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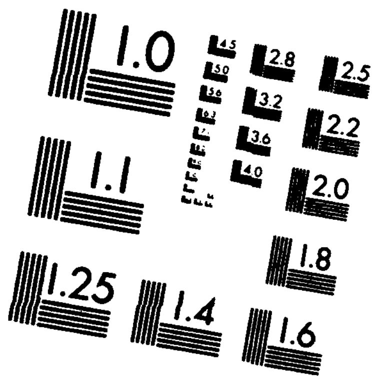
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ASD(ENA)-TR-82-5031
VOLUME III

2

2nd AFSC STANDARDIZATION CONFERENCE

COMBINED PARTICIPATION BY:
DOD-ARMY-NAVY-AIR FORCE-NATO

30 NOVEMBER - 2 DECEMBER 1982
TUTORIALS: 29 NOVEMBER 1982

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This report has been reviewed by the Office of Public Affairs (ASD/PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

Jeffery L. Pesler

JEFFERY L. PESLER
Vice Chairman
2nd AFSC Standardization Conference

ERWIN C. GANGL
Chief, Avionics Systems Division
Directorate of Avionics Engineering

FOR THE COMMANDER

Robert P. Lavoie

ROBERT P. LAVOIE, COL, USAF
Director of Avionics Engineering
Deputy for Engineering

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This is a collection of UNCLASSIFIED papers to be distributed to the attendees of the Second AFSC Avionics Standardization Conference at the Convention Center, Dayton, Ohio. The scope of the Conference includes the complete range of DoD approved embedded computer hardware/software and related interface standards as well as standard subsystems used within the Tri-Service community and NATO. The theme of the conference is "Rational Standardization". Lessons learned as well as the pros and cons of standardization are highlighted.

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This is Volume 3

Volume 1	Proceedings pp. 1-560
Volume 2	Proceedings pp. 561-1131
Volume 3	Governing Documents
Volume 4	MIL-STD-1553 Tutorial
Volume 5	MIL-STD-1589 Tutorial
Volume 6	MIL-STD-1679 Tutorial
Volume 7	MIL-STD-1750 Tutorial
Volume 8	MIL-STD-1815 Tutorial
Volume 9	Navy Case Study Tutorial

PROCEEDINGS OF THE

2nd AFSC STANDARDIZATION CONFERENCE

30 NOVEMBER - 2 DECEMBER 1982

DAYTON CONVENTION CENTER
DAYTON, OHIO

Sponsored by:

Air Force Systems Command

Hosted by:

Aeronautical Systems Division

FOREWORD

THE UNITED STATES AIR FORCE HAS COMMITTED ITSELF TO "STANDARDIZATION." THE THEME OF THIS YEAR'S CONFERENCE IS "RATIONAL STANDARDIZATION," AND WE HAVE EXPANDED THE SCOPE TO INCLUDE US ARMY, US NAVY AND NATO PERSPECTIVES ON ONGOING DOD INITIATIVES IN THIS IMPORTANT AREA.

WHY DOES THE AIR FORCE SYSTEMS COMMAND SPONSOR THESE CONFERENCES? BECAUSE WE BELIEVE THAT THE COMMUNICATIONS GENERATED BY THESE GET-TOGETHERS IMPROVE THE ACCEPTANCE OF OUR NEW STANDARDS AND FOSTERS EARLIER, SUCCESSFUL IMPLEMENTATION IN NUMEROUS APPLICATIONS. WE WANT ALL PARTIES AFFECTED BY THESE STANDARDS TO KNOW JUST WHAT IS AVAILABLE TO SUPPORT THEM: THE HARDWARE; THE COMPLIANCE TESTING; THE TOOLS NECESSARY TO FACILITATE DESIGN, ETC. WE ALSO BELIEVE THAT FEEDBACK FROM PEOPLE WHO HAVE USED THEM IS ESSENTIAL TO OUR CONTINUED EFFORTS TO IMPROVE OUR STANDARDIZATION PROCESS. WE HOPE TO LEARN FROM OUR SUCCESSES AND OUR FAILURES; BUT FIRST, WE MUST KNOW WHAT THESE ARE AND WE COUNT ON YOU TO TELL US.

AS WE DID IN 1980, WE ARE FOCUSING OUR PRESENTATIONS ON GOVERNMENT AND INDUSTRY EXECUTIVES, MANAGERS, AND ENGINEERS AND OUR GOAL IS TO EDUCATE RATHER THAN PRESENT DETAILED TECHNICAL MATERIAL. WE ARE STRIVING TO PRESENT, IN A SINGLE FORUM, THE TOTAL AFSC STANDARDIZATION PICTURE FROM *POLICY TO IMPLEMENTATION*. WE HOPE THIS INSIGHT WILL ENABLE ALL OF YOU TO BETTER UNDERSTAND THE "WHY'S AND WHEREFORE'S" OF OUR CURRENT EMPHASIS ON THIS SUBJECT.

MANY THANKS TO A DEDICATED TEAM FROM THE DIRECTORATE OF AVIONICS ENGINEERING FOR ORGANIZING THIS CONFERENCE; FROM THE OUTSTANDING TECHNICAL PROGRAM TO THE UNGLAMOROUS DETAILS NEEDED TO MAKE YOUR VISIT TO DAYTON, OHIO A PLEASANT ONE. THANKS ALSO TO ALL THE MODERATORS, SPEAKERS AND EXHIBITORS WHO RESPONDED IN SUCH A TIMELY MANNER TO ALL OF OUR PLEAS FOR ASSISTANCE.

Robert P. Lavoie

ROBERT P. LAVOIE, COL, USAF
DIRECTOR OF AVIONICS ENGINEERING
DEPUTY FOR ENGINEERING

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE SYSTEMS COMMAND
ANDREWS AIR FORCE BASE DC 20334

28 AUG 1982

REPLY TO ATTN OF: CV

SUBJECT: Second AFSC Standardization Conference

TO: ASD/CC

1. Since the highly successful standardization conference hosted by ASD in 1980, significant technological advancements have occurred. Integration of the standards into weapon systems has become a reality. As a result, we have many "lessons learned" and cost/benefit analyses that should be shared within the tri-service community. Also, this would be a good opportunity to update current and potential "users." Therefore, I endorse the organization of the Second AFSC Standardization Conference.

2. This conference should cover the current accepted standards, results of recent congressional actions, and standards planned for the future. We should provide the latest information on policy, system applications, and lessons learned. The agenda should accommodate both government and industry inputs that criticize as well as support our efforts. Experts from the tri-service arena should be invited to present papers on the various topics. Our AFSC project officer, Maj David Hammond, HQ AFSC/ALR, AUTOVON 858-5731, is prepared to assist.

ROBERT M. BOND, Lt Gen, USAF
Vice Commander

Table of Contents Volume 3

DEPARTMENT OF DEFENSE

DIRECTIVE 5000.29

INSTRUCTION 5000.31

April 26, 1976
NUMBER 5000.29

ASD(I&L)

Department of Defense Directive

SUBJECT Management of Computer Resources in Major Defense Systems

References: (a) through (m) are listed in enclosure 4

I. PURPOSE

This Directive establishes policy for the management and control of computer resources during the development, acquisition, deployment and support of major Defense systems.

II. APPLICABILITY AND SCOPE

A. The provisions of this Directive apply to the Office of the Secretary of Defense, the Military Departments, the Organization of the Joint Chiefs of Staff, and the Defense Agencies (hereinafter referred to collectively as "DoD Components").

B. Its provisions encompass major programs of Defense systems acquisition, as designated by the Secretary of Defense (described in section II. of DoD Directive 5000.1, reference (a)). In addition, it provides principles to be applied in the acquisition of Defense systems that do not fall in the "major acquisition category."

C. Excluded from the provisions of this Directive are general purpose, commercially available automatic data processing assets as defined and administered under OMB Circular A-71, DoD Directives 4105.55, 4160.19, and 5100.40 (references (b), (c), (d), and (e)). However, when feasible, the terms, tools, and techniques employed in the general purpose area will be adopted or adapted to support management of computer resources in major Defense systems.

III. DURATION

It is intended that the policies and principles embodied in this Directive ultimately be assimilated as an integral part of the established process of acquiring major Defense systems. Therefore, the continuing need for this Directive, and all organizational institutions created herein shall be reviewed biannually with a view toward cancellation after 6 years. DoD Directives 5000.1, 5000.2, and 5000.3 (references (a), (g), and (h)) will be modified as appropriate, to reflect this assimilation.

IV. DEFINITIONS

Terms used in this Directive are defined in enclosure 1.

V. POLICY

A. General

1. Annual expenditures by DoD on the design, development, acquisition, management, and operational support of computer resources embedded within, and integral to weapons, communications, command and control, and intelligence sensor systems are measured in the billions of dollars. Unreliability, particularly of software, diminshes DoD mission effectiveness in many major Defense systems.

2. Computer resources in Defense systems must be managed as elements or subsystems of major importance during conceptual, validation, full-scale development, production, deployment, and support phases of the life cycle, with particular emphasis on computer software and its integration with the surrounding hardware.

B. Requirements Validation and Risk Analysis

1. Validation of computer resource requirements, including software, risk analyses, planning, preliminary design, security where applicable (DoD Directive 5200.28, reference (f)) and interface control and integration methodology definition will be conducted during the Concept Formulation and Program Validation phases of Defense system development, prior to Defense Systems Acquisition Review Council (DSARC) II.

2. This analysis must assure conformance of planned computer resources with stated operational requirements.

3. Risk analysis, preliminary design, hardware/software integration methodology, external interface control, security features (DoD Directive 5200.28, reference (f)), and life cycle system planning shall be included in the review.

4. Correctness of software, reliability, integrity, maintainability, ease of modificat..., and transferability will be major considerations in the initial design.

5. The risk areas, and a plan for their resolution shall be included in the Decision Coordinating Paper (DoD Directive 5000.2, reference (g)).

6. In addition, computer resource requirements will be continuously coordinated and reconciled with system operational requirements throughout system development after DSARC II.

C. Configuration Management of Computer Resources. Defense system computer resources, including both computer hardware and computer software will be specified and treated as configuration items. Baseline implementation guidance for this action is contained in L D Instruction 5010.21 (reference (i)).

D. ...mputer Resource Life Cycle Planning. A computer resource plan ...ll be developed prior to DSARC II, and will be maintained throughout the life cycle. The purpose of the plan is to identify important Defense system computer resources acquisition and life cycle planning factors, both direct and indirect; and to establish specific guidelines to ensure that these factors are adequately considered in the acquisition planning process. Examples of factors to be addressed are the following, as applicable:

1. Responsibilities for integration of computer resources into the total Defense system and the determination of overall system quality and integrity.

2. Personnel requirements for developing and supporting computer resources.

3. Computer programs required to support the development, acquisition, and maintenance of computer equipment and other computer programs.

4. Provisions for the transfer of program management responsibility after initial system operating capability has been achieved; provisions for system/equipment turnover.

E. Support Software Deliverables. Unique support items required to cost effectively develop and maintain the delivered computer resources over the system's life cycle will be specified as deliverable, with DoD acquiring rights to their design and/or use. Examples of such support items are compilers, environmental simulators, documentation aids, test case generators and analyzers, and training aids. The provisions of ASPR, section IX (reference (j)) shall govern the implementation of the policy.

F. Milestone Definition and Attainment Criteria. Specific milestones to manage the life cycle development of computer resources, including computer system and support software will be used to ensure the proper sequence of analysis, design, implementation, integration, test, documentation, operation, maintenance, and modification. These milestones will include specific criteria that measure their attainment.

G. Sofware Language Standardization and Control. DoD approved High Order Programming Languages (HOLs), (reference (k)) will be used to develop Defense system software, unless it is demonstrated that none of the approved HOLs are cost effective or technically practical over the system life cycle. Each DoD approved HOL will be assigned to a designated control agent who will be responsible for such activities as validating compliance of compiler implementations with the standard language specifications, gathering data as to the use of the language, and for disseminating information, compilers, and tools. The designated control agent will also be responsible for assuring language stability except for DoD HOL specifications which already fall within the purview of DoD Manual 4120.3M (reference (m)).

VI. RESPONSIBILITIES

A. In order to oversee and coordinate the accomplishment of policies in this Directive and the incorporation of its principles into the normal Defense system acquisition process, a Management Steering Committee for Embedded Computer Resources is hereby established. This Committee shall operate under the Charter of enclosure 2 for a period not to exceed the life of this Directive.

B. DoD Components will review their existing regulations, specifications, and standards modifying, cancelling, or supplementing them as required to ensure consistency with the policy in this Directive.

C. DoD Components will develop and implement a disciplined approach to the management of software design, engineering, and programming which will ensure the provision of effective software at minimum life cycle cost. To assist in the achievement of this objective, DoD Components will, as a minimum:

1. Prepare and maintain appropriate guidance documents (e.g., guidelines, checklists, handbooks, and descriptive examples) covering requirements definition, development, acquisition, operation, and support issues attendant to computer software in Defense systems. These documents should be available for use as necessary by program managers and their staffs as well as organizations tasked with specific responsibility for developing, acquiring, operating, and supporting the computer resource elements.

2. Establish and/or maintain appropriate education, training, and experience career paths with accompanying career incentives to foster the development and retention of professional computer resource engineers, managers, and technicians.

3. Plan and execute a coordinated research and development program to identify and supply the technological base needed to support the policy, practice, and procedure rerequirements of this Directive. This coordination will be accomplished using the Technology Coordinating Paper (reference (k)).

VII. EFFECTIVE DATE AND IMPLEMENTATION

This Directive is effective immediately. Five copies of the implementation plan shall be forwarded to the Assistant Secretary of Defense (Installations and Logistics) for approval, prior to issuance. Five copies of the final implementation plan shall be forwarded to the ASD(I&L) within 90 days.

W. P. Clements Jr.
Deputy Secretary of Defense

Enclosures - 4
1. Definitions
2. Charter
3. DDR&E Memorandum, "Technology Coordinating Papers," May 29, 1974
4. List of References

DEFINITIONS

A. Computer Data. Basic elements of information used by computer equipment in responding to a computer program.

B. Computer Equipment. Devices capable of accepting and storing computer data, executing a systematic sequence of operations on computer data or producing control outputs. Such devices can perform substantial interpretation, computation, communication, control, and other logical functions.

C. Computer Firmware. The logical code of computer equipment which interprets the control functions of that equipment.

D. Computer Program. A series of instructions or statements in a form acceptable to computer equipment, designed to cause the execution of an operation or series of operations. Computer programs include such items as operating systems, assemblers, compilers, interpreters, data management system, utility programs, and maintenance/diagnostic programs. They also include application programs such as payroll, inventory control, operational flight, strategic, tactical, automatic test, crew simulator, and engineering analysis programs. Computer programs may be either machine dependent or machine independent, and may be general purpose in nature or be designed to satisfy the requirements of a specialized process of a particular user.

E. Computer Resources. The totality of computer equipment, computer program, computer data, associated documentation, personnel, and supplies.

F. Computer Software. A combination of associated computer programs and computer data required to enable the computer equipment to perform computational or control functions.

G. Embedded. Adjective modifier; integral to, from the design, procurement, and operations point of view espoused in DoD Directive 5000.1 (reference (a)).

H. Software Engineering. Science of design, development, implementation, test, evaluation, and maintenance of computer software over its life cycle.

CHARTER OF

DOD MANAGEMENT STEERING COMMITTEE FOR EMBEDDED COMPUTER RESOURCES

I. BACKGROUND

Current annual expenditures by the Department of Defense on the design, development, acquisition, management and operation support of computer resources embedded within and integral to weapons, communications, command and control, and intelligence systems are measured in the billions of dollars. At the same time such computer resources have often presented critical cost and schedule problems during the development and acquisition of new defense systems. Even after system implementation and fielding the software has often proven unreliable. To correct these problems and to improve the management of embedded computer resources in general, a DoD management steering committee is hereby formed. This committee will be responsible for implementing this Directive and will operate under the provisions of this Charter.

II. SCOPE

A. The Management Steering Committee for Embedded Computer Resources (MSC-ECR)1/ shall implement the provisions of this Directive and issue ensuing policies related to computer resources which are embedded within major Defense weapon, command, control, communications, and intelligence systems.

B. The MSC-ECR activities will not encompass the field of general purpose, commercially available Automatic Data Processing Equipment (ADPE) as defined and administered by references (a), (b), (c), and (d) of this Charter. Working level interfaces will be maintained with the ADPE Community, however, to ensure maximum transferability of ideas and cross-utilization of products.

III. OBJECTIVES

The objectives of the MSC-ECR are fourfold:

A. Improve the management of computer resources embedded in major Defense systems.

1/ Formerly named "Weapon Systems Software Management Steering Committee."

B. Increase visibility of computer resources in overall system acquisitions.

C. Formulate a coordinated DoD Technology Base Program for software basic research, exploratory development, advanced development, and technology demonstrations addressing critical software issues that can be recommended to the Director, Defense Research and Engineering.

D. Guide the assimilation and integration of computer resource policy, practice, procedure, and technology into the normal process of major Defense systems acquisition.

IV. ACTIVITIES

In carrying out the objectives of section III., the MSC-ECR shall:

A. Develop proposed future policies, or changes to existing policies as may be necessary for the acquisition and management of embedded computer resources in major Defense systems, and oversee the implementation of policies stated in this Directive.

B. Advise the Principals of the Defense System Acquisition Review Council on general policy matters and on specific embedded computer resource issues related to major Defense Systems.

C. Provide recommendations and advice to DDR&E on Computer resource R&D technology programs.

D. Provide a focal point for inter- and intra-Service coordination on policy and management issues.

E. Coordinate technology efforts among DoD Components.

F. Review DoD Component activities for compliance with the provisions of this Directive.

V. ORGANIZATION & COMPOSITION

The MSC-ECR shall be composed of an Executive Board and a Management Advisory Board, assisted as necessary by technical panels working in areas of specialized expertise.

A. The Executive Board shall consist of one designated representative from Assistant Secretary of Defense(Installations and Logistics), DDR&E, Director, Telecommunications and Command and Control Systems, Assistant Secretary of Defense (Comptroller), and Assistant Secretary of Defense(Intelligence). The Executive Board will be chaired by ASD(I&L). All decision-making power of the MSC-ECR shall be vested in the Executive Board; opinions and decisions of the Board will be expressed by the chairman, acting as principal spokesman for the MSC-ECR, and will be based on concurrence of all Board members. If concurrence cannot be achieved, the divergent views will be forwarded with majority and minority reports for resolution by OSD staff principals or the Deputy Secretary of Defense.

B. The Management Advisory Board shall consist of representatives of DoD Components as follows:

Army	3 members
Navy	3 members
Air Force	3 members
Office of the Joint Chiefs of Staff	1 member
Defense Communications Agency	2 members
National Security Agency	2 members
Defense Advanced Research Projects Agency	2 members
TRI-TAC	1 member
Deputy Director (Test and Evaluation), ODDR&E	1 member

VI. RESPONSIBILITIES

Responsibilities pursuant to the provision of this Charter and of this Directive shall be as follows:

A. The Executive Board of the Management Steering Committee shall:

1. Develop policy, or changes to existing policy as may be necessary for the acquisition and management of computer resources in major Defense systems, and oversee their accomplishment.

2. Advise the Principals of the Defense Systems Acquisition Review Council on general policy matters and on specific computer resource issues applicable to DSARC-managed programs.

3. Provide recommendations and advice to the Director Defense Research and Engineering on computer resource R&D technology programs.

4. Review DoD Component activities for compliance with the provisions of this Directive.

5. Assist the Chairman of the OSD Cost Analysis Improvement Group (CAIG) in preparing independent cost estimates for major Defense Systems.

B. The Management Advisory Board of the Management Steering Committee shall, for major Defense Systems:

1. Conduct policy impact assessments and analyses for the Executive Board in both technical and managerial areas relating to computer resources.

2. Serve as focal points for inter- and intra-Service coordination on policy and management issues.

3. Coordinate technology efforts among DoD Components.

4. Review computer resource technology programs for policy consistency, relevancy and impact; advise Executive Board of meaningful technology findings, results, and product developments.

5. Publicize appropriate management and technological developments related to computer resources, throughout DoD and industry.

C. The Management Advisory Board will assist the Executive Board in fulfulling the objectives of the MSC-ECR, and the members will act as focal points for their respective DoD Components in the areas of embedded computer resources.

VII. TECHNICAL PANELS

Adhoc Technical Panels may be formed at the direction of the MSC-ECR to examine problems requiring specialized and detailed expertise. Any panel so formed will be governed by its own Charter, which must be approved by the Executive Board, and will report to the membership of the MSC-ECR. An appropriate Chairman of the Executive Board. Membership on the panel will be determined by the Panel Chairman, and may be drawn from the DoD Components or from industry as appropriate for the task at hand.

VIII. METHOD OF OPERATION

A. The MSC-ECR shall meet quarterly, or upon the call of the Chairman. The agenda will be set by the presiding Chairman, with concurrence by members of the Executive Board.

B. The ASD(I&L), or his designated representative shall act as Executive Secretary to the MSC-ECR, and shall be responsible for preparing the minutes and administering the overall affairs of the committee. Minutes of all :etings shall be distributed no later than 30 calendar days after the subject meeting is adjourned. The ASD(I&L) shall provide administrative support to the MSC-ECR.

IX. DEFINITIONS

The terms defined in the basic Directive shall be applicable to this Charter and the functioning of the MSC-ECR.

X. REFERENCES

A. Office Management Budget Circular A-71, "Responsibilities for the Administration and Management of Automatic Data Processing Activities," March 6, 1965

B. DoD Directive 5100.40, "Responsibilities for the Administration of the DoD Automatic Data Processing Program," August 19, 1975

C. DoD Directive 4105.55, "Selection and Acquisition of Automatic Data Processing Resources," April 5, 1973

D. DoD Directive 4160.19, "Department of Defense Automatic Data Processing Equipment Reutilization Program," April 5, 1973

DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON D C 20301

29 MAY 1974

MEMORANDUM FOR Assistant Secretaries of the Military Departments (R&D)
Director, Defense Advanced Research Projects Agency
Director, Defense Nuclear Agency
Director, Defense Intelligence Agency

SUBJECT: Technology Coordinating Papers

The concept of Technology Coordinating Papers has been evolving for more than four years. In this period, essentially one of trial and error, the concept has been clarified and certain problems associated with the overall implementation have been surfaced. As a result, we are now in a better position to restate the general requirements for TCP's, their utilization, their content, the management of the TCP process, the review and critique process, and the distribution of the coordinated documents. This memorandum provides the overall guidance to DoD personnel involved in preparation or revision of those TCP's either in process or planned for the future, and supersedes prior memoranda of 19 January 1972, 18 August 1972, and 29 March 1973 on this subject.

GENERAL REQUIREMENTS FOR TCP's

The TCP's which have been published are proving invaluable to R&D managers as the best means to provide a bounded overview of selected segments of the DoD technology base. TCP's have served to answer the following questions:

- Are there needless overlaps and duplications?
- Are there vital defense research areas which are underfunded and even missing from the base?
- Are sufficient coordination and interchange taking place among the Services to maximize the return from resources being applied to a given area?

- Are the priorities set correctly; that is, are the spending levels for the various areas consistent with the requirements in those areas?

- Are future weapon system requirements being acknowledged in the more applied work being conducted within the technology base?

- How does the overall program match priorities and mission area deficiencies?

These are the kinds of questions which are of concern to both the DDR&E and the Assistant Secretaries (R&D) & Military R&D Chiefs of the Military Departments who are responsible for overseeing the Service programs. In addition, the Secretary of Defense and the Congress have questions concerning the relative value of the diverse activities contained in the technology base -- questions which can best be answered by showing how the various pieces fit together to make a coherent whole. The TCP's have also served as a device for improving interservice and Defense Agency communications in most technology areas. In some areas, information from the TCP's has also provided the basis for the dissemination of information on technology programs and future needs to the industrial and academic sectors. For these reasons, we shall continue to prepare TCP's in the following technology base program areas:

- Propulsion Technology, Missiles and Space Vehicles

- Medical and Biological Sciences

- Materials Technology

- Structures Technology

- Aircraft Propulsion Technology

- Aeronautical Vehicle Technology

- Human Resources Technology

- Environmental Sciences

- Electronic Devices

- Weapons Technology

- Surface Vehicles

- Electronics Technology (to be initiated in FY 1975)

UTILIZATION OF TCP's

While TCP's have proved an effective mechanism for spotting duplicative, underfunded, or missing programs, they have not generally fulfilled one of the originally intended roles; that of forming a basis for organizing work in specific segments of the technology base where appreciable multi-Service activity or interest exists. Neither have they been optimally utilized by all levels of Service R&D Management as an aid in making decisions on prudent allocation of resources in the various technology areas. Only in some cases have TCP's been used as data bases for the general planning process at the Service staff and systems command levels. In short, it does not appear that middle management in the Services has taken full advantage of the information contained in the TCP documents. This deficiency could be corrected if the TCP's were made a part of the basic documentation for use at all management levels in the preparation of budget and apportionment plans. Additionally, the utilization of TCP information in the preparation of overall investment strategy analyses for specific technology areas would be a valuable adjunct to the planning documents of the individual Services.

CONTENT OF TCP's

The use of a standard format or a standard table of contents for a TCP is not required. The format should be the prerogative and responsibility of the Service/Agency team preparing the TCP. However, if the objectives of the TCP process are to be achieved, these documents should contain at least the following information:

- An examination of the impact of both near term and future military requirements by mission area as they might influence that technology.

- A description of the current and future DoD program in that technology area and the degree to which the program satisfies firm military requirements. This should include a summary of work content, designation of the sponsoring Service or Defense Agency for major tasks, and where these tasks are being performed (in-house or major contractors, by name).

Within this description an explicit discussion of the motivations and relevancy of the 6.1 Research projects should be given. The TCP should also highlight the non-system 6.3 Advanced Technology Demonstration projects with appropriate discussions as to their potential payoff in terms of improved operational capability, cost reduction, or cost avoidance.

- A summary table matrix which correlates technical sub-areas with sponsor, Program Element, and Project number. Because of the problems associated with the distribution of outyear fiscal data, TCP's will be written to contain financial data for only the current and budget years. Data from preceding fiscal years should be selectively included to indicate significant trends. Complete FYDP data will not be shown in the TCP, although anticipated trends in funding levels may be indicated either quantitatively or qualitatively. This restriction is not meant to exclude the consideration of FYDP data in the preparation of a TCP, which can be very useful, or to inhibit publication of FYDP data in an appendix or supplement to the TCP.

- Identification and description (if available) of other DoD programs (i.e., Manufacturing Technology, Component Improvement, etc.) non-DoD programs (NASA, AEC, NSF, etc.) or other major efforts (IR&D), if any, which have a significant impact on the technology area, and an assessment of that impact.

- A short assessment of the technology area itself, including mission area deficiencies, a brief recount of significant historical trends and expected future trends, significant recent accomplishments and (where instructive) significant recent negative results.

No restrictions on the size of TCP's can reasonably be imposed. Some TCP's will be comprised of a single document of perhaps 50-80 pages in length whereas others will be as long as several hundred pages because of the diversity of that technology area. All, however, should contain an Executive Summary (maximum of 20-25 pages) of the salient information in the document.

MANAGEMENT OF TCP PROCESS

- The DD(R&AT) is responsible for the overall implementation of the TCP process.

- The DD(R&AT) is responsible for ensuring that each basic TCP is as concise as possible and that all background information is prepared in a useful format.

- The DD(R&AT) is responsible for determining the rate and frequency of preparation of each TCP. Annual revisions of TCP's will, therefore, not be automatic, but an annual review of each TCP will be made to determine whether to amend, update, rewrite, supplement or make no change.

- It is not required that working drafts or for-comment drafts of TCP's be thoroughly staffed or coordinated at the middle or upper management levels. Forty-five days will be allowed for review of the coordination draft of each TCP. The Assistant Secretaries (R&D) of the Military Departments may, at their discretion, delegate coordination authority. I have delegated the DDR&E coordination authority to the DD(R&AT).

DISTRIBUTION OF TCP's

- The basic TCP documents will not be distributed to industry. They will be selectively distributed to other Federal Agencies such as NASA, CIA, and NSF and to the Congress as appropriate. The DD(R&AT) will determine the appropriateness of TCP distribution outside of DoD.

- Initial and secondary distribution of coordination TCP's will be made through the Defense Documentation Center (DDC). Distribution to other than in-house organizations will require the express approval of DD(R&AT).

- Every effort will be made to distribute TCP information (not TCP's) concerning technology requirements to industry, academic and other non-government personnel. The appropriateness of these distributions will be determined by DD(R&AT).

- Draft and coordinated TCP's will be distributed to appropriate Service laboratories. The appropriateness of these distributions will be determined by the Military Departments.

REVIEWS AND CRITIQUES OF TCP'S

- It shall be the responsibility of the DD(R&AT) to obtain critiques of TCP's as appropriate. The nature of these reviews will vary with the scope and content of the individual TCP. The reviewers may be comprised of professional staff from Federal Contract Research Centers (FCRC's), members of quasi-government institutions such as the National Academy of Sciences (NAS), or selected personnel from private industry or academia.

- When members of private industry or academia are utilized to review TCP's, they will conduct their review in the Pentagon and will not be permitted to take the documents from the building.

- The results of all such reviews will be passed to the Military Departments and appropriate Defense agencies for information and comment if appropriate.

Malcolm R. Currie

REFERENCES

(a) DoD Directive 5000.1, "Acquisition of Major Defense Systems," December 22, 1975
(b) Office of Management and Budget Circular A-71, "Responsibilities for the Administration and Management of Automatic Data Processing Activities," March 6, 1969
(c) DoD Directive 4105.55, "Selection & Acquisition of Automatic Data Processing Resources," May 19, 1972
(d) DoD Directive 4160.19, "Department of Defense Automatic Data Processing Equipment Reutilization Program," April 5, 1973
(e) DoD Directive 5100.40, "Responsibility for the Administration of the DoD Automatic Data Processing Program," August 19, 1975
(f) DoD Directive 5200.28, "Security Requirements for Automatic Data Processing (ADP) Systems," December 18, 1972
(g) DoD Instruction 5000.2, "The Decision Coordinating Paper and the Defense Systems Acquisition Review Council (DSARC)," January 21, 1975
(h) DoD Directive 5000.3, "Test and Evaluation," January 19, 1973
(i) DoD Instruction 5010.21, "Configuration Management Implementation Guidance," August 6, 1968
(j) Armed Services Procurement Regulation, Section IX, Parts 9 and 6
* (k) DoD Instruction 5000.31, "Interim List of DoD approved High Order Programming Languages," November 24, 1976 *
(l) Director, Defense Research and Engineering Memorandum, "Technology Coordinating Papers," May 29, 1974 (enclosure 3)
(m) Defense Standardization Manual 4120.3M, "Standardization Policies, Procedures and Instructions," January 1972

#First amendment (Ch 1, 12/28/76)

NUMBER 5000.31

DATE November 24, 1976

ASD(I&L)/DDR&E/DTACCS/ASD(C)

Department of Defense Instruction

SUBJECT : Interim List of DoD Approved High Order Programming Languages (HOL)

References: (a) DoD Directive 5000.29, "Management of Computer Resources in Major Defense Systems," April 26, 1976
(b) DoD Directive 5000.1, "Acquisition of Major Defense Systems," December 22, 1975
(c) DoD Directive 5100.40, "Responsibility for the Administration of the DoD Automatic Data Processing Program," August 19, 1975

I. PURPOSE

This Instruction specifies the High Order Programming Languages (HOL) which are approved for use in conjunction with reference (a).

II. APPLICABILITY AND SCOPE

A. The provisions of this Instruction apply to the Office of the Secretary of Defense, the Military Departments, the Organization of the Joint Chiefs of Staff, and the Defense Agencies (hereinafter referred to collectively as "DoD Components").

B. Its provisions encompass the selection of HOL for the development of software in major programs of defense systems acquisition as designated by the Secretary of Defense (described in section II of reference (b)), as well as for defense system acquisitions that do not fall in the "major acquisition" category.

C. Excluded from the provisions of this Instruction are:

1. Commercially available software for use with automatic data processing assets as defined and administered under reference (c).

2. Those application or user oriented languages which do not fall within the category of a programming language (e.g., User Requirements Languages, Automatic Test Equipment Languages, Production Control Languages, simulation Languages, and Analyst Aid Languages).

D. The provisions of the Instruction are not to be applied retroactively on any defense systems where a language commitment has already been made, nor is it to be interpreted as prejudicial to language selections occurring before DoD policy formulation.

III. DEFINITION

For purposes of this Instruction a HOL is one which provides compression of computer instructions such that one HOL statement represents many machine language instructions. It is non-problem-specific and is used by programmers to communicate with a computer.

IV. POLICY

A. General

1. This Instruction and DoD Directive 5000.29 (reference (a)) is designed to reduce the proliferation of HOL in defense systems and to ensure control of those HOLs which are approved.

2. DoD approved HOLs will be used to develop defense system software, unless it is demonstrated that none of the approved HOLs are cost effective or technically practical over the system life cycle (reference (a), subsection V.G.). Each DoD Component will designate in its instruction implementing DoD Directive 5000.29 (reference (a)) one office authorized to approve requests for such exceptions. The designated approval authority will maintain appropriate records to support periodic review by the Management Steering Committee for Embedded Computer Resources.

3. Each DoD approved HOL will be assigned to a designated control agent who will be responsible for such activities as assuring language stability and configuration management, validating compliance of compiler implementations with the standard language specifications, gathering data as to the use of the languages, and for disseminating information, compilers, and tools (reference (a) subsection V.G.).

B. Approved High Order Programming Languages

1. The DoD approved High Order Programming Languages, and their defining specification documents are:

a. CMS-2 "CMS-2Y Programmers Reference Manual," M-5049, FDCSSA, San Diego, CA., October 1, 1976; and "CMS-2M Computer Program Performance Specifications," NAVELEX 0967LP-598-2210.

b. SPL-1 "SPL-1 Language Reference Manual," Intermetrics Report No. 172-1.

c. TACPOL CPCEI Part I Specification EL-CG-00043082C Volume 1, April 16, 1971 with ECO Modifications (Appendix 10).

d. JOVIAL Military Standard (MIL-STD) 1588 (USAF) for J3 and MIL-STD-1589 (USAF) for J73.

e. COBOL ANSI X3.23 - 1974.

f. FORTRAN ANSI X3.9 - 1974.

2. The languages CMS-2 and SPL-1 shall be controlled within DoD by the Department of the Navy.

3. The language TACPOL shall be controlled by the Department of the Army.

4. The language JOVIAL shall be controlled by the Department of the Air Force.

5. The languages COBOL and FORTRAN shall be controlled by the Office of the Assistant Secretary of Defense (Comptroller) acting with the National Bureau of Standards and the American National Standards Institute (DoD Directive 5100.40, reference (c)).

V. RESPONSIBILITIES

A. The Management Steering Committee for Embedded Computer Resources, DoD Directive 5000.29 (reference (a)), shall oversee and coordinate the accomplishment of the policies in this Instruction, and advise the principal assistants of the Office of the Secretary of Defense on matters related to this policy.

B. The Military Departments will designate control agents for each HOL under their purview.

C. The HOL control agents so designated by the Military Departments are authorized to update their designated language with compatible extensions and improvements to satisfy validated requirements. Such extensions (e.g. new syntax and/or new semantics) should not be made more often than once per year. The COBOL and FORTRAN control agents must comply with the current approved version of the American National Standards Institute.

VI. EFFECTIVE DATE

This Instruction is effective immediately.

Assistant Secretary of Defense
(Installations and Logistics)

Fred P. Wacker
Assistant Secretary of Defense
(Comptroller)

Director Telecommunications and
Command and Control Systems

Director of Defense Research and
Engineering

DEPARTMENT OF THE AIR FORCE

REGULATIONS

Acquisition Management

MANAGEMENT OF COMPUTER RESOURCES IN SYSTEMS

Volume I establishes policy for the acquisition and support of computer equipment and computer programs employed as dedicated elements, subsystems or components of systems developed or acquired under the program management concept established in AFR 800-2. Other computer resources will be acquired and managed in accordance with applicable regulations.

SECTION A—GENERAL INFORMATION

1. Applicability of This Regulation. This regulation applies to all Air Force activities responsible for planning, developing, acquiring, supporting and using systems managed or acquired under AFR 800-2.

2. Objective of This Regulation. The objective of this regulation is to insure that computer resources in systems are planned, developed, acquired, employed, and supported to effectively, efficiently, and economically accomplish Air Force assigned missions.

3. Air Force Policy on Management of Computer Resources in Systems:

a. Computer resources in systems are managed as elements or subsystems of major importance during conceptual, validation, full-scale development, production, employment, operation and support phases. System performance requirements are allocated to subsystems using in-depth trade-off studies and cost-effectiveness analyses.

b. Management responsibility for the integration of computer equipment and computer programs into a system remains centralized for the life of the system. Responsibility for the computer equipment and computer programs will transfer in accordance with AFR 800-4 and turnover in accordance with AFR 800-19. Responsibility for development maintenance and modification of selected computer programs may be assigned commensurate with operational and support requirements.

c. Organic computer equipment maintenance and computer program development and maintenance capabilities are established where economical or to satisfy system requirements. Common and existing capabilities are used wherever practicable.

d. Computer equipment and computer programs are standardized to the extent practicable within each system as well as across systems. Common purpose automatic test equipment is desirable.

e. Automatic data processing (ADP) standards and

Supersedes AFR 800-14, 10 May 1974. (For summary of revised, deleted, or added material, see signature page.)

OPR: RDM

DISTRIBUTION: F; X: (Defense Systems Management School Ft Belvoir VA 22060 .... 100) higher level programming languages are used to the maximum extent practicable in the system under development.

f. Computer equipment and computer program trade-offs are conducted throughout the life cycle of the system to minimize cost and insure growth capability consistent with operational requirements.

g. Organizational responsibilities and computer resource requirements, including support facilities, personnel, documentation, training and other essential resources are identified early in the system development program to insure coordinated actions and integrated support for the system life cycle.

h. Data item descriptions are identified and developed as required to insure timely and adequate program documentation support throughout the system life cycle.

i. Solicitation documents include explicit statements establishing Air Force rights to computer programs required to operate, simulate and support the system. This includes computer programs and associated documentation required for the maintenance and modification of these programs.

j. Configuration management procedures are developed to assure control during development, test, transfer and turnover, operational maintenance, and major modification.

k. An inventory of computer equipment and computer programs is developed and maintained.

l. User involvement is an integral part of computer program development, test, operational maintenance and major modification. The scope and degree of involvement is determined by system and operational requirements.

m. Program Management Directives (PMDs) require and Program Management Plans (PMPs) provide for:

(1) Establishment of computer technical and managerial expertise responsive to the Program Office (PO) which is independent of the system prime or computer program development contractor and, preferably, an organic capability of the PO.

(2) The specification and allocation of system performance and interface requirements to be met by computer equipment and computer programs.

(3) Reliability, maintainability, and availability as prime development objectives.

(4) Sufficient computer equipment capacity and flexible computer program design during the planning and development phases to provide for planned growth and ease of modification and maintenance throughout the system life.

(5) The timely preparation of support plans for development, acquisition, life cycle operational maintenance and training for computer equipment, computer programs, supporting documentation and facilities.

(6) The level of simulation to be employed to assist and assure the acquisition of systems responsive to mission requirements and to minimize the cost or risk associated with changes throughout the system life cycle.

(7) The comprehensive test of computer equipment and verification and validation of computer programs. Special emphasis is directed to these items during the testing and evaluation conducted in accordance with AFR 80-14.

(8) The identification of computer equipment and computer programs as configuration items (CIs).

(9) Work breakdown structures (MIL STD-881) designed to facilitate identification of computer resource costs.

(10) Coverage of computer equipment and computer programs during the conduct of system design reviews, audits and management assessments.

SECTION B—ASSIGNED RESPONSIBILITIES

4. Headquarters USAF:

a. Provides for the management of computer resources in systems consistent with the policies in this and other applicable regulations.

b. Insures that policies and procedures for the management of computer equipment and computer programs are consistent with other applicable policies, regulations and directives.

5. Air Force Systems Command (AFSC):

a. Provides for the implementation of this regulation in the development, acquisition, transfer and turnover of assigned systems involving computer resources.

b. Maintains an organic capability of computer technical and managerial expertise as necessary to support assigned responsibilities.

c. Provides for the standardization of computer equipment and computer programs between and within systems and insures optimum usage of available computer resources as practicable.

d. Insures the timely application of advanced computer technology into systems.

e. Develops jointly with AFLC an inventory and data base on computer equipment and computer programs used in systems. Provides update information to AFLC as new systems are developed.

f. Satisfies other responsibilities as defined in the Air Force 800 series and other applicable regulations.

6. Program Manager:

a. Provides management and technical emphasis to computer equipment and computer program requirements identified in the PMD.

b. Directs the preparation, update and implementation of the PMP consistent with the policies of this regulation.

c. Insures that the PO works with AFLC and the user to incorporate their needs into the PMP, supporting plans and other system documents prepared and implemented by the PO.

d. Satisfies other responsibilities as defined in the Air Force 800 series and other applicable regulations.

7. Air Force Logistics Command (AFLC):

a. Provides for the implementation of this regulation during the transfer and support of systems involving computer resources.

b. Maintains an organic capability of computer technical and managerial expertise as necessary to support assigned responsibilities.

c. Develops jointly with AFSC and maintains an inventory and data base on computer equipment and computer programs in systems.

d. Participates with the PO and the user in the preparation, update and implementation of the PMP, support plans (including the integrated logistics support plan) and other system documents.

e. Participates with the PO and the users in determining responsibilities for the maintenance and modification of computer equipment and computer programs for incorporation into system documents.

f. Programs for, establishes and operates facilities determined necessary to support AFLC assigned responsibilities for the integration and maintenance of the total system. Uses common and existing facilities wherever practicable.

g. Insures the standardization of computer equipment and computer program support facilities and equipment wherever practicable.

h. Satisfies other responsibilities as defined in the Air Force 800 series and other applicable regulations.

8. Using Activities:

a. Provide for the implementation of this regulation in the turnover, operation and maintenance of systems involving computer resources.

b. Assure continuing involvement with the PO and AFLC in the development, test, transfer, turnover and operation of computer equipment and computer programs in systems.

c. Maintain an organic capability of computer technical and managerial expertise as necessary to support assigned responsibilities.

d. Participate with the PO and AFLC in the preparation, update and implementation of the PMP, support plans and other system documents. Insure accurate incorporation and timely update, within the approved program, of mission requirements.

e. Participate with the PO and AFLC in determining responsibilities for the maintenance and modification of computer equipment and modifications to computer programs for incorporation into system documents.

f. Program for, establish and operate facilities determined necessary to support assigned responsibilities for the maintenance, modification and development of computer programs.

g. Satisfy other responsibilities as defined in the Air Force 800 series and other applicable regulations.

9. Air Training Command (ATC):

a. Reviews system documents and initiates training support planning.

b. Provides and administers training programs to support systems in accordance with AFR 50-9.

10. Air University. Provides professional education in computer sciences and management in accordance with AFR 53-11 and AFM 50-5.

BY THE ORDER OF THE SECRETARY OF THE AIR FORCE

OFFICIAL

DAVID C. JONES, General, USAF
Chief of Staff

JAMES J. SHEPARD, Colonel, USAF
Director of Administration

SUMMARY OF REVISED, DELETED, OR ADDED MATERIAL

This revision renumbers AFR 800-14 to AFR 800-14, Volume I; and updates the terms "transition and turnover" to "transfer and turnover" in accordance with AFRs 800-4 and 800-19.

TERMS EXPLAINED

1. **Availability**. A measure of the degree to which an item is in the operable and committable state at the start of the mission, when the mission is called for at an unknown (random) point in time. (MIL-STD-721)

2. **Computer Program**. A series of instructions or statements in a form acceptable to an electronic computer, designed to cause the computer to execute an operation or operations.

3. **Computer Resources**. The totality of computer equipment, computer programs, associated documentation, contractual services, personnel and supplies.

4. **Configuration Item (CI)**. An aggregation of equipment/software, or any of its discrete portions, which satisfies an end use function and is designated by the Government for configuration management. CIs may vary widely in complexity, size and type, from an aircraft or electronic system to a test meter or round of ammunition. During development and initial production, CIs are only those specification items that are referenced directly in a contract (or an equivalent in-house agreement). During the operation and maintenance period, any reparable item designated for separate procurement is a configuration item. (AFR 65-3)

5. **Data Item Description, DD Form 1664**. A form which specifies an item of data required to be furnished by a contractor. This form specifically defines the content, preparation instructions, format and intended use of each data product. (AFR 310-1)

6. **Higher Level Programming Languages**. Primarily, machine independent programming languages (of a higher order than assembly languages) designed for ease of expression of a class of problems or procedures by humans. These languages are designed for convenience of program specification rather than for easy conversion to machine code instruction. The languages are intended:

a. As a means for directly presenting procedures to a computer for which a compiler exists; and

b. As a means of communicating such procedures among individuals. (AFR 300-10)

7. **Program Manager**. The generic term used to denote a single Air Force manager (System Program Director, Program/Project Manager, or System/Item Manager) during any specific phase of the acquisition life cycle. (AFR 800-2)

8. **Program Management Directive (PMD)**. The official HQ USAF management directive used to provide direction to the implementing and participating commands and satisfy documentation requirements. It will be used during the entire acquisition cycle to state requirements and request studies as well as initiate, approve, change, transition, modify or terminate programs. The content of the PMD, including the required HQ USAF review and approval actions, is tailored to the needs of each individual program. (AFR 800-2)

9. **Program Management Plan (PMP)**. The document developed and issued by the Program Manager which shows the integrated time-phased tasks and resources required to complete the task specified in the PMD. The PMP is tailored to the needs of each individual program. (AFR 800-2)

10. **Program Office (PO)**. The field office organized by the Program Manager to assist him in accomplishing the program tasks. (AFR 800-2)

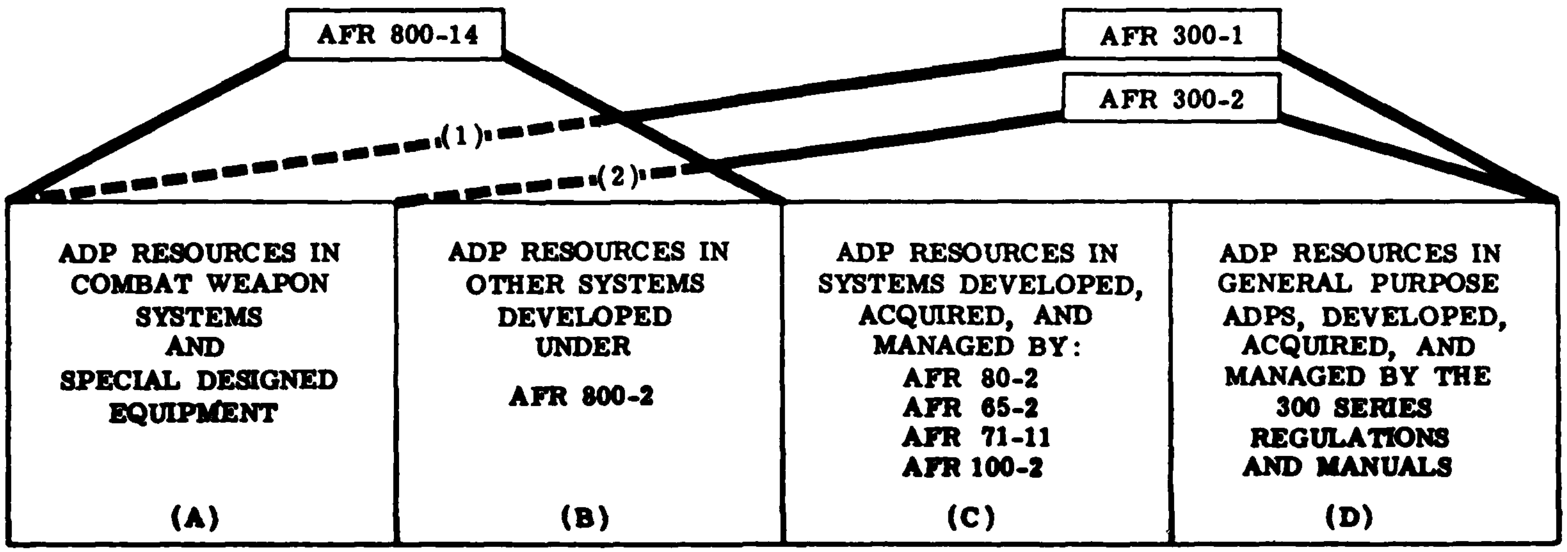
11. **Simulation**. The representation of physical systems or phenomena by computers, models or other equipment.

