part of the earnings are subject to retainage, and at what rate. The user also supplies information on the period covered, materials on site, deductions, and refunds.

Output

Screen 1432, Option 1 will produce the Payments Statement report (Figure 17) and Option 3 will produce the Summary Payments Statement report (Figure 18). The Payments Statement report shows the payment status of all the project's activities; it also gives a grand total. This report, which translates progress into dollars, is the detailed backup for the ENG Form 93 payment document. The Summary Payments Statement report allows the user to see the same information, but summarized into the activity groups he selects. The Payment Estimate report reflects the project status information input by the user (Figure 19). Hard copies of the Payment Estimate and Payments Statement reports should be kept in the Resident Engineer's files.

To display ENG Form 93 on the terminal screen, the user selects Screen 1432, Option 2 (Figure 20). If this is the contract's first payment, the form will be blank. For subsequent payments, the form is completed in the same way, except new spaces will be designated for the new data. (Note that some

RUN DATE 20-JAN-81 14:48:35		P A Y M E N T S S T A T E M E N T				PROJECT START 23-JAN-81			
PROJECT AFT		P A Y M E N T S S T A T E M E N T				CURRENT COMPLETION 18-JAN-81			
D E S C R I P T I O N		S U B T N O D E S				D A T A D A T E 23-JAN-81 PAGE 1			
		PCT/	PAYMENT	PERIOD	TOTAL	PREVIOUS	PERIOD	RETAINED RATE	
		TOTAL	VALUE	EARNED PCT	EARNED PCT	PAYMENTS	PAYMENT	TOTAL / AVG	
200 MOBILIZE	500	1000	1000	100	1000	100	0	900	100 100
300 LAUNCH SITE	400	500	500	100	500	100	0	450	50 100
400 EXCAVATE FOUNDATION	500	2000	0	0	0	0	0	0	0 100
500 BUILD FENCEWORK	600	3000	0	0	0	0	0	0	0 100
600 POUR CONCRETE FOUNDATION	700	2000	0	0	0	0	0	0	0 100
700 CUR CONCRETE	800	500	0	0	0	0	0	0	0 100
800 SET FENCEWORK	900	1000	0	0	0	0	0	0	0 100
...GRAND TOTAL		10000	1500	15.00	1500	15.00	0	1350	1500 100
WETAINED		150	15.00	15.00	15.00	15.00	0	1350	1500 100

Figure 17. The Payments Statement report.

PAYMENTS STATEMENT SUMMARIZE BY CODE 34

....PROJECT/2....				PROJECT SOFTWARE & DEVELOPMENT			
SUMMARY PAYMENTS STATEMENT				PROJECT START 1AUG77			
PROJECT EXMPL1 SAMPLE PROBLEM *ACTIVITY-ON-NODE*				BASE COMPLETION 180CY77			
				DATA DATE 10SEP77 PAGE 1			
DESCRIPTION	PCT/ TOTAL	PAYMENT VALUE	PERIOD EARNED PCP	TOTAL EARNED PCP	PREVIOUS PAYMENTS	PERIOD PAYMENT	RETAINED RATE TOTAL /AVG
1 PRELIMINARY OPERATIONS	31.77 RETAINED	1150 29	PERIOD 290 25.22	730 63.48	396 PAYMENTS	261 657 TTC	73 10 10.00
2 CONCRETE WORK	23.48 RETAINED	850 26	PERIOD 249 29.29	392 46.12	128 PAYMENTS	223 551 TTD	41 10 10.46
11 SUPERSTRUCTURE	39.64 RETAINED	1435 0	PERIOD 0 0.0	0 0.0	0 PAYMENTS	0 TTD	0 0 0.0
12 ELECTRICAL	5.11 RETAINED	185 0	PERIOD 0 0.0	0 0.0	0 PAYMENTS	0 TTD	0 0 0.0
...GRAND TOTAL RETAINED		3620 55	PERIOD 539 14.89	1122 50.99	524 PAYMENTS	484 1008 TTD	114 10 10.16

Figure 18. The Summary Payments Statement report.

of the new data already will have been inserted by the computer.) The user then is prompted through a sequence of input reviews and edits to check the final document. The final ENG Form 93 is authenticated by the Corps' and contractor's authorized representatives affixing their security protected passwords. The system will not allow the ENG Form 93 to be entered into the official file unless these passwords are entered.

After ENG Form 93 is entered into the official file, it can be accessed by the Area Office and CEMXCO for further processing and payment to the contractor. If any changes are made to the payment data after the user has placed it in the official file, those authorizing such changes will immediately correct the official file and advise the user so his working file and records may be corrected.

Security

As noted, the Resident Engineer's working files are not available to other users. Progress data, payment estimates, and other information and reports are released for review only after the user has developed the report data in his working file and transferred a copy of that file to either a common or official file. The Resident Engineer should be very careful that the information placed in the official file is correct, since any wrong data, even if on file a short time before correction, may mislead other users who depend on the accuracy of the official file.

PAYMENT ESTIMATE -- CONTRACT PERFORMANCE For use of this form, see ER 37 2 10 and ER 37 345 10						1. DATE		SHEET ____ of ____	
2 CONTRACTOR AND ADDRESS				3 CONTRACT NO			4 DISTRICT		
5 DESCRIPTION OF WORK				6 APPROPRIATION AND PROJECT			7 REQUIRED COMPLETION DATE		
8 LOCATION		9 PERIOD COVERED BY THIS ESTIMATE FROM _____ THRU _____			10 JOB ORDER NO		11 ESTIMATE NO		
ITEM NO a	DESCRIPTION b	CONTRACT			TOTAL TO DATE				
		QUANTITY AND UNIT c	UNIT PRICE d	AMOUNT e	QUANTITY AND UNIT f	AMOUNT g			
INCLUDES MODIFICATION THRU					TOTAL CONTRACT → \$		TOTAL EARNINGS TO DATE → \$		
12 PRESENTED FOR PAYMENT					14 A. PREVIOUS DEDUCTIONS OTHER THAN RETAINED PERCENTAGE**				
PAYEE		PER			B. PREVIOUS RETAINED PERCENTAGE				
DATE		TITLE			C. PREVIOUS PAYMENTS				
13 APPROVED FOR PAYMENT					D. PREVIOUS EARNINGS (A+B+C)				
I CERTIFY that I have checked the quantities covered by this bill or estimate, that the work was actually performed, that the quantities are correct and consistent with all previous computations as actually checked, that the quantities and amounts are wholly consistent with the requirements of the contract or other instrument involved.					E. EARNINGS THIS PERIOD (TOTAL EARNINGS TO DATE MINUS D)				
					F. LESS RETAINED PERCENTAGE				
					G. LESS DEDUCTION OTHER THAN RETAINED PERCENTAGE FOR				
					H. TOTAL DEDUCTIONS THIS PERIOD (F+G)				
SIGNATURE		TITLE		DATE		I. RETAINAGE REFUNDED			
						J. OTHER REFUNDS			
						K. TOTAL REFUNDS THIS PERIOD			
						L. AMOUNT DUE CONTRACTOR (E-H+K)			
CONTRACTING OFFICER APPROVAL (Signature)				DATE		15 RECAPITULATION			
						TOTAL RETAINED PCTG (B+F-I) \$		TOTAL PAID (C+L) \$	

ENG FORM 93
1 MAR 78

PREVIOUS EDITION OF THIS FORM IS OBSOLETE

**USE REVERSE SIDE FOR DETAILED EXPLANATION AND OR REMARKS

Figure 20. The Payment Estimate report -- sample 2.

Authenticating Passwords

Certain communications, reports, etc. mailed from the Resident Office over the Resident Engineer's or other authorizing signature must be authenticated in the electronic medium by assigning passwords to authorizing individuals in the Resident Office. The computer will not accept material into the official file unless it has the correct password. Access to material in the official file will also be controlled by passwords.

To maintain the security of the system, passwords will be changed frequently. The CEMXPA Management Support Group will assign passwords.

Individuals who are assigned passwords are responsible for their security and any transactions made under their authority. CEMXPA will immediately issue a new password when notified of a compromise.

Operational Passwords

Only a few key people will be assigned authenticating passwords. Other authorized system users will be issued operational passwords. The Resident Office will need an operational password to access the computer system and use its capabilities. The user will have to assign himself passwords to enter his various working files. Various levels of passwords will be in use at the same time for various purposes. Only those directly responsible for an activity will be able to input and subsequently change stored data. Others, who have a need to know, will only be able to read the data. Who has access to what and for what purpose will be controlled through the password system.

Electronic Transfer

Screen 14, Option 4, starts the process of placing ENG Form 93 into the official file. Option 4 also can be used to reproduce and transfer specific materials developed in the working file (inaccessible to other users) into another file (e.g., the official file). Material is placed in the official file to give other users the information they need to do their jobs, or in the case of the Payment Estimates report, to have others pick up the information and continue its processing. The official file is the user's outgoing mail box for much of his correspondence with higher organizational levels.

The official file contains only the latest data. For example, when a user enters Payment Estimate report No. 6 documentation, the previously stored No. 5 documentation is destroyed.

Material placed in the official file is available immediately to authorized users. In addition to sending things out via the official file, the user also will receive messages electronically. When the user logs onto the system, general messages will appear. As the user selects subsequent options, messages pertinent to those options will appear.

Record Copies

Generally, the computer (particularly the official file), will store only current data. As the user updates or revises data, superseded data are destroyed. If a historical record of the contract is desired, it must be created by generating and filing hard copies of pertinent reports as the job progresses.

The Resident Office is responsible for maintaining the record files for its contracts. Among other things, this includes copies of ENG Form 93 and the Payment Statement report.

5 MODIFICATIONS AND CLAIMS

Change Orders

When the contractor's progress schedule was approved, the Corps accepted it as a definition of a practical way to finish the work on time. As long as the work remains unchanged and actual progress meets or exceeds that scheduled, the originally approved progress schedule is viable. Unfortunately, it is often necessary to change the work. The Modification Impact Evaluation Module, Module 15, helps the Resident Engineer determine the effect a change order will have on the contractor's approved schedule. Figure 21 gives Module 15's flowchart. The screens supporting Module 15 shown in Appendix A, Figures A41 through A53. Module 15 also speeds the implementation of schedule revisions which reflect change orders. It is essential to successful contract administration that the approved planning schedule be current.

The key to maintaining the planning schedule is prompt revision when a change order occurs. This cannot be done if the contractor responds late to an RFP or fails to negotiate the time element in good faith. However, the computer can quickly quantify the time element involved in the changed or unchanged work caused by a change order. Using this information (plus knowledge regarding the granting of additional time or buying back time to meet a critical date), the time factor for a modification can be unilaterally resolved. The contractor then can be notified (in the RFP) that he has x number of additional days to complete the changed work. Thus, the contractor is responsible only for developing the change order's dollar proposal. At the same time, since the time has been quantified and network revisions identified, the network can be input immediately with the new data (and be used to evaluate the impact of the next change order, if necessary).

Since change orders are not initiated unless they are absolutely essential, there is very little danger that an RFP will not be followed by an executed modification. Consequently, there is little risk in revising the planning schedule network before issuing a Notice To Proceed (NTP), or reaching a dollar agreement. In the rare event that an RFP is withdrawn, the network revisions can be removed easily. Of course, any time element analyses based on the withdrawn revisions would have to be reevaluated.

As change orders occur, there should be a way of identifying the network activities whose dollar value or duration are affected. Changes in existing activities (and any new activities) will be identified in the contractor's proposal, the resume of negotiations, the findings of fact, and the contract modification documents. The B-code digits 789 code network revisions so they keep their identity. This allows the computer-generated ENG Form 93 to either include earnings on modifications in the total earnings to date amount, or to separately list earnings on modifications, at the user's option. The total contract amount will include the value of all executed modifications.

The network will be affected by factors other than the change orders. It may have to be revised because it no longer accurately represents the contractor's plan for executing the work, or because actual progress has not kept up with the schedule.

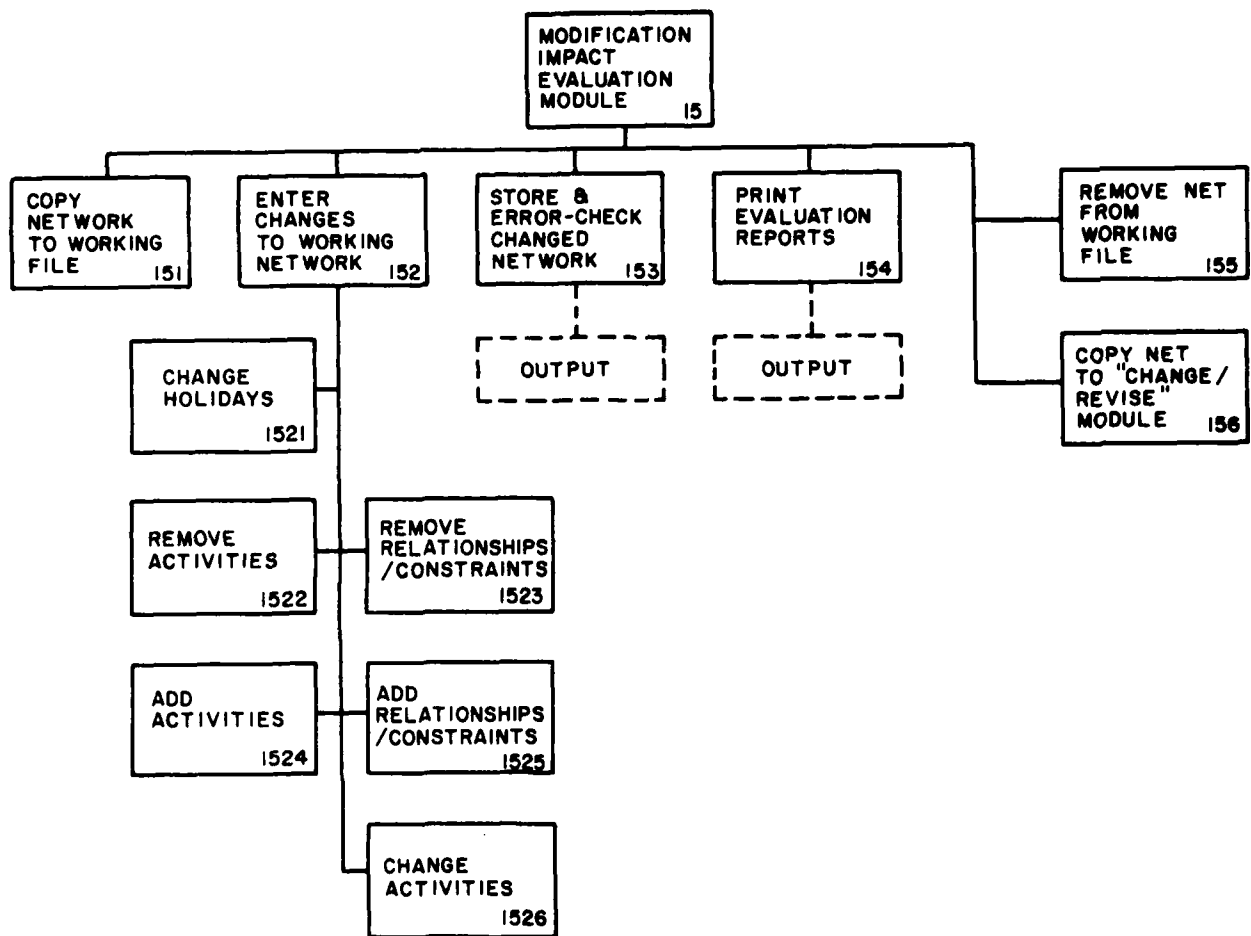


Figure 21. Module 15 -- flowchart.

Any revised logic or durations must be developed by the contractor and submitted for approval. After the revisions are input, the computer produces a new official Planning Network report. This new schedule then is the basis for evaluating the effect of subsequent changes, if any. Since the snowballing effect of unresolved modifications makes it less likely that a truly equitable adjustment can be achieved on any single modification, change orders must be handled one at a time. Since they may come quite rapidly during a project, the system and its users must be prepared to process them quickly. But issuing an NTP simultaneously with the RFP should be reserved only for truly urgent situations. It should not be used as a panacea to relieve the pressure to properly process the change in a short time.

Because the Modification Impact Evaluation Module lets Resident Engineers quickly analyze the time impact of change orders, delays in "plugging" changes into a schedule can be avoided. This eliminates the problem of having to evaluate the effect of Modification 5 when the planning schedule has not been updated to reflect the changes caused by Modifications 1, 2, 3, and 4. Following up with the dollar agreements also is made less difficult because activities both directly affected and indirectly affected (i.e., the unchanged work) are identified.

Impact Analysis

To estimate the effect of a change order, the current status of the work and the contractor's approved plan for completing the remaining activities must be known. The Modification Impact Evaluation Module provides this information. It also lets anticipated network adjustments to be temporarily (or permanently) input and their effect observed. Screen 15 (Figure A41) offers options that let the user:

1. Obtain copies of the current approved planning schedule.
2. Input appropriate changes to the network; i.e., delete activities, create new activities, change durations, change descriptions, etc.
3. Process revised data.
4. Obtain reports (standard or customized) to compare the new schedule to the old schedule.
5. Copy all or part of anything produced before restoring the files to their original condition.
6. Keep all or part of the revised reports for use in justifying the time element involved in the change order.
7. Keep the revised input in the system, thus making a new planning schedule available for official approval and implementation.

The change order's time effects can be observed by comparing the current Target Date report to the Target Date report generated after the changes to the network have been input to the working file and processed. At this point, it is known whether the change order work normally would delay the completion of the remaining work (or any critical part of it), and, if so, quantify the delay. (Whether the time extension actually will be granted is a management decision influenced by broader considerations.) This analysis will show those activities both directly and indirectly affected by the change order; estimating the dollar cost of the change order must take both into consideration. The estimate must also consider that time has value, whether or not it is on the critical path.¹

¹ For examples of using the NAS to develop the modification estimates, see Modification Impact Evaluation Guide, Engineer Pamphlet (EP) 415-1-3 (Office of the Chief of Engineers, July 1979).

Computer support speeds the assessment of the effects of time on a schedule, even for a large network and complex change order. As noted, change orders are not the only reasons an original plan is amended. For example, when the contractor falls behind the approved schedule, and the official schedule no longer reflects the time needed to finish the remaining work per contract requirements, the contractor must submit a revised schedule. Ordinarily, only the durations or the sequencing of the remaining activities will be changed, with shortened durations implying the assignment of increased resources by the contractor. No increase in contract price or the value of the various activities is permitted, since the need for schedule revision stems from contractor-responsible causes. After the Corps reviews and approves the revised schedule, it becomes the new official schedule.

Request For Proposal (RFP)

An RFP should define the time, if any, allocated for a change order to achieve the following benefits:

1. Reduce the time needed to reach agreement with the contractor on the price of a change order.
2. Permit prompt revision of the progress schedule to accommodate the changed work.
3. Maintain the contractor's incentives for efficiency.
4. Allow equitable handling of a large number of change orders.

A computer-supported NAS allows the user to predict time impacts, and to document his findings. For those findings to be reasonably accurate, the user must use good judgment in deciding where in the sequence of events the new work could and should be accomplished. He also must decide how long the change will take, considering the normal workweek, the other work, and resources available to the contractor. The contractor's only responsibility is to price the work appropriately for the specified timeframe (like he did when he bid the original contract work).

The RFP also should contain other pertinent information such as the date by which the contractor's proposal will be received, any instructions concerning coordinating the cost proposal with network activities, and the separation of direct costs from impact on unchanged work. The contractor should be told whether the progress schedule is unchanged or revised (see Appendix C).

Finalization

It is easier to arrive at an equitable adjustment on the price of a change order if the price is negotiated separately from the time element. It is best to agree on the time and price of a change order before the changed work begins. If the contractor does not cooperate with a prompt, responsive, reasonable proposal, unilateral modification may be used.

The modification document should state that the agreed price includes all amounts due the contractor for the changed work, and show the portions of the cost attributed to directly changed work and impact. If no impact costs are involved, the modification should so state.

Network Revisions

A construction contract can have only one official progress schedule. That schedule remains in force until the Resident Engineer approves a revision; then the revised schedule becomes the official schedule. The Correct/Revise Stored Network Module, Module 12, lets the user (1) revise a network after it has been stored in PROJECT/2, (2) check the results of his revision, and (3) place the revised network into the official file. The screens supporting Module 12 are shown in Appendix A, Figures A54 through A66.

Module 12 helps the user input network changes and place the revised progress schedule into the official file after he has selected the best way to incorporate change order work or he has reviewed and accepted a revised plan from the contractor. For change orders, the network is revised when the RFP is issued (it is not necessary to wait for a dollar agreement). For planning changes requested by the contractor, the official schedule is updated when the Resident Engineer approves the contractor's revised plan. In either case, the contractor is told of any schedule revisions through the RFP (for change orders) or the regular approvals procedures (for contractor-initiated network revisions). The rest of the system's users are informed by transferring the new, approved schedule to the official file.

Claims

General

All claims submitted by the contractor must be carefully evaluated. If the claim is justified, it will generate a contract modification, through which an equitable adjustment may be reached. All changes must be resolved promptly, whether they are initiated by the Corps or the contractor (claim).² Claims cause contract modifications, are withdrawn by the contractor, or are denied via a contracting officer's decision. Regardless of the ultimate disposition of a claim, some review of the job's history usually is required. Job status records and computer-generated reports can help reconstruct the conditions that prompted the claim. Networking capabilities also can help analyze claims that affect future job activities.

Impact Analysis

The only difference between analyzing the effect of the change alleged in a claim and that of a change order issued by the Corps is the time in which the effect begins. A claim's effect may have begun before the claim notice is received. (See the section titled Change Orders, above.)

² For policy and procedures, see Modifications and Claims Guide, EP 415-1-2 (Office of the Chief of Engineers, July 1979).

Resolution

Claims are either accepted, denied, or withdrawn. Accepted claims are resolved through the change order process. Denied claims do not always stay denied; if the contractor submits the claim without asking for a contracting officer's decision, if appropriate, the Resident Engineer may deny the claim and support his position with appropriate documentation. The contractor may then withdraw his claim or request a contracting officer's decision. The contractor may also appeal a contracting officer's decision that denies his claim. The contractor may withdraw his claim at any time.

6 SUPPLEMENTAL MODULES

User Message Module

The User Message Module, Module 18, lets system users communicate electronically with all other (or selected) system users. A flowchart for Module 18 is shown in Figure 22. The screens supporting Module 18 are shown in Appendix A, Figures A67 through A73. Module 18 supplements the electronic information transfer abilities used for construction scheduling, progress, and payments provided by the system's other modules. The User Message Module is intended primarily for text, but also can be used to circulate statistical data. Whatever message the originator wishes to transmit becomes available instantaneously at the terminal of those the originator selects to receive it.