12. **Transfer**. That point in time when the designated Supporting Command accepts program management responsibilities from the Implementing Command. This includes logistic support and related engineering and procurement responsibilities. (AFR 800-4)

13. **Turnover**. That point in time when the operating command formally accepts responsibility from the Implementing Command for the operation and maintenance of the system, equipment, or computer program acquired (AFR 800-19).

14. **Verification/Validation (of computer programs)**. The process of determining that the computer program was developed in accordance with the stated specification and satisfactorily performs, in the mission environment, the function(s) for which it was designed.

APPLICABILITY OF AIR FORCE REGULATIONS PERTAINING TO ADP AND COMPUTER RESOURCES



CATEGORY A - These items are excluded from the DOD and Air Force ADP Programs. They are subject to the policies of AFRs 300-1 and 800-14.

CATEGORY B - The ADP resources integral to these systems are subject to policies of AFRs 300-1, 800-14, and 300-2.

CATEGORY C - Management of the ADP resources in these systems are subject to AFR 300-1, AFR 300-2, and the cited regulations. As these ADP resources are dedicated to the systems they support, primary management stems from the basic regulation governing the system.

CATEGORY D - These systems are developed, acquired, operated, and managed using the 300 series regulations and manuals.

(1) Technical and managerial expertise is provided by ADP Program Single Manager organizations by means of review, consultation, recommendation and Hq USAF coordination.

(2) Pertinent AFR 300-2 policy requirements will be specified by the PMD.

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DEPARTMENT OF THE AIR FORCE
Headquarters US Air Force
Washington DC 20330

AF REGULATION 800-14
Volume II
26 September 1975

Acquisition Management

ACQUISITION AND SUPPORT PROCEDURES FOR COMPUTER RESOURCES IN SYSTEMS

This volume of AFR 800-14 consolidates procedures that apply when implementing the policies of AFR 800-14, Volume I and other related publications (attachment 2) as they pertain to the acquisition and support of computer resources. It applies to all activities responsible for planning, developing, acquiring, supporting and using computer resources in systems acquired and managed under the AFR 800-2 program management concept.

OPR: RDM
DISTRIBUTION: F;X: (Defense Systems Management School Ft Belvoir VA 20060) 100 copies

Chapter 1

INTRODUCTION

1-1. Scope. The uniqueness of computer resource management requires the publication of a document which consolidates and explains the applicability of other publications to computer resource acquisition and support. This volume of AFR 800-14 serves that purpose by restating applicable portions of related publications identified in attachment 2 and amplifies the policies of those publications. It is intended to ensure that specific attention to the management of computer resources is accomplished within the context of the overall system program technical and management efforts. It must be used with any other publication in attachment 2 that applies. Offices responsible for policy in those publications remain responsible for policy in the functional areas, for example, HQ USAF/LG will establish and interpret all policy related to procurement and configuration management. Conflicts between this publication and the referenced publications will immediately be called to the attention of HQ USAF/RDM with an information copy to the functional office responsible for the other publication.

1-2. Applicability. The procedures prescribed in this volume are tailored to the needs of the program or project. Changes to existing systems, including deployed systems, will be reviewed on a case-by-case basis to determine their application to this regulation. This determination will be made by the command or agency having final approval authority for the change in coordination with implementing, supporting and using commands. Commands may supplement this regulation. One copy of each command supplement will be forwarded to HQ USAF/RDM.

1-3. Glossary. See attachment 1.

1-4. Bibliography. See attachment 2 for a compilation of referenced documents.

1-5. Air Force Working Group. A working group will be established to review the implementation of this regulation. The executive agent of the working group will be HQ USAF/RDM and membership will consist of representatives from HQ USAF, Air Force Systems Command (AFSC), Air Force Logistics Command (AFLC), and appropriate using commands. The group will meet 6 months after the publication date of this regulation and annually thereafter to recommend changes and incorporate new developments.

1-6. Interface With AFR 300-1, Automatic Data Processing Program Management. Automatic data processing (ADP) resources in systems acquired under AFR 800-2 are subject to the policies of AFR 300-1 as well as AFR 800-14. The policies of AFR 300-1 apply in the sense that the program manager is encouraged to seek technical and managerial expertise from the ADP Single Manager organization. These organizations will provide, upon request, reviews, consultation and recommendations.

1-7. Interface With AFR 300-2, Management of Automatic Data Processing Systems. ADP resources, in systems acquired under AFR 800-2, are subject to the policies of AFR 300-2 to the extent specified by the program management directive (PMD). If the PMD does not require AFR 300-2 procedures, then the program manager will follow the provisions of AFR 800-14 and will exercise identical authority in the acquisition of system computer resources and other system components.

1-8. Supporting/Using Command Roles. The supporting and using commands will actively participate in all phases of acquisition. Participation includes, but is not limited to: requirements definition, specification development, source selection, design reviews, audits, validation/verification (of computer programs), testing, and acceptance.

1-9. Implementation. At the time of publishing this volume several exsiting publications will require change to provide for the concept set forth herein. For example: AFR 800-14, 10 May 1974, will be renumbered as volume I; AFR 57-4 and TO 00-35D-54 require expansion to provide more detailed guidance for computer resources; and AFR 8-2 and TO 00-5-1 require change to delete computer programs from the technical order system. Further, some major command actions are necessary, such as: the development of a numbering system for computer programs by AFLC in conjunction with AFSC, and development of configuration status accounting procedures to include computer resources into existing management systems as configuration items. All such actions will be expedited to assure policy consistency. Managers should recognize that the changes are in process and initiate management actions in accordance with the provisions of this regulation.

Chapter 2

COMPUTER RESOURCES IN THE SYSTEM ACQUISITION LIFE CYCLE

2-1. Purpose. This chapter discusses computer resources in the system acquisition life cycle, defines the computer program life cycle and discusses the relationship of the two cycles.

2-2. System Acquisition Life Cycle. The system acquisition life cycle provides a basis for categorizing program management activities. It consists of five major phases with major decision points as defined in AFR 800-2. Programs may skip a phase or have program elements in any or all phases. The following description explains a normal system acquisition with emphasis on computer resources.

2-3. Conceptual Phase. This is the initial planning period when the technical, military and economic bases are established through comprehensive studies, experimental development and concept evaluation. The objective of this initial planning may be directed toward refining proposed solutions or developing alternative concepts to satisfy a required operational capability.

a. During this phase, proposed solutions are refined or alternative concepts are developed using feasibility assessments, estimates (cost and schedule, intelligence, logistics, and so forth), tradeoffs, studies, and analyses (chapter 3).

b. The major definitive document resulting from this phase is the initial system specification which documents total system performance requirements. It may document the requirements to be met by computer resources as well as relevant design constraints. An adequate definition of essential system interfaces between computer equipment functions, communication functions, and personnel functions should be provided to enable the further definition and management of the computer programs and computer equipment into configuration items. Normally, this information is derived from system engineering studies of the system functions.

2-4. Validation Phase. This is the period when major system characteristics are refined through studies, system engineering, and preliminary equipment and computer program development, test and evaluation. The objective is to validate the choice of alternatives and to provide the basis for determining whether or not to proceed into the next phase.

a. During this period, system performance requirements including computer resources are further defined and preferred development methodologies for computer programs, such as organic or contractor, per AFR 26-12, are selected. Validation phase activities define the efforts required by characteristics (performance, cost and schedule) and provide confidence that risks have been resolved or minimized. Technical reviews that should be accomplished are the System Requirements Review(s) and System Design Review (chapter 4).

b. For computer resources, the major definitive documents resulting from this phase are the authenticated system specification, the preliminary development specifications containing system functional requirements allocated to configuration items of computer programs and equipment, and the initial computer resources integrated support plan (CRISP). The initial preparation and coordination of the CRISP (chapter 3) is accomplished as soon as possible to permit the program manager to accommodate appropriate CRISP provisions in the full-scale development contracts.

2-5. Full-Scale Development Phase. This is the period when the system, equipment, computer programs, facilities, personnel subsystems, training, and the principal items necessary for support are designed, fabricated, tested, and evaluated. The intended outputs are a system which closely approximates the production item, the documentation necessary to enter the production phase, and the test results which demonstrate that the system to be produced will meet the stated performance requirements.

a. The development specifications are completed and authenticated. Authentication of any development specification establishes the allocated baseline. A preliminary design effort is accomplished leading to an acceptable design approach. A preliminary design review (PDR) is held for each equipment configuration item and computer program configuration item (CPCI) to review the preliminary design against the respective authenticated development specification (chapter 4). Formal engineering change control procedures are implemented to prepare, propose, review, approve, implement, and record engineering changes to the allocated baseline (chapter 6). For computer programs, the preliminary design includes the definition of the entire computer program in terms of functions, external and internal interfaces, storage allocation, computer program operating sequences, and the design of the data base. This information should be contained in the development specifications and become the basis for the PDR of the computer program.

b. Following an acceptable PDR for a configuration item, detailed design of that item begins. This activity produces engineering documentation such as drawings, product specifications and test plans. For computer programs, design is accompanied by documentation of logical flows, functional sequences and relations, formats, constraints, and the data base. This documentation should be reviewed by Air Force engineering personnel prior to the critical design review (CDR). The CDR should assure that the recommended design satisfies the requirements of the development specification. At the CDR, specified portions of draft Product Specifications are reviewed. Equipment/personnel/computer program interfaces should be finalized at this time. A Computer Program Identification Number (CPIN) should be assigned to all CPCIs and related documents prior to CDR (chapter 6). The primary product of the CDR for CPCIs is the identification of specific portions of the Product Specification which will be released for coding and testing.

c. Development, test and evaluation (DT&E) and initial operational test and evaluation (IOT&E) are conducted (chapter 5). Testing of configuration items is performed according to formal test plans initially submitted in preliminary draft form for review at CDR, and finalized prior to the start of testing. These activities normally proceed in such a way that testing of selected functions begins early during development and proceeds through successively detailed levels of assembly to the point where the complete computer program is subjected to formal qualification testing. Additional computer programs and equipment may be required to properly simulate the operational environment or to test the computer programs. The scope and realism of computer program testing may be progressively expanded as additional items of the operational computer equipment, are made available for this purpose. Adequacy of the performance of the computer programs is checked to the maximum extent possible through prudent use of simulation prior to the installation of the computer program in a field site or flight computer. The use of artificial data or recorded data from similar equipment should be considered. Nuclear safety cross-check analysis (NSCCA) is also performed on specified computer resource items (AFR 122-1). Satisfactory performance of the computer program for a large operational system may not be completely demonstrated and assessed until completion of operational test and evaluation (OT&E). For less complex computer programs, or for computer programs which are relatively insensitive to the system operational functions, formal qualification testing may be accomplished earlier in the acquisition (chapter 5).

d. Planning for transfer of the system to the supporting command and turnover to the using command begins early in this period. Necessary agreements should be prepared, coordinated, and approved prior to the end of this phase (chapter 9).

2-6. Production Phase. This is the period from production approval until the last system item is delivered and accepted. The objective is to efficiently produce and deliver effective and supportable systems to the using command(s).

a. The product specifications define the product configuration baseline. This baseline, in conjunction with the development specifications, acts as an instrument for use in diagnosing troubles, adapting the computer resources to environmental and operational requirements of specific site locations, and designing changes.

b. Functional and Physical Configuration Audits are performed on all configuration items (chapter 6).

c. Provisions should be made in contracts and follow-on support arrangements to maintain the currency of the equipment/computer program configuration and associated documentation in accordance with AFR 65-3. Failure to properly consider these provisions may result in support complications, obsolete documentation, and costly "modernization" programs.

d. The supporting and using commands continue to program for resources necessary to support the computer programs throughout the deployment phase. At program management responsibility transfer, the role of the implementing command normally terminates except for identified residual tasks and phase-out responsibilities.

2-7. Deployment Phase. This period commences with delivery of the first operational unit and terminates when the system is removed from the operational inventory.

a. Operational test and evaluation (OT&E) is performed on all operational configuration items to assess the system operational effectiveness and suitability in a deployed configuration (chapter 5).

b. The CRISP continues as an active document during this phase. It is the basic agreement between the using and supporting commands for computer resource management.

c. After a system is in operational use, changes to computer programs may be necessary to remove latent errors, improve coding or operation, adapt to changes in system requirements, or incorporate knowledge gained from operational use. Based upon complexity and other factors such as system interfaces, constraints, and priorities, control may vary from on-site management to complex checks and balances with mandatory security keys and access codes. The authority to change the computer programs must be carefully and specifically delineated, particularly when security, safety, or special nuclear restrictions are involved.

2-8. Computer Program Development in the System Acquisition Life Cycle. Computer program development can be conceptualized as the computer program life cycle shown in figure 2-1. This cycle may span more than one system acquisition life cycle phase, or occur in any one phase. For example, a mission simulation computer program may undergo all of the phases of the computer program life cycle during the conceptual phase, while a mission application program may undergo these phases during the validation, full-scale development, and production phases. The computer program life cycle, and the formal activities associated with it (configuration management, technical reviews, testing and audits, and so forth), will occur at least once for each CPCI during the system acquisition life cycle. The activities need not be sequential, instead, there are potential loops between all the phases. For example, design may reveal problems (for example, in performance and cost) which lead to the revision of requirements and reinstitution of certain analyses. Checkout may reveal errors in design, which in turn may lead to redesign or requirements revision. The phases of the computer program life cycle are discussed below.

a. Analysis Phase. The purpose of the analysis phase is to define the functional performance requirements for a computer program. These requirements describe the functions the computer program configuration item is required to accomplish as part of the system. Additionally, the functional interfaces and the necessary design constraints are defined. This phase normally begins with the release of the system specifications, and terminates with the successful accomplishment of the PDR. During this phase, various design approaches are considered, analyses and trade-off studies are performed and design approaches selected. The authenticated development specification forms the baseline from which the design phase initiates.

b. Design Phase. The purpose of the design phase is to develop a design approach including mathematical models, functional flow charts, and detail flow charts. The design approach should also define the relationship between the computer program components. The detail flow charts define information processing in terms of the logical flow and operations to be performed by the set of computer instructions. This information is contained in the preliminary product specification and is normally presented and reviewed during the CDR. The design approach should be documented in a preliminary Computer Program Product Specification and reviewed against the requirements of the development specification prior to initiating the coding phase.

c. Coding and Checkout Phase. The coding and checkout phase normally follows the successful accomplishment of the CDR. The purpose of coding is to translate the flow charts into computer programs and data. The purpose of checkout is to convert the initial computer program code and data into an operational computer program. The determination that a computer program is operational is based upon checking that it produces correct outputs when operating upon predefined inputs. This first check is usually limited within each computer program and upon successful completion leads into the test and integration phase.

d. Test and Integration Phase. The purpose of the test and integration phase is to test the computer program against the requirements specified in the computer program development specification. This test and integration process includes the individual computer program function or module tests and extends through total computer program formal qualification tests. Integration of the computer program with the total system is also accomplished and tested during this phase.

e. Installation Phase. The installation phase includes the loading and running of computer programs which have been successfully qualified and integrated. It may include peculiar adaptation to various sites for multisite systems. It should include checkout to establish that the system operates with a required or specified level of confidence in support of the total system within the operational environment.

f. Operation and Support Phase. During the operation and support phase, the operational suitability of the system is assessed. Also, the capability of the computer program to operate on the total set of input data presented in an operational environment is evaluated. The support of a computer program includes all resources and activities required to insure that the computer program continues to meet the required operational capability. These activities may include responding to changes by modification of existing computer programs and the creation of new computer programs. Changes, not only to the computer programs themselves, but also to the associated documentation must be addressed. Incorporation of new programs or program modifications to an existing system normally requires reaccomplishment of all the phases in the computer program life cycle. Hence, the computer program life cycle is a continuing process throughout the system acquisition life cycle.

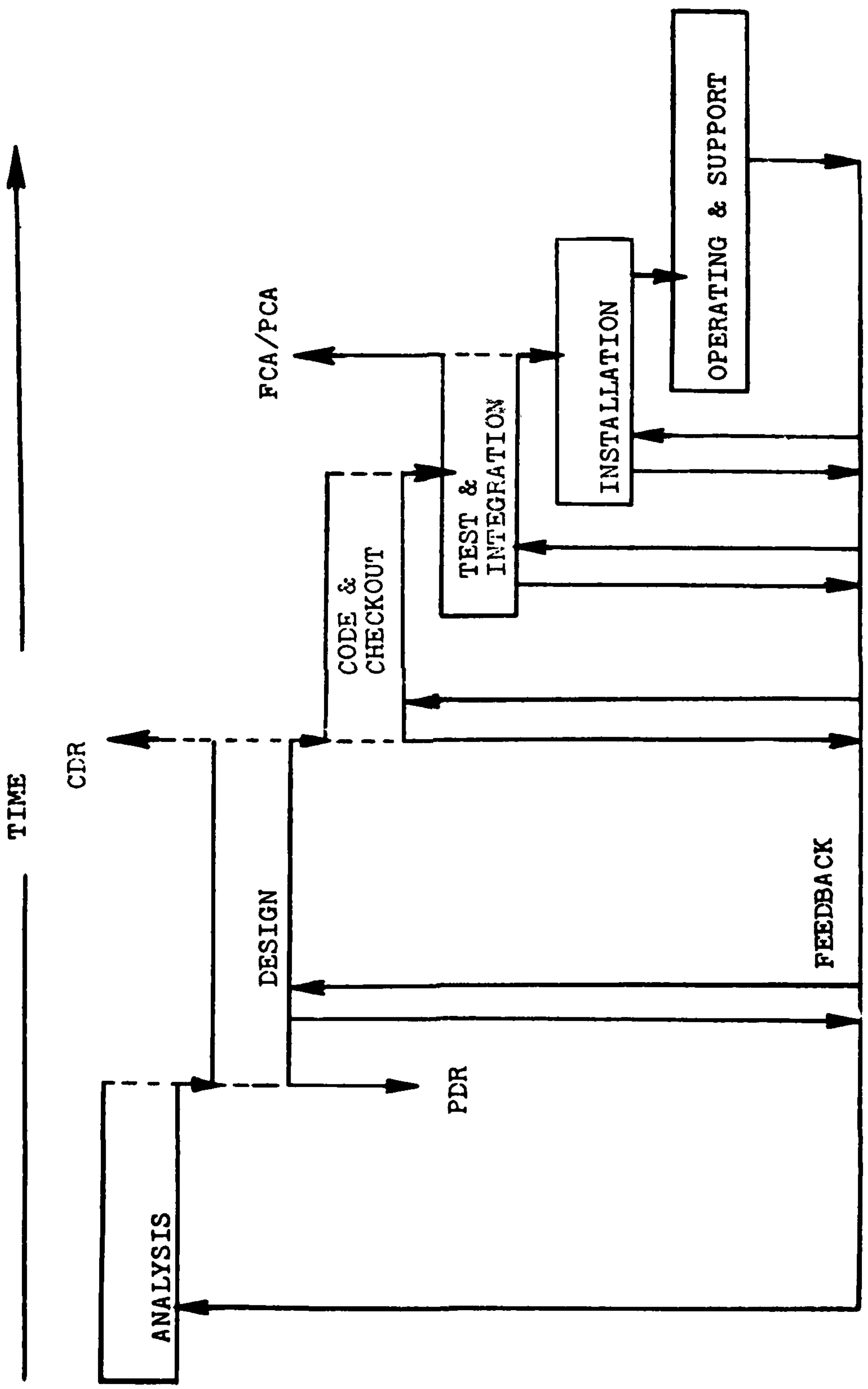

Figure 2-1. Computer Program Life Cycle.

Chapter 3

PLANNING

3-1. Purpose. This chapter provides guidance in planning the acquisition and support of computer resources. This guidance applies to the case in which the computer resources are identified during the course of system or equipment development and to the case in which the computer resources are known to be required at the outset.

3-2. Establishing Computer Resource Requirements. Requirements for computer resources originate in a number of ways. (For example, in master plans for commands or other organizations or as a result of specific mission or functional analysis studies.) Computer resource requirements may originate as a result of system development efforts which are undertaken in response to a validated required operational capability (ROC) (AFR 57-1). This occurs when it is determined that computer equipment and computer programs are appropriate solutions to the design objectives. Computer resource requirements may be stated in a data automation requirement (DAR) (AFM 300-12). In identifying and stating requirements for new or improved capabilities, it is essential to consider the impact of computer resources, including computer programs, on the system operation, maintenance, and support. The required capability must consider the life cycle mission, intended interface, and relationship with existing or planned systems. When initiating a requirement that may be satisfied by computer resources, the using and other participating commands should consider:

a. Recognized requirements for computer program capabilities.

b. The requirement for either general purpose or special purpose computer equipment.

c. Requirements for operational system availability.

d. Compatibility considerations relative to interfacing with existing systems.

e. When desired, the preferred programming language or computer equipment and accompanying rationale.

f. Known or predicted requirements for system flexibility and growth.

g. Management and technical training required to develop or maintain expertise to operate and support the computer programs and equipment.

h. Factors which will affect development and maintenance of an organic computer equipment and computer program support capability.

i. The computer program support concept envisioned relative to both the supporting and using command resources, including manpower.

j. Existing computer resources which should be considered in the conceptual planning for the system.

k. Security requirements peculiar to computer resources including requirements for handling classified information during computer processing.

l. Known trade-offs between equipment and computer programs.

m. Feasibility of trade-offs between central versus non-central computer resources approaches.

n. Capabilities required to implement V&V plans for computer programs.

o. Special environmental considerations.

p. Other considerations pertinent to the computer resources requirements.

3-3. Development of Computer Resource Requirements. Requirements for computer resources evolve from overall system requirements as a result of applying system engineering disciplines. The system configuration which results should meet the total system mission requirements in the most cost effective manner. This result can only be accomplished by insuring that every element is included in the total system optimization. In this regard, computer resources must be considered as an integral part of the system and must be subjected to trade-off and optimization studies in the same manner as other elements. The refinements of these studies through system analyses result in a set of requirements (specifications) which establish in detail the required performance of each system segment and configuration item. It is through this systematic application of engineering principles that the full capability of computer resources can be achieved.

3-4. System Studies. Trade studies, related studies and analyses are performed primarily during the conceptual and validation phases, and continue throughout the system acquisition life cycle. These studies and analyses are performed to determine the identification of alternative approaches and the sequence of functions within these approaches; the design requirements imposed by the functions; and the best design approach to satisfy the design requirements. Only reasonably attainable design approaches should be pursued considering technical capabilities, cost, time, schedules, resource limitations, technology, or other constraints as specified in the system documentation. These studies and analyses are conducted by the implementing command with inputs from all of the participating commands. Supporting and using commands may also conduct studies and analyses, as required, in support of operational systems.

a. Trade-offs between alternative methods of achieving a requirement may be required between computer equipment and computer programs. For example, higher level languages may simplify programming and thus reduce programming costs, but for real time processing systems more powerful and expensive computer equipment may be necessary to efficiently process computer programs written in these languages. Therefore, this trade-off must consider the number of items to be developed and the expected level of computer program change activity. The number of items to be procured is important since computer equipment costs are incurred for each item, whereas the computer program development cost is not. Life cycle computer program support costs are a major consideration in this trade-off.

b. Another trade-off may involve the sizing of the computer capacity to allow for flexibility and growth. Specification of minimum spare capacity is essential. Reprogramming to optimize coding within the constraints of the computer equipment usually increases the complexity of the computer programs and increases cost. An assessment should be made early in system development to determine the probable level of computer program(s) change and growth activity over the anticipated life of the system. This assessment should be reflected in the specification of computer equipment spare capacity including spare central processing time, spare memory and spare input/output channel capacity.

c. Other trade-offs may be performed to determine the optimum programming language(s) for the computer program within the specific system. The trade-off between alternative higher level languages or assembly languages should consider the following:

(1) Programming language used in similar systems (commonality).

(2) Personnel resources with applicable rogramming language skills (to include required training) within the using and supporting command.

(3) Predicted level of computer program change activity.

(4) Impact of programming language selection on computer equipment complexity.

(5) Computer program support concept to include levels and cost of documentation required.

(6) Review of applicability of standard or special purpose higher level programming languages.

(7) Suitability of the language (ease of programming), and time responsiveness.

(8) The processor independence afforded by the higher level language; that is, the requirement for transferability of the computer programs to other computer equipment.

(9) Existing compiler availability and the requirement for, and attendant cost and schedule impact of, compiler development.

(10) The impact of using either the system equipment or an additional computer facility for support.

(11) Computer program development time.

(12) Translation processing time.

d. Trade-offs between hard-wired digital processing and general purpose programmable processing may be required. Certain high speed information processing requirements such as real-time implementation of a basic function, not likely to change over the life of the system, may be cost-effectively implemented with hard-wired digital processing equipment. Functions likely to change over the system life cycle may be most cost-effectively implemented with general purpose programmable techniques.

e. Studies or analyses should be performed to establish minimum design characteristics of the computer equipment. The following characteristics should be considered, when applicable:

(1) Cycle time.

(2) Word length.

(3) Memory size, type, and characteristics.

(4) Arithmetic capability: fixed point, floating point.

(5) Multiprocessor, multicomputer, single computer configurations.

(6) Input/output channels and configuration, transfer rates and interrupts.

(7) Power fail safe.

(8) Parity checks.

(9) Interval timer and real time/line time clocks.

(10) Address and instruction traps.

(11) Number and type of registers.

(12) Instruction repertoire.
(13) Peripheral equipment.
(14) Off-line backup storage capacity.
(15) On-line mass storage devices.
(16) Communication options.
(17) Interrupt structure.
(18) Sequential logic control/micro program control.
(19) Equipment redundancy.
(20) Impact on facilities.
(21) Electromagnetic interference.
(22) Security features.

f. Other studies and analyses should be performed to establish minimum computer program design characteristics. The following characteristics should be considered, when applicable:
(1) Executive/supervisor features.
(2) Modularity of the computer programs.
(3) Types of computer programs required.
(4) Minimum iteration rates for various functional processing.
(5) Computer program media.
(6) Accuracy and stability.
(7) Fixed point versus floating point arithmetic.
(8) Security features.
(9) Existing computer programs.
(10) Restart, restore and recovery features.
(11) Computer/Assembler features.

3-5. Directives and Plans. Directives originate in response to requirements and may direct that studies and analyses be performed to validate the requirement, or to establish major trade-offs. Later the program management directive (PMD) (AFR 800-2) authorizes the development of the system or equipment, thereby initiating a project or program. The PMD or similar document may direct that a plan or plans be prepared. Plans for computer resources are prepared in consonance with the plans for the system of which they are a part. The major computer resource documents are the PMD, the program management plan (PMP), the computer resources integrated support plan (CRISP), and computer program development plan (CPDP).

3-6. Program Management Directive. The PMD is issued in accordance with AFR 800-2. The following direction may be included in PMDs:

a. Identification of computer resources technical and managerial expertise responsible to the program manager for managing the acquisition of subsystems which contain computer equipment and computer programs. This includes management expertise to focus attention on computer program development and integration across the total system.

b. Management responsibility for the integration of computer equipment and computer programs into the overall system will remain centralized.

c. Standardization, within each system as well as across systems, of computer equipment and computer programs will be applied to the maximum extent practicable.

d. Solicitation documents will include explicit statements defining Air Force rights to computer equipment and computer programs required to operate, simulate, and support the system. This includes computer programs and associated documentation (content and media) required for maintenance and modification.

e. Supporting and using commands will participate in the requirements definition, development, audits, test, and maintenance, and major modification of computer programs and equipment.

f. Acquisition of support equipment (such as a dynamic avionics integration laboratory) and documentation will be identified when determined necessary to establish organic or competitive contractor support facilities.

g. Computer equipment reliability, maintainability and availability will be prime development objectives.

h. Functional analyses, trade-off studies and cost-effective optimizations will be performed to determine and define a low-risk development approach to computer equipment and computer programs. Modeling and simulation techniques will be used when appropriate.

i. Existing systems or proven concepts will be considered whenever practical.

j. Computer program development and support requirements will be defined including the use of government funded equipment and facilities.

k. System capacity to provide growth capability consistent with the anticipated level of computer program change activity and ease of computer program support during the life of the system will be evaluated.

l. Computer equipment and computer programs will be identified as configuration items.

m. Comprehensive testing of computer resources will be performed and the use of independent V&V of computer programs should be considered.

n. Computer equipment and computer program development costs will be identified in appropriate work breakdown structures. Provisions should be made to insure proper identification of cost data by the contractor and delivery of the cost data to the Air Force as required.

o. Computer equipment and computer programs will be emphasized in design reviews, audits, and management assessments.

p. The Air Training Command (ATC), in conjunction with the using and supporting commands, will initiate plans for computer resources training programs.

q. The Advanced Procurement Plan will reflect computer resources planning.

r. Computer resources planning will consider life cycle costing concepts.

s. The development of a computer resources integrated support plan (CRISP) will be initiated at the earliest possible phase of the system acquisition life cycle.

3-7. Program Management Plan (PMP). The computer resources content of the PMP is prepared by the implementing command in conjunction with supporting, using, and other participating commands. It includes complete planning for the acquisition management of the computer resources. If the computer resources are identified later in the program, a change to the PMP will be published covering such resources. The PMP coverage of computer resources will include the following, when applicable:

a. Operational and support concepts for computer programs based upon studies, economic analyses, experience and participating command inputs. A decision for organic support must be based upon the policies of AFR 26-12.

b. Identification of technical and managerial expertise allocated to the program office for the acquisition management of computer equipment and computer programs.

c. The system engineering approach to be followed in transforming operational needs into computer resources. The selection from configuration options should be based on life cycle costs.

d. A discussion of the appropriate tradeoffs between hardwired digital processing equipment and programmable computers. The discussion should include design risk, system integrity and life cycle cost.

e. Standardization and commonality considerations used in determining computer equipment and computer program requirements.

f. Requirements for computer program and data rights consistent with the planned operational and support concepts.

g. A master schedule of major milestones, key events, and any critical actions essential to timely development of computer resources in relation to the total system acquisition schedule.

h. Identification of required interfaces between the computer resources of this system and other systems.

i. A discussion of the requirements for growth capability and spare processing capacity.

j. Requirements for acquisition and support of documentation.

k. Requirements for simulation, integration and other facilities necessary to support computer programs.

l. Configuration management concepts.

m. Criteria for the transfer of program management responsibility and system/equipment turnover.

n. Preparation of a computer resources integrated support plan (CRISP).

3-8. Computer Resources Integrated Support Plan (CRISP). The CRISP identifies organizational relationships and responsibilities for the management and technical support of computer resources. It functions during the full-scale development phase to identify computer resources necessary to support computer programs after transfer of program management responsibility and system turnover. The CRISP continues to function after the transfer of program management responsibility and system turnover as the basic agreement between the supporting and using commands for management and support of computer resources. The following items should be included, as applicable:

a. Offices of primary responsibility and management focal points for support of computer resources and the channels of communication among organizations.

b. Planning for configuration management of computer programs including the assignment of configuration control responsibilities during the deployment phase. This planning will reflect the operational and support concepts for the system.

c. Responsibilities for composite system integrity which includes:

(1) Computer storage utilization.

(2) Computer program operating time and priorities.

(3) Computer program interface techniques.

(4) Computer program baseline integrity.

(5) Utilization of computer modules and peripherals.

d. Documentation required to support each type of computer program.

e. Responsibility for funding, scheduling, and system integration.

f. Qualified personnel required for supporting computer equipment and computer programs together with training requirements.

g. Computer equipment and devices required to facilitate computer program changes, including acquisition responsibilities.

h. Computer programs required to support computer equipment and other computer programs including acquisition responsibilities.

i. V&V of computer programs.

j. Plans to establish and operate necessary support facilities. Common and existing facilities will be used whenever practicable. The size and scope of the support facility will be based on work load predictions.

k. Provisions for the transfer of program management responsibility.

l. Provisions for system/equipment turnover.

3-9. Computer Program Development Plan (CPDP). The CPDP identifies the actions needed to develop and deliver computer program configuration items and necessary support resources. It will be prepared by the implementing command or, if the development effort is contracted, the plan may be prepared by the contractor and approved by the implementing command. The plan should address the following items:

a. The organization, responsibilities and structure of the group(s) that will be designing, producing, and testing all computer programs.

b. The management and technical controls that will be used during the development, including controls for insuring that all performance and design requirements have been implemented.

c. The methodology for insuring satisfactory design and testing, including quality assurance.

d. The development schedule for each computer program configuration item and proposed program milestone review points.

e. The procedure for monitoring and reporting the status of computer program development.

f. The resources required to support the development and test of computer programs. Special simulation, data reduction or utility tools that are planned for use in the development of computer programs should be identified.

g. The general procedures for reporting, monitoring, and resolving computer program errors and deficiencies during development and testing.

h. The methods and procedures for collecting, analyzing, monitoring, and reporting on the timing of time critical computer programs.

i. The management of computer program development masters, data bases, and associated documentation including its relationship to the configuration management plan.

j. Guidelines and checkpoints for insuring future computer program growth, modularity, and ease of modification.

k. The approach for developing computer program documentation.

l. Training requirements and associated equipment for the deployment phase.

m. Engineering practices to include: standards, conventions, procedures, rules for program design; program structures and conventions; display and logic standards; input/output signal standards; and other disciplines affecting development.

n. Security controls and requirements.

o. Simulation techniques and tasks.

3-10. Computer Resource Working Group (CRWG). Initially chaired by the program office, the CRWG consists of representatives from the implementing, supporting, and using commands. The group is responsible for preparation and update of the CRISP and insures that necessary elements of the CRISP are included in transfer and turnover agreements. The CRISP and updates will be approved by the program manager after coordination with the appropriate commands. The chairmanship and membership of the CRWG will be amended after the transfer of program management responsibility and system/equipment turnover as mutually agreed by the supporting and using commands. (Normally, the chairmanship will be assumed by the supporting command.)

Chapter 4

ENGINEERING MANAGEMENT

4–1. **Purpose.** This chapter provides guidance in the engineering management of computer resources. Discussions include systems engineering, systems engineering documentation, and technical design reviews.

4–2. **Objectives of Engineering Management.** The objectives of engineering management are described in AFR 800–3. The objectives of engineering management in regard to computer resources in systems are:

a. That computer resources are managed as an integral part of the total system.

b. That the engineering tasks associated with computer resources are part of the mainstream engineering effort throughout the system acquisition life cycle.

4–3. **Baseline Management.** A fundamental concept associated with engineering management is the use of a series of configuration management baselines which aid in assuring an orderly transition from one major decision point to the next throughout the system acquisition life cycle. The output of the system engineering process is technical data which is used to establish baselines to which configuration management procedures are applied. A prime configuration management function is the documentation of the functional, allocated and product baselines (AFR 65–3). Baselines are established at discrete points in a program when it is necessary to define a formal departure point for control of future changes. These baselines are continuously updated, serve as engineering reference points and are documented by specifications and associated data.

4–4. **System Engineering.** Although systems are not identical, there is a fundamental, identifiable process for arriving at engineering decisions regardless of the system purpose, size or complexity. The process involves a hierarchy of requirements beginning with the using command's needs, usually stated in operational terms, and ending with detailed engineering specifications and data. Each level of requirements leads to the preparation of subordinate detailed requirements in terms suitable for the engineering activity involved until the entire system responsive to the using command's needs is described. The system engineering process is a network of actions with very close interrelationships.

a. A system must be developed, produced, tested, operated, and supported. All functional performance requirements, therefore, are derived from the needs of these functional areas. The system elements are identified and developed to meet the performance requirements derived from the functional areas of operations, logistics support, test, production, and deployment. For example, the functions which must be accomplished for successful performance of the operations functions generate the requirements for operations equipment, facilities, computer programs, personnel, and procedural data. Each of the other functional areas generate requirements for its respective system elements.

b. System engineering defines the system on a total basis so that the design will reflect requirements for equipment, computer programs, facilities, procedural data, and personnel in an integrated fashion. It provides the source requirement data for the development of specifications, test plans and procedures. It also provides the data required to define, contract for, design, develop, produce, install, checkout, and train personnel to test, operate and support the system.

4–5. **System Engineering Process.** The system engineering process is iteratively applied to the interrelated functional areas of operations, logistics support, test, production, and deployment. Each application of the process is accomplished to define and optimize the combination of system elements needed to satisfy the requirements of a functional area. Applications of this process are termed functional cycles.

a. The initial cycle addresses the operations requirements of the system. The inputs to the operations area include the operational concept, operational environment, system constraints, and measures of effectiveness which have been established by prior system analysis. The output of this cycle is a description of an optimized combination of system elements for the performance of operations functions. This description is complete only when the inputs from all engineering disciplines and specialty programs have been integrated.

(1) Operational requirements are identified through functional analyses. The objective is to define a baseline of functions and function performance requirements which

must be met in order to accomplish the operational requirements of the system. Each function is described, including a statement of beginning and end conditions; that is, inputs, outputs, and interface requirements. Functions are identified from the top down so that subfunctions are recognized as part of larger functions. Functions are arranged in their logical sequence so that any specified operational usage of the system can be traced in an end-to-end or in a closed-loop path.

(2) The functions and associated criteria are analyzed and translated into design requirements. The design requirements are comprised of all requirements, including design constraints, that have a bearing on the functions being analyzed.

(3) Engineering studies are then performed to determine the best way to satisfy the requirements and select the best approach for integrating the design requirements into a total system configuration including computer equipment configuration items and computer program configuration items.

b. In the subsequent functional cycles, the system engineering process is applied to determine the logistic support, test, production, and deployment requirements imposed by the selected combination of system elements. The production and logistic support cycles are concerned with the requirements to produce, maintain, and support equipment and facilities. The test and development cycles, however, are concerned with the requirements imposed by all of the system elements. (For example, personnel, computer programs, and procedural data, as well as the equipment and facilities that require testing.) The outputs of these cycles of the process are the descriptions of the logistic support, test, production, and deployment elements.

c. Although the functional requirements analyzed in each cycle are based upon the characteristics of the operational elements, this does not imply that the operation cycle is completed before the other cycles are initiated. At each level of definition, from the system level down to the component level, the requirements imposed by logistic support, test, production, and deployment are considered in the system optimization. At each level, the process is accomplished for each of the functional cycles to identify risks and to validate the decisions which must be made at that level.

4–6. System Engineering Documentation. The detailed system engineering documentation may involve time-line sheets, facility interface sheets, maintenance sheets, requirement allocation sheets, and similar documentation. In some cases, summary sheets for the documentation of powerload schedules, electrical input/output signals, monitor and checkout requirements, may be required. In the case of computer programs, documentation specifically tailored to computer program needs may be necessary. For example, the format of the design sheet may not be appropriate for specifying the design requirements for computer programs. In this case, the preliminary development specification may serve in lieu of the design sheet. The choice of documentation format must be made on an individual program basis and specific system engineering documentation, if needed, must be defined in the contract.

4–7. System Engineering Documentation Uses. Use of system engineering documentation will vary depending upon the system. Examples of the type of tasks and products supported by this documentation follow.

a. Conceptual and Validation Phases:

(1) Technical inputs to the DCP.

(2) Justification and rationale for procurement of technical data including computer program documentation.

(3) Work breakdown structures and specification tree including computer programs.

(4) Initial system specifications and revisions or expansions thereto.

(5) Reliability and system effectiveness models.

(6) Test concepts and overall requirements to support test planning and development.

(7) Statements of work and requests for proposals.

(8) Contractor proposals.

(9) Program office and contractor reviews.

(10) Performance, design, and test requirements for development specifications.

(11) Preliminary quantitative and qualitative personnel requirements information (QQPRI), training equipment planning information (TEPI), and procedural data.

(12) Evaluation of contractor proposals and reports.

b. Full-Scale Development and Production Phases:

(1) Expansion and verification of the system specification and development specifications, product specifications for computer programs, and preparation of drawings.

(2) Qualification and acceptance test requirements for inclusion in the system specification and development specifications, and to support the development of detailed test procedures, plans, directives, and other test documentation.

(3) Technical reviews, audits, and acceptance tests.

(4) Activation, operations, and maintenance data.

(5) Problem evaluation, test result evaluations and required change definition during testing.

(6) Update QQPRI, TEPI and procedural data.

(7) Define training programs.

(8) Logistic support requirements.

(9) OT&E test equipment development, test procedures, test plans and other test documentation.

(10) System security, system safety and nuclear safety requirements.

c. Deployment Phase:

(1) Follow-on test requirements, test plans and procedures.

(2) Problem evaluation and required changes to follow-on testing, the analysis of system test data and follow-on system modification.

4-8. Technical Control. This aspect of engineering management includes planning for and control of the technical tasks required to progress from an operational need or requirement to the deployment and operation of the system by the user. Formal technical control is accomplished by technical reviews at discrete milestones. Informal technical control is accomplished through periodic technical interchange meetings and independent reviews.

4-9. Formal Technical Reviews. Integrated engineering and technical direction of engineering efforts must be reviewed on a periodic basis to determine the technical adequacy of contractor efforts in meeting system requirements. Technical reviews must be conducted to evaluate the degree of accomplishment of the engineering efforts and to insure the utilization of engineering documentation by the contractor as detailed in the contract. The completeness of the reviews provide the basis for rendering decisions during the course of the program to ensure that the system design integrity is maintained, technical deficiencies are isolated, and necessary changes are identified promptly. The number and types of reviews depend upon the complexity of the systems acquisition. The formal technical reviews are specifically detailed in MIL-STD-499A (USAF) and MIL-STD-1521 (USAF). They are as follows: System requirements reviews (SRRs), system design reviews (SDRs), preliminary design reviews (PDRs), and critical design reviews (CDRs). The supporting and using commands will participate in formal technical reviews to assist the program manager in assessing the contractor's technical performance and progress but not to give specific direction to the contractor. The responsibility for directing contractor effort still remains with the program manager.

a. System requirements reviews (SRRs) are conducted when a significant part of the system functional requirements have been established. The basic purpose for conducting SRRs is to evaluate the contractor's responsiveness to the Statement of Work and his interpretation of the system or system segment specification requirements. The specific documentation to be reviewed, the technical depth, the tentative schedule, and the number of reviews must be contractually established. SRRs may result in technical or engineering management realignment to assure that the contractor's initial technical interpretation of the contract is in line with program objectives. Computer resources personnel should participate in these reviews and consider at least the following:

(1) The functional flow diagrams as they are related to computer program allocations.

(2) The requirements allocation sheets for computer programs and related interfacing equipment.

(3) Integrated test plans, schedules and milestones including preliminary computer program requirements for possible test equipment, data facilities, etc.

(4) Trade studies to support computer program and related equipment definition.

(5) High risk areas associated with computer programs and related interfacing equipment.

b. System design reviews (SDRs) are conducted to review the system documentation and to assess the degree of accomplishment of the engineering management activities. They insure that the system definition effort products are necessary and sufficient to proceed into preliminary design of selected solutions for allocated requirements. An SDR should be conducted as the final review prior to the submittal of validation phase products or as the initial full-scale development review for systems not requiring a formal validation phase. If the SDR is satisfactory, the contractor should be allowed to enter into preliminary design. A portion of an SDR should address the allocated requirements for computer resources. Without agreement on these allocated requirements, proceeding with computer program preliminary design should be avoided. The following items should be reviewed for mutual understanding and contractual interpretation:

(1) The results and progress of computer programs and related equipment trade studies.

(2) Computer programming techniques to be adopted.

(3) Programming languages to be used.

(4) Computer resources needed for development, integration, testing, operation, training and support.

(5) Computer program interface requirements. It is important to identify interface requirements to be controlled by the development specifications and those to be controlled by the interface control drawings (ICD).

(6) The list of CPCIs including those for support and test equipment.

(7) Preliminary development specifications which must include the design of computer programs and any related equipment.

c. Preliminary design reviews (PDRs) should be conducted for each configuration item identified as part of the system. The purpose of a PDR is to evaluate the progress, consistency, and technical adequacy of a selected design and test approach; and to establish compatibility with program requirements and preliminary design. A successful PDR is required for each CPCI prior to proceeding into detail design. A single PDR treating several CPCIs individually may be held when such an approach is advantageous to the program manager. This depends upon the nature and complexity of the computer programming effort. The design approach for computer programs is contained in portions of the product specification. The initial portion of the product specification (computer program functional flow, storage allocation charts, control functions description, and structure and organization of the data base) describing the design approach should be made available by the contractor for Air Force review. At a PDR and from a computer resources point of view, the following will typically be performed:

(1) Review of all functional interfaces between a CPCI and other CPCIs, and between CPCI and related equipment CIs. Action should be taken to insure that interface design requirements are adequately identified in the development specification and that implementing solutions to these design requirements are in Interface Control Drawings.

(2) Review implementation design of word lengths, message formats, available storage, memory maps, timing and sizing data, operational interfaces and other considerations included in the development specification.

(3) Review the CPCI structure as a whole emphasizing computer program functions, computer program functional flow, storage requirements and allocations, computer program operating sequences, and design of the data base.

(4) Analyze critical timing requirements and estimated running times.

(5) Review the human interaction aspects of the CPCI.

(6) Review CPCI test requirements, documentation, and tools.

d. Critical design reviews (CDRs) should be conducted on each configuration item to determine the acceptability of detail design, performance, and test characteristics depicted by the design solution specified in the draft product specification, accompanying drawings, and other engineering documentation. For computer programs, product specifications cannot be finalized until after the development effort (coding and checkout) is complete. The CDR for a CPCI is a formal technical review of the CPCI design. The purpose is to establish the integrity of computer program design at the level of flow charts or computer program logical design prior to coding and testing. For complex CPCIs the CDR may be performed in stages as the logical design of computer program components (CPCs) or groups of CPCs is completed. For less complex CPCIs, the CDR may be accomplished at a single review meeting. The primary product of the CDR is the formal identification of specific computer program documentation to be released for coding and testing. The following are typical of what is performed at CDR:

(1) Establish compatibility and traceability of design with the development specification.

(2) Analyze detailed flow charts and other descriptive documentation to establish compatibility of system design.

(3) Insure interface requirements are satisfied and ICDs are complete and approved.

(4) Review interactions of the CPCI with the data base.

(5) Review test and analytical data such as logic diagrams, algorithms, storage allocation charts, and detailed flow charts to establish design integrity.

(6) Review draft of complete product specification with exception of instruction listings which can only be produced after coding.

(7) Review system allocation document for CPCI inclusion at each scheduled location.

(8) Review test plans and procedures for satisfying the development specification requirements including: location and schedule, planning factors, test objectives, test description (scope. type, and range of values), and data reduction/analysis (scope, method and presentation).

(9) Review computer loading, iteration rates, processing time, and memory estimates.

4-10. Technical Interchange Meetings. The formal technical reviews provide a means for the program office to periodically determine the technical status of a computer program development effort and to make certain managerial decisions on the adequacy of design, documentation, testing, etc. These reviews, however, are often separated by a considerable length of time and may result in an incomplete picture of contractor progress. For the program office to be able to obtain a realistic picture of contractor progress and to maintain control of the development process, the program office and the using and supporting commands should create a close working relationship with the contractor. A good approach is to conduct frequent technical interchange (TI) meetings at the contractor's facility. The format and content of TI meetings is left to the discretion of the program office. Consequently, TI meetings are a very flexible and powerful tool for progress measurement and engineering control. Generally, a TI meeting covers cost status, schedule status, and technical status/problems. Listed below are some significant points pertinent to computer resources, to consider in relation to TI meetings:

a. The frequency of TI meetings.

b. Representation at TI meetings. The program manager and the using and supporting commands should be represented by personnel with computer expertise and familiarity with the development effort.

c. Actual versus planned progress.

d. Possible misinterpretation of computer resource design or functional requirements.

e. Actual versus planned expenditures and manpower alignments.

f. The resolution of problems.

4-11. Independent Reviews. The need may arise for the program office to perform independent reviews to solve problems. To assist in these reviews and provide specialized expertise, the program office may need to call upon other Air Force agencies or contractors.

Chapter 5

TESTING OF COMPUTER PROGRAMS

5-1. Purpose. This chapter provides guidance for creating and accomplishing a test program for new or modified computer programs which are a part of a total system test program. Commands involved in computer program management in the deployment phase will apply those portions of this chapter required to accomplish testing. The principles of AFR 80-14 apply to testing of computer resources. This chapter discusses events and milestones applicable to the test and evaluation (T&E) of computer programs within the framework of that regulation. Computer equipment testing is governed by the same principles that apply to other equipment testing and is discussed only in relation to computer program testing.

5-2. Test and Evaluation. Responsibilities of organizations participating in the development test and evaluation and initial operational test and evaluation test program will be specified in the PMD. Major program test objectives may be *identified in the* Test and Evaluation Objectives Annex (TEOA) of the PMD. Responsibilities and objectives will be amplified to an appropriate level of detail in the T&E section of the PMP, in the T&E Master Plan (AFR 80-14), and in supporting lower level test plans. AFR 80-14 covers the entire spectrum of test and evaluation for systems. The basic types of test and evaluation are development test and evaluation and operational test and evaluation.

5-3. Development Test and Evaluation (DT&E). DT&E evaluates the technology, design and engineering of systems. It is the responsibility of the implementing command. Participants in DT&E include the implementing command, the contractor(s), and appropriate supporting and using commands. Control of the contractor portion of the test program is established by contract provisions and specification requirements. DT&E is normally completed prior to the production phase. The DT&E effort is divided into two areas, configuration item (CI) test and system level test.

a. The object of configuration item testing for computer programs is to establish each computer program configuration item (CPCI) as a qualified item suitable for entry into the system level test program. This qualification is accomplished by verifying that the CPCI meets the performance and design requirements of the computer program development specification. Contractor personnel normally conduct CPCI testing. The program manager designates representatives to monitor the test progress, adherence to test procedures, validity of collected data, and performance of the computer equipment and computer programs. CPCI testing is divided into informal and formal testing.

(1) CPCI informal testing is that testing performed by the contractor at his discretion to assist in the development of the CPCI, provide visibility regarding the progress of the development, and prepare for formal testing. Air Force approved test plans are not required, however, the informal test program should be described in the computer program development plan. Usually, the contractor will use internal documentation during informal testing and this information will be available to the Air Force only upon demand. When the test results provide an indication of contractor progress in the development of CPCIs they should be summarized in periodic progress reports. Informal testing continues throughout the full scale development phase. Each computer program component (CPC) or subprogram should pass through a series of operations and iterations such as: desk checking, elimination of illegal or erroneous instructions, parameter tests, functional testing with controlled data inputs, assembly testing with other components of the CPCI, performance testing with simulated inputs and performance testing in the system.

(2) Formal testing is that portion of CPCI testing which is conducted in accordance with Air Force approved test plans for the purpose of verifying that the CPCI fulfills the requirements of the development specifications. There are two distinct types of formal testing, preliminary qualification testing (PQT) and formal qualification testing (FQT).

(a) PQT is designed to be an incremental process which provides visibility and control of the computer program development during the time period between the critical design review (CDR) and FQT. A PQT should be conducted for those functions which are critical to the CPCI. The test plan should specify CPCs or functions to be tested during the PQT, the sequence of the tests and the performance and design requirements to be tested. The contractor should submit a separate test procedure for each function or CPC to be tested to the monitoring agency prior to the test for review and analysis. As the design progresses, these procedures will evolve and should become a part of the FQT test procedures. PQT results will not be used as a substitute for FQT results. The selection of functions to be tested during PQT may be based on time critical requirements (for example, the development of the executive function of an operational CPCI is usually designated "time critical" because the orderly progression from parameter testing to assembly testing requires the timely development of the executive function) or performance critical requirements (for example, the tracking function of a CPCI for an on-line radar system may be designated "performance-critical" due to the utilization of new tracking, smoothing, and filtering techniques).

(b) FQT is a complete and comprehensive test of the CPCI in a continuous test period prior to functional configuration audit (FCA). It is conducted after the design process culminates. Each function of the CPCI should be tested regardless of prior PQT testing. The FQT procedures should be maintained and used throughout the remainder of the system acquisition life cycle. This maintenance should include the addition of new tests or the revision of existing tests to properly test all functions affected by changes. For those CPCIs (such as a utility program) which are relatively insensitive to the system operations, formal qualification will usually be conducted at the development facility. For a large operational CPCI, the complexity of the performance requirements may require testing in the operationally configured system and may require use of the system test location.

b. Integration of the computer programs into the system is performed to insure that all detected deficiencies and marginal conditions have been eliminated and that the computer programs are ready for the system level test. Integration testing normally occurs after installation and checkout of the test site equipment and facilities. Integration testing is usually performed by the contractor in accordance with an approved test plan. The contractor should identify and document all aspects of the integration activities. Schedules will be prepared and all support requirements clearly understood including requirements for government furnished equipment, computer time, displays, consoles, communications, and support personnel.

c. The objective of system level DT&E is the formal qualification of the system. It is conducted according to the system level portion of the DT&E plan and assures the integration of all configuration items and other system components into a complete system. It includes development tests of the completed system in as near an operational configuration and environment as practicable. The implementing command conducts the effort with appropriate participation of the contractor(s) and the supporting and using commands. Air Force personnel who have received formal system training should perform test operation and maintenance. Sufficient emphasis should be given to the interaction of the computer equipment and computer program CIs within the system and methods for testing the interactions.

5-4. Operational Test and Evaluation (OT&E). OT&E determines that the system will satisfactorily perform the functions for which it is designed in the mission environment. AFR 80-14 requires an initial operational test and evaluation (IOT&E) phase of OT&E to be accomplished prior to the first major production decision. Thus, this element of OT&E may overlap certain phases of DT&E, normally the system testing. The phase of OT&E conducted after the first major production decision is follow-on OT&E (FOT&E). OT&E will normally be conducted by the Air Force Test and Evaluation Center (AFTEC) or the using command, with the support of the implementing and supporting commands. The responsibilities of AFTEC are specified in AFR 23-36.

5-5. Test Documentation. There are several types of documentation which, collectively contribute to an effective test program:

a. The DCP presents the critical questions and issues which must be addressed by the total system test program (AFR 800-2).

b. The PMD will amplify or supplement those critical questions and issues as necessary. The TEOA (prepared in accordance with AFR 80-14) lists the major objectives of the total system test program. The purpose of the TEOA is to insure that all evaluations of the system (or parts thereof) are conducted using a common baseline.

c. The PMP in outlining the development program should contain a schedule and summary of the segments of the total system test program. It indicates how the test program interrelates with the total program.

d. The T&E Master Plan (TEMP) is an overall plan which identifies and integrates the effort and schedules of all T&E to be accomplished in the system development program. The test program should be structured to include tests which will provide answers to the critical questions of the DCP and PMD. The TEMP for major programs may be required by the PMD to be forwarded to OSD. It may be used as the T&E section of the PMP.

e. In addition to the test requirements delineated in the above documents, specific test requirements are imposed on the contractors through the system specification and through the computer program development specifications. Each system specification will identify a requirement to verify each performance and design requirement contained in the specification. Computer program development specifications will identify test approaches for use in qualifying the CPCIs (for example, inspection, analyses, demonstration, and formal test). They should identify known contractor requirements for government furnished equipment and facilities needed for support of the computer program test and evaluation. They should designate any performance and design requirements to be verified during system level testing. Informal testing need not be addressed in the specifications except where:

(1) The informal tests must be accomplished as part of an integrated test program involving other systems/equipment/computer programs.

(2) The informal tests require the use of government furnished test facilities or equipment.

f. Test plans are formal documents which provide detailed, coordinated, integrated, and time-phased planning for providing answers and solutions to the critical questions, areas of risk, and fulfilling other requirements for test identified in the documentation of subparagraphs a through e above. The plans directly support the TEMP. There are usually at least three test plans; DT&E, IOT&E, and FOT&E. (There will be an integrated plan for a combined DT&E/IOT&E.) AFR 80-14 specifies responsibilities for preparing these plans.

(1) The portion of the DT&E plan which encompasses the formal CPCI tests, normally prepared by the contractor, establishes criteria, methodology, responsibilities, and overall planning for CPCI testing. The plan should include information related to the preliminary and formal qualification tests as follows:

(a) Specific objectives of each test.

(b) Locations at which the tests will be conducted and schedules relative to milestones in the overall acquisition schedule.

(c) General methods for preparation of input data; for example, simulation or generation vehicles to be used.

(d) General procedures for test conduct, and responsibilities for test direction, operation, and observation.

(e) Data recording requirements.

(f) General procedures for data reduction and analysis of test results.

(g) Requirements for other computer programs, equipment, and facilities.

(h) Qualified personnel; that is, numbers, responsibilities, and required knowledge and skills.

(i) Requirements and procedures for controlling and documenting the CPCI test program, including procedures for preparing, reviewing, and revising documentation of specific test procedures and requirements and procedures for preparing and reviewing reports of individual qualification tests.

(2) The DT&E plan will contain provisions for the installation and checkout of computer programs at follow-on installations. This testing will include the loading and running of computer programs which have been successfully qualified and integrated at the system DT&E test site.

g. Test procedures present the detailed steps for the conduct of each test specified in the test plans. They are prepared by the agency which is to conduct the particular test. The following policies should be applied to test procedures prepared by contractors for formal CPCI DT&E:

(1) Procedures will be prepared for each qualification test (PQT or FQT). These procedures should be completed prior to the pertinent PQT or FQT test date. The PQT and FQT procedures should be reviewed by the Air Force in preliminary form, and proposed changes should be resolved with the contractor prior to testing. The following information should be included in the test procedures.

(a) Test objectives.

(b) Location and schedule of the test briefings, debriefings, and any associated data reduction/analysis.

(c) Reference to applicable test plans, specifications, manuals, and handbooks.

(d) Requirements and responsibilities for console operators, test directors, technical consultants, data analysts and other test personnel.

(e) Requirements for other computer programs (other than the CPCI being tested) or equipment.

(f) Test operating procedures which specify how to initiate, maintain, terminate, and restart the computer program operation.

(g) A description for each test to be performed which includes test inputs, outputs, expected results, reactions to be verified, and methods of verification.

(h) Requirements and procedures for recording, reduction and analysis of test data.

h. Results of all tests should be documented. Informal contractor CPCI DT&E need not be formally reported to the Air Force, however, documented test results should be available for Air Force review. Formal CPCI test results will be reviewed and approved by the implementing command. (PQT and FQT are normally reported separately.) Other testing will be reported in accordance with AFR 80-14.

5-6. Computer Program Validation/ Verification (V&V). This paragraph discusses computer program V&V in its relationship to the computer program life cycle.

a. Analysis Phase. A review of all available documentation for logic and completeness should be made. A gross functional simulation of certain new or critical aspects of the design may be accomplished to study system design, system level tradeoffs and functional interfaces. A timing and sizing study should be conducted to insure that the proposed computer system is adequate. A discrete event simulation of the computer system using a specialized simulation language may be used to assist in this study.

b. Design Phase. All models should be checked for logic and completeness. In some cases it might be desirable to independently rederive equations to insure correctness. A scientific simulation of the system may be produced; that is, the algorithms are coded in a higher order language such as FORTRAN and run on a general purpose computer. This type simulation is used to develop algorithms and to check system interfaces. The outputs from such a simulation may be useful for later comparison with actual system outputs.

c. Code and Checkout Phase. After a program has been coded, it must be reviewed to insure that it agrees with the program specifications. This can be accomplished by cross-checking the code itself with earlier specifications, flow charts, and so forth, or by running the code in a simulated computer environment. One way to accomplish this type of checkout is by desk-checking; that is, by manually going through the code and comparing it to the specifications. Another method is a correctness proof; that is, a mathematical proof that code performs exactly the functions given in the coding specifications and no others. Correctness proofs are only practical for relatively small routines. A variety of automated test tools are available for static checking of code as explained in the following:

(1) Comparators. Programs which do an instruction-by-instruction comparison on two versions of the same program. The comparator flags differences thus indicating where a program has been changed.

(2) Editors. Programs which find and flag coding errors and produce cross-reference listings.

(3) Flowcharters. Programs which operate on a program written in either assembly or higher order language and produce a flowchart of the program. This flowchart can then be compared to the original program flowchart.

(4) Logic/Equation Generators. Programs used to reconstruct arithmetic text and to flowchart assembly language programs.

(5) Pathfinders, Traps and Traces. Programs which analyze possible paths through a given program. This information is useful for planning test cases.

(6) Interpretive Computer Simulation (ICS). An ICS is an instruction-level simulation of the operational computer on a host computer, usually a large general purpose machine. The host computer is programmed to act on an operational program in exactly the same way the operational computer would act. The host computer will give the same results bit-for-bit as would be produced by the operational computer under the same conditions, using the same inputs. An ICS gives greater insight into actual computer program operation and provides greater diagnostic facilities than could be obtained by running the operational program on the operational computer. Also, an ICS is useful for checking out computer programs in cases where the operational computer is unavailable. Output from an ICS can be compared with output from a scientific simulation as a check on the operational program. Drawbacks of an ICS are that it may run slower than the computer it simulates, will not identify timing problems, and it must itself be subject to V&V.

d. Test and Integration Phase. Several different types of simulation are used in the test and integration phase.

(1) In one simulation, the operational program is run on the actual operational computer, while another computer is used to simulate the inputs to the interfacing electronic equipment. The operational computer memory and electronic interfaces should be monitored to obtain data for program performance evaluation. Ideally the analyst should be able to monitor selected registers and addresses of the operational computer. He should be able to stop the program, change parameters, restart the program and single-step through the program. He should also be able to perform traces, traps and dumps on selected areas of the operational program.

(2) Another simulation is similar to the above except that some system equipment is used, in addition to the operational computer. The equipment is artificially stimulated so that it produces realistic inputs to the operational program. The same computer monito and control capabilities are needed. Th s method is especially useful for equipment/computer program integration.

(3) A further simulation uses system equipment and some live inputs; for example, the use of a radar set against actual aircraft in flight. Again, this method is useful for overall systems integration. The last stage in test and evaluation is operational testing (for example, flight testing for an Operational Flight Program), preferably with special instrumentation to record pertinent data. If nearly identical test conditions are maintained in the simulation and the operational tests, the results of the two tests can be compared. If close agreement is observed in the data, a high degree of confidence may be given to the simulation tests and more reliance can be placed on this type of testing in the future.

e. Operational and Support Phase. V&V is a process which must continue through the system life cycle. Whenever changes are made to equipment or computer programs, the operational program must be retested. Simulations are useful for reproducing operational problems and for retesting the system. Simulation tools and accompanying documentation should be identified in the CRISP and acquired at the same time the system is acquired.

Chapter 6

CONFIGURATION MANAGEMENT

SECTION A—GENERAL CONCEPTS

6-1. Purpose. This chapter contains guidance to assist Air Force activities in applying the configuration management practices and procedures of AFR 65-3 to computer resources throughout the system acquisition life cycle. It provides additional information that is unique to computer programs and guidance in the application of configuration management principles to computer program acquisition, operation and support.

6-2. Configuration Management. Configuration management is a discipline applying technical and administrative direction and surveillance to (a) identify and document the functional and physical characteristics of systems and configuration items; (b) control changes to those characteristics; and (c) record and report change processing and implementation status. Configuration management is also the means by which design, engineering and cost trade-off decisions are recorded, communicated, and controlled.

6-3. Configuration Management Environments. Configuration management requirements may be subject to different environments during a system acquisition life cycle. Several examples are:

a. When the implementing command acquires a system by contract, the contractor uses those practices described in his configuration management plan. This normally occurs during the validation, full scale development, and production phases.

b. When the supporting command has configuration management responsibility, configuration management is performed in accordance with the supporting command's established practices. This normally occurs after program management responsibility transfer (PMRT) (AFR 800-4).

c. When the supporting and using commands each have configuration management responsibility for portions of the system, the division of responsibilities is documented in mutual agreements between the commands and incorporated into the CRISP. The commands coordinate those actions affecting each other's area of responsibility. This situation normally occurs during the deployment phase.

6-4. Principles and Practices. In developing a configuration concept and configuration management plans, the following applies:

a. Computer programs will be managed as essential system elements using common procedures tailored to recognize their unique properties.

b. Configuration management, as specified in AFR 65-3, will be applied to each computer program configuration item (CPCI) throughout the system acquisition life cycle.

c. Configuration management will be established as early as possible and should address the interrelations of the implementing, supporting, and using commands.

d. Approval of changes to computer resources will be in accordance with AFR 57-4 as amplified in this regulation.

e. Overall responsibility and authority for the configuration management of the entire system must be vested in one manager. This manager must have the primary responsibility for committing resources toward the accomplishment of changes to the system. Authority may be delegated, based on mutual agreements, to other commands or organizations where operational considerations dictate.

f. After system/equipment turnover and program management responsibility transfer, the using command may have control over those computer programs required for the direct performance of its mission. For example, AFR 102-5 contains special provisions for command and control systems. Whether this be data input to the system or the actual computer programs will depend upon mission requirements and the design of the system. In those cases where the using command relies on a separate supporting command to effect changes, the using command provides their approval for all changes made to the computer programs through the mutually established configuration control procedures.

g. Computer program configuration management must not be fragmented from the overall system configuration management. Interfaces are important and must be specified and controlled. Continuous communication between the equipment and computer program activities is essential.

SECTION B—VALIDATION, FULL-SCALE DEVELOPMENT, AND PRODUCTION PHASES

6-5. Identification. Configuration management requires the identification of each CPCI and its interfaces within the system.

a. In the initial phases of the system acquisition life cycle, computer program requirements together with design and qualification requirements are documented in a development specification. The physical design of the computer program is documented in a product specification which is the complete technical description of the CPCI as designed, coded and tested. The product specification may identify other information used for operation, correction, and modification of the CPCIs. The organization and content of the specifications should be tailored to the functional application of the CPCI.

b. The Air Force Logistics Command (AFLC), in conjunction with the Air Force Systems Command, is responsible for the design and maintenance of the Air Force CPCI numbering system subject to HQ USAF approval and in coordination with Air Force major commands.

(1) The CPIN will be an unchanging Air Force unique number.

(2) AFLC issues the CPIN.

(3) The CPIN will be used to identify each CPCI and associated documentation for configuration management purposes. It will be supplemented to reflect changes to the CPCI.

(4) The CPIN will be used to satisfy the configuration management identification requirements of the implementing, supporting, and using commands wherever practicable.

(5) Commands may supplement the CPIN, when cost effective, to provide further identification or information.

c. Interfaces between items of a system are sources of design requirements or constraints and are contained in the development specification. Computer programs have interfaces with computers and other system equipment, other CPCIs, and between components of a complex CPCI. Interface control drawings are working tools which implement the interface requirement of the development specification. The ICDs document interface agreements between the system contractor or participants and should not be used as a substitute for stating interfacing requirements in the development specification. The interface control working group (ICWG) serves as the official communications link between program participants to resolve interface problems. Guidance on interface control, use of ICDs and the functions of the ICWG can be found in MIL-STD-483, Appendix II.

6-6. Control. Change control is the most apparent and formal aspect of configuration management. During the validation, full scale development, production, and, in some cases, the deployment phase, changes are processed by engineering change proposals (ECPs) or as modifications under the provisions of AFR 57-4. The ECP is a comprehensive document which contains provisions for supplying all the information necessary to make a thorough evaluation of the change and its impact on the entire system. When the change is approved, it may also generate changes to system documentation such as specifications (through a Specification Change Notice, MIL-STD-490, or a Notice of Revision, MIL-STD-480), drawings and lists, technical orders, spare parts lists and provisioning documents, test procedures, and manuals for operation, maintenance, and training.

a. MIL-STD-480 describes procedures for configuration control, including the preparation and processing of enginering changes, deviations and waivers. It contains an appendix defining configuration management terms. MIL-STD-483, Appendix XIV, contains procedures for processing ECPs to CPCIs and supplements MIL-STD-480 for this purpose.

b. The configuration control board (CCB) is the official organization empowered to act on all proposed changes. During the validation phase, a CCB is established for each system at the program office level. It is chaired by the program manager with members representing all program office functional areas, AFLC, ATC, using commands, the ICWG, and other participating government agencies. Board decisions are documented on a configuration control board directive (CCBD) which also contains each board member's position. The CCBD is directive on all personnel who must act on the change. The CCB acts on all CPCI Class I ECPs. All CPCI changes must be reflected in the associated documentation, since this is the only tangible and visible representation of computer program content.

c. Engineering release systems are internal procedures and standard practices which the contractor uses to assure that only properly approved data is released to contractor development and production functions. The program manager must insure that the contractor establishes a system for approval, control, and release of CPCI engineering data. MIL-STD-483, Appendix X, contains provisions for contractual application to assure the contractor has an adequate engineering release system. It should be tailored to cover all CPCI documentation.

d. AFSC and AFLC will use the time compliance technical order (TCTO) to distribute CPCI changes (use of the TCTO is described in TO 00-5-15). The TCTO may include a version description document (VDD) and a specification change notice (SCN). Use of the VDD is described in MIL-STD-483, Appendix VIII. The use of the SCN is described in MIL-STD-490 and MIL-STD-483, Appendices VII and VIII.

e. When the using command has configuration management responsibilities for a computer program the VDD and SCN or other method described in the O/S CMP may be used to distribute CPCI changes.

6-7. Status Accounting. Configuration status accounting documentation is the means through which actions affecting CPCIs are recorded and reported to program and functional managers. It principally records the "approved configuration" (baseline) and the implementation status of changes to the baseline. In this way it provides managers with confirmation that decisions of the CCB are being implemented as directed. Configuration status accounting has its greatest activity after establishment of the product configuration baseline. Only the minimum information necessary to manage configuration effectively and economically will be recorded and reported. The command having configuration management responsibility should take action to assure that any Air Force activity or contractor responsible for implementing changes to CPCIs reports the accomplishment of these changes in an accurate and timely manner. MIL-STD-482 contains data elements for use in the accounting and reporting process and allows the use of any data content and format necessary to perform status accounting.

6-8. Audits. Configuration audits are performed in accordance with AFR 65-3 and MIL-STD-1521 (USAF) to verify compliance with specifications and other contract requirements. The audit function validates accomplishment of development requirements and achievement of a product configuration through examination of the CPCI's technical documentation. MIL-STD-1521 contains detailed procedures on the conduct of configuration audits and should be used as a basic reference. Two kinds of audits are performed, functional and physical.

a. The functional configuration audit (FCA) is a review of test or analysis data to confirm that an item, as designed and developed, meets the requirements specified in its development specification.

b. The physical configuration audit (PCA) compares the "as-built" item with its approved and released technical documentation to assure the documentation is complete. It establishes the product baseline and is appropriate for operational, maintenance and support purposes. For CPCIs the program listing is compared to the product specification and supporting documentation to check for adequacy and validity. This audit is essential for CPCIs because the product specification and associated documentation represent the complete and only technical description of the CPCI.

SECTION C—PRODUCTION AND DEPLOYMENT PHASES

6-9. Configuration Management Change Control. Changes to the CPCIs must be controlled in an efficient and responsive manner; yet, provide the flexibility required to meet mission requirements. CPCI changes are classified as Class I (design) and Class II (discrepancy) changes and are defined in Appendix XIV of MIL-STD-483 (USAF). These changes are required for different reasons, such as problems identified in the field, testing conducted at a support facility, new mission requirements, and engineering modifications. (Care must be exercised to avoid confusing Class I and Class II CPCI changes with Class I through Class VI modifications under AFR 57-4). CPCI changes may be implemented individually or held for the next version release of the computer program, computer data, or documentation. This decision will be based upon unique system and using command requirements. Change control must provide for:

a. Systems engineering reviews to determine the inter-related effects between CPCIs and system equipment.

b. Changes which involve both system equipment and computer programs.

c. CPCI Class I design changes not affecting system equipment. These changes may originate as a problem or as an engineering or mission requirement. Each change must be examined to determine any impact upon equipment or other computer programs.

When the change affects equipment or exceeds the existing organic capabilities, AFR 57-4 procedures apply.

d. CPCI Class II changes not affecting system equipment. These changes result from a discrepancy and are not design or equipment problems. They can be changes to the CPCI or the associated documentation.

e. Changes to computer data as defined in chapter 10.

f. The assignment of available resources to develop and test the change after approval.

g. Tracking all changes from identification through approval and implementation.

6-10. Operational/Support Configuration Management Procedures (O/S CMP). The basic configuration management approach contained in the CRISP will be detailed further in the operational/support configuration management procedures (O/S CMP). These procedures will be written by the supporting and using commands in conjunction with the implementing command. They are the configuration management procedures to be used during deployment of the system. These procedures must be written during the Full Scale Development Phase, before the system begins its operational life. As a minimum, the O/S CMP should incorporate the provisions of change control described in paragraph 6-9 and address the following:

a. The relationships of all commands involved. If a Computer Program Configuration Sub-Board (para 6-11b) is required, representation should be designated, a chairman identified, and authorities specified.

b. The reporting of problems.

c. The method for processing deficiency reports or proposed modifications.

d. Approval authority for changes.

e. The status accounting procedures and responsibilities.

f. The handling of emergency changes.

g. The methods for distribution of CPCIs, documentation and changes thereto.

h. Situations where system turnover preceeds program management responsibility transfer.

6-11. Board Reviews. After system/equipment turnover and program management responsibility transfer, the configuration control board (normally the Air Logistic Center CCB) is the configuration change control authority. In large, complex systems or when the using command has some change control responsibility, a Computer Program Configuration Sub-Board (CPCSB) may be required to facilitate computer program change processing. The responsibilities of the CPCSB will be outlined in the CRISP and detailed in the O/S CMP. Board membership will include representation from the supporting commands, using commands and appropriate engineering personnel.

a. The configuration control board (CCB) has responsibility for all changes to the system and its configuration items. Its members should be representatives of all involved agencies and system functional areas such as, configuration management, engineering, programming, system analysis, test, procurement, financial control, training, and logistic support. This board will assure that all system impacts of CPCI changes including those that affect equipment or other computer programs have been evaluated, changes to system documentation have been identified and the resources have been identified to implement the change.

b. A Computer Program Configuration Sub-Board (CPCSB) functioning as a subordinate element of the configuration control board may be designated for computer program change processing as follows:

(1) The CPCSB will review and may be delegated approval authority for CPCI Class I changes which do not affect system equipment and can be accomplished within the existing organic resources of the responsible command. This includes Computer Program Engineering Change Proposals.

(2) The CPCSB will review and should have approval authority for CPCI Class II changes. When appropriate, considering the complexity of the system, the board may act upon CPCI Class II changes or handle these changes by means of a screening function.

(3) The CPCSB will insure that all CPCI changes are properly coordinated in accordance with agreements between the commands involved as specified in the O/S CMP.

(4) The CPCSB will insure the identification of all costs, required testing, changes to system documentation and affects on equipment and computer programs associated with a change.

(5) The CPCSB will convene, as required, with the CCB to provide technical expertise in regard to proposed changes.

c. A screening function, will be performed in support of the CCB or CPCSB. The extent to which the screening function is formalized depends upon the complexity of the system and will be detailed in the O/S CMP.

(1) When problems have been identified, they will be screened to determine the validity of the problem and the CPCI change clas-

sification, such as discrepancy (Class II) or design (Class I).

(2) If the change is determined to be a CPCI Class I change, it will be submitted to the CPCSB for appropriate processing.

(3) The approval and implementation authority for CPCI Class II changes may be assigned to the manager of the screening function. In all cases the CPCSB and other affected organizations will be notified of the change.

6-12. Deficiency and Improvement Reporting. In the production of any complex computer program, errors will be generated. It is the responsibility of all personnel to report problems as well as detected errors. Chapter 10 provides methods for identifying and reporting deficiencies, malfunctions, or errors and for requesting improvements which may be implemented to meet special command need.

6-13. Computer Resources Integration. Integration is the combining of the computer and its computer programs with the associated equipment to establish equipment/computer program compatibility, and to isolate program/interface and timing problems. The configuration control procedures will include the integration function to insure control and identification of related changes for management attention.

6-14. Systems Integration. A requirement exists to examine the change or modification across various system elements. In avionics systems, for example, changes to the operational flight program could impact the avionics hardware, associated airborne equipment, flight simulators, automatic test equipment, operator manuals or various combinations of the above. The configuration control procedures will provide for control and identification of related changes for management attention.

Chapter 7

DOCUMENTATION

7-1. Purpose. This chapter provides guidance for determining the need for, acquiring, and controlling computer resources documentation, both organically and contractor generated. It describes a standard set of documents for computer equipment and computer programs, and provides guidelines for tailoring these documents to meet individual system *requirements.*

7-2. Requirements. Only that documentation necessary to satisfy specific needs will be acquired. The requirements for documentation and the selection of documentation should receive continuing evaluation. Data Item Descriptions should be identified and developed to insure timely and adequate system documentation throughout the system acquisition life cycle. Each phase of development should be documented.

a. Documentation is needed during development in order to track progress and provide information for management visibility and decision making. For example, specifications are required to describe the computer equipment and computer programs in terms of design, performance, configuration and test requirements.

b. Documentation is needed to enable proper life cycle support and maintenance of the computer resources. This documentation should be maintained and updated, as required, for each change to the system or system operation.

7-3. Determining Documentation Requirements. Requirements for documentation are generated in many ways.

a. In addition to cost-effectiveness consideration for documentation acquisition, the PMD or similar work-initiating directives may direct specific tailored approaches. For example, in experimental or prototype activities, the PMD may direct the acquisition of only that documentation necessary to ascertain the feasibility of a design approach. The PMD may limit the support and maintenance alternatives affecting the support and reprocurement data requirements.

b. The supporting and using commands submit data needs for future operation and support within the constraints imposed by the initial directives. These commands identify documentation requirements during the early phases of the system acquisition. For computer resources, the CRISP provides the basis for identifying related support and maintenance documentation requirements. Command requirements are processed through a data management office (DMO) focal point as established by AFR 310-1. This action is initially accomplished by means of a *Data Call. The supporting and using com*mands should continually review and update their data requirements with the DMO. Data determination is not limited to an initial Data Call. It is a flexible and continuing process. The potential impact on procurement dollars requires that changes in data requirements must be communicated as soon as possible.

c. The DMO should evaluate the requirements. This evaluation should include several considerations: the type of acquisition, associated organic capabilities, support concepts, uses of the system and potential needs for data.

d. Consideration should be given to the optimum use of deferred ordering, deferred requisitioning, and accession list techniques. The first two techniques are described in AFR 310-1 and ASPR Section 7, and deal with deferring selection or delivery of the data specified in the contract until the actual requirements can be economically determined. Use of these techniques should be evaluated to avoid impacting data needs related to other system elements such as Automatic Test Equipment (ATE). The Accession List technique requires the contractor to provide a list of the internal data he is generating for his own use in the performance of the contract. The Air Force can acquire this data in the contractor's format, however, it is not subject to Air Force approval or a delivery schedule.

7-4. Management. The implementing command establishes a focal point within each program office as required by AFR 310-1 to manage data acquisition. The primary responsibility of this data management activity is to insure the selective application and acquisition of documentation.

a. The DMO should track all data requirements generated in the CRISP.

b. The following topics should be considered from a computer resources viewpoint in documentation management plans:

(1) The source, scope and content of the documentation required.

(2) The extent of Air Force rights required to satisfy the computer program support concept.

(3) The working relationship, points of contact, responsibilities, communication procedures, scheduled review cycles and controls for changing data requirements.

(4) The procedures for inspection and testing including validation of the data by contractor personnel prior to delivery to the Air Force and the process to be used to verify the documentation.

(5) A schedule showing how the preparation, delivery, and review of computer resource data relates to major program milestones such as SDR, PDR, CDR, FCA, PCA, and system test.

(6) The interface/interaction of computer resource data items.

(7) Procedures for review, control, and update of accepted data items.

7-5. Acquiring Contract Data. The DOD authorized data list (TD-3) identifies standard data item descriptions (DIDs) for use in acquiring data from contractors. Examples of DIDs applicable to computer resource data requirements are shown in table 7-1. The contract data requirements list (CDRL) is used for specifying data delivery requirements on contract. Care should be taken to tailor the DIDs to actual requirements.

7-6 Modifying Data Item Descriptions. AFR 310-1 provides guidelines for modifying data item descriptions. The contractor data products should be used if they will satisfy the Air Force needs. Certain data must not be modified without the agreement of the using and supporting commands such as, data required for follow-on test, modification, maintenance or logistic support. Major data item descriptions in this category are specifications, drawings, technical orders, positional handbooks, and user manuals.

7-7. Unique Data Item Descriptions. Data not specified in the authorized data list (ADL) may be acquired through use of a unique or nonstandard data item description. These data requirements are usually program peculiar or command peculiar and are directed toward a one-time specific application. These items are created by the agency requiring the data, and submitted for approval to the Command Data Management Office. For computer equipment and computer programs, such data items may be required for special design information such as programmer notebooks, algorithm development studies, and specialized computer program listing printouts.

7-8. Division Options for Computer Program Documents. For large computer programs and computer program components, the specifications or associated documents may be logically divided into volumes or sections to achieve a reasonable document size. In cases where common areas within each document may be combined into separate documents, such as common data base material, the depth of coverage must be consistent with the individual documentation requirements. The division options should be specified in the CDRL.

7-9. Partial or Incremental Submittals. It may be in the best interests of the Air Force to review data, especially voluminous data such as computer program product specifications, incrementally. Incremental draft submittals of data should be specified in the CDRL and the actual content expected with each submittal should be specified in backup sheets to the data items. For example, partial drafts of the product specification for computer programs could be submitted in three or more increments. The top design flow charts could be specified for delivery prior to CDR, the complete draft except for listings at CDR, and any major revisions that occur after CDR in subsequent submittals. Added drafts or change pages could be specified to be delivered when any major change in the detailed design approach agreed to at CDR is made and a current draft should be provided for review at the PCA. The option for a complete review of the document prior to final acceptance should be maintained, wherever practicable.

7-10. Application. Data organically generated or contractor prepared can be discussed in terms of primary uses:

a. Many of the organically generated documents are used to establish system requirements and facilitate acquisition management. These documents are the required operational capability (ROC), program management directive (PMD), program management plan (PMP), computer resources integrated support plan (CRISP), and the computer program development plan (CPDP). The CPDP may be an organic or contractor prepared document. These documents are used by the program manager and other participating organizations to define program concepts, agreements, and planned actions.

b. Contractor prepared data may include the configuration management plan, systems engineering management plan, human factor development plan, system safety plan, personnel subsystem test and evaluation plan, and computer program development plan. These documents are used to evaluate contractor proposed approaches to system development and, when incorporated into the contract or statement of work, establish contractual requirements.

c. Documents used for procurement purposes are organically prepared and include the request for proposal (RFP), statement of work (SOW), and the contract.

d. Major documents for monitoring contractor performance are usually contractor prepared and are used for configuration management, engineering, test, system operation, and support. These documents can be associated with the computer program life cycle as shown in figure 7-1. Documentation in one category may form an integral part of other categories. For example, specifications are used for design and development, to establish baselines and control changes, to generate test plans and procedures, and for updates and modifications. Also, certain documents provide a basis for other documentation. The operational concepts documents and computer program specifications developed as a part of the engineering activity provide the basis for the computer program user manuals and handbooks.

(1) Configuration management documentation is used to establish baselines and to provide methods for controlling and recording changes to the established baselines.

(2) Engineering documentation is used for progressive definition of technical performance and relating performance requirements to the design definition. Specialized types of data are not usually required for computer resources, but documentation coverage and content must be adjusted to account for their peculiarities.

(3) Test documentation is used for the qualification and acceptance of equipment and computer programs, and to provide the basis for testing future modifications.

(4) Operation and support documentation is used to operate, maintain, modify, and otherwise support the system after acceptance. The uses of the documentation, including formats and reporting procedures, should be discussed in the CRISP, O/S CMP and command manuals. Specialized documentation for computer programs include positional handbooks, computer programming manuals, user manuals, and version description documents.

(5) Specifications are engineering documents used to define the management baselines as departure points for engineering development, configuration control, documentation, test, and support activities. Specifications provide the basis for documenting requirements, controlling the incremental development between major program milestones and providing visibility. The specification provides a level of control that is initially broad in scope and progressively narrowed to become more restrictive as the design becomes definite. MIL-STD-490, MIL-S-83490, and MIL-STD-483 (USAF), establish the specification documentation for systems, system segments, computer equipment, computer programs, and other components of the system.

Phase	Primary Output	Products
System Analysis & Requirement Definition	System Functional Description	Requirements/Allocation/Time Line Sheets, System Specification Analysis Reports, Engineering Design Data
System Segment Analysis	System Segment Functional Description	Computer Program Dev Plan, Development Specification, Analysis Reports, Test Plans, Trade Studies, System Engineering Management Plan
Design	Detailed (System Segment) Design	Interface Control Drawings, Draft Product Specification, Test Plans Installation Plans Personnel Subsystems Test and Evaluation Task Analysis, Programming Manuals, (Draft) User's Manuals, (Draft) Positional Handbooks (Draft) Training Plans
Code & Checkout	Computer Programs	Timing & Sizing Data Test Plans & Procedures
Test & Integration	Testing Results of Computer Programs in System	Test Reports Operating & Maintenance Manuals Product Specifications Version Description Doc
Installation, Operate & Support	Modifications	Revised Documentation

Figure 7-1. Data Related to the Computer Program Life Cycle.

Table 7-1. Standard Contract Data Items.

CONFIGURATION MANAGEMENT

Configuration Management Plan
Version Description Document (Computer Programs)
Configuration Index (Computer Program)
Change Status Report (Computer Program)
Engineering Change Proposals
Specification Change Notice (Computer Program)
Time Compliance Technical Orders

ENGINEERING MANAGEMENT

Contract Work Breakdown Structure
Data Accession List/Internal Data
Engineering Drawings for Design Reviews, Audits, and Evaluations
System Specification
System Segment Specification (Modification Program)
Configuration Item Development Specification
Computer Program Development Specification
Configuration Item Product Fabrication Specification
Computer Program Product Specification
Inventory Item Specification
Personnel Subsystem/Human Factors Development Plan
Human Operator Task Analysis for Information Systems
Personnel Subsystem Test/Evaluation Plan
Training Needs/Exercising Requirements Analysis
Reliability and Maintainability Allocations, Assessments, etc.
Reliability and Maintainability Report on Commercial Equipment
Subsystem Design Analysis Report
System/Subsystem Summary Report
Functional Flow Diagrams
Requirements Allocation Sheets
System/Design Trade Study Reports
Schematic Block Diagrams
Time Line Sheets
System Engineering Management Plan
Technical Performance Measurement Report
System Safety Plan

Chapter 8

IDENTIFYING CONTRACTUAL REQUIREMENTS

8-1. Purpose. The purpose of this chapter is to describe the responsibilities of the program manager in identifying for the appropriate contracting authority those system acquisition requirements related to computer resources. Discussion of the contract and its preparation is included for informational purposes.

8-2. Program Management Responsibilities. The program manager will insure that the requirements for the management of computer resources contained in this regulation are tailored to the particular system acquisition and submitted to the appropriate procurement authority for inclusion in the contractual instruments.

a. The program manager provides requirements to the procurement authority by means of inputs for and participation in the preparation of the procurement package. A typical procurement package contains specifications, instructions to offerers (for the preparation of proposals), a proposed statement of work (SOW), and a contract data requirements list (CDRL, DD Form 1423).

(1) The mission and technical requirements are provided in the procurement package in the form of performance and design specifications. Depending on the type of system, these requirements are specified in a system specification, a system segment specification, or a similar specification document. For large systems, the computer programs may constitute a distinct system segment and the resulting procurement is accomplished through a prime contractor in association with other system segments or through a separate associate contractor. For smaller systems, the procurement may be accomplished through a prime contractor by means of one system specification, with computer equipment and computer programs identified as separate configuration items.

(2) The instructions to offerors provides for the format and content of each offeror's proposal. Where computer programs are involved, the program manager should insure that these instructions provide for preliminary contractor plans which describe the computer program development concept (chapter 3). Information provided may be used to aid in the evaluation of the contractor's capability to manage computer program development.

(3) The contract statement of work identifies the design, engineering, management, administrative, and support tasks that are to be performed during the life of the contract. SOW topics are discussed in paragraph 8-4.

(4) Deliverables are identified in the contract schedule or as data in the CDRL.

b. The procuring contracting officer (PCO) conducts negotiations between prospective contractors and the Air Force. The program manager or his representatives participate in the negotiations with personnel from various disciplines as required. The negotiations may result in modifications to the contents of the system specifications or contract documents to take advantage of possible tradeoffs that can result in cost savings. Technical and managerial requirements which are modified or waived may have significant impact and should be considered carefully. Documentation related to computer resources required by the using or supporting commands should not be deleted from the CDRL without appropriate coordination. The program manager should be represented in the negotiations by individuals who understand both the technical and management aspects of computer programs. The Air Force rights to computer programs and associated data must be identified and understood by all parties to the negotiation.

8-3. Contract Statement of Work. The program manager provides the required contractual tasks to the PCO by means of a statement of work. The contract statement of work specifies tasks to be performed during the life of the contract. Tasks are described below in three categories: program management tasks, design and engineering tasks, and management support tasks. The SOW is tailored according to the complexity and magnitude of the contractual effort.

a. The Program Management Tasks include procedures to assure an orderly management approach to the contract performance, provide a means to continually evaluate contractor performance, and identify problems and suggested corrective actions. Topics in this task description generally require the contractor to: develop and maintain plans which are consonant with overall program planning for the computer program life cycle; establish and maintain management, financial, and technical controls to assure identification of deviations from the plans; maintain schedules, forecasts, analyses and reports for each functional area of the computer programs. Certain of these topics have been formalized in standardized management systems such as:

(1) The work breakdown structure (WBS) task requires the contractor to develop a contract WBS. The WBS is a product oriented family tree composed of equipment, computer programs, services, and data items. A WBS organizes and portrays the product as well as the associated work to be accomplished. MIL-STD-881 describes the WBS system and is authorized for use by both the Air Force and contractor in the development of the preliminary project summary WBS and the contract WBS. Computer programs should be identified at level 3 in the project WBS.

(2) When cost reporting (AFR 800-6) is applicable, these requirements will be tailored to the individual contract. Identification of computer program configuration items at level 3 of the WBS will provide the visibility necessary to evaluate cost, schedule, and performance of contracted efforts.

(3) For those contracts which are covered by Contractor Cost Data Report, a Contract Cost Data Reporting Plan will be prepared to specify cost data reporting requirements. The Contractor Cost Data Reporting Plan and forms as described in AFR 800-6 should require the separate identification of cost associated with CPCIs.

b. The Engineering and Design Tasks are those related to system engineering, design and development, test, and system safety (chapter 4).

c. Management Support Tasks:

(1) In the configuration management task, the contractor should be required to implement a Configuration Management Plan (chapter 6).

(2) In the data management task, the contractor should be required to supply appropriate data, designate a focal point for integrating the data management effort, develop controls for data preparation, and collect, prepare, publish and distribute the data in the quantities and types designated on the CDRL.

(3) In the maintenance and support task, the contractor should be required to identify all of the computer programs, equipment, and documentation necessary to support the system according to the maintenance and support concepts. The appropriate provisions of the CRISP should be used as a reference for this task.

8-4. Rights in Data and Computer Programs. The program manager should insure that contractual provisions reflect requirements for delivery of CPCIs and associated data (chapter 7). These provisions should assure that the Air Force will have the rights to use the CPCIs and associated data to meet the support concept and requirement outlined in the CRISP. The program manager should consult the PCO and legal counsel (Staff Judge Advocate) in connection with contracting for these rights. Local Staff Judge Advocates should consult higher headquarters on problems not previously arising in their command. Requirements which may require special consideration are:

a. The right to order computer programs or data not generated under the contract.

(1) Privately developed computer programs used in the performance of contract work or data pertaining to such computer programs or other items, components or processes used in the performance of contract work.

(2) Privately developed computer programs or technical data needed to perform operation and support of the equipment, computer programs, or other items produced under the contract.

b. The Air Force requirement to acquire computer programs or rights greater than those originally set out in the contract. For example, the right to use computer programs, subject to restricted rights, outside the Air Force or in more than one computer or installation. The contractual provisions should set out the results of any predetermination of rights and a manner under which the Air Force might subsequently acquire additional required rights.