All messages are identified by a serial number, the originator's identification, a date, and a recipients' list. Originators may remove their message from the list at any time. Recipients will electronically acknowledge they have received a message. The system will automatically remove any messages more than 15 days old.

The computer will automatically assign each message a number when it is entered into the system. This numbering system is designed and managed to prevent duplicate numbers.

System security is maintained by requiring password authentication before an originator's messages are dispatched. This will inhibit pranksters and practical jokers, who otherwise might destroy system credibility. The system is not suitable for transmitting classified information.

The module's initial screen, Screen 18, lists options coordinated with system functions (Figure A67).

PROJECT/2 Access

The full PROJECT/2 Access Module, Module 17, is for users who wish to expand the capabilities of the MX Construction Planning Management System and who are familiar with PROJECT/2 processors, their command language, and protocol. (A PROJECT/2 flowchart is shown in Figure 23. The Module 17 screen is shown in Appendix A, Figure A74.) This module places the full capabilities of PROJECT/2 at the user's disposal. Unlike other system modules, it requires a thorough knowledge of PROJECT/2 command structures.

The other modules in the system use PROJECT/2 by working through an intermediary software package that translates more or less familiar terms and commands into a language understood by PROJECT/2. These modules give the user enough processing and reporting options to perform all networking functions. So, under normal circumstances, most users will not need to access PROJECT/2 directly.

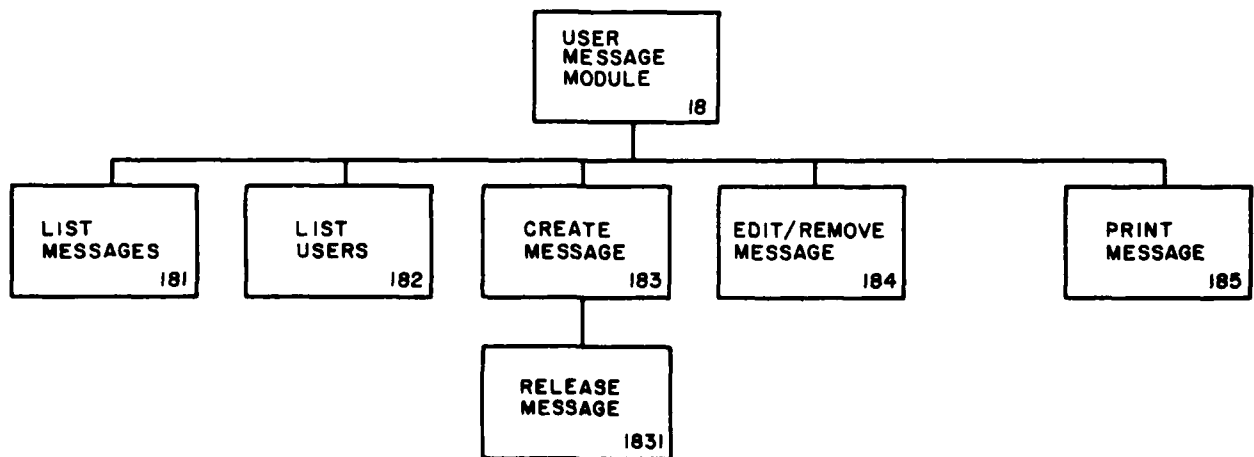


Figure 22. Flowchart -- Module 18.

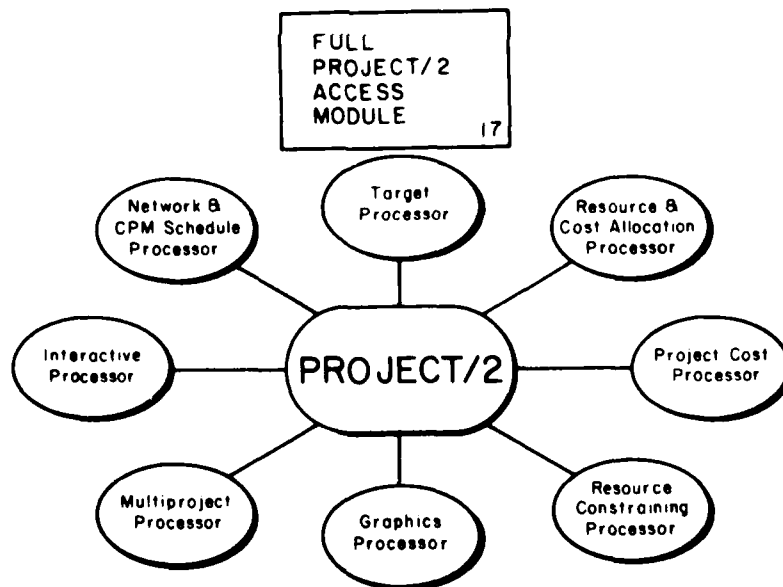


Figure 23. PROJECT/2 flowchart.

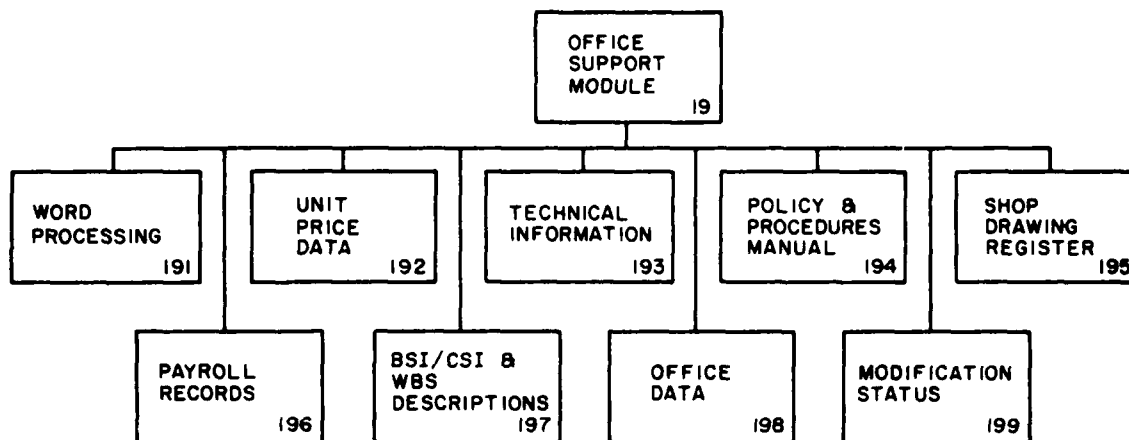


Figure 24. Module 19 -- flowchart.

Office Support Module

Many construction field officer functions can be done better and quicker with the computer support offered by the Office Support Module, Module 19. A flowchart for Module 19 is shown in Figure 24. The Module 19 screen is shown in Appendix A, Figure A75:

1. Word Processing. This submodule helps prepare correspondence and forms not otherwise automated. It requires its own dedicated terminal and processor.
2. Unit Price Data. This submodule can generate and update a list of unit prices from Government estimates, bid breakdowns, change order settlements, etc. It is adjusted to geographical area.
3. Technical Information. This submodule can access stored text such as American Society for Testing and Materials (ASTM) standards, Federal specifications, and other reference material.
4. Policy and Procedures Manual. This submodule can access stored, indexed, and keyworded CEMXPA regulations, circulars, forms, pamphlets, etc. Material can be called up and read from the CRT screen or printed, eliminating the need to distribute the same data in hard copy to all offices.
5. Shop Drawing Register. This submodule can set up a tracking system to help the office engineer control submittal activities, and maintain records of value in the event of claims.
6. Payroll Records. This submodule can store and process payroll data, both for the contractor (if required) and the Government.

7. BSI/CSI and WBS Description. This submodule can list Building System Index (BSI) and Construction Specification Institute (CSI) codes and descriptions, and generate an indented hierarchical listing of the MX deployment work breakdown structure (WBS). (The MX coding system must be uniformly applied to construction networks to allow this integration.)

8. Office Data. This submodule offers miscellaneous packages to help flag vehicle preventive maintenance, maintain an inventory of accountable Government property, prepare and distribute DD Form 1354s and associated materials, etc.

9. Modification Status. This submodule offers a package to help manage change orders: lists per contract, per stage, per all contracts assigned to the office, per contracts more than 75 percent complete, etc. It also helps establish priorities for assigning resources to problem areas.

The minimum Office Support Module should contain the Word Processing and BSI/CSI and WBS Description submodules. Expansion will depend on the size and mission of the office and the operating procedures implemented by the Resident Engineer.

7 CONCLUSION

The Network Analysis System (NAS) provides an effective and versatile means of planning, managing, and monitoring construction. The Corps is committed to its use on all but its very smallest projects. Through the use of hierarchical networking, the significant elements of a number of individual projects can be combined to produce summary data for major programs. Efficient application of these principles, even on moderately sized projects, requires real time or near real time computer support. PROJECT/2 (an NAS software package developed by Project Software & Development, Inc.) has been selected for use on the MX program.

This report has described and provided user guidance on an MX Construction Planning Management System based on NAS and PROJECT/2. The system is oriented toward the needs of the Corps MX Area/Resident offices, while at the same time providing higher echelon management information needed for their functions. Although the system was developed to satisfy the management needs of the MX program, it is equally applicable to other Corps projects and programs.

APPENDIX A:
MX CONSTRUCTION MANAGEMENT SYSTEM
MODULE SCREENS

MX CONSTRUCTION MANAGEMENT SYSTEM

INPUT NEW NETWORK MODULE

Options:

1. Enter a new network
2. Resume entering new network -- edit data
3. Store and error-check network
4. Copy a network
5. Exit module

Enter contract number (or short name): _____

A network with this identification already exists

*

Would you like to see the active network list? ____ (Y or N)

Enter option or help: _____

11

*Prints only if contract number or short name entered is presently in use.

Figure A1. Module 11 -- Screen 11.

MX CONSTRUCTION MANAGEMENT SYSTEM

INPUT NEW NETWORK MODULE

Network: _____

Header Data

Contract Title:

Contractor's Name:
& Address:

Area Office:

Network Type (A/A or A/N):

Contractual Start Date: __/__/__

Contractual Completion Date: __/__/__

Working Days Per Week: ____

*Holidays (Standard, Government, Manual Loading): ____

- Options:
1. Assign Code Descriptions
 2. Edit Data
 3. Exit Module

Enter option or help: ____

111

*"Manual Loading" option selects menu 1111

"Network Type" selection determines input screen series: for activity on arrow (A/A), screens 1115 and 1117; or for activity on node (A/N) screens 1114, 1116, and 1118.

Figure A2. Module 11 — Screen 111.

MX CONSTRUCTION MANAGEMENT SYSTEM

INPUT NEW NETWORK MODULE

Network:

Assign holidays (DDMMYY):

---	---	---
---	---	---
---	---	---
---	---	---
---	---	---
---	---	---

- Options:
1. Assign more holidays
 2. Return to header menu
 3. Assign code descriptions

Enter option or help: ____

1111

Figure A3. Module 11 -- Screen 1111.

MX CONSTRUCTION MANAGEMENT SYSTEM

INPUT NEW NETWORK MODULE GLOBAL CODES

Network: _____

The following global code descriptions are required for contract networks to integrate with higher level networks. They may also be used for internal office networks.