8-5. Contract Deliverables. Contract deliverables are specified as line items in the contract. When the list of items is too lengthy to list in the schedule of the contract, they may be listed on either an exhibit or attachment. When deliverables are listed on an attachment, a contract line item or sub-line item must be set forth in the schedule for each deliverable item. While computer programs and documentation must be listed on the DD 1423, the DD 1423 should be identified as an exhibit or attachment depending on the required management emphasis. In establishing the requirement for delivery of all CPCIs, the program manager should consider the delivery of all media necessary for planned support of the CPCIs. These requirements should be included in the contract. The deliverable items should include the complete source form (tape or card deck) suitable for assembly or compilation. Additionally, a complete object form (tape or card deck) suitable for loading and execution in both the operational computer(s) and any computers applied to direct support may be required.

8-6. Change Control and Accounting of Commercial Computer Equipment and Computer Programs. Appropriate safeguards should be included in contracts to insure that the contractor reviews all subcontractor or vendor changes and that all computer equipment or computer programs in a system are maintained to the same configuration level. The contractor should be responsible for obtaining these changes from the subcontractor or vendor and maintaining the computer equipment or computer programs to the latest released configuration as required. The contractor should also be made responsible for maintaining the engineering compatibility between all system equipment and computer programs, including incorporation of new subcontractor or vendor released versions of computer programs, as required.

8-7. Subcontractor Management. Computer resources may be developed under a subcontract to a prime contractor. When a prime contractor is employed in a system acquisition, the management of the subcontractor is by the prime contractor and any interaction with the subcontracted task by the Air Force is effected through the prime contractor.

Chapter 9

TURNOVER AND TRANSFER

9-1. Purpose. This chapter identifies the major agreements and actions necessary to effect the system/equipment turnover and program management responsibility transfer (PMRT) of systems which include computer resources from the implementing command to the using and supporting commands.

9-2. Policy. Air Force regulation AFR 800-19 for system/equipment turnover and AFR 800-4 for program management responsibility transfer will govern the turnover and transfer of computer resources. The turnover and transfer of computer resources, particularly computer programs, must be considered during the preparation and coordination of the PMD, PMP, CRISP, O/S CMP, and turnover and transfer agreements. The implementing command, supporting, and using commands will determine the responsibilities for the management of computer resources that are identified and incorporated into the turnover and transfer agreements. The Computer Resources Working Group should insure that agreements incorporated in the CRISP are in the system turnover and transfer agreements.

9-3. Documents. Major documents associated with the turnover and transfer of computer resources are:

a. The CRISP and O/S CMP which are used in developing the agreements.

b. The PMRT agreement which will:

(1) Include appropriate provisions of the CRISP and O/S CMP.

(2) Identify the computer resources covered by the agreement.

(3) Indicate scheduled delivery dates for the computer programs.

(4) List, wherever possible, those computer programs containing major discrepancies or omissions as of the PMRT date.

(5) Indicate any special change procedures and phasing requirements for the period between turnover and transfer.

(6) Indicate the status of completion of the system, subsystem, or functions affected by computer programs, where significant.

(7) Identify provisions for completion of training.

(8) Identify computer resource action items and assign responsibilities for their accomplishment.

(9) Incorporate special provisions for the management of computer programs common to more than one system.

c. The system/equipment turnover agreement, which will:

(1) Incorporate appropriate provisions of the CRISP and O/S CMP.

(2) Identify the computer resources covered by the agreement.

(3) List computer resource discrepancies and exceptions.

(4) Incorporate special provisions for the management of computer programs common to more than one system.

(5) Indicate any special change procedures and phasing requirements for the period between turnover and transfer.

d. The turnover certificate which lists computer resource deficiencies and exceptions at the time of turnover, indicates responsibilities for corrective action, and forecasts correction dates.

Chapter 10

SUPPORT

10-1. Purpose. This chapter provides additional guidance for the management of computer resources during the Deployment Phase. It discusses types of computer programs, computer data, reporting procedures, and interservicing agreements.

10-2. Support Objectives. The supporting command will provide for the support of computer resources according to the following objectives:

a. Minimum cost consistent with mission requirements.

b. Consultation with and guidance for the user in achieving his mission requirements.

c. The expeditious correction of all computer resource deficiencies.

d. Introducing state-of-the-art improvements when they are cost effective or required to satisfy mission requirements.

10-3. Planning. The using command, in conjunction with the supporting and implementing commands, develops the Maintenance Concept in accordance with AFR 66-14. The supporting command, in conjunction with the using and implementing commands, develops the integrated logistics support plan in accordance with AFR 800-8. The CRWG develops the CRISP which defines the concept of computer resources support and identifies responsibilities (chapter 3).

a. Throughout the system acquisition life cycle, the implementing, supporting and using commands will identify computer resources and associated documentation necessary to operate and support the system.

b. Periodic assessments will be made to determine the optimum method of support (that is, organic, contractor, or a combination thereof; AFR 26-12 applies). This assessment will consider the requirements for programming aids, type and degree of simulation, test, safety, cost, system stability, and interface requirements.

c. The CRISP will be continually updated to reflect the current support concept.

10-4. Responsibilities. Assignment of support responsibilities and authority for individual computer programs will be determined by its impact upon system equipment, mission responsibilities and the availability of both expertise and support equipment.

10-5. Computer Program Types. The following definitions are provided for categorizing computer programs:

a. Operational. Computer Programs required to operate the system. These programs are loaded and run in the computer equipment during system operation and can include the following:

(1) Executive/Supervisor. The computer program or CPC which controls the execution of functional/application programs and the input/output programs.

(2) Functional/Application. The computer program or CPC which implements functional performance requirements. Examples are: navigational functions, weapons delivery, engine performance simulation, and radar tracking.

(3) Input/Output. The computer program or CPC which transfers computer data between the computer equipment and the system equipment.

b. Test. Computer programs developed to analyze or test system and component performance. These programs may be integrated into the operational computer programs as test CPCs which operate concurrent with system operation. They include maintenance/diagnostic programs to analyze performance and detect or isolate faults in the computer equipment. Maintenance/diagnostic programs can be developed to check out system equipment not normally considered integral to the computer equipment, for example, interface/conversion equipment between the computer and the system for which it processes information.

c. Support. Computer programs generally used for the development and maintenance of other computer programs. Support programs include operating systems, assemblers, compilers, and loaders. For example, in the case of training devices, these programs include preflight check programs, data base modification programs, and student performance data printout programs.

10-6. Computer Data. Data operated on, produced by, or otherwise used by a computer program. Data may be relatively fixed, such as earth coordinates that may be a part of the system data base, or dynamic such as mission data that may be unique to a single mission and input only for that purpose. All data must be under positive control. The extent and nature of this control will depend upon usage. Mission data, such as target, weapons load, terrain features, must be under the control of the user. Data which is relatively fixed, and may apply to the entire system such as a fleet of aircraft, or interface data with other systems is usually controlled at the system level. Control procedures for data should be defined in the O/S CMP.

10-7. Deficiency Reporting.

a. To provide a formalized method for reporting deficiencies in computer programs and assure correction of problems, the following types of reports are authorized for use. Response times and specific channeling of reports and formats for these reports, both intra and intercommand, will be identified in the O/S CMP in accordance with TO 00-35D-54 and the following guidance.

(1) Emergency Report. This report deals with problems critical to mission performance or which would result in fatal or serious injury to personnel. This report will be certified as mission critical and transmitted to the appropriate responsible authority as rapidly as possible. The information will also be provided other affected users. The responsible authority will analyze the report, determine the impact, and furnish disposition to all affected units as rapidly as possible.

(2) Routine Report. This report deals with problems of a noncritical nature. This report should be submitted to the appropriate responsible authority. The responsible authority will analyze the report, determine possible solutions and impacts and furnish disposition to all affected units.

b. The basic information that must be submitted when reporting a deficiency is as follows:

(1) Identify the document as a Deficiency Report.

(2) Date submitted.

(3) Submitting organization

(4) Computer Program Identification Number and other nomenclature.

(5) Explanation of the deficiency.

(6) Recommendations.

(7) Name, grade, phone number and title of the action officer.

10-8. Change Reports. All proposed changes will be documented by the submitting organization and forwarded to the appropriate approval authority in accordance with the procedures contained in the O/S CMP

10-9. V&V of Computer Programs in the Deployment Phase. Inherent in the updating of computer programs is the necessity to insure that adequate testing is performed. Planning and procedures for computer program updates will include testing and V&V (chapter 5).

a. Procedures for V&V of a computer program are distinctly related to its type, the magnitude of the change and the required degree of confidence in the product for its application. System/nuclear safety must be considered in determining the amount of V&V required.

b. Computer programs should be exercised through a predetermined specified range of performance prior to final acceptance. All changes to a computer program require V&V prior to computer program release for operational use.

10-10. Interservice Support of Computer Resources:

a. Existing DOD resources will be used to the maximum practical extent. When computer resource support cannot be accomplished through existing Air Force capabilities, other DOD capabilities should be considered prior to initiating contractual actions. Life cycle costs will be considered in any decision for interservice support or single service support.

b. Interservice support agreements will be prepared by the supporting organization and approved at Major Command level. These agreements will detail the DOD Service responsible for the performance of each required function. The agreements will contain schedules, organization, procedures, personnel, facilities, and funding requirements with a delineation of the resources to be furnished by each Service.

c. Cross Servicing agreements financing will be determined by the attaining agency.

d. Host-tenant agreements will be governed by AFR 172-3/AR 37-19/SECNAVIST 7020.4B.

10-11. Security Assistance Program. The general policies and procedures for implementing and managing approved Grant Aid/Securing Assistance Service Funded programs and Foreign Military Sales are in AFR 400-20, AFR 5-16, AFM 400-3, AFR 800-18, and AFM 67-1, Volume IX. Security regulations in connection therewith are in AFR 205-1.

BY ORDER OF THE SECRETARY OF THE AIR FORCE

OFFICIAL

DAVID C. JONES, General, USAF
Chief of Staff

JAMES J. SHEPARD, Colonel, USAF
Director of Administration

GLOSSARY

ADL	Authorized Data List
ADP	Automatic Data Processing
AFLC	Air Force Logistics Command
AFSC	Air Force Systems Command
AFTEC	Air Force Test and Evaluation Center
ATC	Air Training Command
ATE	Automatic Test Equipment
CCB	Configuration Control Board
CCBD	Configuration Control Board Directive
CDR	Critical Design Review
CDRL	Contractor Data Requirements List
CI	Configuration Item
CPC	Computer Program Component
CPCI	Computer Program Configuration Item
CPCSB	Computer Program Configuration Sub-Board
CPDP	Computer Program Development Plan
CPIN	Computer Program Identification Number
CRISP	Computer Resources Integrated Support Plan
CRWG	Computer Resources Working Group
DAR	Data Automation Requirement
DCP	Decision Coordinating Paper
DID	Data Item Description
DMO	Data Management Office
DT&E	Development Test and Evaluation
ECP	Engineering Change Proposal
FCA	Functional Configuration Audit
FOT&E	Follow-On Operational Test and Evaluation
FQT	Formal Qualification Test
FORTRAN	A Computer Programming Language
ICD	Interface Control Drawing
ICS	Interpretive Computer Simulation
ICWG	Interface Control Working Group
IOT&E	Initial Operational Test and Evaluation
NSCCA	Nuclear Safety Cross Check Analysis
O/S CMP	Operational/Support Configuration Management Procedures
OSD	Office of the Secretary of Defense
OT&E	Operational Test and Evaluation
PCA	Physical Configuration Audit
PCO	Procuring Contracting Officer
PDR	Preliminary Design Review
PMD	Program Management Directive
PMP	Program Management Plan
PMRT	Program Management Responsibility Transfer
PQT	Preliminary Qualification Test
QQPRI	Quantitative and Qualitative Personnel Requirements Information
RFP	Request for Proposal
ROC	Required Operational Capability
SCN	Specification Change Notice
SDR	System Design Review
SOW	Statement of Work
SRR	System Requirements Review
TCTO	Time Compliance Technical Order
T&E	Test and Evaluation
TEMP	Test and Evaluation Master Plan
TEPI	Training Equipment Planning Information
TEOA	Test and Evaluation Objectives Annex
TI	Technical Interchange
VDD	Version Description Document
V&V	Validation/Verification
WBS	Work Breakdown Structure

BIBLIOGRAPHY

A2-1. Interservice Publications

ASPR	Armed Services Procurement Regulations

A2-2. Air Force Regulations (AFRs)

5-16	Issuing Air Force Publications Under Grant Aid Provision of the Military Assistance Program
23-36	Air Force Test and Evaluation Center
26-12	Use of Contract Services and Operation of Commercial or Industrial Activities
57-1	Policies, Responsibilities, and Procedures for Obtaining New and Improved Operational Capabilities
57-4	Retrofit Configuration Changes
65-3	Configuration Management
66-14	Equipment Maintenance Policies, Objectives, and Responsibilities
80-14	Test and Evaluation
102-5	USAF Management Policies Governing Development, Acquisition and Operation of Command Control Systems
122-1	The Air Force Nuclear Safety Program
172-3	Host-Tenant Relationships
205-1	Information Security Program
300-1	Automatic Data Processing Program Management
300-2	Management of Automatic Data Processing Systems
310-1	Management of Contractor Data
400-20	Administration of Military Assistance Program
800-2	Program Management
800-3	Engineering for Defense Systems
800-4	Transfer of Program Management Responsibility
800-6	Program Control—Financial
800-8	Integrated Logistics Support (ILS) Program for Systems and Equipment
800-18	Program Management of Systems Acquisition for Foreign Military Sales
800-19	System/Equipment Turnover

A2-3. Air Force Manuals (AFMs)

67-1	USAF Supply Manual
300-6	Automatic Data Processing (ADP) Resource Management
300-12	Procedures for Managing Automatic Data Processing Systems
400-3	Foreign Military Sales

A2-4. Military Specifications

S-83490	Specifications, Types and Forms

A2-5. Military Standards (MIL-STDs)

480	Configuration Control—Engineering Changes, Deviations and Waivers
482	Configuration Status Accounting Data Elements and Related Features
483	Configuration Management Practices for Systems, Equipment, Munitions, and Computer Programs
490	Specifications Practices
499A	System Engineering Management
881	Work Breakdown Structures for Defense Material Items
882	System Safety Program for Systems and Associated Subsystems and Equipment, Requirements for
1521	Technical Reviews and Audits for Systems, Equipment, and Computer Programs

A2-6. Air Force Technical Manuals

TO 00-5-15	Air Force Time Compliance Technical Order System
TO 00-35D-54	USAF Material Deficiency Reporting System

DEPARTMENT OF THE AIR FORCE
Headquarters Aeronautical Systems Division (AFSC)
Wright-Patterson AFB, OH 45433

ASD SUPPLEMENT 1
AFR 800-14, Vol I
30 January 1979

Acquisition Management

MANAGEMENT OF COMPUTER RESOURCES IN SYSTEMS

AFR 800-14, vol I, 12 September 1975, is supplemented as follows:

1. The ASD Weapon System Computer Resource Focal Point, ASD/EN, will resolve questions concerning the applicability of AFR 800-14 at the ASD level. In matters that relate to avionics within the scope of AFR 800-28 the resolution will be coordinated with ASD/AX. The focal point will refer questions or conflicts to AFSC/XRF if further resolution is required.

3a(AFSC) Sup). Programs not subject to DSARC/AFSARC reviews will accomplish computer resource requirements reviews before release of full-scale development phase solicitation documents.

3e(1)(AFSC Sup). Program and project offices will coordinate requests for waivers (as required by AFR 300-10) for use of nonapproved programming languages with the ASD Weapon System Computer Resource Focal Point. This action will be completed as early as possible in the program life cycle, always before the full-scale development solicitation.

3i(1)(Added). Solicitation documents will include statements that require the responder to identify and cost all computer resource items. ASPR 9-500 governs requirements for rights in technical data and computer software.

3i(2)(Added). Special procedures are required for computer programs which are considered for release to foreign governments or to foreign nationals. For systems having computer programs which are scheduled for foreign release, the chairperson of the Computer Resource Working Group (CRWG) will consult with the ASD Foreign Disclosure Policy Office, ASD/XOP, in planning that release.

3i(3)(Added). Computer Program Development Planning (CPDP) information will be solicited during the proposal phase of the contracting process where computer programs are to be developed. This proposal information may be negotiated and made part of the contract.

3m(4). Computer programs which contain mission parameters and mission peculiar data will be designed in such a way that the mission parameters and data can be loaded/modified without affecting the remainder of the computer program.

3m(5). The Computer Resources Integrated Support Plan (CRISP) for different computer programs within a system such as operational flight programs and automated test equipment computer programs may be separate volumes for ease of preparation. The CRISP is to be an Air Force generated document that is used as a planning tool by the participating Commands.

5b(1)(AFSC Sup). ASD maintains an organic computer resource acquisition support capability. The acquisition support capability includes organizations in avionics, automated test equipment, and simulator disciplines and specialists in the integration and utilization of computer systems in most distributed application areas. Functional responsibilities for computer resources within ASD are allocated as follows:

No. of Printed Pages: 2
OPR: EN
Writer: F. H. Banks
EN approval: Col Harold C. Pluenneke
Editor: Cleetta C. Brown
DISTRIBUTION: F; X: AFSC/XRF

(a) Computer Center: Responsible for the maintenance of wea (assemblers, compilers, etc.) when ASD organic maintenance is determine Furnishes technical guidance and assists in the formal evaluation and proc Requirements (DARs) generated by users of weapon system computer reso Agency Procurement Requests required to obtain Delegation of Procurem for ADPE items. Participates in proposal evaluation of weapon system su

(b) Configuration Management: Identifies and tracks all comp items to a sufficient level of detail to enable adequate configuration cont allocated and product baselines, modifies these baselines through configur and maintains status of the current approved configuration. Responsible f tion requirements and format. Reviews all computer resource configurati management of their compliance with the contract.

(c) Comptroller: Provides techniques and procedures for estim resource costs from conceptual through the operational phases. Determin systems for collection and evaluation of cost related data and validates co with actual data.

(d) Engineering: Responsible for validation/coordination of te preparation of specifications, statements-of-work and other engineering d of proposals including risk and suitability determination to meet the techn technical guidance and support to program offices.

(e) Procurement: Establishes procurement policy and furnishe and assistance in all phases of procurement of computer resources.

(f) Program Management: Manages acquisition of the comput element of the weapon system. Ensures that computer resources are cove ment Plan (PMP). Establishes and chairs the Computer Resource Working the Computer Resources Integrated Support Plan (CRISP). Responsible fo Computer Program Development Plan (CPDP).

5b(1)(a)(AFSC Sup). The ASD Weapon System Computer Resource Focal P office of the ASD Deputy for Engineering, is the Product Division Focal P the focal point will be to monitor the implementation of AFR 800-14 and policies arising from it. For matters relating to avionics within the scope will be compatible with the Air Force Avionics Master Plan implemented b point will provide a liaison between ASD and higher headquarters, other pr and industry in matters relating to weapon system computer resource polic conduct seminars on pertinent aspects of computer resource technology ar focal point will interface with the ASD Automatic Data Processing (ADP) involving application of 300 series regulations.

5d. The ASD Weapon System Computer Resource Focal Point interfaces w Center, control and standardization groups, development planning, the eng program offices, and AFSC laboratories to assist in assuring the timely ap computer technology into systems.

6h(Added). The program and project offices will identify an individual wh for all matters pertaining to computer resources for that program or proje

OFFICIAL

GEORGE H. SYLVESTE
Commander

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DEPARTMENT OF THE AIR FORCE
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AF REGULATION

15 Decem

Data Automation

COMPUTER PROGRAMMING LANGUAGES

This regulation prescribes policy for using computer programming languages, and for specify curement and testing requirements for computer programming language compilers. It imp DOD Directive 5100.40, August 19, 1975; DOD Instruction 5000.29, April 26, 1976; DOD Ins 7900.1, May 19, 1976; and DOD Manual 4120.3-M, January 1972.

1. Objectives. Implementation of this policy provides Air Force computer programming language standards to enable commanders and their staffs to improve interchangeability and upward compatibility of computer programs within and among Air Force systems; reduce programming and reprogramming costs; reduce conversion efforts during transition from one computer to another; minimize requirements for retraining of computer programmers; and ensure that standard computer programming language compilers acquired from vendors comply with the Air Force standard specifications.

2. Applicability. This regulation applies to all Air Force activities using or planning to use computer programming languages, or acquiring computer programming language compilers for current and future ADS. It applies to all requests for and use of computer programming languages and associated compilers in support of Air Force systems, whether this support is developed in-house or under contract.

3. Definitions:

a. **Assembly Languages.** Machine dependent, low order programming languages consisting of symbolic operation codes and symbolic addresses. Each language requires an ass which translates symbolic operation cod machine operation codes and symbolic ad into absolute or relocatable machine addr

b. **Basic Software.** See AFR 300-2.

c. **Command ADP Program Single Ma** The Director of Data Automation or com official at each MAJCOM/SOA designated Commander thereof. Responsibilities Command ADP Program Single Manager tablished by AFR 300-2.

d. **Compiler Testing.** The operation of puter programming language compiler rigidly controlled data base and a selecte well-defined computer programs which standard language features, such that the produced from the exercise can be co against an expected set of answers to det the compiler's compliance with the la standard. A report is prepared at the co of the testing exercise which summarizes sults of the tests including a composite lis features exercised and any noted discrep

e. **Computer Program.** See AFR 300-

f. **Designated Control Agent.** The Ai organization responsible for assuring the ity and configuration of an Air Force st high order programming language; ensu correctness of testing routines which e the correspondence between the languag ard and compiler implementations; dissem available aids for conversion from past to versions of a language standard; and e that computer programming language co

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Supersedes AFRs 300-10, 20 October 1971 and 300-11, 12 April 1973. (For summary of revised, deleted, or added material; see signature page.)
OPR: KRAX
DISTRIBUTION: F

acquired by Air Force activities comply with the standard language specification.

g. **Data Processing Installation (DPI) Managers.** See AFR 300-2.

h. **Federal COBOL Interpretations Committee.** The committee, established and chaired by the National Bureau of Standards, which is responsible for the uniform interpretation of the Federal (Air Force) COBOL Standard.

i. **FPMR.** Federal Property Management Regulations issued by the General Services Administration (GSA).

j. **High Order Programming Languages.** Programming languages (of an order higher than assembly languages), designed for ease of expression of a class of problems or procedures by humans to achieve varying degrees of machine independence. These languages are designed for programming convenience, rather than for easy generation of machine code instructions. The languages are intended as a means for directly presenting procedures to a computer for which a compiler exists, and as a means of communicating such procedures among individuals.

k. **Specialized High Order Programming Languages.** For the purpose of this regulation, all high order programming languages, except those listed in paragraph 4c, are classified as specialized high order programming languages.

l. **Structured Programming.** The writing of computer programs in a disciplined, modular fashion, such that the overall program logic is designed first, and each major component is designed before any of its subcomponents. Structured programming uses only three logic structures: (1) a simple sequence of one or more operations; (2) a conditional execution of one or more operations within a sequence; and (3) a repetition of one or more operations while a condition is true. A logical routine within a structured program has only one entry point and one exit point.

m. **American National Standards (ANS).** ANS for ADPE and computer software are approved and issued periodically by the American National Standards Institute (ANSI) X3 Standards Committee, which includes membership of the Department of Defense. The ANSI standards which have been adopted for Air Force use are published in the DOD Index of Specifications and Standards.

n. **Federal Information Processing Standards (FIPS).** FIPS, issued by the National Bureau of Standards, announce the adoption and implementation of specific computer standards within the Federal Government.

o. **The CODASYL COBOL Journal of Development.** The complete specification of COBOL elements and capabilities which have been approved as the COBOL language. The Air Force COBOL Standard is a subset of the complete language contained in this Journal.

4. Policy:

a. The ANSI and the National Bureau of Standards are recognized as the organizations responsible for the development of the National and Federal computer programming language specifications, respectively, which have been adopted as Air Force standards.

b. The Programming Language Committee of the Conference on Data Systems Languages (CODASYL) is recognized as the sole International development group for the COBOL language.

c. The Air Force standard high order programming languages are:

(1) COBOL—as defined in Federal Information Processing Standards Publication (FIPS PUB) 21-1, 1 December 1975. In addition to the complete set of language capabilities, three subsets are identified in FIPS PUB 21-1 which may be specified and used as data processing requirements dictate.

(2) FORTRAN—as defined by American National Standards X3.9-1966 or X3.10-1966.

(3) JOVIAL (J3)—as defined by MIL-STD-1588 (USAF).

(4) JOVIAL (J73/I)—as defined by MIL-STD-1589 (USAF).

(5) PL/I—as defined by American National Standard X3.53-1976.

d. Use of standard compilers developed in accordance with the specifications contained in ANS COBOL X3.23-1968 will continue to be used in currently operational systems until the present ADPE is replaced or until a requirement exists that dictates procurement of a new COBOL compiler for the current ADPE.

e. The use of specific Air Force standard high order languages in Air Force systems will be based on the capability of the Language to meet the system requirements.

f. The Air Force standard programming language specifications are minimum compiler specifications for procurement purposes. Additional language specifications may be procured and used to satisfy programming requirements not incorporated in the approved standard specification in accordance with paragraph 5b.

g. Structured programming will be used to the maximum extent possible in the development of Air Force systems.

h. An Air Force standard high order programming language will be employed in all future Air Force systems except that:

(1) Specialized high order programming languages may be used for classes of applications

where, for technical reasons, the use of an Air Force standard high order programming language would not be feasible. These languages must be specified and justified in accordance with paragraphs 5d and e, and approved in accordance with paragraph 9.

(2) Assembly languages may be employed for future computer programs and basic software when the Air Force standard high order programming languages do not have the capability to accomplish required functions which can be accomplished in an assembly language, and where it would not be cost beneficial to have the capabilities added to the Air Force standard high order programming language compiler. (NOTE: The potential costs for subsequent reprogramming of these programs in a high order programming language must be considered in determining the cost benefits, ratios, and effectiveness to justify the use of an assembly language.)

i. Computer programs on hand that are coded in an assembly language should be converted to a high order language if the programs are expected to have a usefulness extending into the next computer replacement period, provided operational requirements would make such conversion economically and technically feasible. If cost effective, such program conversion should be accomplished during program modification or maintenance.

j. Use of implementor-defined features and vendor supplied nonstandard extensions in high order programming language compilers will be avoided when there is a probability that the ADS being developed will be additionally operated upon, or converted for use with, new or different computer systems.

k. Retrieval systems and associated special purpose retrieval languages will not be used for recurring RCS reports. Such systems and languages may be used to fulfill only the requirements for one-time reports unless approval for retrieval use on recurring non-RCS reports is obtained from the appropriate Command ADP Program Single Manager. This approval authority may be delegated to the DPI Manager as appropriate. Caution must be exercised in approving use of retrieval systems written in programming languages other than COBOL, FORTRAN, JOVIAL or PL/I for recurring reports since Air Force system compatibility and interchangeability will be seriously jeopardized when subsequent action is taken to replace or upgrade current computer equipment.

5. Requirements:

a. Air Force standard high order computer programming language requirements submitted under any directive, plan, or program will be processed through established channels for review and approval.

(1) COBOL specifications will reference *FIPS PUB 21-1, 1 December 1975*, when the complete set of capabilities of the Air Force Standard COBOL is required. When less than the complete set of capabilities of the Air Force standard is required, specifications will cite the specific subset, as reflected in FIPS PUB 21-1. For example, if only the minimum COBOL capability is desired, the citation would be "Low Level Subset, FIPS PUB 21-1, 1 December 1975."

(2) FORTRAN specifications will reference *American National Standard FORTRAN X3.9-1966* if the complete set of capabilities of the Air Force Standard FORTRAN is required. When less than the complete FORTRAN capability is required, *American National Standard Basic FORTRAN X3.10-1966* will be cited.

(3) JOVIAL (J3) specifications will reference *MIL-STD-1588 (USAF)*.

(4) JOVIAL (J73/I) specifications will reference *MIL-STD-1589 (USAF)*.

(5) PL/I specifications will reference *American National Standard Programming Language PL/I X3.53-1976*.

b. The specification of required capabilities, in addition to those contained in the Air Force standard specification, is permissible. Such extended capabilities will be coordinated with the Designated Control Agent prior to submission as part of the specification. These extended capabilities will be specified in the following manner.

(1) COBOL:

(a) Capabilities consisting of elements which are contained in the latest edition of the *CODASYL COBOL Journal of Development* will be specified by page number and issuance date of that edition.

(b) Capabilities consisting of elements which are not contained in the *CODASYL COBOL Journal of Development* will include explicit syntactic and semantic definitions of the desired language elements.

(2) Specification for additional capabilities for all other Air Force standard high order programming languages will contain explicit definition of the required language elements.

(3) Justification for the use of all additional capabilities will be submitted as part of the specification.

c. The language specifications described above, including approved additional capabilities, are established as the minimum specifications for procurement purposes. Vendors will not be penalized for proposing compilers which contain elements above a required Air Force standard language specification, provided these elements are furnished without additional cost and do not impose any additional processing burden by their inclusion. Caution must be exercised when using these additional features as outlined in paragraph 4j.

d. The specification of capabilities required for specialized high order programming languages will contain either the complete list of required language elements, including syntactic and semantic features as well as functional and technical characteristics, or a reference to a documented language specification which contains the required facilities.

e. Justification will be submitted with the specifications for the proposed use of assembly language or a specialized high order programming language, as specified in paragraph 9.

6. Compiler Testing:

a. All COBOL compilers will be tested in accordance with FPMR 101-32.1305-1 to ensure their compliance with the Air Force COBOL Standard prior to acceptance of the compiler for Air Force use.

b. All JOVIAL compilers will be tested by Air Force Systems Command, using the documentation procedures outlined in FPMR 101-32.1305-1, to ensure their compliance with the Air Force JOVIAL Standard prior to acceptance of the compiler for Air Force use.

c. The Air Force activity conducting the procurement and the user of the proposed system have final authority to determine whether the tested compiler is acceptable to the user.

d. Compiler testing systems for other Air Force standard high order programming languages will be used as they become available to verify conformance to the respective Air Force standard specifications prior to acceptance of the compiler for Air Force use.

7. Conversion:

a. FIPS PUB 43 is an aid in the transitioning of COBOL programs from use with compilers developed in accordance with the previous Air Force COBOL Standard specifications contained in ANS X3.23-1968 to compilers developed in accordance with FIPS PUB 21-1.

b. As other Air Force standard high order programming language specifications are revised, conversion aids will be provided.

8. Designated Control Agents. Each of the Air Force standard high order programming languages has an Air Force Designated Control Agent established, as follows:

a. Air Force Systems Command is the Designated Control Agent for JOVIAL specifications.

b. HQ USAF/KRAX is the Designated Control Agent for COBOL, FORTRAN, and PL/I specifications.

9. Waivers:

a. Requests for waiver for procurement of assembly language or specialized high order programming language compilers will be submitted to HQ USAF for approval prior to acquisition.

b. Requests for use of assembly language or a specialized high order programming language for any purpose other than that specified in the waiver described in paragraph 9a will be submitted to HQ USAF for approval prior to use. The approval will specify the extent to which the assembly language or specialized high order programming language may be used.

c. New waivers are not required for the previously approved use of assembly language or a specialized high order programming language for those Air Force ADS which were operational or under development as of the date of this regulation. If use is extended to other ADS in the future, the waiver procedures in paragraphs 9a and 9b will be applied.

10. Publications Distribution:

a. The following publications may be obtained free of charge through normal Air Force channels for distribution of computer standards documents by contacting the Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia PA 19120.

(1) American National Standard Programming Language PL/I, X3.53-1976.

(2) American National Standard FORTRAN, X3.9-1966.

(3) American National Standard Basic FORTRAN, X3.10-1966.

(4) FIPS PUB 21-1, COBOL.

(5) FIPS PUB 29, Interpretation Procedures for Federal Standard COBOL.

(6) FIPS PUB 43, Aids for COBOL Program Conversion.

(7) MIL-STD-1588 (USAF), JOVIAL J3.

(8) MIL-STD-1589 (USAF), JOVIAL J73/I.

b. The CODASYL COBOL Journal of Development may be obtained at a cost from the Technical Services Branch, Department of Supply and Services, 5th Floor, 88 Metcalfe Street, Ottawa, Ontario, Canada K1A 0S5.

11. Responsibilities:

a. **HQ USAF:**

(1) The Director of Data Automation (AF/KRA):

(a) Serves as the Air Force manager for the use, standardization, and further development of computer programming languages in Air Force systems.

(b) Serves as the Air Force Designated Control Agent for the Air Force Standard COBOL, FORTRAN, and PL/I programming languages.

(c) Coordinates Air Force participation in computer programming language development and standardization activities, compiler testing systems development and maintenance, and computer program conversion aid activities among the Air Staff agencies involved, the military services and other components of the Department of Defense, and within Federal and National organizations.

(d) Develops and promulgates the Air Force policy on the use of computer programming languages, including use of validation routines, conversion aids, and other related language tools.

(e) Develops the Air Force position on the acceptability of draft National and Federal standard programming language specifications, in coordination with interested major commands, separate operating agencies, and elements of HQ USAF.

(f) Provides DOD participation in the planning and policy councils of the ANSI and the Federal Standards committees to ensure that timely revision of those programming language standards derived from National and Federal specifications is undertaken and completed, as required to meet Air Force needs; and to ensure that standard specifications are expeditiously developed for those nonstandard programming languages which are of special interest to the Air Force.

(g) Provides Air Force participation on the CODASYL Programming Language Committee to ensure the continuing growth of the COBOL programming language in areas where Air Force needs are not currently being met.

(h) Provides Air Force participation on the Federal COBOL Interpretations Committee and Federal COBOL Standards Task Group 9, and coordinates such participation among the Air Staff agencies, the military services, and other DOD components.

(2) HQ USAF Staff Offices. Within their functional areas of responsibility, these offices will ensure that high order computer programming languages and assembly languages are justified and utilized according to the provisions contained herein and in coordination with HQ USAF Air Staff offices concerned.

b. **Major Commands and Separate Operating Agencies:**

(1) Ensure that high order computer programming languages and assembly languages are justified and utilized according to the provisions of this regulation.

(2) Ensure that specifications for computer programming languages submitted under any directive, plan, or program are in accordance with this regulation.

(3) Review and evaluate proposed language specifications and justifications at command or agency level before forwarding them through established channels.

(4) Provide technically qualified participants for computer programming language development and standardization activities, as directed by HQ USAF.

(5) Establish and maintain publication distribution requirements for Air Force standard high order programming language specifications and the latest edition of CODASYL COBOL Journal of Development, referenced herein.

(6) Forward to the Air Force Designated Control Agent, through command channels, suggestions on new or existing capabilities for Air Force standard high order computer programming languages, and all questions that arise regarding the meaning of standard language specifications.

c. **Air Force Systems Command.** In addition to the responsibilities included in paragraph 11b, the Air Force Systems Command will serve as the Air Force Designated Control Agent for the Air Force Standard JOVIAL programming language.

d. **Air Force Designated Control Agents.** Within their assigned areas of control, Designated Control Agents will:

(1) Ensure that compiler testing routines are developed and maintained to satisfy compiler testing requirements for Air Force standard programming language compilers.

(2) Ensure that MIL-STD-1588(USAF) (JOVIAL J3) and MIL-STD-1589 (USAF) (JOVIAL J73/I) are developed and maintained in a current status.

(3) Ensure that the most recent compiler testing routines are available to computer manufacturers.

(4) Ensure that the Air Force major commands, separate operating agencies, and HQ USAF Air Staff offices are notified of changes in Air Force standard high order programming language specifications, changes in compiler testing routines, and aids for program conversion from past to current standard specifications as they become available or are adopted.

(5) Ensure that all questions received regarding the meaning of current language specifications are satisfied. All requests for interpretation of COBOL will be processed in accordance with the provisions of FIPS PUB 29.

BY ORDER OF THE SECRETARY OF THE AIR FORCE

OFFICIAL

DAVID C. JONES, General, USAF
Chief of Staff

JAMES J. SHEPARD, Colonel, USAF
Director of Administration

SUMMARY OF REVISED, DELETED, OR ADDED MATERIAL

This revision deletes the requirement to restrict the use of COBOL, FORTRAN and JOVIAL to certain types of computer applications; revises the Air Force COBOL and JOVIAL standards; adds PL/I as an Air Force Standard programming language; provides revised guidance on procurement and use of computer programming languages; adds policy on use of structured programming, retrieval systems and retrieval languages; revises policy for testing programming language compilers; assigns Designated Control Agents for each Air Force Standard programming language; and revises responsibilities for policy implementation.

DEPARTMENT OF THE AIR FORCE
Headquarters Air Force Systems Command
Andrews Air Force Base, DC 20334

AFSC SUPPLEMENT 1
AFR 300-10
2 September 1980

Data Automation

COMPUTER PROGRAMMING LANGUAGE

AFR 300-10, 15 Dec 76, is supplemented as follows:

2. This supplement applies to AFSC activities using or planning to use computer programming languages for systems managed under either 300- or 800-series regulations. Process actions that affect systems managed under 300-series regulations through the ADP Program Single Manager. Refer questions or conflicts about the applicability of this regulation to HQ AFSC/XRF for resolution.

3p(Added). JOVIAL Language Control Agent. The organization responsible to the JOVIAL Designated Control Agent for ensuring stability and configuration of the JOVIAL standard high order programming language J73. The JOVIAL Language Control Agent controls changes to the language standard. Ensures changes are reviewed by the AFSC Product Division, Laboratory, and other language focal points.

3q(Added). Language Focal Point. Includes representatives from various DOD agencies, other MAJCOMs, and the following AFSC organizations: ASD, ESD, SD, AD, BMO, RADC, AFWAL, and AFATL. The Language Focal Point will ensure communication between the parent organization and other organizational elements of the language control structure.

3r(Added). JOVIAL Language User. Any person or organization (DOD or otherwise) that uses or plans to use JOVIAL (J73).

3s(Added). JOVIAL Language Control Facility. A service organization established by the JOVIAL Language Control Agent to perform the functions listed in paragraph 11c(1) of this supplement.

3t(Added). JOVIAL User's Group. A working group that provides a forum for discussing language issues; provides inputs to the Language Control Facility and Language Control Board on language changes or subsets, user experience with the language, compilers, and other support tools. Reviews and comments on proposed revisions to the language standard made by the Language Control Facility.

3u(Added). JOVIAL Language Control Board. An organization established jointly by the JOVIAL Language Control Agent and the JOVIAL Designated Control Agent to assist in making JOVIAL language control and policy decisions. Its primary responsibility is to review and recommend proposed changes to the JOVIAL language standard and policy on a quarterly basis. It is chaired by the JOVIAL Language Control Agent and is composed of the Designated Control Agent, the language focal points, and representatives from other selected DOD organizations. The Designated Control Agent or Language Control Agent may invite representatives from organizations outside of DOD to participate.

3v(Added). IEEE ATLAS Committee. An international committee established under the Institute of Electrical and Electronic Engineers (IEEE) to develop and standardize the Abbreviated Test Language for all Systems (ATLAS). This group reviews and approves all changes to ATLAS and controls its configuration baseline. It consists of a steering committee and eight technical working groups.

3w(Added). ATLAS Language Control Agent. The organization responsible to the Air Force Designated Control Agent for the compliance, stability, and configuration of ATLAS as used within AFSC. The ATLAS Control Agent ensures AFSC Product Divisions and laboratory language focal points review changes.

3x(Added). ATLAS Language Focal Points. The AFSC organizational representatives that are responsible for ensuring compliance to IEEE STD 416 and for coordinating ATLAS changes. Focal points ensure communication between the parent organization and other organizational elements of the language control structure and include representatives from ASD, ESD, SD, AD, BMO, RADC, AFWAL, and AFATL.

3y(Added). ATLAS Language Control Facility. A service organization established by the ATLAS Language Control Agent to perform the functions listed in paragraph 11c(1) of this supplement.

3z(Added). ATLAS Language User. Any person or organization that uses or plans to use ATLAS.

3aa(Added). DOD ATE Language Standardization Committee (DALSCOM). The DOD organization responsible for the configuration of ATLAS as used within the Services. The organization reviews and approves all DOD proposed ATLAS changes that are presented to the IEEE ATLAS Committee.

4c(4) In the absence of compelling justification to the contrary, use J73 on all Air Force embedded computer systems

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until the DOD-wide standard Ada programming language becomes available. This J73 policy does not pertain to software supporting ADP resources in general purpose ADPS, developed, acquired, and managed by the AFR 300-series regulations and manuals (defined as category D in attachment 4 to AFR 300-2). However, in those software systems that interface with or are in direct support of development, test, or support of weapon systems, selection of a language will be guided by J73 policy. General purpose computers acquired by SPOs or project offices under AFR 300-12 for inclusion in a weapon system are part of the system and must use J73 unless compelling justification is furnished. When compelling reasons justify using an HOL other than J73, process a waiver request according to paragraph 9a.

4c(5) PL/I is not approved for use in systems managed under AFR 800-2 and those advanced development and prototype demonstration systems that will change to AFR 800-series management.

4e. JOVIAL (J73) is the required language for development in Air Force aircraft avionics real-time applications. Neither COBOL, ATLAS, nor FORTRAN may be used for on-board operational avionics real-time applications without a previously approved waiver. The Deputy for Avionics Control (ASD/AX) will ensure the use of JOVIAL J73 in all aircraft avionics real-time applications.

4f. Preprocessor input languages, machine-oriented languages and subsets or supersets of standard programming languages other than those defined in paragraph 5a(1) and (2) and ATLAS will be treated as nonapproved languages and require a waiver before acquisition. The use of preprocessors to implement structured programming constructs is considered undesirable.

4h(1) ATLAS is an approved, specialized high order programming language for automatic test equipment applications only. ATLAS is defined by three IEEE ATLAS standards: IEEE STD-416-1978-ATLAS Test Language, IEEE STD-416A-1978-ATLAS Syntax, and IEEE STD-771-1979-ATLAS User's Guide.

5a(6)(Added). ATLAS specifications will reference the three IEEE ATLAS standards cited in paragraph 4h(1) or their official successors. Each organization cited in paragraph 3x will establish an ATLAS Language Focal Point for their organization.

5a(7)(Added). JOVIAL (J73) specifications will reference MIL-STD-1589A (USAF) or official successors. Each organization cited in paragraph 3q will establish a Language Focal Point for JOVIAL (J73). One person can act as an ATLAS Language Focal Point and a Language Focal Point for JOVIAL (J73) at the same time.

5b. Obtain a waiver from the Designated Control Agent for using extensions to standard JOVIAL and ATLAS language versions before submitting as part of the acquisition specification. Send waiver requests according to paragraph 9a.

5c. Process extensions to JOVIAL and ATLAS languages according to b above. Requests for extensions will receive prompt attention to minimize system schedule or cost impacts.

6b. Submit JOVIAL compilers for each separate Air Force application through the JOVIAL Language Control Agent to the Language Control Facility for validation testing. JOVIAL compilers will not be accepted without a completed validation test report. Compilers will not be used for fielded applications software until the compiler passes the validation acceptance test.

8c(Added). HQ AFSC/XRF is the AFSC designated control agent for JOVIAL (J73). HQ AFSC/SDDL is the designated control agent for the approved, specialized high order programming language, ATLAS.

9a. Send requests for waiver to the appropriate designated control agent through the language focal points for AFR 800-series applications or through the ADP Program Single Manager for AFR 300-series applications. Send information copies of all requests to the Language Control Agent. Waiver requests will receive prompt attention to minimize system schedule or cost impacts. Justification based on life cycle cost savings and language technical characteristics must accompany requests for waiver. The justification will include a comparison of the selected language or compiler against the standard languages. The justification, as a minimum, will address:

(1) Direct development cost of compiler and support software.

(2) Compiler and support software delivery schedules and the impact in system schedule.

(3) Commonality of the selected language with languages used to implement existing software within the system.

(4) Commonality of the selected language with existing and new development software on other systems that interface with the system.

(5) Support concepts and relative support cost over the system life cycle for each of the languages being compared.

(6) Technical deficiencies of the languages being compared that affect the language decision.

(7) Changes required to the existing language definition to meet the system requirements.

(8) Direct and indirect contractor cost associated with language application (for example, training, subcontractor cost).

(9) Programming languages and support tools used to develop and maintain the support software.

9b. Use of assembly language in subsegments of a computer program where an approved HOL is used does not require a waiver. Product divisions, centers, and separate operating agencies will establish guidance for use of assembly language in applications within their control.

10c(Added). Obtain specifications for the ATLAS language by contacting HQ AFSC/SDDL.

11b(4) AD/KR will represent Air Force on the ANSI X3J3 FORTRAN Standard Development Committee. HQ AFSC/SDDL and Air Force designated members to the

DALSCOM Technical Advisory Group will represent the Air Force on the IEEE ATLAS Committee.

11c(1)(Added). HQ AFSC/XRF is the designated control agent for JOVIAL (J73). Control of JOVIAL (J73) will be executed through the JOVIAL Language Control Agent. The Language Control Agent will transition from RADC to ASD/AX in FY 81. The Language Control Facility will transition in FY 81 from RADC to ASD/AD. The Language Control Agent will task the Language Control Facility with the performance of the following control functions for JOVIAL (J73):

(1) Maintain the approved baseline language specification MIL-STD-1589A and official successors. Process changes to the specification according to DOD 4120-3M.

(2) Provide for distribution of the language specification to language focal points and user representatives.

(3) Test each compiler for adherence to the standard language specification before acceptance of the compiler for Air Force use. Identify extensions that have been implemented in the compiler and recommend to the user on acceptance of the compiler.

(4) Provide technical advice to the users.

(5) Maintain a directory and inventory of compilers and support tools for JOVIAL (J73). Distribute the directory to language focal points.

(6) Develop and maintain operating procedures for the JOVIAL language policy and control process.

(7) Serve as office of record for JOVIAL User's Group activities.

(8) Maintain and enhance selected JOVIAL tools.

(9) Correct and enhance selected JOVIAL compilers and code generators.

11c(2)(Added). HQ AFSC/SDDL is the Air Force Designated Control Agent for ATLAS. Control of ATLAS languages will be executed through the ATLAS Language Control Agent. ASD/AEG is the ATLAS Language Control Agent. Functional areas, or organizations within a functional area, may implement additional controls within their area of responsibility. The ATLAS Language Control Agency will perform the following control functions:

(1) Review and coordinate proposed ATLAS changes and waivers. Send changes and waivers to the Designated Control Agency.

(2) Provide for distribution of ATLAS standards and implementation guidelines to language focal points and ATLAS language user.

(3) Test compiler for adherence to the standard language before acceptance of the compiler for Air Force use. Identify extensions that have been implemented in the compiler and recommend to the user on acceptance of the compiler.

(4) Provide technical advice to the users.

(5) Maintain a directory and inventory of compilers and support tools for the standard languages.

(6) Develop and maintain operating procedures for ATLAS language policy and control process.

(7) Maintain and enhance selected ATLAS compilers and tools.

11d. The JOVIAL Language Control Agent will perform through the Language Control Facility these functions as they relate to JOVIAL (J73).

OFFICIAL

ALTON D. SLAY, General, USAF
Commander

JAMES L. WYATT, JR., Lt Col, USAF
Director of Administration

AFSC Andrews AFB Md 1980

DEPARTMENT OF THE ARMY

REGULATION 70-16

DEPARTMENT OF THE ARMY
HEADQUARTERS US ARMY MATERIEL DEVELOPMENT AND READINESS COMMAND
5001 Eisenhower Ave, Alexandria, VA 22333

DARCOM REGULATION
No. 70-16

16 July 1979

Research, Development, and Acquisition

MANAGMENT OF COMPUTER RESOURCES IN BATTLEFIELD AUTOMATED SYSTEMS

Further supplementation of this regulation is permitted. If supplements are issued, one copy will be furnished to the Commander, DARCOM, ATTN: DRCDE-C.

CHAPTER 1

GENERAL

1-1. Purpose. This regulation implements DOD Directive 5000.29 Management of Computer Resources in Major Defense Systems. It establishes policy and assigns responsibilities for the planning, development, acquisition, testing, training, and support of major and non-major Army battlefield automated systems employing computer resources.

1-2. Scope. a. This regulation applies to Headquarters, US Army Materiel Development and Readiness Command (DARCOM); DARCOM major subordinate commands (including subordinate installations and activities); DARCOM program/project/product managers; and separate installations and activities reporting directly to HQ, DARCOM.

b. The systems subject to the provisions of this regulation are those that employ computer resources and operate or have components that operate within the boundaries of the battlefield (Army battlefield automated systems).

1-3. Explanation of terms. See appendix A.

1-4. Objective. The objective of this regulation is to insure that computer resources in Army battlefield automated systems are planned, developed, tested, acquired, fielded, and supported in a cost effective and timely manner.

1-5. Policy. a. Computer resources in Army battlefield automated systems will be managed as elements of major importance throughout the entire system life cycle with particular emphasis on computer software.

b. Validation of computer resource requirements will be conducted during the Exploration of Alternative Systems Concepts and Demonstration and Validation Phases. In addition, computer resource requirements will be continuously coordinated and reconciled with system operational requirements throughout system acquisition.

c. Analyses will be performed prior to Milestone II to identify risk areas involving planned computer resources. The risk areas, and a plan for their resolution consistent with stated operational requirements, will be included in the Materiel Acquisition Decision Process documentation at the Milestone II review.

d. Systems will be compatible and interoperable with other systems employed by all US and Allied military forces where the system under development is to fill a need for such compatibility and interoperability. Interoperability and communications support requirements for using computer resources will be identified, defined, validated, and included in appropriate planning documentation during the Demonstration and Validation Phase.

e. Systems using computer resources, where applicable and cost effective, will include provisions for training simulations or programs.

f. Computer resources will be addressed as major elements during all system reviews.

g. Computer resource planning shall be initiated as early in the system life cycle as possible. Computer resource management will be included in the Outline Acquisition Plan. A Computer Resource Management Plan (CRMP) will be prepared for each Army battlefield automated system during the Demonstration and Validation Phase of system acquisition. The CRMP will identify important computer resource acquisition and life cycle planning factors and establish specific guidelines to insure that these factors are adequately considered in the acquisition planning process. The CRMP will be used to support the other formal planning documents required throughout the system life cycle, e.g., Integrated Logistic Support Plan and Coordinated Test Program. The CRMP is the primary document used to establish the necessary framework and support system for computer software control during production and post deployment. The CRMP will be tailored for each Army battlefield automated system. It will be implemented and maintained current throughout the system life cycle. The CRMP will be prepared by the materiel developer, in coordination with the combat developer, development and operational testers, development and operational evaluators, and designated readiness activity. System acquisition will not proceed into full scale engineering development until the CRMP has been prepared and approved.

h. The milestones of the materiel acquisition decision process will be used to manage the life cycle development of computer resources, including software, to insure the proper sequence of analysis, design, documentation, implementation, integration, test, training, operation, maintenance, and modification. The standard decision milestones (0, I, II, III) will apply in accordance with guidance contained in AR 1000-1.

i. Software quality and support will be addressed as a major consideration during all phases of the system life cycle.

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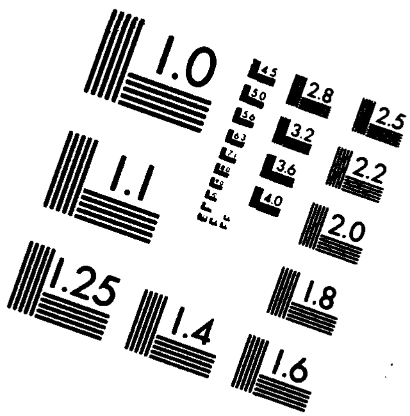

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j. Quality Assurance and Configuration Management procedures will be developed, specified in the CRMP, and implemented to assure proper assessment and control of computer resources and their requirements throughout the system life cycle. Army battlefield automated system computer resources, including both computer hardware and computer software, will be specified and treated as configuration items. The Configuration Control Board (CCB) will be the primary medium for managing hardware and software change control and release throughout the remaining system life cycle. Membership of the CCB will be determined by the materiel developer in accordance with the provisions of AR 70-37 and DARCOM Supplement 1 thereto.

k. A Computer Resources Working Group (CRWG) will be established by the materiel developer immediately after Milestone I for each system to aid in the management of the system's computer resources. The prime purpose of the CRWG is to assist the materiel developer in initiating early tasks and activities that are prerequisites to development and test functions (such as configuration management, system level testing and post development support.) The CRWG will assist in insuring the compliance with policy, procedures, plans, and standards established for computer resources. Membership will include the combat developer, materiel developer, development and operational testers and evaluators, and designated post deployment support activities.

l. Computer resources, including hardware, software, and support items, with associated documentation required for the development and support of operational systems, will be specified as deliverable items in all solicitation documents with the Government acquiring rights and data as specified in the Defense Acquisition Regulation (DAR).

m. Computer resources will be standardized to the extent practicable within each system as well as across systems.

n. Already developed computer resources will be used to the maximum extent practicable in Army battlefield automated systems.

o. Organic computer equipment maintenance and computer program development and maintenance capabilities will be established where economical or to satisfy system requirements. Common or existing capabilities will be used wherever practicable.

p. Army battlefield automated systems that include commercial computer re[illegible]es will be developed and managed in accordance with the provisions [illegible]'s 70-1, 700-127, 1000-1 and DARCOM Supplement 1 to AR 700-127.

q. DOD approved High Order Programming Languages (HOL's) (DOD Instruction 5000.31, will be used to develop all Army battlefield automated system software, unless it can be demonstrated that none of the approved HOL's are cost-effective or technically practicable over the system life cycle. The Assistant Chief of Staff for Automation and Communications (ACSAC), is the designated approving authority for exceptions to this policy. Request for approval of exceptions will be submitted through the Commander, DARCOM, ATTN: DRCDE-C.

r. Test support facilities required to test hardware, firmware and software for development, production and deployment will be included in system acquisition plans in accordance with the provisions of AR 70-1.

s. An inventory of computer equipment and computer programs included in Army battlefield automated systems will be maintained.

t. For all Army Battlefield Automated Systems employing computer resources, both software and hardware will be subject to:

(1) Formal materiel release certification procedures in accordance with DARCOM-R 700-34.

(2) Transitioning of management responsibility from the materiel developer to readiness command will be accomplished in accordance with DARCOM-R 70-1.

1-6. Responsibilities. The responsibilities and major functions of Headquarters, DARCOM and the DARCOM major subordinate commands are established in DARCOM-R 10 series. Specific responsibilities with respect to computer resource management in Army battlefield automated systems follows:

a. Headquarters, DARCOM. The Associate Director of Battlefield Automation Management within the Directorate for Development and Engineering, DARCOM, will be responsible for:

(1) The overall DARCOM computer resource management policy for Army battlefield automated systems to insure that policies and procedures for the management of computer resources are consistent with applicable policies, regulations, and directives.

(2) In conjunction with the Office of Laboratory and Development Management, develop, coordinate, and submit to Department of the Army (DA), the DARCOM Research and Development Technology Base Program for Computer Resources, to insure the availablity of advanced and innovative computer hardware and software technology necessary to support Army battlefield automated system needs.

(3) Reviewing and approving the CRMP for each Army battlefield automated system to insure proper planning and logistic supportability of the system throughout the life cycle.

(4) Coordinating the DARCOM computer resources and system engineering activities and programs for battlefield automated systems with TRADOC, and other Army/service commands as appropriate.

b. Subordinate Commands. The commanders of research and development commands, materiel readiness commands, and program/project/product managers, and separate installations and activities will (unless otherwise specified by an individual organizational responsibility):

(1) Prepare the CRMP to provide effective life cycle support for Army battlefield automated systems using computer resources.

(2) Provide the necessary support for fielded systems.

(3) Provide the development, test and evaluation of the necessary logistic support and insure that systems are supportable prior to fielding.

(4) Provide automated system accreditation authority in accordance with the provisions of AR 380-380.

(5) Implement the policies contained herein.

c. US Army Communications Research and Development Command (CORADCOM) Ft. Monmouth, NJ. The Commander, CORADCOM, will be responsible for:

(1) Standardizing computer equipment, computer programs, and supporting software among and within Army battlefield automated systems to insure optimum usage of available computer resources.

(2) Achieving and maintaining technical compatibility and interoperability among Army battlefield automated systems and those of the other services or allies for which such requirements have been identified.

(3) Maintaining an organic capability for the development, coordination, and DARCOM-wide implementation of computer resource management procedures, guidelines, and standards applicable to Army battlefield automated systems.

(4) Developing and maintaining the Army inventory of all computer equipment and computer programs included in Army battlefield automated systems.

(5) Providing the focal point for Defense system HOL efforts and the language control facility assigned to DARCOM for those DOD-approved languages under the Army purview in accordance with DODI 5000.31.

d. US Army Test and Evaluation Command (TECOM), Aberdeen Proving Ground, MD. The Commander, TECOM, will be responsible for developing the capability and methods necessary to:

(1) Support test and evaluation of Army battlefield automated systems during development and production (development test and First Article Test (FAT)). The extent of TECOM involvement in FAT will be as mutually agreed between TECOM and the test proponent.

(2) Determine system conformance with established requirements (performance, environmental, safety, human engineering, cost constraints, reliability, availability, maintainability, etc.).

(3) Conduct testing in a realistic environment whenever practical. However, when simulation or static testing is performed, emphasis should be placed on providing a controlled and reproducible test environment that stress the system design limits (worst-case testing).

(4) Participate in materiel release certification in accordance with DARCOM-R 700-34.

CHAPTER 2

LIFE CYCLE COMPUTER RESOURCE MANAGEMENT

2-1. General. The acquisition and support of computer resources in Army battlefield automated systems will be planned and managed as elements of major importance throughout the system acquisition process. Computer resource management requirements will be included in the life cycle system acquisition process and the associated documentation. The intent of this chapter is to insure that computer resources in Army battlefield automated systems are treated and managed as integral but subordinate parts of the overall system and not as separate or unique elements. To the extent feasible, computer resource management requirements promulgated in this regulation will be included in the acquisition process.

2-2. System life cycle. a. Systems containing computer resources shall satisfy all milestone and phase requirements of the System Life Cycle as defined in AR's 70-1, 700-127, 1000-1, and DARCOM Supplement 1 to AR 700-127. These regulations emphasize flexibility and require an acquisition strategy tailored to each individual program. In addition, special emphasis and interpretation will be applied at the major technical and systems milestones as indicated below.

b. Milestones definition and attainment criteria.

(1) Computer resources will be considered during each phase of the acquisition cycle and at each milestone. Development of computer resources necessitate clear specification of requirements, appropriate allocation of functions between hardware and software, and a division of large systems into manageable subsystems. The software milestones and attainment criteria emphasize those actions that must be satisfactorily completed prior to progressing from one system acquisition phase to the next.

(2) In all Army battlefield automated systems the hardware and accompanying software will proceed through the system life cycle concurrently. A system will not be approved for advancement to the next acquisition phase until both hardware and software have satisfied all requirements of the earlier phase. The following milestone attainment criteria is a summary of the additional requirements established herein for those systems containing computer resources:

(a) Milestone 0 - Decision for Program Initiation. The planning process begins with the identification of personnel having the requisite computer experience and skills required to conduct the investigation throughout the Exploration of Alternate System Concepts Phase.

(b) Milestone I - Decision to enter Demonstration and Validation Phase.

1. The Materiel Acquisition Decision Process (MADP) documentation (Outline Acquisition Plan (OAP)/Army Program Memorandum (APM)/Decision Coordination Paper (DCP) etc.,) will identify the potential computer resource implications and associated risk areas of the proposed system acquisition.

2. The System Specification (Type A, MIL-STD 490) must be prepared and the System Requirements Review completed prior to Milestone I.

3. Prepare a draft CRMP.

4. Computer resource considerations for milestone review are listed in appendix C.

(c) Milestone II - Decision to enter Full-Scale Engineering Development Phase.

1. Establish the CRWG.

2. The CRMP is updated, approved, and included as part of the MADP documentation.

3. The Development Specification (Type B-5, MIL-STD 490) is prepared and System Design Review completed.

4. Computer resource considerations for milestone review are listed in appendix C.

(d) Milestone III - Decision to enter Production and Deployment Phase.

1. Update CRMP.

2. Prepare Product Specification (Type C-5, MIL-STD-490) and perform Preliminary and Critical Design Reviews.

3. Computer resource considerations for milestone review are listed in appendix C.

(3) Technical Milestones and Attainment Criteria.

(a) System specification. A System Specification (Type A, MIL STD 490) will be prepared during the Program Exploration of Alternative System Concepts Phase by the materiel developer in coordination with the combat developer to establish the system baseline functional requirements. A technical review and evaluation (System Requirements Review) of this specification will occur prior to Milestone I. In cases where ASARC/DSARC I review is not required, the designated approval authority (AR 70-1) will coordinate the necessary technical review and approve entry into the Demonstration and Validation Phase. The System Specification will be placed under Government configuration management upon entry into the Demonstration and Validation phase and will be maintained under Configuration Management throughout the system acquisition.

(b) Development specification. A Development Specification (Type B, MIL-STD-490) will be prepared by the materiel developer prior to Milestone II or equivalent reviews. For systems with integral computer components, particular attention will be paid to the allocation of functions between computer and noncomputer resources. Functions allocated to software will be documented in the Computer Program Development Specification (Type B-5, MIL-STD-490). The Development Specification will establish the design necessary to implement, test, and maintain the functional requirements established in the System Specification. The Development Specification will be placed under Government configuration management upon entry into the Full-Scale Engineering Development phase and will be maintained under Government configuration management throughout the system life cycle.

(c) Product specification. A Product Specification (Type C, MIL-STD-490) will be prepared by the materiel developer prior to Milestone III review or prior to a development acceptance review for non-major systems. The Product Specification documents the details of system implementation for production and maintenance. The Computer Program Product Specification (Type C-5 MIL-STD-490) details the system software implementation, which in fact documents the system production software. The Product Specification will be placed under Government configuration management upon delivery and will be maintained under Government configuration management throughout the balance of the system life cycle.

(d) System requirements review (SRR). The objective of this review is to ascertain the adequacy of the contractor's efforts in defining system requirements. Independent validation of the system Specification (Type A, MIL-STD-490) shall be performed prior to approval. It will be conducted when a significant portion of the system functional requirements has been established. (AR 70-37 and DARCOM Supplement 1 thereto and MIL-STD-1521).

(e) System design review (SDR). This review shall be conducted when the definition effort has proceeded to the point (Type B-5 Computer Program Development Specification, MIL-STD-490) where system requirements and the design approach are more precisely defined, (i.e., alternate design approaches and corresponding test requirements have been considered and the contractor has defined and selected the required equipment, logistic support, personnel, procedural data, and facilities). This review shall be in sufficient detail to insure a technical understanding between the contractor and the procuring activity on: The system segments identified in the system specification and the configuration items identified in the Computer Program Configuration Item (CPCI) Development Specification(s) (AR 70-37 and DARCOM Supplement 1 thereto and MIL-STD-1521).

(f) Preliminary design review (PDR). A PDR will be conducted for each CPCI, or for a group of functionally related CPCI's. Its purposes will be:(1) evaluate the progress and technical adequacy of the selected design approach; (2) determine the CPCIs compatibility with the performance requirements of its development specification; and (3) establish the compatibility of the interfaces between the CPCI and other items of equipment for facilities. The PDR will be a formal technical review of the basic design approach. It will be conducted after approval of the development specification and after the accomplishment of preliminary functional design efforts, but prior to the start of detailed design. The PDR assures the CPCI functional flowcharts, memory allocation charts, control functions, and data base are adequate (AR 70-37 and DARCOM Supplement 1 thereto and MIL-STD-1521).

(g) Critical design review (CDR). The CDR will be a formal technical review of the detailed CPCI allocated Computer Program Component (CPC). This review established the integrity of the program design, at the level of detailed flowcharts or logical design, prior to coding and testing. It will be conducted for a single CPC, or for functionally related CPC's, when detailed design is essentially complete, and when the draft computer program product specification and test procedures (Type C-5, MIL-STD-490) have been prepared. The purposes of the CDR will be: (1) determine the detailed design of the CPC satisfies the performance and design requirements established in its development specification;

(2) establish the exact interface relationships between the CPC and other programs or items of equipment and facilities; and (3) review interactions with the data base. The draft product specification will be revised to reflect the recommendations of the CDR (AR 70-37 and DARCOM Supplement 1 thereto and MIL-STD-1521).

(h) Formal qualification review (FQR). A FQR will be held for each CPCI in order to establish that the end item software meets the contractual and performance requirements. The objective of the FQR will be to verify that the actual performance of the CPCI complies with its development specification, and to identify test reports and data that document the results of the program qualification tests. Input to the FQR consists of the final test results of each CPCI in an operational environment. The FQR will be conducted with the FCA, after the formal qualification tests, when sufficient test results are available to insure that the CPCI will perform in its system environment (AR 70-37 and DARCOM Supplement 1 thereto and MIL-STD-1521).

(i) Functional configuration audit (FCA). A FCA will be performed for each CPCI. This audit will be a formal examination of the CPCI functional characteristics and test data, which verifies that the CPCI has achieved the performance specified in the development specification. The FCA will be conducted with the FQR, after the formal qualification test has been completed. At the FCA, the test plans, procedures, and test results will be reviewed for compliance with specification requirements. The FCA determines whether all of the requirements have been met, and whether any tests should be repeated (AR 70-37 and DARCOM Supplement 1 thereto and MIL-STD-1521).

(j) Physical configuration audit (PCA). A PCA will be conducted for each CPCI to establish that the CPCI technical data package is complete, and that all physical items called for by the contract have been produced in the specified configuraton. The PCA will be conducted on a CPCI that is representative of the configuration specified as the production contract deliverable. A detailed audit of the product specification(s) and the physical items included in the technical data package will be performed. Approval of the Product Specification(s) establishes the product baseline (AR 70-37 and DARCOM Supplement 1 thereto and MIL-STD-1521).

2-3. Computer resource management plan (CRMP). A CRMP will be developed by the materiel developer in coordination with the combat developer, development and operational testers and evaluators and designated post deployment support activities prior to Milestone II and will be maintained throughout the system life cycle. The CRMP will be keyed to overall system acquisition milestones and schedules. The CRMP is the primary document to be used at all decision levels for assessment as to the adequacy of overall computer resource management efforts. The CRMP will be developed as an annex to the System Acquisition Plan and will be approved by the Commander, DARCOM, ATTN: DRCDE-C, prior to implementation.

a. The purpose of the CRMP is to identify computer resources acquisition and life cycle planning factors and to insure that these factors are adequately considered in the acquisition planning process. The CRMP (see app B for format) will address, as a minimum, the following:

(1) Responsibilities for integration of computer resources into the total system and the test and evaluation of that system to determine entire system quality and integrity.

(2) Computer programs required to support the development, production, deployment and post deployment support of the total system.

(3) Personnel requirements for developing and supporting computer resources.

(4) Provisions for the transfer of system management/operational/support responsibility from the materiel developer to the user/support organizations.

(5) Complete management planning for the acquisition, test, evaluation and post deployment support for all functions related to the computer resources in, or in support of, the Army battlefield automated system.

(6) The method by which the post development software support concepts/procedures are tested (supportability demonstration planning).

b. The CRMP will be tailored to the specific aspects and requirements of the Army system.

c. The CRMP is not intended to replace other required plans that support overall system requirements, e.g., Coordinated Test Program, Integrated Logistic Support Plan, Quality Assurance Plan.

2-4. Computer resource management. Requirements for computer resources evolve from overall system requirements as a result of applying system engineering disciplines. The system configuration which results must meet the total system functional requirements in the most cost-effective manner. This is accomplished by insuring every system element, including computer resources, is included in the total system optimization. Computer resources as such are considered to be an integral part of the system and are subject to trade-off and optimization in the same manner as other system elements. Therefore, the management of computer resources is accomplished in the larger context of the overall system program technical and management efforts. The areas covered below will be considered in the development of the overall system plans and will be specifically addressed in the CRMP. Type classification of Army battlefield automated systems containing computer resources will be done in accordance with the provisions of AR 70-61.

a. System engineering management.

(1) The materiel developer will be responsible for managing the total engineering effort during the system life cycle. The materiel developer will assure that system engineering applied to computer resources is adequately planned, executed and evaluated, and will result in computer resources that meet operational and support needs.

(2) Computer resource requirements validation and risk assessment will be managed as key elements of the system engineering management effort, integral to overall system acquisition.

(3) The principal products produced by the materiel developer during the system engineering effort are the System Specification, Development Specification, Product Specification for the system's configuration items (MIL STD 490), and technical documentation, such as trade-off study reports, test documentation, and user/operator documentation.

b. Requirements validation. The objective of computer resource requirements validation is to assure requirements and specifications are consistent, sufficient, and unambiguous. During the Demonstration and Validation Phase the materiel developer will address computer resource requirement validation as an integral part of the overall system requirements validation. Computer resource requirements must be validated prior to the approval of development specifications. The validation process will include the approach to be used in insuring the systems specifications meet the user requirements. This validation process will insure that:

(1) System operational concepts and approved mission profiles are available.

(2) The system functions allocated to computer resources are clearly identified and attainable, and traceable to the system requirements specification.

c. Risk analysis and management. Risk analysis and management, which includes elements of risk identification, planning, analysis, evaluation, resolution, and review, will be completed for computer resources prior to Milestone II. Computer resource risk analysis and management will be closely coordinated with the requirements validation effort and the overall systems engineering effort to assure that the risks associated with achieving validated cost, schedule, and technical performance requirements are identified and assessed in advance, are within acceptable thresholds, and are continuously monitored and reported during subsequent development.

d. Contracting. The contracting strategy, planning, and techniques for acquiring computer resources will be stated in the CRMP. All proposed Army contracts for system/major item acquisition, modification, or support will conform to the provisions of paragraph 1-5.1 and will specify specific data items to be delivered. Full-scale engineering development contracts for systems including computer resources will not be awarded prior to approval of CRMP.

e. Configuration management (CM).

(1) CM is a discipline applying technical and administrative direction and surveillance throughout the systems life cycle.

(2) CM is intended to:

(a) Assist the materiel developer in achieving, at lowest possible life cycle cost, the required performance within realistic schedules while insuring the operational efficiency of the configuration item (CI).

(b) Allow the maximum degree and development latitude yet introduce at the appropriate time the degree and depth of management and earliest technical control of configuration items necessary for effective development and follow-on production and logistic support.

(c) Attain maximum efficiency in the management of configuration changes with respect to their necessity, cost, timing, and implementation. The materiel developer will design and tailor the configuration management program in accordance with AR 70-37. Specifically, computer software, as well as computer hardware, will be specified and treated as separate configuration items. The configuration management procedures specified in AR 70-37 and DARCOM Supplement 1 thereto will provide for categorizing all software modifications, implementing changes, assessing changes, determining level of testing/validation effort, and controlling release of new software system versions to the distribution points. The CCB will be responsible for establishing and maintaining a record of all computer software configuration change actions. The record must be in sufficient detail to provide an audit trail, document the technical evaluations and CCB decisions, and provide a current configuration status of the CPCI.

(3) For the purpose of controlling and validating software changes/modifications, the CCB will be responsible for determining the validity of all proposed changes/modifications to an Army Battlefield Automated System, approving/disapproving, and classifying the approved proposals into the following categories: (A clear distinction will not always be available; however, classification responsibiilty rests with the CCB. The CCB decision rationale will be entered into the change action record.)

(a) System refinement software changes usually deal with program optimization, error correcting, improving system performance, and incorporating technological advances. Changes of this nature usually do not deal with major changes in application. Included in this category, however, are evolutionary modifications to major weapon system tactical software in response to evolving/changing tactical doctrine and threat.

(b) New requirement are program modifications which result from major changes or new applications.

(c) Interoperability interface configuration changes/modifications are those affecting the design baseline of those systems controlled by Battlefield Interface Implementation Plans, Interoperability Design Standards, or Army Technical Interface Design Plans.

(4) Those proposed changes/modifications classified as interoperability interfaces must be forwarded to the Army Interoperability Configuration Control Working Group/Steering Comittee for approval to implement. The implementation of approved interoperability interface changes/modifications will be in accordance with the instructions provided by the approving authority. The implementation of changes/modifications not classified as an interoperability interface will be handled as follows:

(a) Changes categorized as new requirements are to be managed as a Product Improvement Proposal (PIP) in accordance with AR 70-15. The cost of product improvements will be carefuly weighed against the expected improvements in reliability, maintainability, operational readiness, and operational capabilities and effectiveness within the remaining life cycle.

(b) Software changes in the system refinement category will be recycled back into the Full-Scale Engineering Development Phase and all software documentation will be reviewed and updated accordingly. All systems refinements changes will not necessarily require the same magnitude of effort for incorporating and validating the change. The nature of the change/modification will dictate the level of effort necessary to implement and the magnitude/type of test program necessary to validate the changes. After completion of the verification testing, the configuration change(s) will be documented by an Engineering Change Proposal (ECP) with the necessary accompanying documents, e.g., Notice of Revision (NOR), test reports, technical evaluations (MIL-STD's 480, 481, 482, and 483). The new software version that results from a change or group of changes may reenter the Production and Deployment Phase after the combat developer concurs in the adequacy of the testing and the CCB approves the ECP. Prior to the issue of a new software version to the field, the materiel developer must complete a formal release certification in accordance with DARCOM-R 700-34. The ECP, CCB decisions, combat developer's concurrence, and release certification will be made part of the change action record.

f. Test management (TM).

(1) Computer resource testing will be accomplished throughout the life cycle of a system to provide data relative to the state of the system development or operation of the computer resources segment of the system. Proper TM will assure that timely and adequate testing is performed to verify required technical and operational capabilities of the computer resources as well as the overall system and system interfaces.

(2) Materiel developers will prepare TM plans, as early as possible, and will summarize overall TM efforts in the Computer Resource Management Plan. The Coordinated Test Program (CTP) will continue to be the basic document to address test and evaluation of the Army battlefield systems, including those which contain computer resources. Computer resources will be specifically addressed in all:

(a) Development Tests (DT's), Operational Tests (OT's), Test Design Plans (TDP's), and Outline Test Plans (OTP's).

(b) Independent Evaluation Plans (IEP's).

(c) Government performed Engineering Design Test Plans pertaining to computer resources.

(d) Contractor test plans pertaining to computer resources.

(3) Test planning for computer resources will insure that testing is adequate and not redundant throughout the life cycle; that support equipment/software instrumentation including such items as test drivers, data records, and monitors are validated, placed under configuration control, and acquired in a timely manner.

(4) Test planning will also provide for an independent assessment and evaluation of the contractor's computer resources performance demonstration testing by the materiel developer prior to acceptance for Government testing.

(5) Computer resource test planning and management as contained in the CRMP and CTP will be reviewed by the Computer Resource Working Group prior to Milestone II.

(6) Test support facility requirements will be considered as an integral part of the overall system acquisition and will be designed to be used throughout the system life cycle. As a minimum, test support facilities will include the necessary computer hardware, software, environmental simulators, hardware and software monitors, test case generators and analyzers, training aids, and collection and data reduction equipment required to demonstrate and validate system performance and provide for system maintenance. Test support facility requirements to be provided by the developing contractor will be included as deliverable items on the contract and will be consistent with those test support requirements necessary for Government development and operational test and system post deployment support. If practicable, Government-owned test support facilities and equipment will be made available for contractor use during the Demonstration and Validation and Full-Scale Engineering Development phases of the system acquisition in order to prevent duplication.

(7) Test planning during the production and post deployment phase will be designed in accordance with the following provisions:

(a) Acceptance testing is mandatory for revalidation of all new versions of computer software irrespective of the impetus for the change, i.e., system refinement, new requirement.

(b) Prior to the issuance of any new versions of computer software to the field, the new software version must undergo formal release certification, in accordance with DARCOM-R 700-34.

g. Quality assurance.

(1) The materiel developer will develop independent assessment procedures to insure that the product will meet management policies and appropriate regulations, conform to standards, and meet performance and quality requirements throughout the life cycle.

(2) Product assurance for systems using computer resources will be achieved by performing continuous assessments throughout the system life cycle, in accordance with the guidance delineated in DA PAM 11-25. The contractor's Software Quality Assurance Program (MIL-STD 52779 (AD)) must be approved by the Government prior to software development. Those assessments include reviews, audits, verification, testing, and enforcement activities applied to procedural and to product aspects of the system development. Results of assessments will be documented and will be subject to Materiel Acquisition and Decision Process (MADP) reviews in accordance with the guidance contained in chapter 2, AR 70-1.

(3) Computer resources product assurance planning will be addressed in the CRMP. The Product Assurance Plan called for in AR 70-27 will continue to be the primary document for overall system product assurance planning. As a minimum, the CRMP will include:

(a) System project organization and interface among the system development community including responsibilities of the members and interface control documents, specifically as regards the computer resources.

(b) Policies, procedures, and tasks to be implemented to assure proper assessment and control of computer resources and their requirements, both performance and quality, throughout the system life cycle.

h. Data management.

(1) Computer resource documentation will include only that documentation required by computer resource regulations, standards, and management policies and procedures that are necessary for the disciplined control of the development and complete description of the product.

(2) Documentation will include both technical data addressing the computer resource produce and its support, management data necessary for the control of the system development, and documentation acquired from contractors as products of the various life cycle phases.

(3) Computer resource data management planning will be addressed in the CRMP. Computer resource data management planning will include those

policies and procedures necessary for effective life cycle management of data pertaining to the system's computer resources.

i. Integrated Logistics Support (ILS). ILS is the process through which logistic considerations are integrated into the design effort and all elements of the logistic support system are planned, acquired, tested, and deployed.

(1) Materiel developers will establish internal policy, procedures, and techniques for integrating life cycle logistic support considerations into the Army's battlefield systems for computer resources, under the provisions of AR 700-127 and DARCOM Supplement 1 thereto.

(2) The materiel developers, in coordination with the combat developers and training and support elements, will determine overall aspects of the ILS concept for computer resources. In establishing the ILS concept for computer resources, the following will be considered:

(a) Current and proposed changes in maintainability, supply and maintenance, doctrine, concepts, organization, and procedures, applicable to the anticipated environment for the computer resources.

(b) Use of common computer support software and test facilities for use during all phases of system acquisition.

(c) The identification of appropriate support parameters, life cycle support cost goals, and limits on the requirements for logistic resources.

(d) Indentification of qualitative and quantitative personnel requirements information.

(e) Establishment of procedures for the use of computer assisted repair part maintenance and diagnostics.

(f) Development of support software.

(g) Estimation of life cycle operating and support costs for computer resources, and their inclusion in total system life cycle cost assessments.

(h) Refinement and evaluation of alternative computer resource logistic support concepts and establishment of the selected baseline support concepts.

(i) Documentation of the results of computer resource logistics planning and analysis by updating the computer resource portion of the Plan for Support, section VI of the Acquisition Plan.

(j) Analysis of the supportability of firmware/software requirements in terms of possibie enhancements or requirements changes.

(k) Assurance of the sufficiency of technical publications necessary to operate, maintain, and train for the operational computer programs (and their support computer programs), Automatic Test Equipment (ATE) computer programs, and training computer programs.

(1) Planning for post deployment software support will be initiated prior to Milestone II. Support software as deliverables will be specified prior to entering the Full-Scale Engineering Development Phase. Newly developed support software documentation will comply with MIL-STD-490. Existing support software should meet good commercial documentation practices. The CRMP will address the post deployment issue and will include an estimate of the resources for support equipment, applications software, software support, and personnel required to maintain/modify the fielded system. The organization responsible for post deployment software support will also be identified at this time. The software support facility will be responsible for maintaining a software malfunction reporting system for assessing software performance and determining necessary modifications. The CRMP will also address software changes during the post deployment phase and discuss the methods to be used for validation to the satisfaction of the user prior to any release for field usage.

(3) The logistic support of computer resources will be included as a topic of major importance at each Logistic Command Assessment of Projects (LOGCAP) briefing/reviews (DARCOM-R 1-41 and DARCOM Supplement 1 to AR 700-127).

j. Training. Planning for training of personnel to operate, test, maintain, and modify computer resources will be initiated early in the system life cycle. The CRMP will address all aspects of personnel training involving computer resources. Maximum consideration will be made to use the system computer resources for training in the field and in garrision.

k. Personnel. Personnel requirements for all DARCOM organizations directly involved in the development and support of computer resources for the system will be identified in the CRMP. As a minimum, this should cover the project office and training, operation, maintenance, test, configuration management, and post deployment support activities. Separate estimates will be made for military, civilian, and contractor personnel for the development and support phases.

l. Deployment planning. A materiel fielding plan will be prepared that includes a complete system description, logistic support management, system support details including the maintenance concept and integrated logistics support, and support required from the gaining command including communication requirements, necessary to deploy and support the system in any tactical environment.

m. Compatibility and interoperability.

(1) Compatibility and interoperability requirements of Army battlefield automated systems which include computer resources will be addressed throughout the system's life cycle. There will always be a continuum of Army battlefield automated systems, for which interoperability requirements have been identified, existing in all phases of the system acquisition process. A similar continuum of communications necessary to support these Army battlefield automated systems will also exist. A highly coordinated management effort is crucial to insure the concurrent availability of the Army battlefield automated systems for which interoperability requirements and supporting communications systems requirements are met. Systems planning and development must also be consistent with joint and allied forces requirements for interoperability, compatibility, and integration of Army battlefield automated system concepts, operating procedures, software programs, and communications, including those systems that interact and operate with other services or allied forces systems.

(2) Army battlefield automated systems compatibility and interoperability requirements will be defined, developed, and tested as an integral part of the life cycle system acquisition process. The combat developer will identify potential Army battlefield automated system compatibility and interoperability requirements in the initial requirements document, e.g., MENS, LOA, LR, or ROC. This will include potential joint and friendly forces systems requirements, as well as intra-Army system requirements.

(3) For those Army battlefield automated systems that include computer resources, the Computer Resource Working Group, in coordination

with representatives of other services or friendly forces as applicable, will develop as a part of the system CRMP the interoperability, compatibility, and communications requirements and identify the resources and schedules necessary for their effective development, implementation, and support.

(4) The materiel developer, in coordination with the combat developer, will insure that all Army systems for which interoperability requirements have been identified are included in the overall Army Interoperability Plan (AIP) and will recommend to HQ, DARCOM those systems that must be included in joint or friendly forces interoperability programs. The materiel developer will insure that interoperability resource requirements of interfacing systems, to include the supporting communications, are properly coordinated during system development, and that system interoperability is tested and verified prior to request for production decision.

(5) Interoperability plans will be included in operational tests and will be reviewed at Milestones II and III.

(6) Technical and operational interoperability configuration control for Army battlefield automated systems is the responsibility of the materiel developer in coordination with the combat developer for intra-Army systems and as designated by appropriate authority for joint or friendly force systems.

n. Validation and verification. The primary objective of the computer resources requirements validation efforts is to insure that the stated requirements for total computer resources generated during the Demonstration and Validation phase are complete, consistent, and unambiguous, and will result in a system that meets the stated operational needs of the user and can be supported in the field. The computer resource related technical, cost schedule, and performance risks associated with the system as based on the stated and validated computer resource requirements, will be addressed in the CRMP. The verification of computer resource requirements will include necessary planning and execution by the materiel developer of those monitoring and test activities that will ascertain that the system fulfills the stated requirements. Included will be sufficient tests, through simulation and actual executions, to determine that the system performs correctly against the previously validated requirements.

2-5. Standards. a. General: Computer resource management standards such as MIL-STD, FIPS, FED STD, and approved non-Government standards, for measuring software performance shall be adopted on a project by project basis by the materiel developer. These standards are categorized in subsequent paragraphs.

b. Computer resource planning standards. These standards shall provide specific detailed guidance for developing and maintaining the CRMP throughout the life cycle.

c. Specification standard. These standards shall provide guidance on the format, structure, and content of computer program functional and performance specificaton (TYPE A System Specification), computer program development specifications (TYPE B-5 Development Specification), and computer program product specifications (TYPE C-5 Product Specification).

d. Documentation standards. These standards shall specify the structure and content of the external documentation set. They shall provide standards and guidance for developing and maintaining the software documentation set, and define in detail the specific content of each document required, and how, when, and where it should be produced throughout the life cycle.

e. Programing standards. These standards shall provide guidance for writing and maintaining computer programs. Standards for specific languages will include rules to be followed when writing programs in that language.

f. Quality control standards.

(1) Testing standards. These standards shall provide guidance for the development and maintenance of software test facilities and instrumentation to be used during development and validation of changes throughout the system life cycle.

(2) Configuration management standards. These standards shall provide guidance for the implementation and control of configuration management practices as they apply to software driven systems. They shall also provide policies and procedures for maintenance, refinement, and enhancement of a system that is in production at multiple installations that are geographically separated.

Appendix A

EXPLANATION OF TERMS

A-1. ARMY BATTLEFIELD AUTOMATED SYSTEM. A system employing computer resources that operates or has components that operate within the boundaries of the battlefield regardless of the function, mission, or battle involvement. The system may be an offensive, defensive, or direct/indirect support system. Examples of such systems are weapons, communications, command and control, intelligence, avoinics, missiles, combat support, and combat service support systems.

A-2. AUTOMATIC DATA PROCESSING EQUIPMENT (ADPE). This includes general purpose electronic data processing equipment (EDPE) and punch card machines (PCM or EAM) irrespective of use, application, or source of funding, and includes ADPE built to Government specifications.

A-3. COMBAT DEVELOPER. The agency or command responsible for the formulation of concepts, doctrine, organization and materiel objectives, and requirements for the employment of US Army Forces in a theater of operations and in the control of civil disturbances. The combat developer formulates Army functional systems (logistics, personnel, administrative, and others, as designated) which impact directly on or extend into a theater of operations. The US Army Training and Doctrine Command (TRADOC) is the Army's principal combat developer.

A-4. COMPUTER. Electronic machinery, which by means of stored instructions and data performs rapid complex calculations or compiles, correlates, and selects data. Examples are analog and digital processors, data processors, information processors, real-time control processors, electronic calculators, hybrid computers, communications processors, and microprocessors.

A-5. COMPUTER DATA. A representation of facts, concepts, or instructions in a structured form suitable for acceptance, interpretation, or processing by communication between computer equipment. Such data can be external to (in computer-readable form) or resident within the computer equipment and can be in the form of analog or digital signals.

A-6. COMPUTER EQUIPMENT/COMPUTER HARDWARE. Devices capable of accepting and storing computer data, executing a systematic sequence of operations on computer data or producing computer outputs. Such devices can perform substantial interpretation, computation, communication, control, or other logical functions. Examples are central processing units, terminals, printers, analog/digital converters, tape drives, disks, drums, microprocessors, and automatic test equipment.

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A-7. COMPUTER, GENERAL PURPOSE. A computer designed to solve a large variety of problems, e.g., a stored program computer that may be adapted to any of a very large class of applications.

A-8. COMPUTER FIRMWARE. Programs or instructions that are stored in read only memory; firmware is analogous to software in unalterable form.

A-9. COMPUTER PROGRAM. A series of instructions or statements in a form acceptable to computer equipment, designed to cause the computer equipment to execute an operation or operations. Computer programs include operating systems, assemblers, compilers, interpreters, data management systems, utility programs, sort-merge programs, and maintenance/diagnostic programs, as well as applications programs such as payroll, inventory control, operational flight, satellite navigation, automatic test, crew simulator, and engineering analysis programs. Computer programs may be general-purpose in nature or be designed to satisfy the requirements of a specialized process or a particular user.

A-10. COMPUTER RESOURCES. The totality of computer equipment, computer programs, computer data, associated computer documentation, contractual services, personnel, and computer supplies.

A-11. COMPUTER SOFTWARE. A combination of associated computer programs, documentation and computer data required to command the computer equipment to perform computational or control functions.

A-12. COMPUTER SOFTWARE DOCUMENTATION. Technical data, including computer listings and printouts in human-readable form, that documents the design or details of computer software, explains the capabilities of the computer software, or provides operating instructions for using the computer software to obtain desired results from computer equipment. For the purposes of documentation, the term software includes all information, data, analysis, algorithms, etc., that have been generated, acquired, or applied in developing computer programs for the system and system support equipment. This includes specifications, functional descriptions, design analysis, program coding, flow charts, algorithms, interface definitions, technical manuals, source and object decks and listing, test plans/procedures/reports, and support programs and their documentation.

A-13. COMPUTER SYSTEM. An interacting assembly consisting of computer equipment, computer programs, and computer data.

Appendix A--Continued

A-14. COMPUTER SYSTEM DOCUMENTATION. Information that describes the technical details of the computer system over its life cycle. Documentation includes, but is not limited to, equipment design specifications, engineering drawings, operators manuals, technical orders, computer software documentation, systems specifications, run diagrams, and interface specifications.

A-15. CONFIGURATION ITEM (CI). An aggregation of hardware/software, or any of its discrete portions, that satisfies an end use function and is designated by the Government for configuration management. CI's may vary widely in complexity, size, and type from an aircraft, electronic, or ship system to a test meter or round of ammunition. During development and initial production, CI's are only those specification items that are referenced directly in the contract (or an equivalent in-house agreement). During the operation and maintenance period, any repairable items designated for separate procurement is a configuration item (DOD Directive 5010.19).

A-16. EMBEDDED COMPUTER RESOURCES. The totality of computer resources that form a subsystem or part of an Army battlefield automated system e.g., intelligence collection system, target acquisition system, or weapon system. (For the purposes of this regulation the term "Embedded Computer Resource" is replaced by "Army battlefield automated system" as defined in para A-1.)

A-17. INDEPENDENT ASSESSMENT. The assessment of a system or subsystem by an organization that is independent of the combat developer and the materiel developer.

A-18. INDEPENDENT EVALUATION. The evaluation of a system or subsystem by an organization that is independent of the combat developer and the materiel developer.

A-19. INTERNAL SYSTEM CONTROL. Any device(s) automatic or manual, that controls the operation of a system without external stimulus.

A-20. MATERIEL DEVELOPER (OR DEVELOPING AGENCY). The command or agency responsible for research, development, and production validation of an item (including the system for its logistic support) which respond to DA objectives and requirements (table 6-1, AR 70-1).

A-21. FIRST ARTICLE TEST. That test and evaluation of production items to demonstrate that items delivered fulfill the requirements and specifications of the production contract or agreement.

A-22. SOFTWARE QUALITY. Attributes of a software package other than performance requirements that indicate the character of the software;

usually defined in terms of quality factors, e.g., correctness, reliability, acceptability, flexibility, efficiency, human factors engineering, integrity, and testability.

A-23. SYSTEM ACQUISITION PLAN. The basic management document for all Army materiel acquisition programs supported by an approved materiel requirement, regardless of the level of the MADP review/approval.

Appendix B

COMPUTER RESOURCE MANAGEMENT PLAN (CRMP)

Development of the Computer Resource Management Plan (CRMP) will begin as soon as it is determined that computer resources will be used to support the satisfaction of stated system functional requirements. The CRMP will be an annex to the System Acquisition Plan and will consist of six sections as follows:

CRMP		Related Sections of Acquisition Plan
Section I	General	Section I
Section II	Program Management	Section III
Section III	Acquisition Management	Section III
Section IV	Development Management	Section III
Section V	Coordinated Test Program Mgt	Section IV
Section VI	Plan for Support	Section VI

B-1. Section I, General. This section will provide an overview of the overall system requirement and the relationship thereto of the proposed computer resources. Any unique operational or technical system requirement that could affect the development or use of the proposed computer resources should be indicated.

B-2. Section II, Program Management. This section will be prepared immediately upon the determination that computer resources are required in the system. This would normally occur during the Demonstration and Validation phase. It is to address the organizations and personnel involved in the management of computer resources. As a minimum, this section will contain:

a. Identification of computer resources technical and managerial expertise responsible to the program manager for managing the acquisition of subsystems that contain computer equipment and computer programs. This includes management expertise to focus attention on computer program development and integration across the total system.

b. Identification of management responsibility for the integration of computer equipment and programs with the rest of the system.

c. Identification of computer programs development and support requirements, including use of Government-funded equipment and facilities.

Appendix B--Continued

d. The extent, within each system as well as across systems, to which computer equipment and computer programs will be standardized.

e. A plan for development and/or modification of computer software or equipments covering definition of requirements, development, audits, testing, and maintenance.

f. Plans and justification for acquisition of any support equipment (e.g., a simulation facility) that is required.

g. A plan for the functional analysis and trade-off studies to be employed to minimize risk in the development of computer equipment and computer software.

h. An indication of the extent to which existing systems, existing equipments and proven concepts will be used.

i. An evaluation of the systems capacity to provide for growth consistent with anticipated change to the system capabilities and an indication of the resources required for and risk associated with computer program support throughout the system life cycle.

j. Identification of projected computer equipment and computer program development costs, including appropriate work breakdown structures.

B-3. Section III, Acquisition Management. This section will be prepared during the Demonstration and Validation phase. It will address the computer resource acquisition strategy, the participation of the combat developer, materiel developer, development and operational testers and evaluators, and designated post deployment support activities, the risks involved, and trade-offs to be considered. In addition, it will address the adequacy, consistency, and firmness of requirements driving the computer resource development. This section is prepared by the materiel developer in coordination with the aforementioned participating commands and activities. It includes complete management planning for the acquisition and support of the computer resources. If additional computer resources are identified later in the program, a change to this section will be published covering such resources. As a minimum, this section will contain:

a. Identification of technical and managerial expertise allocated to the program office for the acquisition management of computer equipment and computer programs.