<u>Code Field</u>	<u>Description</u>	<u>Code Field</u>	<u>Description</u>
A12	BSI	B123	Facility ID
A34567	CSI	B45	Subfacility
*A89	Subcont. ID	B6	Responsibility
		**B789	Modification ID

(*Optional input by contractor, **optional use by government.)

- Options:
1. Enter optional code descriptions
 2. No optional codes used, proceed to network data input
 3. Exit module

Enter option or help: _____

1112

Figure A4. Module 11 -- Screen 1112.

MX CONSTRUCTION MANAGEMENT SYSTEM

INPUT NEW NETWORK MODULE CODE DESCRIPTION

Network: _____

Assign Code Descriptions:

Field (A-B-C):____ Code: _____ Title: _____

<u>Code</u>	<u>Description</u>
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Options: 1. Enter more this field 2. Next field
 3. Edit data 4. Finished, proceed to enter
 network data 5. Exit module

Enter option or help: _____

1113

Figure A5. Module 11 -- Screen 1113.

MX CONSTRUCTION MANAGEMENT SYSTEM

INPUT NEW NETWORK MODULE

Network: _____

Enter activities and events -A/N-

Node: _____ Description: _____

Duration: _____ Codes: _____ Value: _____

- REPEAT -

- REPEAT -

- REPEAT -

Options: 1. Enter more 2. Edit data 3. Enter
relationships 4. Store network 5. Exit module

Enter option or help: _____

1114

Figure A6. Module 11 -- Screen 1114.

MX CONSTRUCTION MANAGEMENT SYSTEM

INPUT NEW NETWORK MODULE

Network: _____

Enter activities and events -A/A-

I _____ J _____

Description: _____

Duration: _____ Codes: _____ Value: _____

- REPEAT -

- REPEAT -

Options: 1. Enter more 2. Edit data 3. Enter constraints
4. Store network 5. Exit module

Enter option or help: _____

1115

Figure A7. Module 11 -- Screen 1115.

MX CONSTRUCTION MANAGEMENT SYSTEM

INPUT NEW NETWORK MODULE

Network: _____

Enter activity/event relationships -A/N-

Node: _____ Node: _____

Relationship (SS-FF-SF-FS): _____ Lag: _____ work days

- REPEAT -

- REPEAT -

Options: 1. Enter more 2. Enter constraints
3. Edit data 4. Assign list
5. Store network 6. Exit module

Enter option or help: _____

1116

Figure A8. Module 11 -- Screen 1116.

MX CONSTRUCTION MANAGEMENT SYSTEM

INPUT NEW NETWORK MODULE

Network: _____

Assign constraints -A/A-

(Note contractual start and finish dates have been entered.)

I _____ J _____

Constraint (START - FINISH): _____ (ON-NET-NLT): _____ Date: _____

- REPEAT -

- REPEAT -

Options: 1. Enter more 2. Edit data 3. Assign list
4. Store network 5. Exit module

Enter option or help: _____

1117

Figure A9. Module 11 -- Screen 1117.

MX CONSTRUCTION MANAGEMENT SYSTEM

INPUT NEW NETWORK MODULE

Network: _____

Assign constraints -A/N-

(Note: Contractual start and finish dates have been entered.)

Node: _____

Constraint (STArt - FINish - EVEnt): _____ (ON-NLT-NET): _____
Date: _____

- REPEAT -

- REPEAT -

Options: 1. Enter more 2. Edit data 3. Assign list
4. Store network 5. Exit module

Enter option or help: _____

1118

Figure A10. Module 11 -- Screen 1118.

MX CONSTRUCTION MANAGEMENT SYSTEM

INPUT NEW NETWORK MODULE
RESUME/EDIT INPUT

Network: _____

Options:

1. Edit previously input data
2. Add to previously input data
3. Edit and add to previously input data
4. Delete all data stored under network name above.

Note: This module is operational only on network data not already submitted to Project 2 for processing and storage.

5. Exit module

Select option or help: _____

112

Options 1, 2, and 3 will return user to screen 111 with previously input data shown as the inputting sequence is recycled.

Figure A11. Module 11 -- Screen 112.

MX CONSTRUCTION MANAGEMENT SYSTEM

INPUT NEW NETWORK MODULE

Network: _____

Submit network to Project 2 for processing, error-check, and storage.

Select output:

Planning schedule, sort I-J _____ (Y or N)

Planning schedule, sort ES-LF-Float _____

Network listing _____ (Y or N)

Other _____ (Y or N)

Options: 1. Exit module 2. Edit data 3. Process network

Select option or help: _____

*Enter password: _____

113

*Appears upon selection of Option 3. If no specific output is selected, default is Planning Schedule, I-J sort. "Other" output selection calls up Screen 162.

Figure A12. Module 11 -- Screen 113.

MX CONSTRUCTION MANAGEMENT SYSTEM

INPUT NEW NETWORK MODULE

Copy network:

Name of network file to be transferred: _____

Contract number or short name to be assigned: _____

Does this network replace an existing network of the
same name (Y or N): _____

Options: 1. Copy network
 2. Edit data
 3. Exit module

114

Figure A13. Module 11 -- Screen 114.

MX CONSTRUCTION MANAGEMENT SYSTEM

ANALYZE NEW NETWORK SUBMITTAL MODULE

Options:

1. List active networks
2. Select reports
3. Approve and release to official file
4. Exit module

Select option or help: _____

*Enter network contract number (or short name): _____

13

*Appears upon selection of Option 2 or 3.

Figure A14. Module 13 -- Screen 13.

MX CONSTRUCTION MANAGEMENT SYSTEM

ANALYZE NEW NETWORK SUBMITTAL MODULE

ACTIVE NETWORKS

Contract # or
Short Name

Data Date

File Location

LIST

LIST

LIST

Options: 1. Next page 2. Previous page 3. Exit module

Enter option or help: _____

131

Figure A15. Module 13 -- Screen 131.

MX CONSTRUCTION MANAGEMENT SYSTEM

ANALYZE NEW NETWORK SUBMITTAL MODULE SELECT REPORTS

Options:

1. Basic submittal review package

Network listing - sort I-J - ejected and sorted BSI/CSI
Network listing - sort decreasing duration
Network listing - sort decreasing cost
Planning schedule - sort I-J
Planning schedule - sort ES
Planning schedule - sort Float
Planning schedule - sort LF
Cost analysis (graphs)

2. Customized reports

3. Exit module

Select option or help: _____ Enter network ID: _____

132

Figure A16. Module 13 -- Screen 132.

MX CONSTRUCTION MANAGEMENT SYSTEM

ANALYZE NEW NETWORK SUBMITTAL MODULE

Copy approved network to official file -

Network ID: _____

Enter password to start procedure:

Password: _____

- Options:
1. Execute copy procedure
 2. Edit data
 3. Exit module

Enter option or help: _____

133

Figure A17. Module 13 -- Screen 133.

MX CONSTRUCTION MANAGEMENT SYSTEM

PROGRESS REPORTING/PAYMENT MODULE

Enter network ID: _____

Options:

1. Print update input report
2. Enter/edit progress data
3. Prepare payment estimate
4. Release payment estimate to official file
5. Exit module
6. Exit system

Enter option or help: _____

14

Figure A18. Module 14 -- Screen 14.

MX CONSTRUCTION MANAGEMENT SYSTEM

PROGRESS REPORTING/PAYMENT MODULE UPDATE INPUT REPORT

Network: _____

Print update input report

Options:

1. Include activity descriptions
2. Suppress cost information
3. Suppress codes

Enter option(s) or help: _____

141

Figure A19. Module 14 -- Screen 141.

MX CONSTRUCTION MANAGEMENT SYSTEM

PROGRESS REPORTING/PAYMENT MODULE

ENTER/EDIT PROGRESS DATA

Network: _____

Data Date: ____

Options:

1. Enter progress data
2. Change/review progress data
3. Place progress data in official file
4. Exit module

Enter option or help: _____

142

Figure A20. Module 14 -- Screen 142.

MX CONSTRUCTION MANAGEMENT SYSTEM

PROGRESS REPORTING/PAYMENT MODULE ENTER PROGRESS

Network: _____

Data Date: _____

Activity No.	Start Date	Days Compl.	% Compl.	Rem Dur	Finish Date
_____	_____	_____	_____	_____	_____

Options: 1. Enter more 2. Review/edit input
 3. Exit module

Enter option or help: _____

1421

Figure A21. Module 14 -- Screen 1421.

MX CONSTRUCTION MANAGEMENT SYSTEM

PROGRESS REPORTING/PAYMENT MODULE REVIEW PROGRESS INPUT

Network: _____

Data Date: _____

Activity No.	Start Date	Days Compl.	% Compl.	Rem Dur	Finish Date
_____	_____	_____	_____	_____	_____

-(PREVIOUS ENTRY)-

(CURRENT ENTRY-THIS ONE CAN BE MODIFIED)

(NEXT ENTRY)

- Options:
1. Next entry
 2. Previous entry
 3. Modify current entry
 4. Place progress data in official file
 5. Exit module

Enter option or help: _____

1422

Figure A22. Module 14 -- Screen 1422.

MX CONSTRUCTION MANAGEMENT SYSTEM

PROGRESS REPORTING/PAYMENT MODULE
PREPARE PAYMENT ESTIMATE

Network: _____

Options:

1. Enter payment instructions
2. Print payment documents
3. Exit module

Enter option or help: _____

143

Figure A23. Module 14 -- Screen 143.

MX CONSTRUCTION MANAGEMENT SYSTEM

PROGRESS REPORTING/PAYMENT MODULE PAYMENT INSTRUCTIONS

Network: _____

Estimate No. _____ Period: From _____ To _____

Retainage ____% of total earnings this period (Y or N)
of activities coded

Value of materials on site: \$_____

Deductions other than retained percentage: \$_____
Description: _____

Retainage refund: \$_____

Other refund: \$_____
Description: _____

Options: 1. Edit input 2. Enter data to working file
3. Exit module

Enter option or help: _____

1431

Figure A24. Module 14 -- Screen 1431.

MX CONSTRUCTION MANAGEMENT SYSTEM

PROGRESS REPORTING/PAYMENT MODULE PRINT PAYMENT DOCUMENTS

Network: _____

Estimate No. _____

Period: From _____ To _____

Options

1. Print payments statement
2. Print Eng Form 93
3. Print payment estimate
4. Print all of the above
5. Exit module

Enter option or help: _____

1432

Figure A25. Module 14 -- Screen 1432.

MX CONSTRUCTION MANAGEMENT SYSTEM

PROGRESS REPORTING/PAYMENT MODULE RELEASE PAYMENT ESTIMATE TO OFFICIAL FILE

Network: _____ Estimate No. _____

Period: From _____ To _____

Amount Due Contractor: \$ _____

Options: 1. Edit input
2. Exit module
3. Release estimate to official file

Enter option or help: _____

Enter password: _____

Password is accepted -- estimate is entered

*

Invalid password -- check your authorization -- try again.

144

*Password is required to enter data in official file, Option 3.
Appropriate statement appears upon entering password.

Figure A26. Module 14 -- Screen 144.

MX CONSTRUCTION MANAGEMENT SYSTEM

REPORTS MODULE

Network: _____

Options:

1. Assign system settings
2. Print reports
3. Generate interactive reports display
4. Interactive reports display
5. Draw network
6. Draw barchart
7. Exit module

Enter option or help: _____

16

Figure A27. Module 16 -- Screen 16.