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b. Operational and support concepts for computer programs based upon studies, economic analyses, experience, and participating activity inputs.

c. The system engineering approach to be followed in allocation of operational needs to computer resources.

d. A discussion of the appropriate trade-offs between hardwired digital processing equipment and programmable computer. The discussion should include design risk, system integrity, and life cycle cost.

e. Standardization and commonality considerations used in determining computer equipment and computer program requirements.

f. Requirements for computer program and data rights consistent with the planned operational and support concepts.

g. A master schedule of major milestone, key events, and any critical actions essential to timely development of computer resources in relation to the total system acquisition schedule and identified risk areas.

h. Identification of required interfaces between the computer resources of the system and other systems.

i. Identification of the requirements for growth capability and spare processing capacity.

j. Requirements for acqusition and support of documentation.

k. Requirements for simulation, integration, and other facilities necessary to support computer programs.

l. Configuration management concepts for the system; computer hardware; support, diagnostic and application software; and intersystem interfaces.

m. Criteria for the transfer of program management responsibility and system/equipment turnover and support.

B-4. Section IV, Development Management. This section will be prepared during the Demonstration and Validation phase. It will address the

Appendix B--Continued

approach for the development of computer resources, tools to be used, necessary facilities, and cost and schedules. This section will identify the actions necessary for the development and delivery of computer program configuration items and necessary support resources. It is prepared by the materiel developer or his contractor. Supporting detail will appear in the Acquisition Plan (see AR 70-27). As a minimum, this section will contain:

a. The organization, responsibilities, and structure of the group(s) that will be designing, producing, and testing all computer programs.

b. The management and technical controls that will be used during the development, including controls for insuring that all performance and design requirements have been implemented.

c. The methodology for insuring satisfactory design and testing, including quality assurance.

d. The development schedule for each computer program configuration item and proposed program milestone review points.

e. The procedure for monitoring and reporting the status of computer program development.

f. The resources required to support the development and test of computer programs. Special simulation, data reduction, or utility tools that are planned for use in the development of computer programs should be identified.

g. The general procedures for reporting, monitoring, and resolving computer program errors and deficiencies during development and testing.

h. The methods and procedures for collecting data, analyzing, monitoring, and reporting on the timing of time critical computer programs.

i. The management of previous, current, and proposed versions of computer program masters, data bases, and associated documentation, including their relationship to the configuration management plan.

j. Guidelines and checkpoints for insuring future computer program growth, modularity, and ease of modification.

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k. The approach for developing computer program documentation.

l. Training requirements and associated equipment for the deployment phase.

m. Engineering practices to include: standards, conventions, procedures, rules for program design, program structures and conventions, display and logic standards, input/output signal standards, and other disciplines affecting development.

n. Security controls and requirements.

o. Simulation techniques and tasks.

p. Schedule and description of the technical milestones listed in paragraph 2-2.b.(3).

B-5. Section V, Coordinated Test Program Management. a. This section will address the issue of the management of the test and evaluation of computer resources in the system. It will contain a plan and schedule for development of test plans for testing, validation, and verification.

b. Preparation of this section will be by the Test Integrated Working Group (TIWG) during the Demonstration and Validation phase. Supporting data will appear in the Coordinated Test Program (see AR 70-10 and DA PAM 70-21).

c. As a minimum, this section will contain:

(1) The responsibilities and interrelationships among the combat developer, materiel developer, contractor, developmental and operational testers and evaluators, and designated post deployment support activities during the various levels of software testing.

(2) The identification of the organizations or activities responsible for the independent software testing (validation and verification).

(3) The development/acquisition schedule for any special test tools required, e.g., driver, monitors, emulators, and whether they will be Government-furnished or contractor-developed.

(4) The schedule for the development and use for simulation models (Functional System, Computer System and Engineering Models).

(5) Test requirements analysis' methodology and associated schedules.

(6) Methodology and schedule for the development of Benchmark Test Cases for the various levels of software testing.

(7) The software monitoring design plan.

(8) Procedures for reporting and resolving computer program errors and deficiencies during testing.

(9) Plan for the conduct of the supportability demonstration of the post deployment software support facilities. The supportability demonstration plan will delineate and specify the requirements for the testing procedures, internal and external interfaces, equipment, and personnel as well as the methodology to be used to verify compliance with the requirements. The plan should exercise the support capability in real-time to permit assessment and certification of its adequacy for the post deployment phase.

(10) Schedules for test plans and testing.

B-6. Section VI, Plan for Support. This section will address the issues of computer resource support, particularly software support after deployment and will be prepared by the materiel developer during the demonstration and validation phase. The organizational relationships and responsibilities for the management and technical support of computer resources will be identified. This section identifies the computer resources necessary to support computer programs after transfer of program management responsibility to the receiving readiness command and system deployment to the field. This section also addresses the basic agreements between the supporting and using commands for management and support of computer resources. The following items should be included, as applicable:

a. Offices of primary responsibility and management focal points for support of computer resources and the channels of communication among organizations.

b. Planning for the configuration management of computer programs, including the assignment of configuration control responsibilities during the deployment phase. This planning will reflect the operational and support concepts for the system.

Appendix B--Continued

c. Responsibilities for composite system integrity that includes:

(1) Computer storage use.

(2) Computer program operating time and priorities.

(3) Computer program interface techniques.

(4) Computer program baseline integrity.

(5) Use of computer modules and peripherals.

d. Documentation required to support each type of computer program.

e. Responsibility for funding, scheduling, and system integration.

f. Qualified personnel required for supporting computer equipment and computer programs together with associated training requirements.

g. Computer equipment and devices required to facilitate computer program changes, including acquisition responsibilities.

h. Computer programs required to support computer equipment and other computer programs, including acquisition responsibilities.

i. Verification and validation of computer programs.

j. Plans to establish and operate necessary support facilities. Common and existing facilities will be used whenever practicable. The size and scope of the support facility will be based on workload predictions.

k. Provisions for the transfer of program management responsibility.

l. Provisions for system/equipment deployment.

Appendix C

SYSTEM ACQUISITION REVIEWS

The following questions concerning the management of computer resources are applicable to the development and acquisition of all Army battlefield systems that include computer resources. The questions supplement the milestone checklists in AR 15-14.

C-1. Milestone I Reviews. a. General.

(1) What steps are being made to insure software visibility?

(2) What other computer/communication systems will the system have to interface with? Is enough known about these other systems to allow design for interoperability?

b. Operational requirements. When will a validation of the computer resources requirements, including software, be conducted? How will the risk analysis be performed?

c. Life cycle management.

(1) How will post deployment support be handled (by contractor or Government personnel)? When will the system life cycle support activity be designated? Who is the designated system life cycle support activity?

(2) Will Operating and Maintenance, Army (OMA) funds be requested to support contractor activities directed toward providing maintenance capabilities and documentation? How will maintenance provisions be specified? When? How will support requirements be determined?

(3) Is any computer hardware unique? If so, how will replacement parts be obtained?

d. Tradeoffs.

(1) How will hardware/software tradeoffs be made?

(2) How will the processor architecture be determined?

(3) How will the processor capacity be determined?

Appendix C--Continued

(4) How will excess memory, processor time, and capability needs be determined?

(5) Will use of computer reduce or increase personnel requirements?

(6) System tradeoffs as a result of cost-benefit analysis.

e. Use of existing hardware and software

(1) Can presently available technology (computer, sensor, and control) be used? Can state-of-the-art technology be used? What special tasks must be performed in advanced development to perfect these new technologies?

(2) How much of the system design can be obtained "off-the-shelf" or plagiarized from previous systems?

f. Possible future problem areas.

(1) Has preliminary systems analysis been performed? What hardware and/or software problem areas have been defined as a result of this preliminary analysis? How will they be handled during advanced development?

(2) What critical questions and areas of risk must be resolved during Program Demonstration and Validation Phase? What are the test objectives schedules, and milestones to be used to determine required information?

(3) Are any risk areas envisioned not previously mentioned? What are your plans to resolve these problems?

(4) Have any system interfaces and supporting communications requirements been identified? Has coordination been effected to insure the availability of these interfaces or communications?

C-2. Milestone II Reviews. a. Operational Requirements.

(1) Have the Type B-5 Computer Program Development Specifications been completed, and is there a cross reference of Operational Requirements to Computer Program Specifications?

(2) How will the system design be validated prior to implementation?

Appendix C--Continued

(3) Was the validation of the computer resource requirements, including software, conducted? How was risk analysis performed?

(4) How will interoperability and communications be tested?

(5) How will you insure that the planned computer resources will meet stated operational requirements?

b. Life cycle management.

(1) How will post development support be handled (by contractor or Government personnel)? When will the system life cycle support activity be designated?

(2) Will OMA funds be requested to support contractor activities directed toward providing maintenance capabilities and documentation? How will maintenance provisions be specified? When? How will support requirements be determined?

(3) Is any computer hardware unique? If so, how will replacement parts be obtained?

(4) What steps have been planned for the software "turnover" from the contractor to the Government?

(5) How will the computer resources be integrated into the total battlefield system?

(6) Were personnel requirements for developing and supporting computer resources determined?

(7) What major computer programs are required to support the development, acquisition, and maintenance of computer equipment?

(8) What software support items will be required for production and maintenance of the system? Are they specified as deliverable?

c. Tradeoffs.

(1) Were the tradeoff decisions mentioned in Milestone I made?

(2) What method will be used to measure memory use and processing time?

(3) What cost benefit type trade-offs are there?

Appendix C--Continued

d. Project manager's staff.

(1) What percentage of the development cost of the project will be spent on computer-related expenses, e.g., systems analysis, interfacing, coding, debugging, etc.?

(2) How many dedicated project personnel are skilled in computers and software? What percentage of project staff?

(3) How many dedicated project personnel have had operational experience in the project application area?

(4) What plans have been made to obtain competent computer and software personnel on temporary assignment from service laboratories and support activities? From contractors?

(5) Does the Project Manager (PM) have an experienced systems engineer agent responsible for overseeing software system engineering?

(6) How will the PM provide for maintenance support requirements? Is there a dedicated person on the PM staff to act as Software Operational Support Agent?

e. Project control.

(1) What management procedures will be used to control software development? How do they monitor costing and scheduling?

(2) Have the proper milestones been chosen in the management plan? Could the failure to achieve a milestone be easily recognized? Can a failure be anticipated in time to take corrective actions? Is the milestone schedule easily adjusted?

(3) Will there be any parallel software development efforts? If so, how will these efforts be controlled?

(4) How will interface control be conducted? What interfaces e.g., intermodule, intersystem, etc?

f. Development contract.

(1) Will the acquisition take place in acccordance with Public Law 89-306, Procurement of ADP Resources by the Federal Government? Why or why not?

Appendix C--Continued

(2) Which type of contract will be employed for the software?

(3) How will the contractor be tasked for software items? What will be the software-related contractor incentives?

(4) How will "negative software incentives" (i.e., simplifying hardware at the expense of software) be handled?

(5) Is all software listed as configuration item(s)?

(6) Is all support software listed as deliverable? Is any support software proprietary? If so, how will this problem be handled?

g. Testing.

(1) When will the system and program designs be frozen?

(2) How will software testing be performed? Who will generate the test data? Have plans been made to insure the test data is representative of the total range of data and conditions that the system might encounter? Is there a software module test plan and a software module test procedure?

(3) How is testing to insure deficiencies clearly identified as software deficiencies or hardware deficiencies? How will the determination of whether other errors are caused by hardware or software be made?

(4) Are "hot beds" required to adequately test software? Will they become Government property after testing is complete? If not, does the Government have equivalent integration and testing facilities available?

(5) How will modules be interfaced with one another? How will these interfaces be tested?

(6) What critical questions and areas of risk still need resolving by testing? What are the test plans and milestones for resolving these problems?

(7) How will test related documentation be maintained to allow repeatability of tests?

h. Software reliability and maintainability.

(1) Will a standard high order language be used for programming? If

Appendix C--Continued

not, why not? What percentage of the software will ultimately be written in assembly language?

(2) Will the plan insure that the software architecture will be modular?

(3) Will the plan insure "top-down" software development methodology, and will structured programing be used?

(4) What programing standards and conventions will be used? How will they be enforced? When will the Data Item Index be prepared and how will it be updated? Will the plan insure that the documentation will be adequate for life cycle maintenance?

(5) Which automatic debugging tools will be used during program development?

(6) How will error data be collected and analyzed?

(7) How will the software be integrated with the hardware during engineering development?

(8) How will software be documented as it proceeds from concept to design to final operational system (e.g., module specifications document, "design to" document, "as built" document, etc.)?

(9) How will the software be supported in the field? What hardware and software will be needed for the Support Base? How will it be procured?

(10) Will the plan insure accuracy of coding to available listings?

i. Miscellaneous.

(1) What has contractor done of a similar nature in the past? What were his successes and failures? What is he doing to eliminate past problem areas? What are his "lessons learned"?

(2) What issues must be resolved prior to Milestone III that have not already been discussed? What is your plan to resolve them?

C-3. Milestone III Reviews. a. Present status.

Appendix C--Continued

(1) Are any software modules incomplete? Which modules and associated hardware are involved? What is extent of incompleteness and the schedule for completion?

(2) What is the profile of the last 3 month's software discrepancy forms and software change requests? How many discrepancies are still to be corrected? How was error data collected and analyzed?

(3) How much of the recent software change activity has been corrective actions and how much was caused by change in requirements? Were changes in requirements due to increased requirements or due to reduced requirements? Who has the authority to change software requirements?

(4) How has delivered code been verified to conform to original software design? Who prepared test data for the verification? How has delivered code been shown to satisfy original operational requirements?

(5) How was hardware/software integration and validation performed?

(6) What is the accuracy of coding to available listings? How can this be demonstrated?

b. Life cycle management.

(1) Are any life cycle management questions from Milestone II still unanswered? Why?

(2) Is the computer resource life cycle management plan on schedule? If not, what impact will this have on the entire weapon system during the full scale production phase?

(3) When will the software "turnover" from the contractor to the Government take place? What steps have to take place before the turnover?

(4) Who will provide software support during operations and maintenance? What items will be required in the support base? How will future modifications to baseline software be handled?

(5) What will be the impact of anticipated software improvements? What are the anticipated improvements and which areas of the system will be involved?

Appendix C--Continued

(6) What is the general logic flow for the system? How would non-contractor personnel go from the general flow chart to detailed flow charts to the actual coding? Is a data item index a deliverable item?

(7) How is the software compatible with operations/logistics concepts?

Appendix D

REFERENCES

NUMBER	SUBJECT:
DODD 5000.1	Major System Acquisitions
DODD 5000.2	Major System Acquistion Process
DODD 5000.3	Test and Evaluation
DODD 5000.29	Management of Computer Resources in Major Defense Systems
DODD 5010.19	Configuration Management
DODI 4105.65	Acquisition of Automation Data Processing Computer Program and Related Services
DODI 5000.31	Interim List of DOD Approved High Order Programming Languages (HOL)
DODI 5010.21	Configuration Management Implementation Guidance
DODI 5010.27	Management of Automated Data System Development
DODI 7041.3	Economic Analysis and Program Evaluation for Resource Management
DA PAM 11-25	Life Cycle Management Model
DA PAM 70-21	The Coordinated Test Program (CTP)
MIL STD 490	Specification Practices
MIL STD 1521	Technical Reviews and Audits for Systems Equipment and Computer Programs
AR 11-18	The Cost Analysis Program
AR 11-28	Economic Analysis and Program Evaluation for Resource Management
AR 15-14	System Acquisition Review Council Procedures
AR 18-1	Management Information Systems: Policies, Objectives, Procedures and Responsibilities
AR 18-3	Automatic Data Processing Management Information System
AR 18-22	Army Inventory of Data Systems (AIDS)
AR 70-1	Army Research, Development, and Acquisition
AR 70-10	Test and Evaluation During Development and Acquisition of Materiel
AR 70-15	Product Improvement of Materiel
AR 70-27	Outline Development Plan/Army Program Memorandum/Defense Program Memorandum/ Decision Coordinating Paper

Appendix D--Continued

Number	SUBJECT:
AR 70-37	Configuration Management
AR 70-60	Army Nuclear Survivability
AR 70-61	Type Classification of Army Materiel
AR 71-3	User Testing
AR 71-9	Materiel Objectives and Requirements
AR 380-380	Automated Systems Security
AR 700-127	Integrated Logistic Support
AR 1000-1	Basic Policies for Systems Acquisition
DARCOM-R 70-1	Transition of Management Responsibility from a Research and Development Command Manager to a Materiel Readiness Command Manager
DARCOM-R 700-34	Release of Materiel for Issue
DARCOM Suppl 1 to AR 70-37	Configuraton Management
DARCOM Suppl 1 to AR 700-127	Integrated Logistics Management

The proponent agency of this publication is the HQ, DARCOM, Directorate for Development and Engineering. Users are invited to send comments to the Commander, DARCOM, ATTN: DRCDE-C, 5001 Eisenhower Ave, Alexandria, VA 22333

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DEPARTMENT OF THE NAVY

POLICY and GUIDANCE DOCUMENTS

DEPARTMENT OF THE NAVY
HEADQUARTERS NAVAL MATERIAL COMMAND
WASHINGTON, D.C. 20360

IN REPLY REFER TO

Ser 00/0468
18 May 1981

From: Chief of Naval Material

Subj: Use of Standard Embedded Computers in Navy Tactical Digital Systems

Ref: (a) CNM ltr 08Y/BWS Ser 231 of 2 July 1981; Standard Embedded Computers, Peripherals, and Input/Output Interfaces (TADSTAND B)
(b) OPNAVINST 4720.9D; Approval of Systems and Equipments for Service Use

1. Reference (a) requires that standard embedded computers be used in all Navy tactical digital systems, and designates as Navy standards the AN/UYK-7 Shipboard Computer and the AN/UYK-20 Shipboard Minicomputer. In addition, reference (a) designates as planned standards the following general purpose, embedded computers:

a. AN/AYK-14 Airborne Minicomputer
b. AN/UYK-43 Navy Embedded Computer System (NECS)
c. AN/UYK-44 Militarized Reconfigurable Processor (MRP) and Computer (MRC)

This letter amplifies policy for the use of general purpose, standard embedded computers in tactical digital systems, as outlined in reference (a).

2. The AN/AYK-14 has been developed by the Naval Air Systems Command as a standard airborne computer capable of satisfying airborne embedded computer requirements through 1990. The AN/AYK-14 production baseline has been established, and first production delivery has been accomplished. The AN/AYK-14 is excluded from the requirement to obtain Approval for Service Use under the provisions of reference (b) because of impracticality of test and evaluation in terms of planned mission capability until actually incorporated in the using system, and is now designated a standard.

3. The AN/UYK-43 is being developed by the Naval Sea Systems Command as a family of high reliability, high performance successors to the AN/UYK-7 for shore, surface ship, and submarine usage. The AN/UYK-43 is specified to execute AN/UYK-7 software in an upward compatible fashion, and is being designed to execute computer programs up to nine times faster than a single bay AN/UYK-7 and have 25 times increased memory capacity. The AN/UYK-43 is being developed with both water-cooled and air-cooled enclosures. The AN/UYK-43 is being designed to reduced power, weight, size, and maintenance requirements compared to the AN/UYK-7, but with increased reliability and availability. Full scale engineering development contracts were awarded in September 1980. Delivery of AN/UYK-43 Engineering Development Models (EDMs) is scheduled to commence in March 1983, and first production delivery is scheduled for December 1984.

4. The AN/UYK-44 is being developed by the Naval Sea Systems Command as a family of high reliability, low cost processors and computers both as successors to the AN/UYK-20 and for direct embedding in equipment. The AN/UYK-44 is specified to execute AN/UYK-20 and AN/AYK-14 software in an upward compatible fashion, and is being designed to execute computer programs up to twice as fast as an AN/UYK-20 and have eight times increased memory capacity. The AN/UYK-44 is being designed to reduced power, weight, size, and maintenance requirements compared to the AN/UYK-20, but with increased reliability and availability. The AN/UYK-44 is being developed as a set of Standard Electronic Modules (SEM) and as a set of components (e.g., integrated circuits) for direct embedding in equipments and systems. This form is called the Militarized Reconfigurable Processor. In addition, the SEM card set is being packaged with memory, power supply, etc. as a complete Militarized Reconfigurable Computer (MRC) with either air or water cooling. Delivery of AN/UYK-44 Advance Production Equipments (APEs) is scheduled to commence in December 1981 for MRPs and September 1982 for MRCs. First production delivery is scheduled for the third quarter of 1983 for MRPs and the third quarter of 1984 for MRCs.

5. Accordingly, the following actions will be taken in order to implement a Naval Material Command policy of appropriate standardization:

a. All shore, surface ship, and submarine tactical digital systems that will enter development or undergo major upgrade after scheduled availability of AN/UYK-43 EDMs and/or AN/UYK-44 APEs shall use the AN/UYK-43 and/or AN/UYK-44, as appropriate, exclusively as their embedded computers.

b. All tactical digital systems requiring programmable processing capabilities directly embedded in equipment units that will enter development or undergo major upgrade after availability of AN/UYK-44 MRP APEs shall use the AN/UYK-44 MRP.

c. Planning for required use of AN/UYK-44 and AN/UYK-43 shall begin immediately.

6. In order to implement this policy as expeditiously as possible, Commander, Naval Sea Systems Command is requested to initiate planning for orderly transition from use of the AN/UYK-7 and AN/UYK-20 to the AN/UYK-43 and AN/UYK-44 at the earliest feasible time throughout the Naval Material Command.

A. J. WHITTLE, JR.

Distribution
(see page 3)

Subj: Use of Standard Embedded Computers in Navy Tactical Digital Systems

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DEPARTMENT OF THE NAVY
HEADQUARTERS NAVAL MATERIAL COMMAND
WASHINGTON, D.C. 20360

IN REPLY REFER TO

Ser 00/0091
3 November 1981

From: Chief of Naval Material

Subj: Standard Navy Tactical Embedded Computer Resources (TECR); use of in all phases of system developments

Ref: (a) CNM memo Ser 00/749 of 9 November 1978; Cost Control of Tactical Computer Software
(b) CNM ltr Ser 00/855 of 19 December 1978; Management of Computer Resources
(c) CNM ltr Ser 09/0415 of 1 May 1981; Navy Ada Implementation
(d) CNM ltr Ser 00/0468 of 18 May 1981; Use of Standard Embedded Computers in Navy Tactical Digital Systems

Encl: (1) NAVMAT Policy Concerning Tactical Embedded Computer Resources

1. The Chief of Naval Material (CNM) in references (a) through (d) promulgated policy concerning the use of Navy standard tactical embedded computer resources by activities of the Naval Material Command (NAVMAT). Specific CNM policies regarding the use of embedded computer resources in tactical systems are implemented by Tactical Digital Standards (TADSTANDs) and NAVMAT Intructions. Enclosure (1) is a current list of these policy documents. The purpose of this letter is to reaffirm the requirement for NAVMAT activities to comply with these vital CNM policies and related directives.

2. In spite of generally improving compliance with these CNM policies there continue to be many instances of system developments that have effectively precluded the use of Navy standards because of decisions and selections of non-standards made in the early phases of development. It is thus essential to reemphasize the fact that these policies apply to all phases of tactical digital system development, acquisition, deployment, and life cycle support. The policies also apply regardless of funding or acquisition category. Moreover, TADSTAND waivers must be obtained prior to commitment of funds to use non-standard embedded computer resources.

3. Particular emphasis and attention must be given to programmatic decisions that can potentially dictate the development of tactical digital system software using programming languages which are not standard Navy higher order languages. Commitments to such languages, particularly hardware-specific assembly languages, usually make it impractical or cost prohibitive to later convert software to a Navy programming language for Navy standard computers even though project management had, in good faith, planned and programmed to transition to standards. Recent experience has also shown that assembly language software developments that appear to be insignificant in the early

Subj: Standard Navy Tactical Embedded Computer Resources (TECR); use of in all phases of system developments

stages of system development will usually expand to such proportions that tens of millions of dollars and often several years of effort are required for subsequent conversion of such software to a Navy standard language.

4. The Tactical Embedded Computer Program Office (TECPO) on the CNM staff develops policy and guidance for the use of embedded computer resources in tactical digital systems by activities of the Naval Material Command. TECPO also serves as the Principal Development Activity (PDA) for Navy standard tactical embedded computer hardware, programming languages, and related support software. In addition, the Director of TECPO acts as primary CNM advisor on the use of embedded computer resources in tactical digital systems. Responsible project/program managers are strongly urged to establish liaison with TECPO in the early stages of system development regarding their digital hardware and support software requirements. In addition, such managers who perceive the need for changes and/or improvements in Navy standard TECR products or the governing policies and directives are encouraged to communicate their concerns and recommendations to TECPO.

5. Systems Commands, Project Offices, Laboratories, and all other Naval Material Command activities are to give wide distribution to this letter and related CNM policies.

J. G. Williams Jr.

J. G. WILLIAMS, JR.
Chief of Naval Material

Distribution:
(see page 3)

NAVAIRSYSCOM

COMPENDIUM OF NAVY SOFTWARE MANAGEMENT POLICY AND GUIDANCE DOCUMENTS

VOLUME I
MARCH 1982

DEPARTMENT OF THE NAVY
PACIFIC MISSILE TEST CENTER

NASMAC

NAVAL AIR SOFTWARE MANAGEMENT ADVISORY COMMITTEE

FOREWORD

This Compendium of Navy Software Management Policy and Guidance Documents has been assembled as a result of the Chief of Naval Material Letter on Management of Computer Resources (copy enclosed at Section 1). The CNM letter underscores the requirements for NAVMAT - wide compliance with all applicable NAVMAT instructions and standards concerning tactical digital computers and software. Accordingly, this document contains a brief abstract, and a copy for reference, of the principal NAVMAT and NAVAIR software management instructions, including TADSTANDS A through E and TADSTANDS 2, 3 and 9.

In an effort to quickly disseminate these software management instructions to the widest possible audience within the NAVAIR community, the Naval Air Software Management Advisory Committee (NASMAC) is making this document available to all cognizant NAVAIR technical personnel. Requests for this document may be made by contacting any of the NASMAC representatives listed at the end of this document.

CHIEF OF NAVAL MATERIAL LETTER,

MANAGEMENT OF COMPUTER RESOURCES , 00/855 19 DEC 1978

ABSTRACT

- Emphasizes requirement for all of NAVMAT to carry out CNM policy in matters concerning tactical digital computers and software.
- Directs attention to the Tactical Digital Systems Office (TADSO) on his staff, and the role of TADSO in development and promulgation of CNM computer and software policy.
- Cites nine TADSTANDS and two NAVMAT Instructions as examples of policy documents which require compliance within NAVMAT activities.
- *Requests inputs on required changes to applicable instructions.*

DEPARTMENT OF THE NAVY
HEADQUARTERS NAVAL MATERIAL COMMAND
WASHINGTON D C 20360

Int. Ser 36
00/855
19 Dec 1978

From: Chief of Naval Material
To: Distribution List

Subj: Management of Computer Resources

1. The Tactical Digital Systems Office (TADSO) on my staff develops tactical digital system policy and guidance for the Naval Material Command. In addition, the Director of TADSO acts as my primary advisor on tactical digital computer and software matters. Policy implementation usually takes the form of TADSTANDS, of which there are now nine. TADSTAND 4 defines tactical digital systems. The other TADSTANDS specify actions to be taken regarding computers and software, and provide a waiver procedure to be followed in those instances where adherence to the TADSTAND is not practical. In other instances, NAVMAT instructions are used to implement software management policy. For example, NAVMATINST 4130.2A addresses Configuration Management of Computer Software, and NAVMATINST 5200.27A establishes policy for the transfer of software support responsibility to maintenance activities upon completion of Navy acceptance. The bottom line of these policy directives is to conserve resources through standardization and sound life cycle management practices. The importance is obvious in view of the substantial resources being expended for embedded computer resources.

2. It appears that some NMC acquisition managers either are not familiar with these TADSTANDS and directives, or ignore them. My policy regarding CNM directives, including the TADSTANDS, is straightforward. Necessary changes will be made when required. In the absence of a clear rationale for non-compliance, properly issued directives will be followed by Naval Material Command activities. In the case of non-compliance, the CNM will be informed.

3. I intend to take whatever action is necessary to insure that the above policy is carried out, not only in regard to computer resources, but in all NAVMAT instructions which contribute to a formal, disciplined approach to the support of systems for which the Naval Material Command is responsible. Accordingly, I welcome your advice on any instructions that are in need of change.

A. J. WHITTLE, JR.

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CNM Comment Sheet 803669

NAVMATINST 4130.2A

"CONFIGURATION MANAGEMENT OF COMPUTER SOFTWARE ASSOCIATED WITH TACTICAL DATA SYSTEMS AND OTHER TECHNICAL COMPUTER SYSTEMS DEVELOPED BY OR FOR THE NAVAL MATERIAL COMMAND"

ABSTRACT

- Provides policy and procedures for configuration management to be applied to the acquisition and maintenance support of software for tactical digital and technical computer systems under NMC management.

- Directs that policy and procedures be carried out.

- Directs creation of a Software Change Control Board (SCCB) in most instances.

DEPARTMENT OF THE NAVY
HEADQUARTERS NAVAL MATERIAL COMMAND
WASHINGTON D C 20360

IN REPLY REFER TO

NAVMATINST 4130.2A
MAT-09Y
19 July 1976

NAVMAT INSTRUCTION 4130.2A

From: Chief of Naval Material

Subj: Configuration Management of Computer Software Associated with Tactical Digital Systems and Other Technical Computer Systems developed by or for the Naval Material Command

Ref: (a) TADSTAND 4 of 6 April 1972
(b) NAVMATINST 4130.1A of 1 Jul 1974
(c) NAVMATINST 5200.27A of 18 April 1973
(d) OPNAVINST 3500.27B of 28 June 1974
(e) OPNAVINST 4130.1 of 2 Oct 1975
(f) SECNAVINST 3560.1 of 8 Aug 1974
(g) NAVMATINST 5460.2A of 28 July 1975

1. Purpose. To promulgate the responsibilities of Naval Systems Commanders and Project Managers for configuration management of computer software associated with tactical digital systems, and other technical computer systems developed and/or maintained by the Naval Material Command.

2. Cancellation. This instruction supersedes NAVMAT Instruction 4130.2 of 21 September 1970.

3. Applicability. This instruction applies to Systems Commanders and their designated Project Managers, CNM-designated Project Managers, and CNM Laboratories/Centers responsible for development, production, procurement and maintenance of tactical digital and technical computer programs for shipborne and airborne applications. (R)

4. Definitions

a. Tactical Digital Systems are those fleet systems which employ digital processing techniques and which contribute directly to performance in the areas of command and control, navigation, communications, weapons delivery, fire control, sensor surveillance, and electronic warfare, as defined by reference (a).

b. Technical Computer Systems are those fleet systems which employ digital processing techniques, which are related to tactical missions and which contribute directly to performance in the areas of intelligence, automatic testing, management information and shipboard logistic support.

c. Software consists of the computer programs, computer data and associated documentation related to the operation of a digital processing system.

5. Background

a. With the increased use of tactical digital and technical computer systems it has become mandatory that control mechanisms be developed and used for consistent and continuing life-cycle configuration management of the software in these systems. Software constitutes an entity equally as critical as hardware and must be described, documented, controlled and managed accordingly. Configuration management must be maintained on all digital systems software, both during development and after it has been delivered to the Navy maintenance activity.

b. Reference (b) states the basic policy, implementing guidance and procedures which govern configuration management within the Department of the Navy. Reference (c) promulgates policy and procedures for the transfer of tactical digital system software responsibilities from a development activity to a program maintenance activity. Reference (d) provides guidance for construction and control of combat direction systems' digital processor programs for the Navy. This guidance includes provisions for the monitoring of program development by the activity which will be responsible for a program's life-cycle maintenance and provides for direct liaison between the Naval Systems Commands and the Fleet Combat Direction Systems Support Activities for programs under development by these activities. Inherent in the above authorities and responsibilities for monitoring and liaison is the requirement
(A) for effective change control. Reference (e) promulgates policy for configuration management of software in surface ship combat systems. The principles therein, excluding the detailed implementation procedures, are applic-
(A) able to submarine and airborne systems as well. Reference (f) specifies documents required for the implementation and maintenance of tactical digital computer systems.

c. This instruction amplifies but does not change the basic Systems Command responsibilities assigned in reference (g).

6. Policy

a. The policy and procedures for configuration management set forth
(R) in reference (b) shall be applied to the acquisition and maintenance support of software for tactical digital and technical computer systems, subsystems
(A) and equipments under the management of the Naval Material Command. Configuration management of software in surface ship combat systems shall also be in accordance with reference (e).

b. The procedures established by reference (c) and the liaison authorized by reference (d) shall be fully utilized in support and implementation of this policy.

7. Action. All components of the Naval Material Command responsible for development, procurement, production and maintenance of computer software associated with tactical digital systems, or technical computer systems shall review their existing instructions and procedures and initiate necessary changes to assure that the principles and policy as set forth in references (b) through (f) and this instruction are applied to software management.

a. For combat systems and other tactical digital and technical computer systems which are under development: (A)

(1) A Software Change Control Board (SCCB) shall be established as appropriate to review, evaluate and approve/disapprove proposed software changes. Proposed changes, both hardware and software, which impact the approved software baseline technical documentation will be brought before the appropriate Project Manager/Systems Command Software Change Control Board (SCCB) for resolution or will be referred to the appropriate level in the chain of command within the Naval Material Command.

(2) For those systems under development which require on-line exchange of digital information or data, an Interface Design Specification (IDS) as defined by reference (f), shall be jointly developed and agreed to by the Project Managers and/or the activities having control of the interfacing systems. This document will be the principal vehicle used to manage and control the software interface configuration of the ship combat system or other systems.

b. For combat systems, interfacing software systems, and other applicable subsystems which are passing from control of the acquiring project manager to the maintenance manager, or for those systems which are already under control of the maintenance manager, the following conditions apply: (A)

(1) The maintenance manager will either continue the project manager's SCCB, or if none exists, create a SCCB as described in subparagraph 7.a(1) above, utilizing the appropriate technical documentation as defined in reference (f).

(2) Membership of the SCCB will be expanded to include representation from each interfacing software subsystem life-cycle maintenance activity.

(3) For those systems which require on-line exchange of digital data, the IDS will continue to be the principal document for software interface configuration control.

(A) c. Reference (e) specifies additional guidance required in the case of surface ship combat systems regarding chairmanship of the SCCB. For other tactical digital and technical computer programs, the project manager/maintenance manager shall specify the chairmanship of the SCCB.

(A) d. For platforms and/or command centers which communicate via data links and/or other off-line media (e.g., magnetic tape, disk packs, punched cards), an inter-platform IDS shall be jointly developed and shall be the principal document for interface configuration control. A Software Change Control Board shall be established for the joint control of this interface. If the interfacing systems are the total responsibility of one command, the SCCB shall be established at that level. If the interfacing systems are the responsibility of more than one Systems Command, the SCCB will be established by CNM. Representatives of the individual platform SCCBs shall be members of the joint SCCB.

(A) 8. Implementation. For software systems under development, the provisions of this instruction are to be implemented immediately. For those operational ships and aircraft being delivered with Model IV, Phase Ø NTDS or ATDS Programs, implementation shall be no later than concurrent with the delivery of these programs. For already operational software systems, the provisions of this instruction are to be implemented no later than 1 January 1977. For those systems that already have a Change Control Board (CCB) or its equivalent in existence, where the function of the existing CCB is to review software changes as well as hardware changes, and provided there are software knowledgeable personnel representing the members of that CCB, a separate SCCB need not be established.

V. A. LASCARA
Vice Chief of Naval Materi-

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NAVMATINST 5200.27A

"TRANSFER OF NAVY TACTICAL DIGITAL SYSTEM SOFTWARE RESPONSIBILITY; PROCEDURES FOR"

ABSTRACT

- Provides procedures for the transfer of Navy tactical digital system software responsibility.
- Directs that procedures be followed.

RETURN TO MAT 055C

DEPARTMENT OF THE NAVY
HEADQUARTERS NAVAL MATERIAL COMMAND
WASHINGTON D C 20360

IN REPLY REFER TO

NAVMATINST 5200.27A
MAT 09Y:RSF

18 Apr 1973

NAVMAT INSTRUCTION 5200.27A

From: Chief of Naval Material

Subj: Transfer of Navy Tactical Digital System software responsibility; procedures for

Ref: (a) NAVMAT Instruction 5230.5 of 11 Aug 1971
(b) TADSTAND 4 of 6 Apr 1972 (NOTAL)

Encl: (1) Operating Procedures
(2) Format of Program Maintenance Milestone Chart

1. Purpose. To promulgate policy and procedures for the transfer of Navy Tactical Digital System software responsibility from a developmental activity to a program maintenance activity.

2. Cancellation. NAVMATINST 5200.27 is cancelled.

3. Background. It is realistic to assume that utilization of general purpose, programmable, digital processors will continue and will grow in importance. Presently, tactical digital systems processor programs constitute the principal medium through which refinements, improvements, and new applications in fleet combat systems are introduced into the fleet. The production of such programs and associated documentation is an undertaking comparable in cost and complexity to the design and development of the system equipments. In recognition of these factors, Navy digital processor programming activities were established to design, develop, produce and maintain operational programs for tactical digital systems (TDS). It was originally expected that the activities would provide the initial as well as the follow-on digital processor programming support for TDS. However, because of the rapidly growing number of TDS designs and the increasing maintenance requirements for existing TDS programs, it has become necessary for the systems developing activity to provide digital processor programming support for many developmental TDS and/or integral subsystems through a prime contractor. This support is then subsequently assigned to a Navy programming activity for the duration of the operational life of the system. Under these conditions it becomes necessary for each activity concerned with the development of new systems or functional application to address in both an efficient and timely fashion the problem of transferring responsibility and providing adequate computer programming support of delivered systems.

4. Definitions

a. Digital processor programming or software as used in this instruction consists of programs resident in digital processors or other storage devices. Examples of these include, but are not limited to; assemblers, compilers, simulators, emulators, utility, diagnostic and maintenance programs and the documentation necessary to generate and support the above digital processor.

b. Tactical digital systems are defined in reference (b).

5. Policy. Uninterrupted software support of tactical digital systems being introduced into the fleet is essential for successful deployment. Efficient management of the transition of digital processor programming responsibility from the development phase to the operational phase will assure the necessary support. This responsibility will be carried out within a standard discipline and framework consistent with the guidance of higher authority and in consonance with the procedures outlined herein.

6. Responsibility. The basic responsibility for policy guidance, coordination, and assistance throughout the Naval Material Command for all tactical digital systems is assigned to the Director, Tactical Digital Systems Office (TADSO,MAT-09Y) by reference (a).

7. Applicability. This instruction is applicable to the Deputy Chiefs of Naval Material, the Naval Systems Commanders, the Director of Laboratory Programs and CNM-Designated Project Managers.

8. Action.

a. Addressees shall be guided and governed by the procedures set forth in enclosures (1) and (2).

b. A copy of all project planning documents concerning digital processor program maintenance shall be fowarded to TADSO (MAT 09Y).

c. Approval for the designation of program maintenance activities must be obtained from TADSO (MAT 09Y).

K. R. WHEELER
VICE CHIEF OF NAVAL MATERIAL

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OPERATING PROCEDURES

The following procedures will be adhered to in the transfer of digital processor programming responsibility for Tactical Digital Systems from a development activity to a program maintenance activity.

1. Principal Development Activity (PDA), shall determine the following during the initial planning phase:

a. Which project planning documents will contain the Digital Processor programming maintenance requirement. If an Integrated Logistic Support Plan (ILSP) is to be prepared for the proposed project, the ILSP shall be used as the means of delineating these requirements. If no ILSP is required for the project, then a Software Life Cycle Management Plan shall be generated and shall specify, in detail, the Digital Processor programming maintenance requirements.

b. In the event that a "Project Office" is not established, an appropriate agent shall be designated for implementing the requirements specified herein.

c. Identify the Navy activity and/or contractor responsible for providing Digital Processor programming maintenance. Concurrence will be obtained from the activity that support can be provided as required by the project.

2. The project planning document shall contain, as a minimum, the following items:

a. A chronological (time-sequence) chart which defines milestones for events related to the orderly transfer of software responsibility to the maintenance activity. Enclosure (2) is to be used as a guide in the preparation of the milestone chart. Events which clarify the overall turnover procedure for each project should be detailed. The format for the chart is left to the discretion of the preparing activity except that the chart shall denote the milestones as related to both calendar and fiscal year chronology.

b. A listing of estimated equipment, personnel, facility requirements, and necessary liaison required by the Digital Processor programming maintenance activity.

c. Funding requirements for accomplishing paragraph 2.b.

d. A statement of impact, and any required action because of paragraph 2.b and 2.c, on other Systems Commanders to support (interface) with the program maintenance activity.

ENCLOSURE (1)

e. Documentation requirements

f. Life cycle funding support for system software being developed.

g. Procedures for the submission of Digital Processor program change requests.

h. Define use of high level language in accordance with TADSTAND 1.

i. When applicable, specify concurrence with the guidelines for construction and control of tactical digital systems computer programs as detailed in OPNAV Instruction 03500.2A. Delineate any deviations required because of unique circumstances not covered in the instruction.

3. The designated programming maintenance activity shall be made a participant in the project during the development phase. This participation shall include as applicable, but not be limited to, the following:

a. The establishment of a liaison team. NOTE: Unless the urgency of the operational requirement for the system dictates a shorter time frame, the liaison team should operate for a period of at least 12 months prior to the turnover date.

b. Definition of liaison procedures and requirements.

c. Review of Digital Processor program design specifications.

d. Monitoring Digital Processor programming efforts.

e. Provide programming technique guidelines, such as for modular programming.

f. Provide existing operational program modules for use where appropriate.

g. Provide advice and consultation on operational doctrine.

h. Definition and review of the Navy test plan for acceptance of the contractual effort (i.e. system, engineering changes, etc.).

i. Prepare in conjunction with the PDA a maintenance programming production plan. This plan shall specify the sequential programming test and integration events associated with the production of the software. The plan shall also specify the interrelationship of the maintenance activity with the cognizant PDA when operational requirements dictate changes which affect the operational hardware and/or system performance.

j. Review Engineering Change Proposals, and comment on their effect on Digital Processor programs.

k. Review and advise the program manager of computer programming changes.

4. If weapon system trainers and simulators are to employ (as an integral part of the design) general purpose processors, the PDA shall perform reviews prior to any contractual commitment to determine what impact there is on the operational software procedures presented herein. Specifically, documentation, languages, and when applicable, machine type should be minimized as to the differences with the requirements of this Instruction.

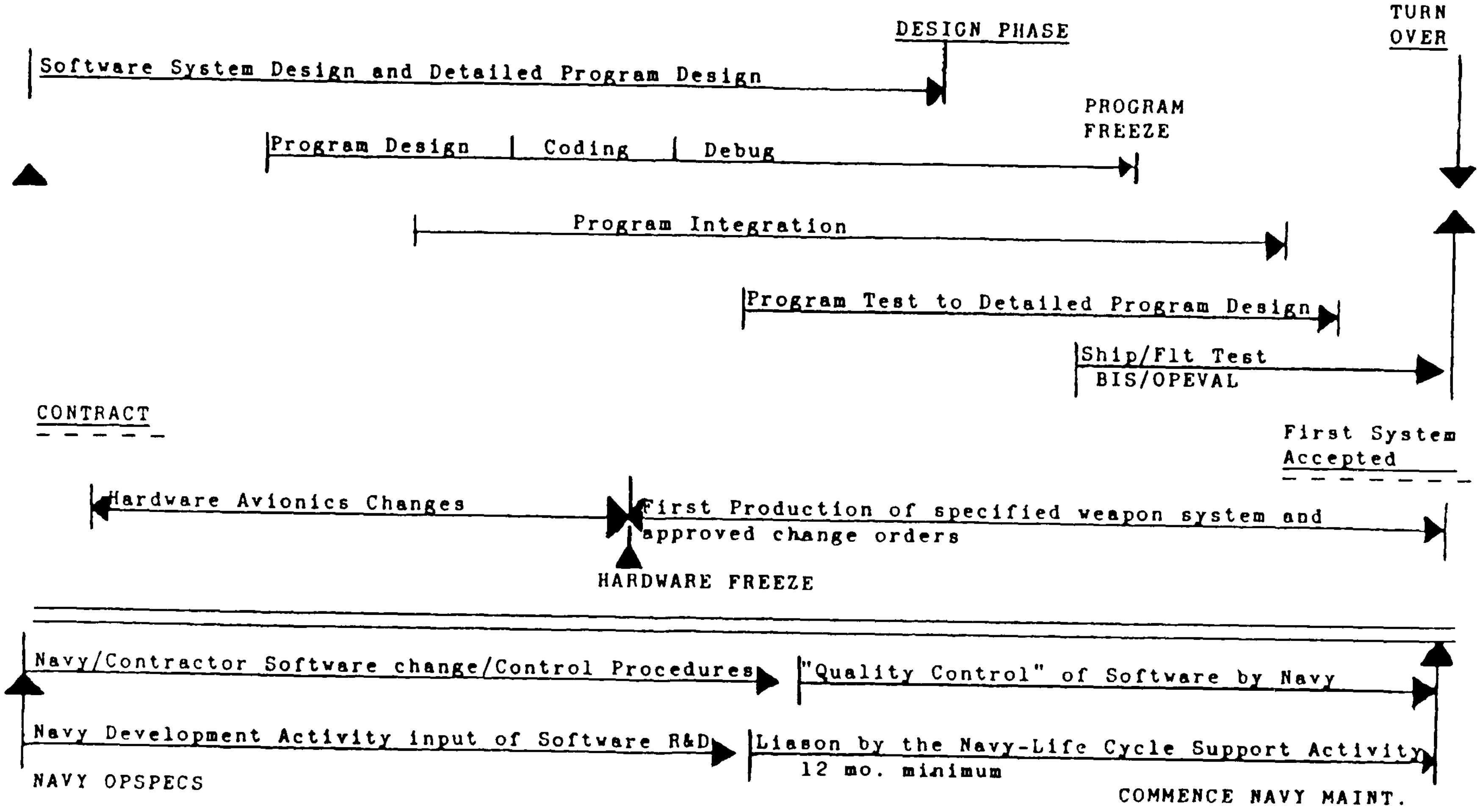
5. It is the specific responsibility of each PDA to insure that both the intent as well as the requirements presented herein are not circumvented because of the establishment of terms and conditions of a contract with an industrial firm. Each PDA, as appropriate, implement the following to effect compatibility of this instruction with the proposed effort:

a. In the request for proposals (RFP) there shall be listed a line item for the requirement on the part of the contractor to interface with the proposed maintenance activity as detailed herein. All costs for any travel, data, etc., shall be clearly specified. The role of the maintenance activities as a Navy team member and technical monitor shall be so stated in the contract.

b. Establish in the contract review points such that new doctrine, procedures, or new and unforeseen tactical situations are examined for impact on the baseline digital processor programs. These reviews should be consistent with the system equipment and software design "freeze" points. It is recognized that in certain instances, the incorporation of new capabilities could impact the performance guarantees, schedules, and cost of a given project. In such cases, the PDA is to present to the Chief of Naval Material and the Chief of Naval Operations, for review, a concise explanation of the effect on the project if such requirements are added and any proposed alternatives. Additionally, the PDA is to establish reviews in a time frame that will permit adequate review prior to the design "freeze" for the baseline system.

c. In those cases where the contractor develops the initial programs for developmental systems and these programs are subsequently used as "interim" operational programs, the Systems Command shall provide for contractual coverage of improvements and new capabilities.

(PROJECT NAME) TACTICAL DIGITAL PROCESSOR PROGRAM MAINTENANCE MILESTONE CHART



ENCLOSURE (2)

NAVAIRINST 5230.5

"RESPONSIBILITY AND REQUIREMENTS FOR PREPARATION OF SOFTWARE LIFE-CYCLE MANAGEMENT PLANS (SLCMP)"

ABSTRACT

- Identifies activity responsible for preparation and maintenance of Software Life-Cycle Management Plans.
- Provides detailed instruction for the format and content of a Software Life-Cycle Management Plan.

DEPARTMENT OF THE NAVY
NAVAL AIR SYSTEMS COMMAND
WASHINGTON D C 20361

NAVAIRINST 5230.5
AIR-5331
21 Jul 1976

NAVAIR INSTRUCTION 5230.5

From: Commander, Naval Air Systems Command
To: Deputy Commander, Assistant Commanders, Comptroller, Command Special Assistants, Designated Project Managers, Project Coordinators, and Office and Division Directors

Subj: Responsibility and requirements for preparation of Software Life Cycle Management Plans (SLCMP)

Ref: (a) NAVAIRINST 5230.4 of 1 Aug 1974, Responsibility for the coordination and management of weapon system tactical digital processors and related software
(b) NAVMATINST 5200.27A of 18 Apr 1973, Transfer of Navy Tactical Digital System software responsibility, procedures for

Encl: (1) Requirements for a Software Life Cycle Management Plan (SLCMP)

1. Purpose. This instruction establishes the requirements and the responsibility for the preparation and implementation of Software Life Cycle Management Plans (SLCMP) for weapon system tactical digital processors and related software.

2. Background. Reference (a) designated the Director of the Avionics Division (AIR-533) as the manager of all weapon system tactical digital processors and related software. Software management plans of varying degrees of detail and in numerous formats have been developed for certain weapon systems. AIR-533 has determined that to successfully manage weapon systems tactical software, it is necessary to develop a SLCMP for each weapon system. In accordance with reference (a), Project Managers (PMs) and Acquisition Managers (AMs) are responsible for providing to AIR-533 sufficient funding to allow AIR-533 to obtain software support activity (SSA) and contractor services required in the preparation and update of a SLCMP. Reference (b) establishes the requirement for a plan to transfer responsibility for software management from the development activity to a SSA. The requirements of reference (b) are encompassed within enclosure (1).

3. Scope. The SLCMP will address the operational software requirements for the complete life cycle of the weapon system. It shall be originated prior to the issuance of the Request for Proposal (RFP) for full scale development and shall be kept current thereafter throughout the life cycle of the system. The SLCMP will address the operational software,

support system software and their possible interfaces with automatic test equipment and trainers. It will identify the disciplines, resources, and procedures necessary for proper control of the weapon system software from conception through ultimate fleet utilization of the system. It is mandatory that pertinent requirements generated by the SLCMP be included in the RFP. Prior to final determination of the cost for a project all known and probable software life cycle costs shall be identified in the SLCMP. Upon approval by the PM or AM the SLCMP shall become the governing document for operational software life cycle support.

4. Applicability. The requirements of this instruction apply to all tactical digital processor software for weapon systems which are the responsibility of the Naval Air Systems Command Headquarters (NAVAIR HQ) and Naval Air Systems Command (NAVAIR) funded and tasked activities. The requirements of this instruction shall not be cause for reformatting existing software management plans. The content of existing plans however, shall be reviewed for consistency with the content requirements of enclosure (1) and shall be updated as required to incorporate the requirements of this instruction. This instruction does not provide for ground support equipment processors, training equipment processors or related software, which are provided for separately.

5. Responsiblity

a. The Director of the Avionics Division (AIR-533) is responsible for the preparation and update of SLCMPs in accordance with this instruction.

b. Each PM or AM shall have approval authority of the SLCMP for his project.

c. The Assistant Commander for Test and Evaluation (AIR-06) shall review all SLCMP submissions to ensure that the proper test and evaluation (T&E) is planned for and that the resources and facilities required are planned to support approved requirements.

6. Action. PMs and AMs shall, on a continuing basis, review their software management planning for adequacy and compliance with this instruction.

7. Forms. DD Form 1423, Contract Data Requirements List is stocked in the NAVAIR HQ Forms Stock Room.

Fred H. Baughman

FRED H. BAUGHMAN
Vice Commander

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REQUIREMENTS

FOR A

SOFTWARE LIFE CYCLE MANAGEMENT PLAN

(SLCMP)

Enclosure (1)

REQUIREMENTS FOR A SOFTWARE LIFE CYCLE MANAGEMENT PLAN (SLCMP)

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Enclosure (1)

REQUIREMENTS FOR A

SOFTWARE LIFE CYCLE MANAGEMENT PLAN

(SLCMP)

1.0 INTRODUCTION

1.1 PURPOSE

The Software Life Cycle Management Plan (SLCMP) will define those tasks, procedures, and functions to be performed throughout the life cycle of the associated weapon system and will identify the responsibilities and scope of participation of all activities (Navy/Contractor) in Software Life Cycle Management.

1.2 OBJECTIVES

The objectives of the SLCMP will be to provide for Navy control of weapon system software; to provide for an orderly transition of software support responsibilities from the development contractor or Navy developer to the Software Support Activity (SSA); and to provide effective design, development, and support of weapon system related software throughout its life cycle.

Upon acceptance of the SLCMP by the appropriate Project Manager, the policy stated will be applicable to all aspects of the weapon system which uses, impacts, or is impacted by the associated software system.

1.3 SCOPE

The SLCMP will address the tactical software requirements for the complete life cycle of the weapon system. It shall be originated prior to the issuance of the Request for Proposal (RFP) and shall be kept current thereafter throughout the life cycle of the system.

The SLCMP will address the operational and support system software and their possible interfaces with automatic test equipment and trainers. It will identify the disciplines, resources, and procedures necessary for proper control of weapon system software from conception through ultimate Fleet utilization of the system. It is imperative that pertinent requirements generated by the SLCMP be included in the RFP.

1.4 ORGANIZATION OF THE PLAN

The material presented in the SLCMP will be arranged in two volumes. Volume I shall contain eight sections: (1) Introduction, (2) Standards, Specifications and Instructions, (3) Software Systems Description, (4) Software Life Cycle Plans and Milestones, (5) Software Management Organization, (6) Software Configuration Management, (7) Quality Assurance, and (8) Software Documentation.

Enclosure (1)

Appendices to Volume I of the SLCMP will include Acronyms, Definitions, Key Personnel, and Software System Technical Descriptions.

Volume II of the SLCMP shall have limited distribution due to the proprietary nature of the material and shall contain sections covering Task Descriptions, Resource Requirements and Funding, Software Responsibility Transition, and Inter-Activity Working Agreements, as appropriate to the project.

1.4.1 Volume I - Sections

The Software life cycle management policies, procedures, and responsibilities applicable to the weapon system will be described in Sections 1.0 through 8.0. The policies, procedures, and requirements set forth in these sections will provide for Navy control of weapon system software and for an orderly transition of software support responsibilities from the development contractor or Navy developer to the Software Support Activity (SSA).

1.4.1.1 Section 1.0: INTRODUCTION - This section will provide an introduction to the SLCMP. The organization of the SLCMP will be summarized to provide an overview of the contents; procedures for maintenance of the SLCMP will be identified. This section will also state the purpose, scope, and objectives of the SLCMP, and will discuss the history and background of the software aspects of the weapon system project.

1.4.1.2 Section 2.0: STANDARDS, SPECIFICATIONS, AND INSTRUCTIONS - This section will identify the standards, specifications, and instructions governing software management. Compliance with NAVAIR, NAVMAT, OPNAV, and DoD instructions and standards will be required.

1.4.1.3 Section 3.0: SOFTWARE SYSTEMS DESCRIPTION - This section will identify, define, and describe the weapon system operational software system and it's interface with automatic test equipment, trainer, and support system software.

1.4.1.4 Section 4.0: SOFTWARE LIFE CYCLE PLANS AND MILESTONES - This section will describe the three major phases of the software life cycle: (1) The Software Development Phase, which includes pre-development/design and development tests and evaluation; (2) the Transition Phase, during which all software support is transferred from the development contractor to the Navy (SSA); and (3) the Navy Support Phase, during which the Navy assumes full responsibility for total software support.

Schedules and milestones of major events associated with the development, acquisition, and management of software throughout the software life cycle will be depicted. Special emphasis shall be directed toward the schedules of events involved in early introduction of Navy SSA personnel in the development phase and in transferring software management responsibility from the contractor/Navy developer to the Navy SSA.

1.4.1.5 Section 5.0: SOFTWARE MANAGEMENT ORGANIZATION - This section will identify the various software support activities and organizations, and define their responsibilities and their supporting relationships with and between each other throughout the software life cycle.

1.4.1.6 Section 6.0: SOFTWARE CONFIGURATION MANAGEMENT - This section will encompass the requirements of software configuration management, configuration identification, configuration change control, and change status accounting as they apply to the weapon system related software.

1.4.1.7 Section 7.0: QUALITY ASSURANCE - This section will describe the quality assurance procedures to be applied and will encompass development/modification, verification/validation and certification, test and evaluation and production.

1.4.1.8 Section 8.0: SOFTWARE DOCUMENTATION - This section will describe the Software Documentation applicable to the project. It will identify SECNAVINST 3560.1 as the governing specification, describe the documentation, detail the documentation delivery schedule, describe contractor monitoring, contract specifications, Government prepared documentation, and supportive technical documentation requirements. On-going projects documented in accordance with previous standards will describe the system documentation in accordance with those standards.

1.4.1.9 Appendices

1.4.1.9.1 Appendix A: Acronyms - This appendix will contain those project peculiar acronyms needed to be conversant with the project, as well as those acronyms commonly used in software engineering and management terminology.

1.4.1.9.2 Appendix B: Definitions - This appendix will contain a standardized set of software and project oriented definitions.

1.4.1.9.3 Appendix C: Key Personnel - This appendix will contain a list of key personnel associated with the project, including codes, phone numbers, and addresses.

1.4.1.9.4 Appendix D: Software System Technical Description - This appendix will be utilized on an optional basis to provide more detailed technical descriptions of the software systems and subsystems, to supplement Section 3.0 of the SLCMP.

1.4.1.9.5 Optional Appendices - The addition of other optional appendices is left to the discretion of the SSA.

1.4.2 Volume II - Sections

1.4.2.1 Section 1: TASK DESCRIPTIONS - This section will include task descriptions based upon authorized AIRTASKS and Work Units.

1.4.2.2 Section 2: RESOURCE REQUIREMENTS AND FUNDING - This section will include funding estimates for all activities participating in the software life cycle management. Included will be both short-range and long-range budget estimates/requirements. Resource requirements such as Facilities, Equipment, Manpower, and Support will also be identified. A definitive statement on the contents of this section is included as Attachment A to this SLCMP Requirements Document.

1.4.2.3 Section 3: SOFTWARE RESPONSIBILITY TRANSITION - This section will consist of the SSA's transition plan for assuming responsibility from the contractor or Navy developer for ultimate Navy support of the software system and will include a milestone chart of major events associated with the transition.

1.4.2.4 Section 4: INTER-ACTIVITY WORKING AGREEMENTS - This section will include those negotiated inter-activity working agreements which have been developed and agreed upon.

1.4.2.5 Optional Sections - Any additional information which the SSA finds of value in managing the weapon system may be included as an optional section.

1.4.3 Changes to the Plan

Changes to the basic SLCMP will be made according to schedules established in the basic document. The basic document shall describe the processes for updating, and changing the SLCMP.

2.0 STANDARDS, SPECIFICATION, AND INSTRUCTIONS

Applicable standards, specifications, and instructions will be adhered to and will be referenced in the SLCMP. The following standards, specifications, and instructions of the issue in effect on the date of invitation for bid or RFP address the core elements comprising the specific requirements to be included in the SLCMP. Additional recognized standards may be included as appropriate. Care must be taken in utilizing standards and specifications not under the direct control of the Navy. Instructions may be used in preparing the SLCMP but should be avoided as references in contract requirements.

2.1 STANDARDS

MIL-STD-480	Configuration Control - Engineering Changes, Deviations and Waivers
MIL-STD-481	Configuration Control - Engineering Changes (Short Form)
MIL-STD-482	Configuration Status Accounting Data Elements and Related Features
MIL-STD-483	Configuration Management Practices for Systems, Equipment, Munitions, and Computer Programs
MIL-STD-490	Specification Practices
MIL-STD-680	Contractor Standardization Plans and Management
MIL-STD-882	System Safety Program for Systems and Associated Subsystems and Equipment, Requirements for
MIL-STD-1521	Technical Reviews and Audits for Systems, Equipment, and Computer Programs

2.2 SPECIFICATIONS

MIL-Q-9858	Quality Program Requirements
MIL-S-83490	Specifications, Types and Forms
WS-8506	Requirements for Digital Computer Program Documentation (Superseded by SECNAVINST 3560.1)

2.3 INSTRUCTIONS

SECNAVINST 3560.1	Tactical Digital Systems Documentation Standards
SECNAVINST 5233.1A	Department of the Navy Automatic Data Systems Documentation Standards
OPNAVINST 3500.27B	Construction and Control of Digital Processor Programs for the Navy Combat Direction System

OPNAVINST 4790.2A	Naval Aviation Maintenance Program
NAVMATINST 3960.6	Planning and Implementation of Tests and Evaluations of New Weapon Systems
NAVMATINST 4130.1A	Department of Defense Configuration Manual
NAVMATINST 4130.2	Configuration Management and Change Control Procedures for Tactical and Technical Computer Programs
NAVMATINST 4130.3A	Standard Combat System Automatic Data Processin Hardware and Software: Joint Configuration Management of
NAVMATINST 5230.27A	Transfer of Navy Tactical Digital System Software Responsibility; Procedures for
NAVAIRINST 3960.2	Test and Evaluation Master Plans; Policies and Procedures Concerning the Preparation, Processi and Approval
NAVAIRINST 4130.1	NAVAIRSYSCOM Configuration Management Manual
NAVAIRINST 4200.14A	Policy and Guidelines for Procurement of Data and Specific Acquisition of Unlimited Rights in Technical Data
NAVAIRINST 4275.3B	Configuration Control, MIL-STD-480 and MIL-STD-481A; implementation of
NAVAIRINST 5215.8A	The NAVAIR Technical Directives System
NAVAIRINST 5230.3A	Standard Specification for Weapon Systems Digit Processor Programming Documentation
NAVAIRINST 5230.4	Responsibility for the Coordination and Management of Weapon System Tactical Digital Processo and Related Software
NAVAIRINST 5400.14A	Policies and Procedures for the Transfer of Engineering Cognizance of and Production Suppor Responsibilities for Service Equipment to Navy Field Activities

2.4 LOCAL COMMAND INSTRUCTIONS

Applicable local command instructions, if required for clarification, wi be appended to the SLCMP.

3.0 SOFTWARE SYSTEM DESCRIPTION

The software systems description includes the major software systems, subsystems, the relationship between the software components of the system, types of software, support software, and the technical documentation for all of the above. As appropriate, it will also address system interfaces with automatic test equipment and trainers.

3.1 GENERAL

This section will contain a brief overview of the total project software system.

3.2 OPERATIONAL

The functions performed by the operational software will be delineated in a narrative description in this section, as an overview of the Program Performance Specification requirements. Operational software includes both tactical and on-board system test software and its supporting documentation.

3.2.1 Tactical Software

The functions performed by the tactical software will be delineated in this section. Tactical software is that software executed in the weapon system computer(s) which provides those functions required for the performance of the tactical missions of the weapon system.

3.2.2 On-Board System Test Software

The functions performed by on-board system test software will be delineated in this section. On-board system test software includes programs designed to provide readiness test, fault isolation, performance monitoring, maintenance data retrieval, and special test capability integral to the weapon system.

(1) Readiness Test Programs provide fault detection capability for the avionics and avionics controlled portions of the weapon system by means of an end-to-end and individual component tests. These programs are generally operator initiated and are used for pre/post flight testing and for verification of maintenance repair.

(2) Fault Isolation Programs provide diagnostic capability to the Weapons Replaceable Assembly (WRA) or lower component level in the weapon system.

(3) Performance Monitor Programs automatically monitor weapon system performance and alert operators and/or the tactical program of malfunction, to allow selection of degraded mode operation.

(4) Maintenance Data Retrieval Programs allow automatic collection of pertinent in-flight system performance information that is utilized for post-flight analysis of system malfunctions, failures, and degraded performance.

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(5) Special Test Programs provide maintenance tests that are not part of normal readiness test or fault isolation routines. Examples are weapon release tests, system alignment routines, computer load/verify programs, and data link evaluation programs. These programs are usually not time-constrained as are most system readiness tests.

3.3 AUTOMATIC TEST EQUIPMENT (ATE) SOFTWARE

The functional interfaces of the operational program with the ATE will be delineated in this section. ATE software includes programs for weapon system peculiar and common ground support equipment (GSE) that is utilized for test and diagnosis of the weapon or its components.

3.4 TRAINER SOFTWARE

The functional interfaces of the operational program with the trainers involved in the project will be detailed in this section and will define the inter-relationships with operational software programs.

3.5 SUPPORT SOFTWARE

Support software will be defined and described in this section. Support system software includes compilers, assemblers, utility packages, diagnostic routines, integration test programs, simulation, and other software associated with the general support function.

3.6 INTERFACE CONFIGURATION

The hardware interface configuration baselines will be defined and described in this section. Hardware interface includes computer-to-computer and computer-to-peripheral equipment interfaces.

4.0 SOFTWARE LIFE CYCLE PLANS AND MILESTONES

This section will identify major elements of the software life cycle which must be addressed in software life cycle planning. The weapon system software life cycle may be divided into three phases: Phase I - Software Development Phase; Phase II - Software Transition Phase; and Phase III - Navy Software Support Phase. These three phases may overlap, since all software elements or subsystems of a weapon system may not complete each phase simultaneously.

The plans, milestones, and schedules to provide life cycle management of weapon system software will be identified in detail in this section of the SLCMP. This section will provide guidance in planning the acquisition and support of software/computer resources, including equipment and programs. This guidance will apply to cases in which these resources are separately identifiable at the outset and to cases in which they are identified during the course of a system, subsystem, or equipment development process.

The individual software life cycle events and requirements will be identified and defined in the order of programmed occurrence. This section will reflect the time(s) required for these events to materialize and progress from start to completion, and will present all of the events together to portray the major elements of the total weapon system software life cycle in a time-phased sequence. In addition, this section will plan and schedule acquisition, development, and/or allocation of resources needed for future development and growth of the weapon system software.

In identifying and stating the needs for new or improved weapon systems capabilities, it is essential to consider the impact of software and computer resources on weapon system operation and its maintainability and support. The required capability must consider the life cycle mission, intended interface, and relationship with existing or planned systems. When initiating software and/or computer resource requirements, either separately or as a part of a weapon system, the using, supporting, and other participating activities' requirements will be identified and alternative solutions (if any) will be provided.

4.1 FIVE YEAR PLAN

The events programmed to occur during the first five years of the software life cycle will be presented, reflecting the relationship between elements. This portion of the SLCMP will provide the Project Manager with the necessary visibility into the software life cycle requirements and milestone completion dates during the programmed five year period.

During the conceptual phase, analyses and tradeoff studies must be performed to establish feasibility and assess risks relative to software and computer resources development and supportability. These studies will be conducted by the implementing organization with inputs from all of the participating activities. Standardization considerations for software, computer hardware, programming, and programming language shall be considered in these studies and tradeoffs.

The five year plan will include a time-phased schedule detailing the management milestones. Direction and assignment of responsibilities will emphasize planning and acquisition management attention to software and computer resources including computer programs to be used in new weapon systems.

Management milestones such as the Defense Systems Acquisition Review Council (DSARC), formal test and evaluation (T&E), and initial operational capability (IOC) which will relate software development with weapon system development will be included as appropriate. The Program Management Directive (PMD) will provide guidance and direction in establishing many of the major program milestones and will assign responsibilities to the appropriate activities/organizations.

4.2 PHASE I - DEVELOPMENT PHASE

Phase I, the Development Phase, will involve (1) the determination and definition of weapon system software requirements based on Navy weapon system planning documents, (2) contractor/Navy development of software specifications for all elements of the weapon system software, and (3) programming, integration, and checkout of initial software definitions.

4.2.1 Pre-Development

The pre-development portion of Phase I of the software life cycle includes the definition of Navy requirements, the statement and definition of the resources required, and the proposal and contract writing.

4.2.1.1 RFP Preparation - This section will include all software life cycle requirements to be delineated in the RFP which will be the responsibility of the software contractor or Navy developer.

4.2.1.2 Contract Writing - The software specifications and contract software deliverable items that are to be included in the contract shall be identified. Only NAVAIR HQ approved Data Item Descriptions (DIDs) will be specified on DD Form 1423, Contract Data Requirements List (CDRL). These DIDs will incorporate the requirements of SECNAVINST 3560.1 and unique NAVAIR HQ requirements.

4.2.2 Design and Development

During Phase I the weapon system software will be designed, developed, coded, debugged, integrated, and tested in both laboratory and flight environments.

4.2.2.1 System Analysis - Systems analysis will address the definition of requirements and the identification of constraints. It will also address the weapon system vehicle, the weapon system operational environment, and the real time response requirements. The weapon system software requirements will be identified from Navy planning documents

4.2.2.2 Concept Formulation - Concept formulation shall describe the method(s) for implementation of the software functions evolving from system analysis. It will describe how functions are to be allocated to existing equipment, new equipment, software, and personnel. The contractor or Navy developer will establish a design approach for all elements of the weapon system software.

4.2.2.3 Performance and Design Specifications - Weapon system performance specifications and software design specifications will be written by the contractor or Navy developer in response to requirements identified in Navy planning documents, requests for quotation/proposal, and contracts.

4.2.2.3.1 Preliminary Design Review (PDR) - The purpose of a PDR is to evaluate the progress, consistency, and technical adequacy of a selected design and test approach; and to establish compatibility with program requirements and preliminary design. A PDR may be used first to approve the Program Performance Specification (PPS), followed by review of the preliminary design to ensure compliance with the approved requirements. PDRs shall be conducted for each computer software Configuration Item (CI) identified as part of the weapon system.

4.2.2.3.2 Prioritization/Assessment - As a result of PDRs, areas of software requiring additional development will be prioritized and assessed. Prioritization will address the necessity for meeting the specification requirements and operational requirements. Assessment will reflect the funding limitations in light of the prioritization.

4.2.2.3.3 Critical Design Review (CDR) - A CDR shall be conducted for each CI prior to start of computer program coding and testing. This review will compare the recommended design with the detailed requirements of the development specification. The recommended design will normally be documented by a finalized PPS and a preliminary Program Description Document (PDD) for each CI. If a Data Base Design (DBD) document has been developed, it shall also be reviewed. Following the CDR, computer program designs will be released for coding and testing, resulting in finalization of the PDD for each CI. This documentation constitutes the CI product baseline.

For both the PDR and CDR, the Navy review team shall comprise a representative cross-section of involved Navy Activities to ensure comprehensive evaluation of all pertinent areas and disciplines.

4.2.2.4 Coding/Lab Tests/Compilation - The process of implementing a software design (coding, compiling, and testing) shall be in accordance with the contract and approved related documents and data. Developmental milestones shall be established with appropriate testing to verify achievement of each goal. Minimum requirements for a recompile shall be defined to insure that programs do not accumulate excessive errata during development. Data will be recorded and analyzed during tests (both ground and flight) in a pilot production aircraft. This will aide in determining the degree to which the software satisfies its allocated requirements as part of the complete weapon system, and will facilitate the localization of deficiencies for elimination or correction prior to the test and evaluation phase.

4.2.2.5 Development Monitor - Navy software support activity and test and evaluation representatives will monitor the contractor development cycle and witness contractor testing and development milestones to provide Navy visibility into software development. Consideration should be given to the requirement for the Navy SSA to establish a software simulation facility for the purpose of conducting verification and validation testing. This coordinated activity will permit insight into possible trouble areas. Knowledge of current status of all software development will be provided, as well as early visibility of the contractor's ability to meet design goals. Design reviews will be held at milestone goals during the contractor development cycle.

4.2.2.6 Design Changes - Design changes to the software and the documentation of those changes will be the responsibility of the contractor or Navy developer in pursuing the initial development, test, and evaluation of the system. The SSA will monitor the design change process in order to acquire an in-depth knowledge of the software configuration. The SSA will also monitor the configuration management requirements of the contract to ensure that the contractor or Navy developer is correctly applying configuration identification, control, and status accounting. All changes shall be fully documented. The NAVAIR-directed software design management team shall review and approve all design changes that affect program performance.

4.2.2.7 Integration - This is the process of bringing together the system software and hardware in a laboratory and/or actual test vehicle. Integration testing will be performed in accordance with previously approved test plans and procedures. Due to the large amount of supporting hardware and software usually required, detailed facility and test planning is essential.

4.3 PHASE II - TRANSITION PHASE

Phase II, the Transition Phase, begins toward the end of Phase I, continues through test and evaluation and ends shortly after initiation of the Navy support phase. Phase II includes formal acceptance T&E, validation of documentation, SSA assumption of custody, configuration accounting responsibility, Fleet introduction coordination, and preparation for future software support.

4.3.1 Configuration Management

During Phase II, the software may undergo frequent change and development to correct deficiencies that become apparent during test and evaluation efforts. Configuration management of software changes is mandatory during this phase. Navy configuration identification and status accounting will begin at the start of this phase. The milestones and procedures for Navy assumption of configuration control responsibility will be identified in the SLCMP and/or the Configuration Management Plan. Details of the configuration management process will be described in Section 6.0.

4.3.2 Test and Evaluation (T&E)

Test and Evaluation will include laboratory and flight testing and evaluation of the software through contractor demonstration tests and a formal Navy evaluation program. T&E covers the entire spectrum of test and evaluation for systems, subsystems, equipment, and software. The purpose of the total test effort is to verify the performance and compliance with specifications of configuration items, subsystems, and the total integrated system and associated software.

Both the technical and operational performance of the software will be tested during this phase. All data and documentation will be closely monitored by the Navy test and evaluation and SSA representatives during this period to ensure they are updated and reflect the current configuration.

Formal Navy evaluation programs which may include Navy Preliminary Evaluations (NPE), Navy Technical Evaluations (NTE), Initial Operational Test and Evaluations (IOT&E), and Board of Inspection and Survey (BIS) will be conducted by designated Navy test and evaluation agencies during this period.

Prior to commencement of any formal Navy evaluation, a program tape, certified as ready for evaluation, shall be provided to the Navy by the contractor or Navy developer. Operational Test and Evaluation (OT&E) may be conducted during or after the Development Test & Evaluation (DT&E) period.

4.3.3 Fleet Introduction

During the latter portion of Phase II a limited number of weapon systems will be introduced into Fleet training squadrons. Phase III of the software life cycle will begin with this introduction and continue during the remainder of the weapon system life cycle. The SSA will coordinate Fleet introduction of the software system.

4.4 PHASE III - NAVY SUPPORT PHASE

Phase III, the Navy Support Phase, will begin with the SSA's assumption of responsibilities for the weapon system software, and will continue during the remainder of the weapon system life cycle.

4.4.1 Software Changes

Software changes may be initiated in response to problems discovered during user operations, or to meet new requirements. Problems or new requirements will be sufficiently defined to permit development of solutions.

4.4.2 Configuration Management

In Phase III total configuration management is the responsibility of the Navy. The Navy will ensure coordination of all weapon system software changes with their associated Fleet requirements, as well as complete configuration control of all weapon system software. Fleet participation in the

Software Change Review Board (SCRB) is mandatory during this phase. Official Navy Software Baseline configuration will have been established and changes to all system software are subject to MIL-STD-480 control. Detailed configuration management procedures will be developed and included in Section 6.0.

4.4.3 Evaluation/Assessment

The impact of proposed change(s) upon the total weapon system and weapon system operational capability will be evaluated and assessed.

4.4.4 Change Implementation

Following approval, the change(s) will be implemented. The SSA will be responsible for change design and implementation.

4.4.5 Test and Evaluation (T&E)/Approval

All changes will be tested and evaluated (validated, verified, and approved) by an organization independent of the change developer. Test and evaluation requirements will be determined by the Software Change Review Board. NAVAIR HQ will designate or request the responsible T&E activity to perform this function. Test and Evaluation of programs incorporating changes will include appropriate testing of the entire program to ensure that the changes have not adversely affected other program areas.

4.4.6 Distribution

Following acceptance by the test and evaluation activity the SSA will reproduce and distribute the final version of the software in accordance with the distribution instructions contained in the SLCMP.

The software change block implementation schedule and schedule for Fleet introduction will be determined by the Software Change Review Board.

4.5 SUPPORT SYSTEM ACQUISITION

The total software life cycle support system acquisition requirements shall be portrayed in a detailed schedule. The PMD normally will contain detailed requirements, schedules, and the activities/organizations responsible for the above.

Identification of funding and effective long range planning and adequate lead time for the procurement of support systems is mandatory.

4.6 FACILITIES

The total life cycle facilities requirements will be portrayed in a detailed schedule. This schedule will be updated periodically as new information becomes available. Detailed descriptions of specific facilities will be contained in Volume II, Section 2: Resource Requirements and Funding.

5.0 SOFTWARE MANAGEMENT ORGANIZATION

The software management organization is the functional element which provides management for the weapon system software throughout the life cycle. This organization operates within established NAVAIR HQ policies and procedures governing change control during all phases of the Weapon System Software Life Cycle.

The Software Management Organization provides the necessary management effort (i.e., planning, administration, and direction for all software development, utilization, verification and validation, and configuration management) throughout the software life cycle, and will administer and maintain configuration management and control procedures and disciplines in accordance with MIL-STD-480, MIL-STD-481 and NAVAIRINST 4130.1.

5.1 INVOLVED ORGANIZATIONS

Organizations involved in software management will include NAVAIR HQ, the SSA, participating Navy activities, Fleet users, and various contractors. Sections 5.1.1 through 5.1.5 of the SLCMP will identify the cognizant codes of the respective organizations and define their responsibilities for software life cycle management during the three phases. The internal structure of each organization showing lines of authority and responsibility shall be shown.

5.1.1 NAVAIR HQ

5.1.2 Field Acitivities/Labs

5.1.3 Contractors

5.1.4 Other Navy Activities

5.1.5 SSA Internal Operations

5.2 ORGANIZATIONAL RESPONSIBILITIES

Functional charts and organizational diagrams shall be constructed to show the composition and interrelationship between activities compris... the Software Management Organization.

5.2.1 Liaison

Close liaison among all activities in the software management organization must be maintained during the life cycle of the weapon system. Direct liaison responsibilities shall be clearly defined by the SLCMP.

5.2.2 Authority

The activities comprising the software management organization shall operate within their assigned authority. The SLCMP will define each activity's authority and responsibility, as outlined in NAVAIR HQ and other Command directives.

Enclosure (1)

5.2.3 Boards/Committees

Boards and/or committees may be formed to provide assistance to management for the life cycle of the weapon system software. Representatives of these boards/committees shall be identified in the SLCMP by activities, and the responsibilities of each shall be defined in detail in the SLCMP.

5.2.3.1 Software Change Review Board (SCRB) - The SCRB shall be established and be responsible for weapon system software life cycle change management. The Project Manager will designate the chairman of the SCRB. The SCRB shall comprise tactical and System Test Program (STP) subcommittees, as applicable, containing a representative cross section of all involved activities. Functions of the SCRB will be defined in Section 6.4.3.

5.2.3.2 Other Boards/Committees - Additional boards and/or committees shall be designated when and if the need arises.

5.3 REPORTING REQUIREMENTS

The progress of all activities involved in support of the weapon system software life cycle will be detailed through the publication of reports as scheduled in the SLCMP.

5.3.1 AIRTASK Requirements

The identification of items to be reported on as well as the required schedule of these reports will be included in AIRTASKS. The information addressed in reports by specific individual activities in response to AIRTASKS will be identified in the SLCMP to prevent duplication and permit dissemination of the total information available, concerning the weapon system software.

5.3.2 Special Requirements

Any special category report initiated by local Commands or Staffs will be included in the SLCMP if the information contained therein will assist other activities involved in the weapon system software life cycle.

5.3.3 Report Distribution

The distribution of all reports shall be listed in the SLCMP. Standard distribution lists may be included in Appendix C.

6.0 SOFTWARE CONFIGURATION MANAGEMENT

Comprehensive software configuration management is an integral part of the total software management for the weapons system.

This section will provide the plan by which software configuration management practices and procedures are applied consistently and uniformly throughout the life cycle of the weapon system. Specifically, these are considered early in the acquisition cycle. It will provide additional information that is unique to software and computer programs and provide guidance in the application of configuration management principles to software/computer program acquisition, operation, and support. It will apply to configuration identification, control, and status accounting, in accordance with the guidance and principles expressed in MIL-STD-480, MIL-STD-481 and NAVAIRINST 4130.1. Configuration management data requirements shall be included on the DD Form 1423, CDRL.

6.1 DEFINITION

Configuration Management is a discipline applying technical and administrative direction and surveillance to (a) identify and document the functional and physical characteristics of a configuration item, (b) control changes to those characteristics, and (c) record and report change processing and implementation status. Configuration management is thus the means through which the integrity and continuity of the design, engineering, and cost trade-off decisions which are made between technical performance, productibility, operability, and supportability, are recorded, communicated, and controlled by program and functional managers.

The SLCMP will provide the general procedures and processes for software configuration management of the system. This section may be expanded into a subsidiary document, the Software Configuration Management Plan. This plan will outline those requirements and procedures which will be required to effect control of all software configuration related to the weapon system. The Software Configuration Management Plan will reflect the requirements and procedures needed for effective and timely configuration control of weapon system software.

6.1.1 Factors

The primary factors of configuration management are the overall control of the system, the specific identification of various configurations, the effective control of changes to those configurations, and the interface with other systems.

Software configuration management requirements must be addressed in the RFP. The RFP must contain sufficient information to ensure that respondees may adequately address both developmental software configuration management and transition of configuration management to Navy control. In this respect, the SLCMP shall contain a configuration management concept that extends throughout the entire life cycle of the weapon system and considers relationships of the developing, supporting, and using Commands. The Software Configuration Management Plan will develop this concept in further detail.

6.1.2 Organizations Involved

The organization for software configuration management will consist of the NAVAIR HQ and the Software Change Review Board (SCRB). The Software Support Activity (SSA) will function as implementor of configuration changes approved by NAVAIR HQ and the SCRB.

The key role of NAVAIR HQ will be that of Project Manager. The specific NAVAIR HQ codes will be identified in the organization breakdown.

The key roles of the Software Change Review Board will be to establish detail procedures relative to the configuration control process to be used by all participants, to review and recommend disposition of all proposed software changes, and to recommend the testing required to validate and certify software programs.

The key role of the SSA will be that of maintaining configuration identification, accounting, and change implementation.

6.2 CONFIGURATION IDENTIFICATION

Configuration identification is the current approved or conditionally approved technical documentation for a configuration item as set forth in specifications, drawings and associated lists, flow charts, and documents referenced therein.

Each item of computer software will be allocated specific performance requirements from the overall system performance requirements, through the system engineering process. These requirements will be documented in a Program Performance Specification (PPS). The programs shall be designed to meet the PPSs and shall be tested to ensure that the design achieves specified performance objectives.

The physical design of each software item will be documented as a Configuration Item in accordance with MIL-STD-480, MIL-STD-481, MIL-S-83490, and SECNAVINST 3560.1. Each configuration item will be identified. Strict configuration identification will be maintained on each software configuration item. Configuration identification requirements must be included on the CDRL.

6.2.1 Responsibility

The performance requirements will be as specified in Navy planning documents. The prime contractor or Navy developer will maintain configuration identification for the weapon system while the software is contractor-furnished equipment. The Navy (SSA) will assume responsibility for software configuration identification and reidentification at the end of Phase II or when the software becomes Government-furnished equipment.

6.2.2 Schedule

A schedule will be portrayed, showing when configuration identification of weapon system software will become the direct responsibility of the Navy SSA.

6.3 CONFIGURATION CONTROL

Configuration control is the systematic evaluation, coordination, approval or disapproval, and implementation of all approved changes in the configuration of a CI after formal establishment of its configuration identification.

The purpose of configuration (change) control is to prevent unnecessary or marginal changes while expediting the approval of those that are necessary or promise significant benefits to the Government. Change control is the most visible aspect of configuration management, since personnel engaged in this effort evaluate and approve or disapprove proposed changes.

In addition to change decision making, change control will include the equally important factors of establishing change priorities (emergency, urgent, routine), and of assuring that necessary instructions and funding authorizations are issued promptly for approved changes. During the acquisition phase, changes are normally processed by Engineering Change Proposals (ECPs), usually submitted by the contractor(s), or by Software Change Proposals (SCPs) submitted by the using Navy Command. Configuration Change Control clauses and data requirements shall be included in the DD Form 1423, CDRL.

6.3.1 Change Proposals

All change proposals will be processed in accordance with MIL-STD-480, MIL-STD-481 and NAVAIRINST 4130.1. The SLCMP will contain sample forms, submittal criteria, and representative change proposal distribution lists. Any additional forms or requirements for data over and above that required by MIL-STD-480 must be listed on the CDRL, DD Form 1423, and be supported by an approved NAVAIR HQ DID. Information which may initiate a change proposal may be received from the following sources:

(a) Chief of Naval Operations
(b) Fleet Users
(c) Systems Command
(d) Test and Evaluation Activities
(e) Navy Laboratories
(f) Contractors

AD-A142 778 PROCEEDINGS PAPERS OF THE AFSC (AIR FORCE SYSTEMS COMMAND) AVIONICS STAND..(U) AERONAUTICAL SYSTEMS DIV WRIGHT-PATTERSON AFB OH DIRECTORATE O.. 3/4

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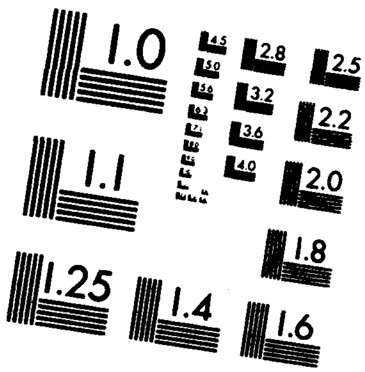

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

6.3.2 Change Classification

All proposed software changes will be categorized with regard to their impact on the operational system, existing documentation, and cost effectiveness. Change classification shall be in accordance with MIL-STD-480 requirements as interpreted below for software.

6.3.2.1 Definition - Categorization of change actions (in accordance with MIL-STD-480) will be either Class I or Class II changes.

6.3.2.1.1 Class I changes will be designated whenever one or more of the following are affected:

a. Operational capability (as specified in the baseline or as part of the computer software Configuration Item (CI) specifications).

b. Contract price or schedule.

c. Systems equipment, computer programs, or facilities produced by other contractor(s), to the extent that other contractors are affected and must accomplish a change to maintain compatibility at the interface.

Class I changes will be submitted to the Navy in accordance with MIL-STD-480, NAVAIRINST 4130.1, and the SLCMP.

6.3.2.1.2 Class II changes are changes that the developer may effect after submittal and subsequent concurrence in classification by the SSA. Such changes may include:

a. Changes to correct editorial errors.

b. Changes to correct coding errors.

c. Additions of clarifying notes or diagrams.

d. Addition or correction to adaptation data.

e. Recompiling within contractual specified limits.

Copies of all proposed Class II changes to avionics equipment will be submitted through the local Government representative (Defense Contract Administrative Services Office or local Navy representative) to the SSA, concurrent with their submittal to NAVAIR HQ. Responsibility for concurrence in classification will be as specified in the contract.

6.4 CONFIGURATION CHANGE PROCESS

The change process involves the preparation, format, submittal, action, approval, implementation, and distribution of software changes made to the approved baseline.

6.4.1 Input

All change proposals will be submitted to the SCRB by the SSA for technical approval/disapproval. The SSA will staff all change actions prior to consideration by the SCRB except in unusual circumstances.

6.4.2 Software Change Process Flow

The SSA will identify the software change process flow in detail. All software change proposals will be reviewed, coordinated, and screened for classification and analysis by the SSA. Analysis of the software change proposals will be performed by the SSA or a designated participating field activity, with appropriate contractor support. All change proposals, with appropriate operational and technical analysis, will be submitted to the Software Change Review Board for review.

6.4.3 Software Change Review Board (SCRB)

The SCRB referenced in Section 5.2.3.1, is responsible for weapon system software life cycle change management functions as follows:

a. Review proposed software changes and provide technical approval/disapproval of these reviews.

b. Determine overall system impact of proposed change and assure that computer program change proposals or change orders cover all sub-systems affected.

c. Provide direction to the SSA, other Navy field activities, and development contractors.

d. Provide liaison with related systems ACCB, CCCB, and SCRB to ensure compatibility with interfacing systems.

6.4.4 Change Implementation

Change implementation responsibility will vary depending upon life cycle phase. The SLCMP will define change implementation responsibility during the three phases.

6.4.5 Notices of Revision (NOR)

NORs for software changes will be prepared in accordance with MIL-STD-480 and will accompany Class I and Class II SCPs.

6.5 CONFIGURATION AUDITS

Configuration audits are performed to certify compliance with configuration management requirements. The audit function validates accomplishment of development requirements and achievement of a product configuration through examination of the CI's technical documentation. Two kinds of audits are performed, functional and physical. A related review is the formal qualification review.

a. The Functional Configuration Audit (FCA) is a review of an item's test/analysis data to confirm that the item, as designed and developed, meets the functional performance requirements specified in its development specification.

b. The Physical Configuration Audit (PCA) compares the "as built" item with its approved and released technical documentation to assure that the documentation is complete and is appropriate for operational, maintenance, and support purposes. In addition, the PCA establishes the product baseline. This audit is vital for software and computer programs because the CI specification and associated documentation represent the complete and only technical description of the programs "as built".

c. The Formal Qualification Review (FQR) is a "certified FCA" used by NAVAIR to assure that the item design is sound and stable enough for spares provisioning and other logistic support purposes.

6.5.1 Purpose

The purpose of the audit/review function is to validate change implementation accomplishments, and to certify the achievement of a product through configuration item technical documentation. Compliance with configuration management requirements will be verified by means of periodic configuration audits and reviews.

6.5.2 Frequency

The SLCMP will identify the frequency of configuration audits.

6.5.3 Responsibilities

The SLCMP shall define in detail the responsibilities of the activities involved in configuration audits.

6.5.4 Reports

The SSA will report to Project Management the results of all completed audits and copies of all audit reports will be distributed to users.

6.5.5 Field Audits

The SLCMP will define in detail the procedures used to assure that users are operating with the Navy approved software baseline and documentation. The SSA will be responsible for management and implementation of field audits.

6.5.6 Product Recall

The SLCMP will describe the detailed procedures for the recall/return of noncurrent, out-of-configuration program tapes and documentation. The SSA will be responsible for the management and implementation of the product recall.

6.6 CONFIGURATION STATUS ACCOUNTING

Configuration status accounting documentation is the means through which actions affecting CIs are recorded and reported to project and functional managers. It principally records the "approved configuration" (baseline) and the implementation status of changes to the baseline. It is the bookkeeping part of configuration management which provides managers with feedback information to determine whether decisions of the Change Control Board (CCB) are being implemented as directed. Configuration status accounting has its greatest activity after establishment of the Product Configuration Baseline (PCB) when formal change control is instituted.

MIL-STD-482 contains data elements to be used in the accounting and reporting process. Provisions of MIL-STD-482 allow the project office to use any data content and format, both input and output, necessary to perform status accounting.

6.6.1 Configuration Status Accounting Records

Software configuration baseline status accounting requirements will be defined in the SLCMP. Status accounting records will be consistent with configuration identification and shall include as a minimum:

a. Identification of initally approved product baselines.

b. Identification of proposed changes to configuration items, status of such changes, and identification of individual or organizational functions responsible for deciding upon such changes.

c. Identification of approved changes to baseline and of current configuration.

6.6.2 Status Reporting/Responsibilities

The SSA will prepare the status summary and maintain it on a monthly basis. The status summary will be a numerical list of each successive change proposal prepared against the end item with a detailed summary of the status information for each change proposal which is currently active.

7.0 QUALITY ASSURANCE

Quality assurance procedures will be established to systematically assure that the quality of products and services will meet the needs of the users and be in accordance with applicable military standards, approved contractor and/or military specifications, and requirements listed in the SLCMP.

A thorough Quality Assurance (QA) Program encompasses many tasks and functions, including a sound concept formulation, the establishment of proper documentation/data requirements, and timely delivery of these data by the contractor(s). The primary means for ensuring an effective QA program is through proper Test and Evaluation (T&E) throughout the design, pilot production, and production phases of the life cycle. MIL-Q-9858 provides the necessary guidelines for the total QA program; NAVMATINST 3960.6 and other Navy T&E Directives provide detailed guidance and direction for all T&E requirements.

Software/Computer Resources Verification, Validation, and Certification (VV&C) is an approach for monitoring and evaluating the development of software and computer programs. VV&C starts at the beginning of the software/computer program and continues throughout the program life cycle. It is closely related to and includes the T&E functions commonly associated with systems acquisition. The concept is generally applied in the use of independent evaluation by agencies other then the developer.

This section shall establish a system of activities to provide the quality of products and services that will meet the needs of users. Management procedures for reviewing and evaluating final test results shall be defined. Guidance for creating and accomplishing a technically adequate quality assurance and test program for new or modified software and computer programs shall be provided.

Computer resources testing is generally governed by the same basic principles that apply to other equipment testing and is discussed only in its relation to and effect on software and computer programs. Additional detailed guidance for developing procedures, selecting test tools and techniques, applying test criteria and standards, and conducting evaluation can be obtained from NAVMATINST 3960.6 and other Navy T&E Directives.

The evaluation criteria (successful test criteria or accept/reject limits) for each test shall be defined, as well as the procedure for obtaining approval of test results by the procuring agency.

Developmental milestones shall be established with appropriate testing to verify achievement of each goal. Validation/Verification/Certification tests and techniques used for testing shall be clearly defined.