MX CONSTRUCTION MANAGEMENT SYSTEM

REPORTS MODULE SYSTEM SETTINGS

Network: _____

Schedule (ORiginal - CURrent): _____
Precedence/Dummies (ON-OFF): _____
Holidays (ON-OFF): _____
Calendars (ON-OFF): _____
Constraints (ON-OFF): _____
Lists (ON-OFF): _____
Header (ON-OFF): _____
Report Type (FULL-BRIEF): _____

Options: 1. Print reports 2. Exit module

Enter option or help: _____

161

Figure A28. Module 16 -- Screen 161.

MX CONSTRUCTION MANAGEMENT SYSTEM

REPORTS MODULE

Network ID: _____

- Options:
1. Network listing
 2. Executive milestone report
 3. Planning schedule reports (print-plot)
 4. Working schedule reports (print-plot)
 5. Project status report
 6. Performance evaluation reports (print-plot)
 7. Current status reports
 8. Cost analysis reports (print-plot)
 9. Predicted status reports
 10. Exit module

Enter option or help: _____

162

Figure A29. Module 16 -- Screen 162.

MX CONSTRUCTION MANAGEMENT SYSTEM

REPORTS MODULE SPECIFY MODIFIERS (1)

Network: _____

Range:

Beginning (DD-MMM-YY): _____

Before _____

Ending _____

After _____

Between _____ and _____

*Interval (week, month, etc): _____

Options: 1. Continue 2. Exit module

Enter option or help: _____

1621

*Appears only for "plot" reports

Figure A30. Module 16 -- Screen 1621.

MX CONSTRUCTION MANAGEMENT SYSTEM

REPORTS MODULE SPECIFY MODIFIERS (2)

Network: _____

Options:

1. Select by activities
2. Select by codes
3. Select by time
4. Select by cost
5. Additional selections
6. Selection complete
7. Cancel selections -- exit module

Enter option or help: _____

1622

Figure A31. Module 16 -- Screen 1622.

MX CONSTRUCTION MANAGEMENT SYSTEM

REPORTS MODULE SPECIFY MODIFIERS (3)

Network: _____

Select _____ Activities with _____
(any) (A) (B)

Options "A": ES-LS-EF-LF-TF-DUR

Options "B": EQ-NE-LE-LT-GE-GT - AND DD-MMM-YY
BET - DD-MMM-YY - AND DD-MMM-YY

- Options:
1. Additional selections
 2. Selection complete
 3. Cancel selection - exit module

Enter option or help: _____

1623

Figure A32. Module 16 -- Screen 1623.

MX CONSTRUCTION MANAGEMENT SYSTEM

REPORTS MODULE SPECIFY MODIFIERS (4)

Network: _____

Do you want the report ejected into subreports: _____ (Y or N)

Primary sort _____ 2nd sort: _____ 3rd sort: _____

Available sorts:

A Code	0;4m(N)0m	TF	TDU	TRL	PCP	
B Code	_____	CES	TES	COST	PV	
C Code	_____	CLS	TLS	AC		
I-J or Nodes		CEF	TEF	DC		
J-I		CLF	TLF	ETC		
ES		CTF	TTF	LRE		
LS		PCT	TRF	OB		
EF		RD	TRE	PCC		
LF						

Options: 1. Submit report 2. Exit module
3. Next report

Enter option or help: _____

1624

Figure A33. Module 16 -- Screen 1624.

MX CONSTRUCTION MANAGEMENT SYSTEM

REPORTS MODULE SELECT PROCESSING MODE

Options:	Response Time	Cost Factor
1. Interactive	5 sec	2
Batch		
2. Priority 10	1 hr	1.5
3. Priority 9	2 hrs	1.25
4. Priority 7	4 hrs	1.0
5. Priority 5	8 hrs	.95
6. Priority 3	12 hrs	.9
7. Priority 1	24 hrs	
8. Exit module		
9. Print reports		

Enter option or help: _____

1625

Figure A34. Module 16 -- Screen 1625.

MX CONSTRUCTION MANAGEMENT SYSTEM

REPORTS MODULE OUTPUT LOCATION

Select location for output to be printed

1. At your terminal (turn on printer)
2. At nearest high speed printer enter remote ID: _____
3. At other remote locations enter remote IDs _____
4. Combinations of the above, specify _____
5. Exit module

Enter option or help: _____

Enter password: _____

Enter network ID: _____

1626

Figure A35. Module 16 -- Screen 1626.

MX CONSTRUCTION MANAGEMENT SYSTEM

REPORTS MODULE

Job 4302 has been submitted for execution

Options: 1. Status jobs 2. Exit module

Enter option or help: _____

1627

Figure A36. Module 16 -- Screen 1627.

MX CONSTRUCTION MANAGEMENT SYSTEM

REPORTS MODULE INTERACTIVE REPORT DISPLAYING GENERATOR

Network: _____

Select available "BROWSE" reports:

1. Print schedule
2. Print working schedule
3. Print target schedule
4. Print current status
5. Print cost
6. Print actual cost

Enter option, exit or help: _____

163

Report modifiers are selected beginning with Screen 1621.

Figure A37. Module 16 -- Screen 163.

MX CONSTRUCTION MANAGEMENT SYSTEM

REPORTS MODULE INTERACTIVE REPORT DISPLAY

Welcome to the interactive report display processor.

If you want help, type "?"

Enter password: _____

I will usually accept whatever you type in, including interrupts.

What is your network name? _____

164

Figure A38. Module 16 — Screen 164.

AD-A116 730

CONSTRUCTION ENGINEERING RESEARCH LAB (ARMY) CHAMPAIGN IL F/G 5/1
MX RESIDENT ENGINEER NETWORKING GUIDE.(U)

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NL

2 of 2

21
01/07/82

END

DATE

FILED

7 82

DTIC

MX CONSTRUCTION MANAGEMENT SYSTEM

REPORTS MODULE DRAW REPORTS

Network: _____

Specify drawing (network) type: _____

(LOGic - COMpress - DIScrete - LINEar)

Optional sheet title: _____

Sheet size: Y (plotter width less 1 in.) ____ in.
X (optional) ____ in.

Criticality (red ink) ____ (ON-OFF)

Include off page connectors (ON-OFF): _____

Assign zones (CODE set - FLOAT): _____

Scale: _____

Options: 1. Select modifiers 2. Print 3. Exit module

Enter option or help: _____

165

Figure A39. Module 16 -- Screen 165.

MX CONSTRUCTION MANAGEMENT SYSTEM

REPORTS MODULE DRAW BAR CHARTS

Network: _____

Select bar chart type: _____
(PLAnning - WORking - TARget)

Optional sheet title: _____

Sheet size: Y (plotter width less 1 in.) _____ in.
X (optional) _____ in.

Summarize on code: _____
(A-B-C) (N)

Criticality (red ink) (ON-OFF): _____

Activity descriptions: _____
(MARGin - INSide - SLIde - UNDer)

Interval scale: _____ in.

Options: 1. Print 2. Exit module

Enter option or help: _____

166

Figure A40. Module 16 -- Screen 166.

MX CONSTRUCTION MANAGEMENT SYSTEM

MODIFICATION IMPACT EVALUATION MODULE

Options

1. Copy a network to working file
2. Enter changes to a network
3. Store and error check changed network
4. Print evaluation reports
5. Remove a network from working file
6. Copy network to "CHANGE/REVISE NETWORK MODULE"
7. Exit module

Enter option or help: _____

15

Figure A41. Module 15 -- Screen 15.

MX CONSTRUCTION MANAGEMENT SYSTEM

MODIFICATION IMPACT EVALUATION MODULE

Options

1. Copy network _____ from official file
to working file ID _____
2. Exit Module

Enter option or help: _____

Enter password: _____

*

Project 2 is executing
Invalid password - check and try again
The network has been copied

151

*Password is required to execute Option 1. Appropriate statements appear after password is entered.

Figure A42. Module 15 — Screen 151.

MX CONSTRUCTION MANAGEMENT SYSTEM

MODIFICATION IMPACT EVALUATION MODULE

Enter changes to network: _____

Header Data

Contract Title:

Contractor's name:
and address:

Area office:

Network type (A/A or A/N): ____*

Contractual start date: ____

Contractual completion date: ____

Working days per week: ____

Holidays (standard/ government/ manual loading): ____

Options: 1. Edit header data 2. Remove activities
3. Add activities 4. Change activities 5. Remove
constraints 6. Add constraints 7. Exit module

Enter option or help: _____

152

*This field cannot be changed.

Figure A43. Module 15 -- Screen 152.

MX CONSTRUCTION MANAGEMENT SYSTEM

MODIFICATION IMPACT EVALUATION MODULE

Network: _____*

Holidays (DD MMM YY):

_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Options: 1. Edit data 2. Return to header menu
 3. Exit module

Enter option or help: _____

1521

*This field cannot be changed.

Figure A44. Module 15 -- Screen 1521.

MX CONSTRUCTION MANAGEMENT SYSTEM

MODIFICATION IMPACT EVALUATION MODULE CHANGE NETWORK

Network: _____

Remove activities and events:

I	J
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

(Enter A/N numbers under "I")

Options: 1. Enter more 2. Add activities 3. Change activities
4. Remove relationships/constraints 5. Add relationships/constraints
6. Edit data 7. Store revisions 8. Exit module

Enter option or help: _____

1522

Figure A45. Module 15 -- Screen 1522.

MX CONSTRUCTION MANAGEMENT SYSTEM

MODIFICATION IMPACT EVALUATION MODULE CHANGE NETWORK

Network: _____

Enter relationships to be removed:

Node

Node

Options: 1. Enter more 2. Edit data 3. Change
activities 4. Remove constraints 5. Add
constraints 6. Store revisions 7. Exit module

Enter option or help: _____

1523

Figure A46. Module 15 -- Screen 1523.

MX CONSTRUCTION MANAGEMENT SYSTEM

MODIFICATION IMPACT EVALUATION MODULE CHANGE NETWORK

Network: _____

Add activities:

I _____ J _____ (Enter A/N numbers at "I")

Description:

Duration: _____ Codes _____ Value: _____

- REPEAT-

- REPEAT -

Options: 1. Enter more 2. Edit data 3. Store revisions
4. Enter relationships/constraints 5. Exit module

Enter option or help: _____

1524

Figure A47. Module 15 -- Screen 1524.

MX CONSTRUCTION MANAGEMENT SYSTEM

MODIFICATION IMPACT EVALUATION MODULE CHANGE NETWORK

Network: _____

Enter relationships/constraints

A/N Node: _____ Node: _____

Relationship (SS-FF-SF-FS): _____ Lag: _____ work days

- REPEAT -

A/A or A/N I _____ J _____ (Enter A/N number at "I")

Constraint (STArt - FINish): _____ (ON-NET-NLT): _____ Date: _____

- REPEAT -

Options: 1. Enter more 2. Edit data 3. Store revisions
4. Assign lists 5. Exit module

Enter option or help: _____

1525

Figure A48. Module 15 — Screen 1525.

MX CONSTRUCTION MANAGEMENT SYSTEM

MODIFICATION IMPACT EVALUATION MODULE CHANGE NETWORK

Network: _____

Change activities/events:

I _____ J _____ (Enter A/N number under "I")

Description: _____

Duration: _____ Code: _____ Value \$ _____

- REPEAT -

- REPEAT -

- REPEAT -

Options: 1. Enter more 2. Edit data 3. Store revisions
4. Exit module

Enter option or help: _____

1526

Note: The "I" or A/N node and "J" fields cannot be changed.

Figure A49. Module 15 -- Screen 1526.

MX CONSTRUCTION MANAGEMENT SYSTEM

MODIFICATION IMPACT EVALUATION MODULE STORE AND ERROR CHECK CHANGES

Network: _____

Submit changed network to Project 2 for storage and error check

Enter password: _____

PROJECT 2 executing

*

Invalid password - check and try again

Options: 1. Exit module 2. Print reports

153

*Appropriate statement will appear upon entry of password.

Figure A50. Module 15 -- Screen 153.

MX CONSTRUCTION MANAGEMENT SYSTEM

MODIFICATION IMPACT EVALUATION MODULE PRINT EVALUATION REPORTS

Network: _____

Options:

1. Standard impact evaluation reports package
 - Planning schedule (before change)
 - Planning schedule (after change)
 - List-activities affected by change
 - Before-after comparison-affected activities
 - Target date report (old vs new)

2. Customized reports

3. Exit module

Enter option or help: _____

154

Note: Option 2 will produce Screen 16, reports module.

Figure A51. Module 15 -- Screen 154.

MX CONSTRUCTION MANAGEMENT SYSTEM

MODIFICATION IMPACT EVALUATION MODULE REMOVE NET FROM WORKING FILE

Options:

1. List working files in this module
2. Delete one or more working files
3. Exit module

Enter option or help: _____

Delete the following networks:

Enter password: _____

Network(s) have been deleted (destroyed):

155

Figure A52. Module 15 -- Screen 155.

MX CONSTRUCTION MANAGEMENT SYSTEM

MODIFICATION IMPACT EVALUATION MODULE COPY NETWORK

Network: _____

The above network is to be placed in the "CORRECT/REVISE STORED NETWORK
MODULE" under the name of network: _____

Enter password: _____

PROJECT 2 executing

Transfer has been accomplished

156

After execution return to Screen 15.

Figure A53. Module 15 -- Screen 156.

MX CONSTRUCTION MANAGEMENT SYSTEM

CORRECT/REVISE STORED NETWORK MODULE

Options:

1. List stored networks
2. Copy network to working file
3. Input network changes
4. Release revised network to official file
5. Exit module

Enter option or help: _____

Enter network ID: _____

12

Figure A54. Module 12 -- Screen 12.

MX CONSTRUCTION MANAGEMENT SYSTEM

CORRECT/REVISE STORED NETWORK MODULE STORED NETWORKS

Contract # or
Short Name

Data Date

File Location

LIST

LIST

LIST

Options: 1. Next page 2. Previous page 3. Exit module

Enter option or help: _____

121

Figure A55. Module 12 -- Screen 121.

MX CONSTRUCTION MANAGEMENT SYSTEM

CORRECT/REVISE STORED NETWORK MODULE COPY NETWORK

Network _____ *is to be copied to working file.

At the same time it is to be renamed _____ (Y or N)

Enter new name _____

*The network that now exists under this name will be revised in accordance with new data.

Options: 1. Copy network 2. Exit module

Enter option or help: _____

Enter password: _____

122

Transfer accomplished

Figure A56. Module 12 — Screen 122.

MX CONSTRUCTION MANAGEMENT SYSTEM

CORRECT/REVISE STORED NETWORK MODULE
INPUT NETWORK CHANGES

Network: _____

Options:

1. Descriptive information
2. Holidays
3. Coding data
4. Network
5. Constraints/relationships
6. All of the above in sequence
7. Exit module

Enter option or help: _____

123

Figure A57. Module 12 -- Screen 123.

MX CONSTRUCTION MANAGEMENT SYSTEM

CHANGE/REVISE STORED NETWORK MODULE

Network: _____

Header Data

Contract title:

Contractor's name:
and address:

Area office:

**Network type (A/A or A/N): _____

Contractual start date: ____/____/____

Contractual completion date: ____/____/____

Working days per week: _____

*Holidays (Standard, Government, Manual loading): _____

Options: 1. Assign code descriptions
2. Edit Data 3. Exit module

Enter option or help: _____

12.1

*"Manual loading" option selects Menu 1232.
**This field cannot be changed.

Figure A58. Module 12 -- Screen 12.1.

MX CONSTRUCTION MANAGEMENT SYSTEM

CORRECT/REVISE STORED NETWORK MODULE

Network: _____

Assign holidays (DDMMYY):

— — —	— — —	— — —
— — —	— — —	— — —
— — —	— — —	— — —
— — —	— — —	— — —
— — —	— — —	— — —
— — —	— — —	— — —

- Options:
1. Assign more holidays
 2. Return to header menu
 3. Assign code descriptions

Enter option or help: _____

1232

Figure A59. Module 12 -- Screen 1232.

MX CONSTRUCTION MANAGEMENT SYSTEM

CORRECT/REVISE STORED NETWORK MODULE
CODE DESCRIPTION

Network: _____

Assign code descriptions:

Field (A-B-C): ____ Code: _____ Title: _____

<u>Code</u>	<u>Description</u>
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Options: 1. Enter more this field 2. Next field
3. Edit data 4. Finished, proceed to enter
network data 5. Exit module

Enter option or help: _____

1233

Figure A60. Module 12 — Screen 1233.

MX CONSTRUCTION MANAGEMENT SYSTEM

CORRECT/REVISE STORED NETWORK MODULE

Network: _____

Enter activities and events -A/N-

Node: _____ Description: _____
Duration: _____ Codes: _____ Value: _____

- REPEAT -

- REPEAT -

- REPEAT -

Options: 1. Enter more 2. Edit data 3. Enter relationships
4. Store network 5. Exit module

Enter option or help: _____

1234

Figure A61. Module 12 -- Screen 1234.

MX CONSTRUCTION MANAGEMENT SYSTEM

CORRECT/REVISE STORED NETWORK MODULE

Network: _____

Enter activities and events -A/A-

I _____ J _____

Description: _____

Duration: _____ Codes: _____ Value: _____

- REPEAT -

- REPEAT -

Options: 1. Enter more 2. Edit data 3. Enter constraints
4. Store network 5. Exit module

Enter option or help: _____

1235

Figure A62. Module 12 — Screen 1235.

MX CONSTRUCTION MANAGEMENT SYSTEM

CORRECT/REVISE STORED NETWORK MODULE

Network: _____

Enter activity/event relationships -A/N-

Node: _____ Node: _____

Relationship (SS-FF-SF-FS): _____ Lag: _____ work days

- REPEAT -

- REPEAT -

Options: 1. Enter more 2. Enter constraints
3. Edit data 4. Assign list
5. Store network 6. Exit module

Enter option or help: _____

1236

Figure A63. Module 12 -- Screen 1236.

MX CONSTRUCTION MANAGEMENT SYSTEM

CORRECT/REVISE STORED NETWORK MODULE

Network: _____

Assign constraints -A/A- and A/N

(Note: Contractual start and finish date have been entered.)

(Enter A/N node number in "I")

I _____ J _____

Constraint (STArt - FINish): _____ (ON-NET-NLT): _____ Date: _____

- REPEAT -

- REPEAT -

Options: 1. Enter mode 2. Edit data 3. Assign list
4. Store network 5. Exit module

Enter option or help: _____

1237

Figure A64. Module 12 -- Screen 1237.

MX CONSTRUCTION MANAGEMENT SYSTEM

CORRECT/REVISE STORED NETWORK MODULE

Network: _____

Submit network to PROJECT 2 for processing, error-check, and storage.

Select output:

Planning schedule, sort I-J _____ (Y or N)

Planning schedule, sort ES-LF-Float _____

Network listing _____ (Y or N)

Other _____ (Y or N)

Options: 1. Exit module 2. Edit data
 3. Process network

Select option or help: _____

*Enter password: _____

124

*Appears upon selection of Option 3. If no specific output is selected, default is planning schedule, I-J sort. "Other" output selection calls up Screen 162.

Figure A65. Module 12 -- Screen 124.

MX CONSTRUCTION MANAGEMENT SYSTEM

CORRECT/REVISE STORED NETWORK MODULE

Copy approved network to official file -

Network ID: _____

Enter password to start procedure:

Password: _____

- Options:
1. Execute copy procedure
 2. Edit data
 3. Exit module

Enter option or help: _____

125

Figure A66. Module 12 -- Screen 125.

MX CONSTRUCTION MANAGEMENT SYSTEM

USER MESSAGE MODULE

Options:

1. List messages
2. List users
3. Create message
4. Edit/remove message
5. Print message
6. Exit module

Enter option or help: _____

Enter password: _____

18

Figure A67. Module 18 -- Screen 18.

MX CONSTRUCTION MANAGEMENT SYSTEM

USER MESSAGE MODULE LIST MESSAGES

Options:

1. List all messages
2. List only messages to or from this user

Select option, exit or help: _____

- MESSAGES -

<u>Number</u>	<u>Date</u>	<u>Subject</u>	<u>From</u>	<u>To</u> _____
---------------	-------------	----------------	-------------	-----------------

Options: 1. Next page 2. Previous page 3. Exit module

Enter option or help: _____

181

Figure A68. Module 18 -- Screen 181.

MX CONSTRUCTION MANAGEMENT SYSTEM

USER MESSAGE MODULE LIST USERS

<u>User No.</u>	<u>Name</u>	<u>User No.</u>	<u>Name</u>
-----------------	-------------	-----------------	-------------

Options: 1. Next page 2. Previous page 3. Exit module

Enter option or help: _____

182

Figure A69. Module 18 -- Screen 182.

MX CONSTRUCTION MANAGEMENT SYSTEM

USER MESSAGE MODULE
CREATE MESSAGE

Message No.: _____

Enter text:

Options: 1. Enter more 2. End of text 3. Exit module

Enter option or help: _____

183

Figure A70. Module 18 -- Screen 183.

MX CONSTRUCTION MANAGEMENT SYSTEM

USER MESSAGE MODULE RELEASE MESSAGE

Message No.: _____

Subject of message: _____

Enter ID no. of those to receive message

or all: # # # #
 # # # #
 # # # #

Options: 1. Release message 2. Exit module

Enter option or help: _____

Enter password: _____

1831

Figure A71. Module 18 -- Screen 1831.

MX CONSTRUCTION MANAGEMENT SYSTEM

USER MESSAGE MODULE EDIT/REMOVE EXISTING MESSAGE

Message No.: _____

Existing text:

Options: 1. Edit 2. Next page 3. Previous page
4. Delete message 5. Exit module

Enter option or help: _____

Enter password: _____

184

Note: Only the originator can change or remove a message.

Figure A72. Module 18 -- Screen 184.

MX CONSTRUCTION MANAGEMENT SYSTEM

USER MESSAGE MODULE PRINT MESSAGE

Message No.: _____

Enter password: _____

Options: 1. Next page 2. Previous page
 3. Hard copy (turn on printer)

Enter option or help: _____

185

Figure A73. Module 18 -- Screen 185.

MX CONSTRUCTION MANAGEMENT SYSTEM

FULL PROJECT/2 ACCESS MODULE

Options: 1. Next 2. Previous 3. Up 4. Down 5. Top
6. Bottom 7. Insert 8. Modify 9. Delete
10. Execute Project 2 11. Erase work area
12. Exit module 13. Exit system

Enter option or help: _____

17

Figure A74. Module 17 screen.

MX CONSTRUCTION MANAGEMENT SYSTEM

OFFICE SUPPORT MODULE

Enter password: _____

Options:

1. Word processing
2. Unit price data
3. Technical information
4. Policies and procedures manual
5. Shop drawing register
6. Payroll records
7. BSI - CSI - WBS descriptions
8. Office data
9. Modification status

Enter option, exit or help: _____

19

Figure A75. Module 19 screen.

APPENDIX B:

EXAMPLE SPECIAL PROVISION

CONTRACTOR PREPARED NETWORK ANALYSIS SYSTEM: The progress chart to be prepared by the Contractor pursuant to GENERAL PROVISIONS clause entitled: PROGRESS CHARTS AND REQUIREMENTS FOR OVERTIME WORK, shall consist of a Network Analysis System (NAS) as described below. In preparing this system, the scheduling of construction is the responsibility of the Contractor. The requirement for the system is included to assure adequate planning and execution of the work, to assist the Contracting Officer in appraising the reasonableness of the proposed schedule, to evaluate progress of the work, to make progress payments and to make decisions relative to time/cost adjustments which may result from changes in the work.

a. In addition to the schedule described hereinafter, the Contractor shall, within ten (10) calendar days after the Notice to Proceed, submit for approval a schedule indicating activities and sequence of operations for the first ninety (90) calendar days of the construction contract. The schedule shall consist of not more than one hundred (100) activities and shall be either an NAS diagram or bar chart. The activities in this preliminary schedule (as approved) shall be subsequently incorporated into the complete schedule.

b. The Contractor shall within 45 calendar days after receipt of Notice to Proceed, submit for approval a complete network-based schedule covering the duration of the work. The submittal shall include a NAS diagram plot and a mathematical analysis as described below.

(1) The NAS plot diagram shall show the order and interdependence of all activities and the sequence in which the work is to be accomplished.

(a) The complete NAS schedule shall include, in addition to construction activities, the submittal schedules of materials, samples, shop drawings, operation and maintenance manuals, master equipment list, spare parts list, and other required documents. Also included shall be activities for the procurement of all major materials and equipment, including fabrication and delivery, installation and testing. All activities of the Government, i.e., GFP, reviews and approvals, etc. that affect the progress and contract required milestones and dates for completion of all or parts of the work shall be shown. Activity numbers shall be selected and assigned so as to permit ready identification of each and every activity in the network with its respective bid/pay item, as well as to facilitate the generation of both summary and partial (fragmented or "frag") networks. Activity numbering shall be assigned so that preceding event numbers are smaller numerically than the following event numbers, without duplication. Gap numbering shall be used on the original network to allow for the addition of subsequent activities and/or logic changes. The work should be broken down into activities having durations of 20 calendar days or less, with not over 2 percent of the activities exceeding these limits.

(2) The Government uses the Project/2 (activity on arrow A/A or activity on node A/N) networking software package, marketed by Project Software and

Development, Inc., Cambridge, Massachusetts. The Contractor may use any system to develop his complete NAS schedule. In addition to furnishing copies of the complete NAS schedule, as hereinafter specified, the Contractor shall provide to the Government his schedule in a form compatible with Project/2 data protocol. Data may be submitted on punch cards or magnetic tape. Magnetic tape specifications are as follows:

- (a) Standard IBM labels or none.
- (b) 800 to 1600 BBI or 6250 density.
- (c) Any blocking is allowed, however, record size must be specified.
- (d) Parity may be odd or even.
- (e) If multi-file tape, number of files on tape must be specified.

(3) Project/2 data input is in free format English-type language. However, there are certain restrictions on prescribed conventions. For these conventions, reference is made to the Project/2 Basic Manual which will be provided by the Government upon request. This manual also provides data form compatibility. The following general data is provided:

- (a) Activities A/A or A/N -- 32,767 per project (including dummies).
 - (b) Node length -- A/A 8 digits, A/N 9 digits.
 - (c) Description length -- 48 characters.
 - (d) Code fields -- three fields, each 9 digits.
 - (e) Durations -- maximum 3,000 work periods.
 - (f) Precedences -- maximum 100,000 (10,000 added at one time).
 - (g) Resources -- 4,000 maximum per activity, description 36 characters, resource numbered 9 digits (xxxxx.xx).
 - (h) Project name -- 8 characters.
- (4) The following information shall be furnished for each activity:
- (a) I-J number (Not to exceed - NTE - 8 digits)
node numbers (NTE 9 digits)
 - (b) Description (NTE 48 characters).
 - (c) Duration (calendar days).
 - (d) Code (see P. (1) below).

(f) Estimated monetary value and labor effort (mandays) for all activities, except Government activities, and administrative activities such as the preparation of contractor submittal manuals, master equipment lists, and the like.

(g) Logic shall be defined through node numbering, dummies or precedences with lead or lag relationships and constraint assignments compatible with Project/2.

(h) Milestones and contract required dates as listed in specifications shall be incorporated into the network.

(i) Coding of each activity shall conform to the following:

FIELD *													CONTRACTOR												
A	*	1	2	3	*	4	5	6	7	*	8	9													
	*				*					*															
	*	BSI*			*	CSI*				*	SUBCONTRACTOR ID														
	*				*					*	(FOR CONST. CON-														
	*				*					*	TRACTOR USE)														
	*				*					*															
* CONTRACTOR													* CORPS												
B	*	1	2	3	*	4	5	*	6	7	*	8	9												
	*				*			*			*														
	*	FACILITY			*	SUB-FACILITY		*	RESPONSIBILITY		*	MODIFICATIONS													
	*				*			*			*														
* CONTRACTOR													* CORPS												
C	*	1	2	3		4	5	*	6	7		8	9												
	*							*																	
	*	UNDEFINED						*		RESERVED															
	*							*																	

* A copy of the Building System Institute and Construction Specifications Institute Codes will be provided to the Contractor by the Government for coding purposes.

(5) Summary Network: In addition to the complete NAS schedule, a summary NAS schedule and network diagram shall be provided. The summary NAS schedule shall consist of a minimum 50 activities and a maximum 150 activities, and shall be based on and supported by details from the complete NAS schedule. Related activities shall be grouped on the summary network. The critical path shall be highlighted. The summary network plot diagram shall be time scaled, using units of approximately 1/2" equals one week, or other suitable scale approved by the Contracting Officer. Weekends and holidays shall

be indicated. Where slack exists, the activities shall be shown at the time when they are scheduled to be accomplished.

(6) The mathematical analysis of the network shall include a tabulation of each activity contained in the detailed network. As a minimum, the following information will be required for each activity:

- (a) Preceding and following event numbers.
- (b) Activity description and estimated value (cost).
- (c) Estimated labor effort for each activity, in mandays.
- (d) Estimated duration of activities, in calendar days.
- (e) Earliest start date (by calendar date).
- (f) Earliest finish date (by calendar date).
- (g) Scheduled or actual start date (by calendar date).
- (h) Scheduled or actual finish date (by calendar date).
- (i) Latest start date (by calendar date).
- (j) Latest finish date (by calendar date).
- (k) Slack or float.

(l) Responsibility for activity (Prime contractor, subcontractors, suppliers, Government, etc.).

(7) Reports and printouts based on the mathematical analysis shall list the activities in sorts or groups as follows:

(a) By the preceding event number, from lowest to highest, and then in order of the following event number.

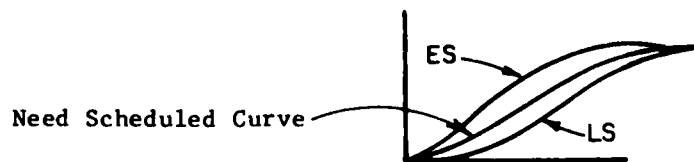
(b) By the amount of slack or float, then in order of preceding event number.

(c) By responsibility, in order of earliest allowable start dates.

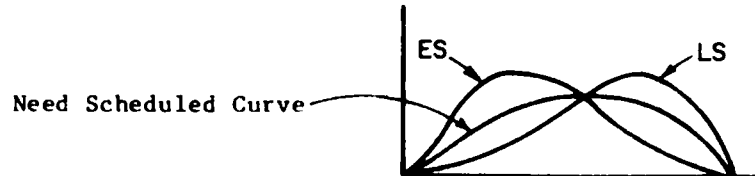
(d) In order of earliest allowable start dates, then in order of preceding event numbers, and then in order of succeeding event numbers.

(e) In order of latest allowable start dates, then in order of preceding event numbers, and then in order of succeeding event numbers.

(f) A chart showing the accumulative schedule (standard "S" curve) of anticipated earnings, in both dollars and percent, based on early, late, and scheduled finish schedules. Actual earnings shall be plotted on the chart as they occur.



(g) Two labor charts -- one showing the accumulative schedules (standard "S" curve) of estimated mandays based on early, late, and scheduled finish schedules, and one showing estimated mandays per month (standard manpower histograms) based on early, late, and scheduled finish schedules. Actual manpower expended (in mandays) will be reported on both charts as it occurs.



(8) The Contractor shall provide, as a part of all required updates and reports, the rationale for assigning all scheduled and actual dates in the network.

c. The Contractor shall participate in a review and evaluation of the proposed network diagrams and printout analysis with the Contracting Officer. Required revisions shall be resubmitted for approval of the Contracting Officer within ten (10) calendar days after the conference. The approved complete NAS schedule shall be used by the Contractor for planning, organizing and directing the work, reporting progress, and requesting payment for work accomplished.

d. The Contractor shall submit on the first and fifteenth of each month, a report of actual construction progress. The report shall consist of an updating of the mathematical analysis printouts, by sorts listed in paragraph b.(7), together with a narrative description of factors delaying progress, and actions being taken to overcome these delays. Printouts shall include completed and partially completed activities and all remaining activities. Submittal of the network diagrams is not required unless significant changes in the approved schedule result in a requirement for the submittal of a revised schedule as outlined in paragraphs (1) and (2) below. Payments, when made pursuant to GENERAL PROVISION clause entitled PAYMENT TO CONTRACTOR, will be based upon the total value of activities completed and partially completed, as updated on the Project/2 networking software package in accordance with this paragraph. If at any time during the life of the project the Contracting Officer finds that the monetary amount of an activity is not properly proportioned and reasonable, the Contractor shall reapportion the amount prior to payments.

(1) If in the opinion of the Contracting Officer, the approved schedule no longer accurately reflects the Contractor's real plan for accomplishing the remaining work, or the schedule no longer reflects a viable way of finishing the work on schedule, the Contractor shall revise the remaining work schedule to accomplish progress compatible with contract requirements, and shall within ten (10) calendar days of being directed to do so, submit the revised schedule to the Government for approval. This submittal shall include a revised NAS diagram plot with accompanying mathematical analysis.

(2) The approved complete NAS schedule will be used, along with current job status data, to determine the time impact of change orders on the work. When the Government issues a request for proposal (RFP), or notice to proceed change over, any additional time allowed to the contract as required by General Provision 3, "CHANGES" and any network changes will be specified by the Government. These network changes shall be incorporated into the approved schedule within ten (10) calendar days after receipt of the Notice to Proceed for the change order, and the revised schedule submitted in accordance with paragraph (1) above. The Contractor shall prepare his cost proposal based on the amount of additional time allowed to the contract.

(3) Sheet size of plot diagrams shall be 30" x 42". Each updated copy shall show a date of the latest revision.

(4) Initial submittal and complete revisions shall be furnished in six copies.

(5) Periodic submittals shall be furnished in five copies.

APPENDIX C:

NOTICE TO CONTRACTOR (USE OF ENG FORM 3938)

1. The attached ENG Form 3938 is used for requesting and submitting proposals on all changes, regardless of amount. This form will also be used for executing modifications of less than \$25,000 absolute value (total of additions and deletions) under the "Changes" clause. Standard Form 30 will be used for executing modifications \$25,000 and above under the "Changes" clause, and for changes under other clauses.

2. Your proposal should be submitted within ___ calendar days on Sheet 2 in Block 11 entitled "Contractor's Proposal." Proposals amounting to \$100,000 or more in absolute value require the completion and execution of DD Form 633. To expedite action on your proposal, you should submit with your proposal a detailed breakdown of your price. If the space provided is insufficient for the breakdown, it should be attached.

3. The time element applicable to this change is indicated in the attached ENG Form 3938. It is the product of an analysis of the various factors involved, such as current approved construction schedule, current job status, scope of the proposed change, need for the completed facilities, etc. Your proposal shall be based upon the time element specified. Your approved progress schedule shall be immediately revised to reflect the changes (if any) itemized in this request for proposal. The network so revised shall be used to evaluate the time impact of subsequent changes, and progress toward project completion. In the event you consider the time element unreasonable or impractical you may propose an alternative and accompany it with its related cost proposal. (The alternative proposal is in addition to the cost proposal based on the specified time element, not a substitute for it.)

4. Your cost breakdown should be referenced to new and/or existing activities in the current approved progress schedule. The cost, if any, associated with impact on unchanged work shall be itemized and subtotaled separately from direct costs.

5. The original and all copies of the form shall be signed in BLOCK 11 ONLY (on Sheet 2 of 2), dated, and returned promptly to the issuing Resident Office. A copy should be retained in your office.

6. After receipt of your itemized proposal at the issuing Resident Office, you may expect the following action:

a. Less than \$25,000 absolute value.

(1) If your proposal is acceptable, the Contracting Officer or his duly authorized representative will sign the form in the space provided. The original and all copies will be returned to you for signing, in the space provided, by your representative authorized to execute contract modifications. The signed original and copies should also be returned to the Resident Office. One copy will be retained for your files. This will constitute the notice to proceed and the fully executed modification.

(2) If your proposal is not acceptable, you will be notified, and the time and price will be negotiated. If time is to be negotiated, it shall be settled first and the progress schedule network revised to reflect such agreement. Upon agreement on price, the ENG 3938 will be completed by the Contracting Officer or his duly authorized representative in accordance with the agreements, and the original and copies will be signed and sent to you for signature, in the space provided, by your representative authorized to execute contract modifications. The signed original and copies should be returned to the Resident Office. This will constitute the notice to proceed and the fully executed modification.

b. \$25,000 or more:

(1) If your proposal is acceptable, Standard Form 30 will be completed, and signed by the Contracting Officer or his authorized representative. It will be sent to you for signing and return to the Resident Office. This will constitute the notice to proceed and the fully executed modification.

(2) If your proposal is not acceptable, you will be notified, and time and price will be negotiated as described in Paragraph a(2) above. Upon agreement, Standard Form 30 will be completed and signed by the Contracting Officer or his authorized representative, and sent to you for signing and return to the Resident Office. This will constitute the notice to proceed and the fully executed modification.

Chief of Engineers
ATTN: Tech Monitor
ATTN: DAEN ASI L (2)
ATTN: DAEN DDP
ATTN: DAEN CW
ATTN: DAEN CME
ATTN: DAEN CMM-H
ATTN: DAEN CMO
ATTN: DAEN CWP
ATTN: DAEN MPC
ATTN: DAEN-MPC
ATTN: DAEN-MPE
ATTN: DAEN-MPO
ATTN: DAEN-MPR-A
ATTN: DAEN-RD
ATTN: DAEN-HDC
ATTN: DAEN-RDM
ATTN: DAEN-RM
ATTN: DAEN-ZC
ATTN: DAEN-ZCE
ATTN: DAEN-ZCI
ATTN: DAEN-ZCM

FESA, ATTN: Library 22060

FESA, ATTN: DET III 79906

US Army Engineer Districts

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Al Batin 09616
Albuquerque 87103
Baltimore 21203
Buffalo 14207
Charleston 29402
Chicago 60604
Detroit 48231
Far East 96301
Fort Worth 76102
Galveston 77550
Huntington 25721
Jacksonville 32232
Japan 96343
Kansas City 64106
Little Rock 72203
Los Angeles 90053
Louisville 40201
Memphis 38103
Mobile 36628
Nashville 37202
New Orleans 70160
New York 10007
Norfolk 23510
Omaha 68102
Philadelphia 19106
Pittsburgh 15222
Portland 97208
Riyadh 09038
Rock Island 61201
Sacramento 95814
San Francisco 94105
Savannah 31402
Seattle 98124
St. Louis 63101
St. Paul 55101
Tulsa 74102
Vicksburg 39180
Walla Walla 99362
Wilmington 28401

US Army Engineer Divisions

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Europe 09757
Huntsville 35807
Lower Mississippi Valley 39180
Middle East 09038
Middle East (Rear) 22601
Missouri River 68101
New England 02154
North Atlantic 10007
North Central 60605
North Pacific 97208
Ohio River 45801
Pacific Ocean 96958
South Atlantic 30303
South Pacific 94111
Southwestern 75202

US Army Europe

HQ, 7th Army Training Command 09114
ATTN: AETTG-OEM (5)
HQ, 7th Army ODCS/Engr. 09403
ATTN: AEAEN-EH (4)
V. Corps 09079
ATTN: AETVDEH (5)
VII. Corps 09154
ATTN: AETSDEH (5)
1st Support Command 09325
ATTN: AEREH (5)
Berlin 09742
ATTN: AEBE-EN (2)
Southern European Task Force 09188
ATTN: AESE-ENG (3)
Installation Support Activity 09403
ATTN: ABUES-AP

8th USA, Korea
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ATTN: EAFE-Y 96358
ATTN: EAFE-ID 96224
ATTN: EAFE-4M 96208
ATTN: EAFE-H 96271
ATTN: EAFE-P 96269
ATTN: EAFE-T 96212

Rocky Mt. Arsenal, SARRM-15 80022

Area Engineer, AEDC-Area Office
Arnold Air Force Station, TN 37389

Western Area Office, CE
Vanderberg AFB, CA 93437

416th Engineer Command 60623
ATTN: Facilities Engineer

USA Japan (USARJ)
Ch, FE Div, AJEN-FE 96343
Fac Engr (Honshu) 96343
Fac Engr (Okinawa) 96331

ROK/US Combined Forces Command 96301
ATTN: EUSA-MHC-CFC/Engr

US Military Academy 10996
ATTN: Facilities Engineer
ATTN: Dept of Geography &
Computer Science
ATTN: DSCPER/MAEN-A

Engr. Studies Center 20315
ATTN: Library

AMPRC, ATTN: DRXMR-WE 02172

USA ARRCOM 61299
ATTN: DHCIS-RI-1
ATTN: DRSAH-IS

DARCOM - Dir., Inst., & Svcs.
ATTN: Facilities Engineer
ARRADCOM 07801
Aberdeen Proving Ground 21005
Army Matls. and Mechanics Res. Ctr.
Corpus Christi Army Depot 78419
Harry Diamond Laboratories 20789
Dugway Proving Ground 84022
Jefferson Proving Ground 47250
Fort Monmouth 07703
Letterkenny Army Depot 17201
Natick R&D Ctr. 01760
New Cumberland Army Depot 17070
Pueblo Army Depot 81001
Red River Army Depot 75501
Redstone Arsenal 35809
Rock Island Arsenal 61299
Savanna Army Depot 61074
Sharps Army Depot 95331
Seneca Army Depot 14541
Tobyhanna Army Depot 18466
Tooele Army Depot 84074
Watervliet Arsenal 12189
Yuma Proving Ground 85364
White Sands Missile Range 88002

DLA ATTN: DLA-WI 22314

FORSCOM

FORSCOM Engineer, ATTN: AFEN-FE
ATTN: Facilities Engineer
Fort Buchanan 00934
Fort Bragg 28307
Fort Campbell 42223
Fort Carson 80913
Fort Devens 01433
Fort Drum 13601

FORSCOM

ATTN: Facilities Engineer
Fort Hood 76544
Fort Indiantown Gap 17003
Fort Irwin 92311
Fort Sam Houston 78234
Fort Lewis 98433
Fort McCoy 54856
Fort McPherson 30330
Fort George G. Meade 20755
Fort Ord 93941
Fort Polk 71459
Fort Richardson 98505
Fort Riley 66442
Presidio of San Francisco 94128
Fort Sheridan 60037
Fort Stewart 31313
Fort Weirwright 98703
Vancouver Bks. 98860

MSC

ATTN: HSLO-F 78234
ATTN: Facilities Engineer
Fitzsimons Army Medical Center 80240
Walter Reed Army Medical Center 20012

INSCOM - Ch, Instl. Div.
ATTN: Facilities Engineer
Arlington Hall Station (2) 22212
Vint Hill Farms Station 22188

MDW

ATTN: Facilities Engineer
Cameron Station 22314
Fort Lesley J. McNair 20319
Fort Myer 22211

MTMC

ATTN: MTMC-SA 20315
ATTN: Facilities Engineer
Oakland Army Base 94626
Bayonne MDT 07002
Sunny Point MDT 28461

NARADCOM, ATTN: DRDWA-F 071160

TARCOM, Fac. Div. 48090

TECOM, ATTN: DRSTE-LG-F 21005

TRADOC

HQ, TRADOC, ATTN: ATEN-FE
ATTN: Facilities Engineer
Fort Belvoir 22060
Fort Benning 31905
Fort Bliss 79916
Carlisle Barracks 17013
Fort Chaffee 72902
Fort Dix 08640
Fort Eustis 23604
Fort Gordon 30905
Fort Hamilton 11252
Fort Benjamin Harrison 46216
Fort Jackson 29207
Fort Knox 40121
Fort Leavenworth 66027
Fort Lee 23801
Fort McClellan 36205
Fort Monroe 23651
Fort Rucker 36362
Fort Sill 73503
Fort Leonard Wood 65473

TSARCOM, ATTN: STSAS-F 63120

USACC

ATTN: Facilities Engineer
Fort Huachuca 85613
Fort Ritchie 21718

WESTCOM

ATTN: Facilities Engineer
Fort Shafter 96858

SHAPE 09055

ATTN: Survivability Section, CCB-OPS
Infrastructure Branch, LANDA

HQ USEUCOM 09128

ATTN: ECJ 4.7-LOE

Fort Belvoir, VA 22060

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ATTN: ATZA-DTE-SW

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ATTN: Library

ETL, ATTN: Library 22060

Waterways Experiment Station 39180
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Ft. Bragg

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Norton AFB 92409

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ATTN: Library (Code L08A)

Tyndall AFB, FL 32403

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O'Connor, Michael J.

MX resident engineer networking guide / by M. J. O'Connor, G. E. Colwell,
R. D. Reynolds. -- Champaign, IL : Construction Engineering Research Laboratory ;
available from NTIS, 1982.

140 p. (Technical Report ; P-126)

1. MX missile system - management. 2. Network analysis (planning). 3. Management information systems. I. Colwell, Glenn E. II. Reynolds, Robert D.
III. Title. IV. Series : Technical report (Construction Engineering Research
Laboratory (U.S.)) ; P-126.

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