7.1 DEVELOPMENT/MODIFICATION

Quality assurance procedures will be implemented during the development and modification of computer programs and will be strictly adhered to.

7.1.1 Development QA

Development QA must include rigorous review of design prior to programming, and thorough testing of individual modules prior to integration in the overall program, to avoid a build-up of errors that can compound during program integration. Developmental milestones will be established and appropriate verification/validation testing will be identified.

7.1.2 Simulation

Weapon system simulation capability will be developed to provide the Navy with a means to test and exercise quality assurance over all software developed during the software life cycle. Consideration should be given to establishing this capability early in Phase I for the purpose of conducting verification and validation (tests) at the Navy SSA.

7.1.3 Integration

The capability for integration testing of newly developed or modified software into the total weapon system environment will be provided.

7.2 VERIFICATION/VALIDATION/CERTIFICATION

Verification, Validation, and Certification procedures will be conducted to assure that the integrated hardware/software system meets all testing requirements in accordance with SECNAVINST 3560.1.

7.2.1 Lab Test

Verification/validation of newly developed software will include integration and testing with necessary elements of the hardware system in a laboratory environment. The developer/support activity will perform laboratory testing during program development. The developer will define the configuration of the laboratory installation and document the difference from the weapon system production configuration.

7.2.2 Environmental Testing

Environmental testing will exercise the software in the weapon system in the operational environment. System Test and Diagnostic software will be tested by actual fault insertion with faults proportioned to weapon system component failure rates and program complexity.

7.3 TEST AND EVALUATION

Following any developmental change or modification to the baseline software, the new computer program will undergo test and evaluation, conducted by a designated activity other than the computer program developer.

Activities responsible for T&E will be designated and applicable instructions included. The SSA and responsible T&E activity(s) will assist NAVAIR HQ in the preparation of a Test and Evaluation Master Plan (TEMP) as required per NAVAIRINST 3960.2. Sufficient lead time and monitor effort must be provided to the T&E activity to permit effective software T&E.

Funding requirements for the supporting T&E activity should be included in the funding section to permit total cost planning.

7.3.1 Development Test and Evaluation (DT&E)

Upon completion of newly developed software, DT&E shall be the responsibility of a developing activity organization which is administratively and technically independent of the actual product engineering process. This DT&E is distinct from developmental (in-process) testing conducted by the contractor or SSA.

DT&E focuses on the technological, engineering, and specified requirements aspects of the system and includes an operatenal emphasis. It is the responsibility of the development activity and is normally completed prior to the production decision. The DT&E effort is dividad into the two areas of configuration item testing, subsystem test and system test.

DT&E consists of the determination of software performance in accordance with Program Performance Specifications (PPS) through witness of contractor and/or Navy laboratory tests and flight testing conducted by the T&E activity. The data accrued from these tests will be used by the developing activity to certify the systems readiness for OPEVAL in accordance with OPNAVINST 3960.10.

7.3.2 Operational Test and Evaluation (OT&E)

Operational Test and Evaluation (OT&E) will be conducted by Commander, Operational Test and Evaluation Forces, or his designated agent. Normally a Navy activity is designated as an operational test facility which reports to the CNO on the operational suitability of the end product.

OT&E addresses the operational effectiveness and suitability of systems and equipment under realistic operating conditions. For all new programs and those in early phases of development, Navy T&E Directives require an initial phase of OT&E to be accomplished, called Initial Operational Test and Evaluation (IOT&E) prior to the production decision. OT&E will therefore parallel certain phases of DT&E, normally the system level testing. Testing will be conducted by officially designated independent agencies, with assistance from implementing and supporting Commands.

7.4 PRODUCTION

Production phase quality assurance procedures shall provide a high level of confidence in the uniform high quality of the deliverable media.

Enclosure (1)

7.4.1 Software Products

All deliverable software products which are duplicated from controlled and tested master copies (magnetic tape, perforated tape, etc.) will be compared with that master copy to assure exact duplication. All duplicate software products will be labeled indicating (1) Serial Number of the master copy, (2) Date of duplication, and (3) Completion of comparison.

7.4.2 Library Storage

The problem of storage is less that of providing a repository for the physical elements of the software (source code, test data, documentation, etc.) than it is of providing a positive means for recognizing related elements (i.e., those versions which constitute a particular baseline) and for protecting the software against destruction or unauthorized modification.

A comprehensive identification technique which ties together all of the different forms of software, will be provided. Access to software storage, particularly for replacement or deletion, will be restricted to personnel authorized to perform such functions. Physical duplication of stored software will be provided as necessary, to protect against failure or destruction of the storage medium.

7.4.3 Distribution

Distribution will include provisions that will enable the recipient to confirm that delivery was complete. He will also be informed as to the method of installation of received items (revision pages in a document, a computer program in storage) in order to verify that installation is correct. Means will be provided to enable the user to acknowledge receipt, installation, and verification activities, and to quickly report any problems encountered.

8.0 SOFTWARE DOCUMENTATION

The procurement of complete and accurate technical data is vital to the weapon system program and is essential to meet the needs of design review and evaluation, operation and maintenance, and further procurements. This section will establish a uniform set of requirements for:

a. Specifications for all software and computer software configuration items.

b. User oriented documentation, such as Computer Program User Manuals, Operator and Maintenance Manuals, and Programmer's Notebooks.

c. Reports, plans, and procedures critical to the design, development, and operational usage of software and computer resources.

d. Engineering data for use in the engineering management process, such as system analyses, trade studies, and interface control.

Data management procedures applicable to all functional areas that govern and control the generation and delivery of data, are required subsequent to procurement of software documentation. Data management procedures will be compatible with current NAVAIR HQ and DoD policies.

To assure that all of the required supporting documentation is available at one central location, the SSA will be designated as the software documentation control activity for tactical software. The SSA shall also maintain (for working references) up-to-date copies of documentation utilized by Naval Air Rework Facilities/Cognizant Field Activities (NAVAIRREWORKFAC/CFA) in their ATE tape maintenance role.

8.1 SECNAVINST 3560.1

SECNAVINST 3560.1 establishes a uniform set of requirements for the preparation of digital computer program technical documentation.

8.1.1 Design Documentation

The Software Documentation specified in the contract will be based on SECNAVINST 3560.1. All design documentation requirements will be specified in the CDRL and will be supported by approved NAVAIR HQ DIDs.

8.1.2 User Documentation

The user documentation specified in the contract will be based on SECNAVINST 3560.1. All user documentation requirements will be specified in the CDRL and will be supported by approved NAVAIR HQ DIDs.

8.2 INTERIM DOCUMENTATION

Interim documentation shall be as specified in NAVAIRINST 5230.3A.

8.3 DELIVERY

This section will identify the documentation to be delivered under the contract. In addition, this section will contain a detailed delivery schedule.

8.3.1 Contract Data Requirements List (CDRL)

All data required as deliverable items shall be specified by the DD Form 1423, Contract Data Requirements List.

8.3.2 Data Item Description (DID)

The contents of each data item required by the CDRL shall be described in detail by an approved NAVAIR HQ Data Item Description (DID). A listing of the more essential DIDs will be provided in the NAVAIR Software Management Manual (to be developed). In addition to items directly related to software and computer resources, items which contain provisions or constraints impacting these resouces are also listed. Specific procurements may require the preparation of unique DIDs to meet the specific system requirements. These unique DIDs must be approved by NAVAIR HQ prior to utilization.

8.4 SECURITY OF CLASSIFIED MATERIAL (SOFTWARE)

The procedure to be followed to determine the classification of software and to ensure the integrity, proper storage, transportation, and handling of software classified material will be stated in the SLCMP. These procedures shall be in accordance with the current Industrial Security Manual for Safeguarding Classified Information (DoD 5220.22M).

8.5 DATA MANAGEMENT

The Navy will monitor the contractor's or developing activity's software documentation effort throughout the Development Phase (Phase I) to assure that the documentation delivered to the Navy will meet contract specifications. This will be accomplished by using standard in-process reviews. The SSA will be the official computer software documentation agency to ensure that all of the required supporting documentation is available in one central location, and that adequate quality control is maintained.

Data Management is applicable to all functional areas and comprises a set of procedures and disciplines that govern and control the generation and delivery of data. The types of data required for a program are directly dependent upon the management disciplines, techniques, and procedures imposed and the level of visibility and traceability required. The SSA Data Management Program will be compatible with current NAVAIR HQ and DoD policies.

8.5.1 Software/Documentation Library

The SSA will staff and maintain a control repository that will contain all the technical data necessary to carry out the mission and tasks of the SSA.

8.5.2 Inventory Control and Distribution

An inventory control system will be created to assume responsibility for overall software material management and control of all stock and undelivered assets. Management will include the responsibility for preparation and distribution of allowance lists, initial outfitting lists, as well as planning, programming, inventory reporting, stock coordination, disposal, and other functions that are necessary for control of all program assets. Specific functions will be:

a. Preparation, distribution, and updating of allowance and initial outfitting lists for inclusion in the Integrated Logistic Support Management Plan (ILSMP).

b. Maintenance of a master data file of technical application and inventory management information.

c. Maintenance of a master tape storage.

d. Coordination of a master tape reproduction capability.

A distribution control system that will be responsive to operational requirements will be developed. This system will be tailored to fit the peculiar nature of software and will be the central control point for the distribution of program assets.

8.6 GOVERNMENT PREPARED DOCUMENTS

The SSA will provide source information and assist in the generation and management of any Government prepared document relating to the control of weapon system software. This section of the SLCMP will include a Government Furnished Information (GFI) Schedule.

8.7 SUPPORTIVE TECHNICAL DOCUMENTATION

The SSA will provide source information and assist the cognizant publications manager for NATOPS Manuals, Tactical Manauals, and Maintenance Manuals, in updating these manuals to reflect the latest computer software configuration.

ATTACHMENT A

RESOURCE REQUIREMENTS AND FUNDING

Enclosure (1)

1.0 GENERAL

Volume II, Section 2.0 of the SLCMP will identify all resources required for immediate, continuing, and future software life cycle support. This section will identify the resources and responsibilities for computer program and other software resources management, including computer program types, modification processing procedures, and interfaces between using and supporting commands. Resources include personnel, equipment, facilities (buildings, laboratories, maintenance facilities, test ranges, etc.) and the funds to support the above. This section will identify "what" is needed and when it is needed. All facilities and resource requirements shall be requested from AIR-06.

2.0 FACILITIES

Facilities requirements will be identified and defined in the SLCMP to permit the weapon system Project Manager to plan effectively and meet program requirements in a timely and orderly manner.

2.1 Military Construction (MILCON)

Requirements for new construction, or for expansion and/or major modification of existing facilities to provide the necessary software life cycle support will be identified and defined in the SLCMP. The SLCMP will specify when these facilities are required, what capabilities they will provide, and the funding that will be required. MILCON documentation development and approval cycle will be considered in establishing planning and facility definition schedules.

2.2 Lab Facilities

Laboratory facilities required to provide software life cycle support will be described in this section.

2.3 Test Ranges

The SLCMP will identify and define the types of test range facilities, recording, and instrumentation equipment required, the need dates, and the objectives to be attained utilizing the range facilities. This section will include provisions for coordination of test range requirements with the NAVAIR HQ Test and Evaluation Coordinator.

3.0 EQUIPMENT

The SLCMP will identify and define the equipment required, the need dates, the capability to be established, and the funds required to provide the necessary equipment. Equipments are to include laboratory equipment, operational computers, associated avionics equipment, and test equipment. Additionally, support aircraft resources will be identified.

3.1 ADP Acquisition

Requirements for ADP equipment will be identified in the SLCMP. Recommendations for the most cost effective means of providing the required ADP equipment (purchase or lease) will be identified.

3.2 Hardware

The hardware required to provide a complete and viable system for supporting the software life cycle will be detailed in the SLCMP. Long acquisition lead times and shortage of assets will be carefully considered and planned for in this requirement. The SLCMP shall have provisions for logistics support via the Weapons Systems Planning Document (WSPD).

3.3 Aircraft

Aircraft requirements to support flight testing and demonstrations will be identified, defined, and justified in the SLCMP. Provisions for coordination of aircraft requirements with designated NAVAIR acitivities will be included in this section. Aircraft resources will be requested from AIR-06.

4.0 SUPPORT SOFTWARE

The SLCMP will identify and define the support software required, the need dates, the capability to be established, and the funds required to provide the necessary software support.

5.0 MANPOWER

All manpower requirements identifying special skills, training, staffing levels, and contractor support will be identified and defined in the SLCMP.

5.1 Special Skills

All requirements for special skills, training, staffing levels, and contractor support will be identified and defined in the SLCMP. Software and computer resources have unique support requirements in specialized personnel skills that require identification during the initial planning phase to ensure adequate lead times for training. Some of the more essential skills required to support the weapon system software and computer resources are as follows:

a. Technical management capability for overall integration of program modifications, determination of priorities, establishment of bounds on problems identified by user commands, and coordination of activities between system manager and engineering.

b. Ability to develop revised equations, to set up the equations into logical steps to be used by the computer, and to perform the actual coding to be used.

c. The specialized testing of computer programs and other supporting software using the integrated support facility to evaluate new programs. This specialty involves actual operation of systems equipment and provides necessary technical direction of support facility maintenance by computer technicians.

d. The ability to analyze and evaluate the performance of the computer program and/or other software using data acquired in testing, to establish that modified programs perform as intended.

e. The engineering ability to interface the computer operation with other system elements (whereas programming (b) is concerned with the operation of the software program itself).

f. The knowledge and ability for routine maintenance and operation of the equipments which comprise the integrated support facility, including trouble-shooting, and repair of system components, within the facility.

6.0 SUPPORT

The requirements for Integrated Logistics Support or special support will be identified in detail in the SLCMP.

6.1 Integrated Logistics Support Plan (ILSP) Input

The interface and impact of the SLCMP on the ILSP will be defined in this section.

6.2 Special Requirements

Special support requirements will be defined in the SLCMP.

NAVAIRINST 5230.6

"ESTABLISHMENT OF TACTICAL SOFTWARE CHANGE REVIEW BOARDS (SCRB)"

ABSTRACT

- Provides for the establishment of Software Change Review Boards.
- Provides a Software Change Review Board Charter.
- Identifies Software Change Review Board Guidance Documents.

DEPARTMENT OF THE NAVY
NAVAL AIR SYSTEMS COMMAND
WASHINGTON, D.C. 20361

IN REPLY REFER TO
NAVAIRINST 5230.6
AIR-5331
1 Jun 1977

NAVAIR INSTRUCTION 5230.6

From: Commander, Naval Air Systems Command

To: Deputy Commander, Assistant Commanders, Comptroller, Command Special Assistants, Deputy Commander, Designated Project Managers, Project Coordinators, and Office and Division Directors

Subj: Establishment of Tactical Software Change Review Boards (SCRB)

Ref: (a) NAVMATINST 4130.1A
(b) NAVMATINST 4130.2A
(c) NAVAIRINST 4130.1
(d) NAVAIRINST 5230.4
(e) NAVAIRINST 5230.5

Encl: (1) Software Change Review Board Charter
(2) List of SCRB Guidance Documents

1. Purpose. This instruction provides for the establishment of Software Change Review Boards (SCRB) by Project Managers (PM) or Acquisition Managers (AM) as a management discipline to exercise configuration control over weapon system tactical digital processor software and related support software.

2. Background. In recent years the weapon systems control functions have been enhanced by the introduction of digital computer technology. Inherent in the use of digital computer technology is the ability to change system operational capability by modification of the computer software programs alone. The relative ease with which such computer program changes can be effected (compared to hardware modifications) provides a high degree of flexibility in responding to new Fleet requirements. This ease of change requires a responsive software configuration management organization with the operational and technical knowledge to evaluate proposed changes and to ensure expeditious implementation for Fleet support. Reference (a) provides statements of policy, implementing guidance, and procedures governing Configuration Managment (CM) in the Department of the Navy. Reference (b) clarifies responsibilities of Systems Commanders and Project Managers for control and coordination of changes to tactical and technical computer programs. Reference (c) implements reference (a) and contains the primary policy and procedures governing CM in the Naval Air Systems Command (NAVAIR). Reference (d) designated the Director of the Avionics Division (AIR-533) as the manager of all NAVAIR weapon system tactical digital processors and related software.

3. Terminology

a. For purposes of this instruction, the term "tactical digital processor(s) and related software" includes only the airborne processor(s) and the operational program(s) with their concomitant host system(s) and development facilities.

b. Digital processors are special or general purpose digital computers which accept data inputs, process these inputs in accordance with a stored set of ordered arithmetic and logic instructions, and output data or commands to external devices.

c. Digital processor programs are the set of ordered arithmetic and logic instructions together with the data on which these instructions operate. The program may be stored (1) on peripheral storage devices, (2) in electrically alterable memory, (3) in non-alterable memory or (4) any combination thereof.

d. Concomitant host systems are those systems which support the development, test and evaluation, and generation of digital processor programs. For these purposes the host system includes computers (military or commercial); the necessary assemblers, compilers and other support software; and ancillary equipment such as tape drives, discs, etc. Development facilities include that combination of actual avionics equipment and stimulation/simulation equipment as necessary to ensure proper integration, checkout and evaluation of the generated digital processor program.

e. Software is all digital processor programs together with all program design and user documentation.

4. Applicability

a. The requirements for SCRB set forth in this instruction apply to all weapon system tactical digital processor software and related support software (GFE or CFE) which are the responsibility of Naval Air Systems Command Headquarters (NAVAIR HQ).

b. Excluded from the provisions of this instruction are management information, logistics, command support type applications and Automatic Test Equipment software.

5. Responsibility

a. The Avionics Division (AIR-533) shall provide coordination and assistance in the application of this instruction.

b. The PM/AM may establish a SCRB in the validation phase when in his judgment the system is of such magnitude or importance that prudent judgment indicates that formal coordination and review of proposed software changes are necessary to protect the Command's interests.

c. In the full scale development phase, a SCRB shall be established by the PM/AM when:

(1) The weapon system tactical digital processor software is of such magnitude or importance, or of such a nature, that prudent judgment indicates that formal coordination and review of proposed software changes are necessary to protect the Command's interests.

(2) The software change matters to be resolved are complex and require the participation and recommendations of several NAVAIR HQ divisions/offices.

d. In any event a SCRB shall be established prior to fleet introduction unless prudent judgment indicates that formal coordination and review, by all affected organizations and activities, is not necessary.

e. In the event a decision is made not to establish a SCRB, all software change proposals shall be processed in accordance with reference (c).

6. Action

a. Project Managers/Acquisition Managers shall establish, as appropriate, a SCRB for the tactical digital processor software and related support software of each weapon system for which he has cognizance. Enclosure (1) sets forth the elements of a Software Change Review Board Charter. Each SCRB established shall be chartered in accordance with this instruction. The charter shall become a part of the appropriate Software Life Cycle Management Plan prepared in accordance with reference (e). Enclosure (2) sets forth SCRB Guidance Documents.

b. Project Managers/Acquisition Managers shall budget and direct the necessary funding to support each SCRB which he establishes.

c. AIR-533 shall provide proper and timely coordination and assistance in response to the needs of the Project Manager/Acquisition Manager in establishing a SCRB.

d. The implementation of this instruction by addressees shall not be cause for reformatting existing software management boards which fulfill the requirements of this instruction. However, the formation of all future SCRB's shall conform to this instruction.

F. H. Baughman

F. H. BAUGHMAN
Vice Commander

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SOFTWARE CHANGE REVIEW BOARD CHARTER

1. Charter. Under direct charter from the Chief of Naval Operations and the Chief of Naval Material, NAVAIR is responsible for providing Fleet activities with effective systems to satisfy Fleet operational requirements. Computer software systems are provided by NAVAIR to help satisfy these requirements. A Software Change Review Board (SCRB) is chartered and established to support the Project Manager (PM) or Acquisition Manager (AM) in exercising configuration control of the software system. The SCRB functions in a technical advisory capacity to the PM/AM. To provide this advisory capability for all aspects of a system software, the membership of the SCRB shall be composed of representatives of all Navy technical, user and support activities and all contractor organizations cognizant of the system software life-cycle. SCRB members will review and evaluate all proposed changes to system software to assess impacts in their areas of expertise and will recommend disposition to the SCRB Chairman. The SCRB Chairman shall report all SCRB findings to the PM/AM by written synopsis. The PM/AM has the final authority in the implementation of software changes. Factors such as budgetary constraints, system needs, implementation, test schedule, fleet release schedule, other system priorities, and impact on interfacing systems will determine which software changes are implemented.

2. Authority of a SCRB

a. A SCRB is required to make recommendations to the PM/AM on all substantive matters relating to the weapon system tactical digital processor software and related support software. Consequently, organizations appointing members to a SCRB shall ensure that such members are qualified and authorized to make technical assessments affecting the interests of their organizations, generally without reference to higher authority.

b. A SCRB is authorized to call upon and shall be supported by any division/office of NAVAIR HQ. The division/office shall furnish information, advice, or other assistance necessary to support the SCRB in its deliberations. Nothing in this instruction shall be construed as affecting the responsibility of the PM/AM.

3. Organization of a SCRB

a. The SCRB shall consist of voting members from each of the following areas as appropriate:

(1) Project Manager/Acquisition Manager
    (a) SCRB Chairman
(2) AIR-04
(3) AIR-05
(4) AIR-06
(5) Navy Field Activities

(6) Navy Software Support Activity (SSA) or Designated Life Cycle Support Activity
(a) SCRB Secretariat
(7) Fleet Major Command Software Representatives

b. The SCRB may consist of non-voting advisors from each of the following areas, as appropriate:

(1) Contractors
(2) Interfacing systems SCRB representative(s)
(3) Operational Test and Evaluation Forces Representatives

c. The SCRB may consist of subcommittees for each major software program utilized by a weapon system (i.e., Tactical Subcommittee, On-Board system test subcommittee, etc.). The subcommittee members shall consist of voting members and non-voting advisors as specified in paragraphs 3(a) and 3(b).

d. Where their participation in specific cases is considered necessary, representatives from other divisions/offices of NAVAIR HQ shall serve as advisors to the board as required by the Chairman. Members may be assisted by such other personnel as they consider advisable or necessary.

4. Functions of a SCRB

a. General Guidance for SCRB Activities

(1) Proposed changes shall be coordinated with and evaluated by affected organization(s) prior to approval.

(2) Factors such as performance guarantees, ground support equipment interfaces, other platform or sensor interfaces, training equipment, Automatic Test Equipment software interfaces, implementation cost and value engineering will be identified in the software change review evaluation.

(3) When a proposed change affects any system or item under the cognizance of another service, command, project, or program, the proposed change shall be coordinated with persons in that service, command, project, or program having cognizance of the system or item affected. Joint SCRB meetings shall be held when required.

(4) Proposed changes submitted for SCRB action shall be complete with respect to technical requirements, justification, cost information, logistics requirements, interface requirements/impacts, retrofit and other applicable information.

(5) Particular attention must be given to the funding and total cost aspects of changes.

(a) The SCRB shall identify funding requirements, tradeoffs and priorities to the PM/AM for funding allocation.

(b) In addition to direct/immediate costs of changes, the cost of logistics support, involving obsolescence or modification of technical data, revisions to manuals and publications, and modifications to tapes, trainers, etc., will be identified.

(6) Status reports of proposed changes produced by the Software Support Activity (SSA) shall be reviewed and evaluated.

(7) The SCRB shall ensure that the affect of proposed changes on foreign military sales programs have been considered.

(8) As a result of SCRB actions resulting in the scheduling of a new baseline program for fleet issue, assure that all affected areas of change have been addressed and a software Engineering Change Proposal has been prepared for processing in accordance with NAVAIRINST 4130.1 prior to fleet release.

b. SCRB Chairman. Ultimate authority for the SCRB rests with the PM/AM. The SCRB Chairman shall be appointed by the PM/AM to act as his agent in all SCRB functions. The SCRB Chairman shall report all SCRB findings to the PM/AM. The responsibilities of the SCRB Chairman are as follows:

(1) Schedule and conduct SCRB meetings.

(2) Ensure that notice of a SCRB meeting is furnished sufficiently in advance so that representatives may attend completely prepared.

(3) Ensure that AIRTASKS, work unit assignments and contract changes are issued to fund SCRB members for direct SCRB participation.

(4) Consolidate budgetary estimates of SCRB members for proposed software changes.

(5) Evaluate and act on proposed software changes.

(6) Present recommended changes to PM/AM to assist him in determining which change requests will be processed for implementation.

(7) Coordinate implementation of software changes approved by the PM/AM.

(8) Present composite software Engineering Change Proposal for new baseline fleet issue programs to the appropriate Change Control Board (CCB) in accordance with NAVAIRINST 4130.1.

(9) Coordinate Navy testing of software changes.

(10) Sign the written synopsis of matters considered and recommendations made by the Board. (The synopsis shall be made a permanent part of the proceeding of the SCRB and copies of the synopsis should be distributed to all SCRB members).

c. SCRB Secretariat. The Software Support Activity (SSA) will provide a Secretariat to perform administrative functions including:

(1) Receiving, recording, compiling, and distributing of proposed changes.

(2) Preparing, coordinating and distributing the SCRB agenda.

(3) Acting as recording secretary during the SCRB meeting.

(4) Preparing the composite software Engineering Change Proposal.

(5) Performing additional staffing functions as directed by the SCRB Chairman.

(6) Preparing and distributing written synopsis of matters considered, recommendations made by the Board, action items, and status reports of proposed changes.

(7) Distributing copies of signed synopsis to all SCRB members.

d. Other SCRB Members. All SCRB members will represent their respective activities regarding all proposed software changes brought before the Board. Their duties include the following:

(1) Review, evaluate and coordinate with other offices as required to determine impact of all proposed changes.

(2) Attend meetings, as required, of the full SCRB to present a position statement on proposed changes.

(3) Assist in the preparation of composite software Engineering Change Proposal to the appropriate CCB for approval prior to release of a new baseline fleet issue program.

(4) Assist the SSA in analysis of the impact of proposed changes as appropriate.

(5) Perform other tasks as assigned by the SCRB Chairman.

5. General Procedures for Processing Proposed Changes

a. Proposed Changes. Proposed changes to software systems may arise from the following sources:

(1) Chief of Naval Operations.
(2) Fleet users.
(3) Systems Command.
(4) Test and Evaluation Activities.
(5) Navy Laboratories.
(6) Contractors.

b. Minimum Content Requirement of Proposed Changes. The minimum information to be set forth in a proposed change shall be:

(1) Originator Name/Address/Telephone No.
(2) Type of change.
(3) Title of change.
(4) Priority.
(5) System identification - Model/Type.
(6) Configuration Item Identification/Software Program Identification - No./Nomenclature.
(7) Other systems/subsystems/configuration items affected.
(8) Documentation Affected - Spec./Doc. No.
(9) Description of change requested or trouble reported.
(10) Need for change
(11) Recommended effective date
(12) Submitting activity authorizing signature/title/date.

c. Submission of Proposed Changes. Proposed changes shall be submitted concurrently to the PM/AM and the SSA.

d. Priorities. Proposed changes shall be assigned priorities of either emergency, urgent, or routine by the originator.

(1) Emergency. This priority shall be assigned to changes proposed for any of the reasons listed in subparagraphs (a) and (b) below. Replies to emergency proposed changes shall be made within twenty-four (24) hours of proposal receipt.

(a) To effect a change in operational characterisitics which, if not accomplished without delay, may seriously compromise national security.

(b) To correct a hazardous condition which may result in fatal or serious injury to personnel, or in extensive damage or destruction of equipment. A hazardous condition usually will require withdrawing the item from service temporarily, or suspension of the item's operation, or discontinuance of further testing or development pending resolution of the condition.

(2) Urgent. This priority shall be assigned to changes proposed for any of the reasons listed in subparagraphs (a) through (e) below. Replies to urgent SCR or STR shall be made within fifteen (15) calendar days of proposal receipt.

(a) To effect a change in operational characteristics which, if not accomplished expeditiously, may seriously compromise the mission effectiveness of deployed equipment.

(b) To correct a potentially hazardous condition which may result in serious injury to personnel, or in damage to equipment. A potentially hazardous condition compromises safety and embodies risk, but within reasonable limits permits continued use of the affected equipment, provided the operator has been informed of the hazard and appropriate precautions have been defined and distributed to the user.

(c) To meet significant contractual requirements (e.g., when leadtime will necessitate slipping approved production, activation, or construction schedules, if the changes were not incorporated).

(d) To effect an interface change which, if delayed, would cause schedule slippage or cost increase.

(e) To effect, through value engineering or other cost reduction efforts, net life cycle savings to the Government of more than $100,000.00, where expedited processing of the change will be a major factor in realizing these lower costs.

(3) Routine. This priority shall be assigned to proposed changes when "emergency" or "urgent" is not applicable. Replies to routine proposed changes shall be made within forty-five (45) calendar days of proposal receipt.

e. Emergency Procedures. In the event that a proposed change is determined to be of an emergency nature by the PM/AM or the SCRB Chairman in accordance with the definitions of paragraph 5d(1), either may, at their discretion, call an emergency SCRB meeting to provide immediate processing of the change request. These meetings may be conducted via phone or message in order to facilitate rapid handling of the request. If an immediate fix cannot be generated appropriate steps will be taken to ensure that lives are not endangered or national security jeopardized. These steps may include aircraft grounding, non-use of certain equipments and the like. All such emergency procedures shall result in a software Engineering Change Proposal in accordance with NAVAIRINST 4130.1.

f. Urgent/Routine Procedures

(1) If the proposed change results from a program malfunction, cognizant user personnel should attempt to duplicate the malfunction to eliminate the possibility that the malfunction was caused by operator error. If the malfunction is substantiated, a proposed change should be submitted concurrently to the SSA and the SCRB. If the proposed change is for modification to an existing software program or a request for a new program to provide better service to the user, cognizant user personnel should review the proposed change and evaluate its merits prior to submission to the SCRB.

(2) Upon receipt of a proposed change, the SSA shall accomplish a preliminary review and evaluation of the merits of the proposal. All proposed changes submitted to the SSA shall be analyzed by the SSA with assistance as required from other SCRB members and presented for consideration to the SCRB. Proposed changes may be returned to the originator for revision or additional information before action is taken. Liaison between proposed change originators and the SSA is encouraged to preclude unnecessary submittals. If a proposed change is determined to have merit, the SCRB Secretariat will provide copies to the cognizant SCRB members for review and comment. Concurrently, the SSA will determine the scope of the requested change, its impact, as well as the cost of implementing the change. The SSA will report these findings to the SCRB at its regular session.

(3) At meetings of the SCRB, proposed changes will be reviewed and evaluated. Factors such as performance guarantees, ground support equipment interfaces, other platform interfaces, training equipment, implementation cost and value engineering shall be considered. The SCRB Chairman will decide, based on the findings of the SCRB, which proposed changes will be recommended by the SCRB. A written synopsis of matters considered and recommendations shall be prepared and submitted to the PM/AM.

(4) The SCRB Chairman will coordinate with the PM/AM to decide which proposed changes will be implemented. The PM/AM is the final authority in the implementation of software changes. Factors such as budgetary constraints, system needs, implementation, test schedule, fleet release schedule, other system priorities, and impact on interfacing systems will determine which software changes are implemented.

(5) Unless previously designated by higher authority, the SCRB Chairman will be responsible for recommending to the PM/AM the activity(s) responsible for developing and verifying the software version package, producing the system tapes and documentation, and distributing these items to the fleet.

(6) All software changes resulting from SCRB actions and resulting in a scheduled fleet release update program shall be processed by a software Engineering Change Proposal by the SCRB Chairman in accordance with NAVAIRINST 4130.1.

6. Recommendations of a SCRB. Recommendations of the Board must be in accordance with the facts; with all applicable laws, regulations, policies and procedures; and must be in the best overall interests of NAVAIR. Enclosure (2) provides a list of documents to be utilized by a SCRB as guidance to the extent that their contents apply to the requirements and operations of the particular system SCRB.

LIST OF SCRB GUIDANCE DOCUMENTS

The following list of documents shall be utilized by the SCRB as guidance resources to the extent that their contents apply to the requirements and operations of the particular system SCRB.

STANDARDS

MIL-STD-480	Configuration Control - Engineering Changes, Deviations and Waivers
MIL-STD-482	Configuration Status Accounting Data Elements and Related Features
MIL-STD-483	Configuration Management Practices for Systems, Equipment, Munitions, and Computer Programs
MIL-STD-490	Specification Practices
MIL-STD-680	Contractor Standardization Plans and Management
MIL-STD-882	System Safety Program for Systems and Associated Subsystems and Equipment, Requirements for
MIL-STD-1521	Technical Reviews and Audits for Systems, Equipment, and Computer Programs

SPECIFICATIONS

MIL-Q-9858	Quality Program Requirements
MIL-S-83490	Specifications, Types and Forms
WS-8506	Requirements for Digital Computer Program Documentation (Superseded by SECNAVINST 3560.1)

INSTRUCTIONS

SECNAVINST 3560.1	Tactical Digital Systems Documentation Standards
SECNAVINST 5233.1A	Department of the Navy Automatic Data Systems Documentation Standards
OPNAVINST 3500.27B	Construction and control of digital processor programs for the Navy Combat Direction Systems
OPNAVINST 4790.2A	Naval Aviation Maintenance Program
NAVMATINST 3960.6A	Test and Evaluation

Enclosure (2)

NAVMATINST 4130.1A	Department of Defense Configuration Management
NAVMATINST 4130.2A	Configuration Management of Computer Software Associated with Tactical Digital Systems and Other Technical Computer Systems developed by or for the Naval Material Command
NAVMATINST 4130.3A	Standard Combat System Automatic Data Processing Hardware and Software; point Configuration Management of
NAVMATINST 5200.27A	Transfer of Navy Tactical Digital System Software responsibility; procedures for
NAVAIRINST 3960.2	Test and Evaluation Master Plans policies and procedures concerning the preparation, processing, and approval
NAVAIRINST 4130.1	NAVAIRSYSCOM Configuration Management Manual
NAVAIRINST 4200.14A	Policy and guidelines for procurement of data and specific acquisition of unlimited rights in technical data
NAVAIRINST 4275.3B	Configuration Control, MIL-STD-480 and MIL-STD-481 implementation of
NAVAIRINST 5215.8B	The NAVAIR Technical Directive System
NAVAIRINST 5230.3A	Standard specification for weapon systems related digital processor programming documentation
NAVAIRINST 5230.4	Responsibility for the coordination and management of weapon system tactical digital processors and related software
NAVAIRINST 5230.5	Responsibility and requirements for preparation of Software Life Cycle Management Plans (SLCMP)
NAVAIRINST 5400.14A	Policies and procedures for the transfer of engineering cognizance of and production support responsibilities for service equipment to Navy Field Activities

Enclosure (2)

TADSTAND A

"STANDARD DEFINITIONS FOR EMBEDDED COMPUTER RESOURCES IN TACTICAL DIGITAL SYSTEMS"

ABSTRACT

- Establishes standard definitions for embedded computer resources (ECR) in tactical digital systems.

DEPARTMENT OF THE NAVY
HEADQUARTERS NAVAL MATERIAL COMMAND
WASHINGTON, D.C. 20360

IN REPLY REFER TO
08Y/DCR
Ser 230
T-9
2 July 1980

TACTICAL DIGITAL STANDARD (TADSTAND) A

From: Chief of Naval Material

Subj: Standard Definitions for Embedded Computer Resources in Tactical Digital Systems

Ref: (a) NAVMATINST 5430.60 of 10 July 1978 (with effective changes); Headquarters Naval Material Command Organization Manual
(b) CNM ltr 09Y/CFH Ser 113 of 6 April 1972; Standard Definition of Tactical Digital Systems (TADSTAND 4)
(c) CNM ltr 09Y/CFH Ser 148 of 5 June 1972; Combat System Designs Employing Multiple AN/UYK-7 Processors (TADSTAND 6)
(d) DoD Directive 5000.29 of 26 April 1976; Management of Computer Resources in Major Defense Systems
(e) SECNAVINST 5200.32 of 11 June 1979; Mangement of Embedded Computer Resources in Department of the Navy Systems
(f) OPNAVINST C3501.2E of 12 April 1979; Naval Warfare Mission Areas and Required Operational Capabilities/Projected Operational Environment Statements
(g) OPNAVINST 4720.9D of 23 August 1974; Approval of Systems and Equipment for Service Use
(h) MIL-STD-1679 (Navy) of 1 December 1978; Weapon System Software Development

1. Purpose. In accordance with reference (a), this TADSTAND establishes standard definitions for embedded computer resources (ECR) in tactical digital systems under the cognizance of the Naval Material Command. This TADSTAND supersedes reference (b).

2. Cancellation. Effective this date, references (b) and (c) are cancelled.

3. Applicability. This TADSTAND applies to all organizational elements within the Naval Material Command. The definitions below are the standard interpretations of terms to be applied to ECR in TDS within the Navy.

4. Background.

a. Reference (d), as implemented by reference (e), establishes DoD policy for the management and control of computer resources during the development, acquisition, deployment, and support of major Defense systems. These policies are applicable to all Defense systems except general purpose, commercially-available ADP systems that are subject to other regulations. Reference (e) further states, "Navy standard embedded computer resources will be utilized in systems, except in those cases where standards are demonstrated to be not cost-effective or not technically practicable over the life of the system."

Subj: Standard Definitions for Embedded Computer Resources in Tactical Digital Systems

b. Reference (a) assigns MAT 08Y, the Tactical Embedded Computer Program Office (TECPO), the responsibility for designating standard tactical embedded computers, digital processors, digital peripherals, interface standards, programming languages, support software, documentation, acquisition policy, and configuration control procedures. These standards are to be promulgated in the form of tactical digital standards (TADSTANDS). To ensure that each TADSTAND is consistent in specifying policy concerning ECR, this TADSTAND provides the standard definitions of terms used in all other TADSTANDS.

5. Definitions.

a. Tactical Digital Systems, in consonance with reference (e), are those tactical weapons, communication, command and control, and intelligence systems and subsystems that employ digital computers and directly support military operations in the following missions areas (as defined by reference (f)):

(1) Anti-Air Warfare

(2) Antisubmarine Warfare

(3) Antisurface Warfare

(4) Strike Warfare

(5) Amphibious Warfare

(6) Mine Warfare

(7) Special Warfare

(8) Mobility (MOB 1 through MOB 11)

(9) Command and Control and Communications

(10) Intelligence

(11) Electronic Warfare

(12) Noncombat Operations (NCO 2-6, NCO 9, NCO 18, and NCO 20)

The surface ship, submarine, and aircraft systems and subsystems included in this definition are:

Combat Direction System (including data processing, display, and data links)

Missile Fire Control

Subj: Standard Definitions for Embedded Computer Resources in Tactical Digital Systems

Gun Fire Control

Underwater Battery Fire Control

Underwater Fire Control

Weapon Delivery (including bombs, torpedoes, and depth charges)

Electronic Warfare (including signal processing, identification, and prediction)

Sensor (including beam forming and signal processing of radar video, beacon video, laser, infrared, and television signals)

Sonar (including beam forming, accoustic signal processing, identification, and prediction)

Communications (including automated message processing and distribution, frequency prediction, and hardware resources management)

Sonobuoy (including deployment, operation, accoustic signal processing, identification, and prediction)

Navigation

Intelligence (including collection, processing, and evaluation of information)

b. Applications Software consists of the computer software/firmware and associated data that implement the operational capabilities of tactical digital systems. Examples include target tracking, navigaton, and avionics programs.

c. Embedded Computer (EC) is a digital computer or processor that is an integral component, from the design, procurement, and operations point of view, of any tactical digital system. This definition includes microcomputer, microprocessor, etc.

d. Embedded Computer Resources (ECR) are the totality of operational and support software/firmware; embedded computers; data storage and display devices; interface standards; programming languages; support facilities ashore; training facilities; training support personnel; and personnel whose primary specialized educational experience and/or training is directed toward operation or maintenance of embedded computers. Specifically included are programmable calculators (PROCALS) that are electrically interfaced to tactical digital systems.

Subj: Standard Definitions for Embedded Computer Resources in Tactical Digital Systems

e. Hardware Intensive Application is one in which the function(s) is/are fixed and hence the computer program, after development and test, is not expected to be changed for the lifetime of the system or subsystem in which the computer is embedded.

f. Low Level Code is a sequence of machine-oriented source statements that implements some desired function or procedure. These code sequences are made up of source statements from "Assembly" languages, "Machine" languages, the CMS-2 "Direct" code feature, etc.

g. Main Memory is that component of an EC from which stored programs are executed and within which data, manipulated by such programs or involved in input/output operations, is stored.

h. Major Upgrade, as it applies to a specific system, is the redesign or substantial addition of hardware, the re-writing of more than half the software, the re-design of the software architecture, or the substantial addition of new software functions. If an operational evaluation, operational functional checkout, or equivalent is required, the system upgrade is considered major.

i. Planned Standard is a designation assigned by the Chief of Naval Material to selected ECR under developement, evaluation, or consideration with the intent to designate them as standards. Normally, approval for service use (ASU) is required for hardware in this category prior to designation as standard. This definition is in consonance with reference (g).

j. Programming Language is a language in which computer program partitioning constructs, symbolic and numerical algorithms, and associated data structures are expressed such that they may be machine translated into executable instructions (under translation and loading directives which may also be included in the programming language syntax).

k. Programming Language Preprocessor is a computer program that transforms input source text into source text suitable for direct processing by a specific compiler. Specific functions include host-dependencies removal, macro expansion, string substitution, file insertion, pre-compilation calculations, and conditional compilation.

l. Pseudo Code is a natural language abstract description of computer programming algorithms and associated data structures. Pseudo code is often used as a programming design language in computer software development.

m. Secondary Storage is that component of an EC that is used as an auxiliary to main memory. Typical types of secondary storage are bulk store, magnetic tapes, disks, and drums.

Subj: Standard Definitions for Embedded Computer Resources in Tactical Digital Systems

n. Standard is a designation assigned by the Chief of Naval Material to selected ECR that are approved for service use or otherwise authorized for use. The minimum criteria for designating selected ECR as standard are assignment to a designated configuration control board, assignment to a designated development or maintenance activity for life cycle support, and in-service use in at least one tactical digital system. This definition is in consonance with reference (g).

o. Support Software consists of the computer software/firmware and associated data that are the means by which software/firmware for tactical digital systems is developed, tested, executed, and maintained. Such software includes:

(1) Requirements and specification analyzers

(2) Text editors, compilers, interpreters, assemblers, linkage editors, builders, librarians, loaders, utilities, and operating systems.

(3) Test case generators, symbolic execution analyzers, and other debugging programs.

(4) Stimulation and simulation programs

(5) Data extraction, insertion, and reduction programs

(6) Programs used for data base management, management control, configuration management, and documentation generation and control.

Trainer, test, and maintenance software are not considered support software in this definition and are separately defined in reference (h).

6. Deviations. The purpose of this TADSTAND is to ensure consistent meaning and usage of terms related to ECR in other TADSTANDs and in documentation associated with tactical digital systems. Therefore, it is inappropriate to request deviation from this TADSTAND.

7. Inquiries. Inquiries concerning the application or intrepretation of this and other TADSTANDs should be addressed to:

Chief of Naval Material (Attn: MAT 08Y)
Navy Department
Washington, D. C. 20360

Phone: Autovon 222-3966; Commercial (202)692-3966

08Y/DCR
Ser 230

Subj: Standard Definitions for Embedded Computer Resources in Tactical Digital Systems

C. F. HAGER
By direction

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TADSTAND B

"STANDARD EMBEDDED COMPUTERS, COMPUTER PERIPHERALS, AND INPUT/OUTPUT INTERFACES"

ABSTRACT

- Established standard embedded computers, computer peripherals and input/output (I/O) interfaces.
- Included are both standards and planned standards.

DEPARTMENT OF THE NAVY
HEADQUARTERS NAVAL MATERIAL COMMAND
WASHINGTON, D.C. 20360

IN REPLY REFER TO
TADSTAND B
(Revision 1)
MAT 08Y
21 June 1982

TACTICAL DIGITAL STANDARD B (Revision 1)

From: Chief of Naval Material

Subj: Standard Embedded Computers, Displays, Peripherals, and Input/Output Interfaces

Ref: (a) NAVMATINST 5430.60 of 10 July 1978 (with effective changes); Headquarters Naval Material Command Organization Manual
(b) CNM ltr 08Y/BWS Ser 231 of 2 July 1980; Standard Embedded Computers, Computer Peripherals, and Input/Output Interfaces (TADSTAND B)
(c) CNM ltr 08Y/DCR Ser 230 of 2 July 1980; Standard Definitions for Tactical Embedded Computer Resources (TADSTAND A)
(d) DoD Directive 5000.29 of 26 April 1976; Management of Computer Resources in Major Defense Systems
(e) SECNAVINST 5200.32 of 11 June 1979; Management of Embedded Computer Resources in Department of the Navy Systems
(f) NAVMATINST 4130.1A of 1 July 1974; Configuration Management
(g) MIL-STD-882A of 28 June 1977; System Safety Program Requirements

1. Purpose. In accordance with reference (a), this TADSTAND reissues reference (b) and is promulgated to establish standard embedded computers, displays, peripherals, and input/output (I/O) interfaces for use within the Naval Material Command.

2. Cancellation. Reference (b) is hereby cancelled.

3. Definitions. The following terms are defined in reference (c):

a. Embedded Computer (EC)

b. Embedded Computer Resources (ECR)

c. Main Memory

d. Major Upgrade

e. Planned Standard

f. Standard

h. Tactical Digital Systems

Subj: Standard Embedded Computers, Displays, Peripherals, and Input/Output Interfaces

4. Applicability

a. This TADSTAND applies to all tactical digital systems under the cognizance of the Chief of Naval Material (CHNAVMAT). This TADSTAND also applies to development programs under the cognizance of CHNAVMAT that are ultimately intended to be employed as tactical digital systems or as components thereof. This TADSTAND applies to all phases of system acquisition, including initial concept formulation and requirements definition, design, development, installation, production, and post-development support throughout the service life of the system regardless of funding or acquisition category.

b. The provisions of this TADSTAND are not to be applied retroactively to systems for which hardware (computer or peripheral) or I/O interface commitments have already been made. However, all hardware commitments made prior to the effective date of this TADSTAND must have been in compliance with superseded reference (b). Compliance includes use of previously designated standards or a CHNAVMAT approved waiver.

c. Excluded from the requirements of this TADSTAND is the use of processors or computers that are wholly contained on a single integrated circuit, that have a data path of eight (8) bits or less to main memory and that have a maximum addressability of 65,536 or fewer memory locations.

5. Background

a. Reference (d), as implemented by reference (e), establishes DoD policy for the management and control of computer resources during the development, acquisition, deployment, and support of major defense systems. These policies are applicable to all defense systems except general purpose, commercially-available ADP systems that are subject to other regulations. Reference (e) further states, "Navy standard embedded computer resources will be utilized in systems, except in those cases where standards are demonstrated to be not cost-effective or not technically practicable over the life of the system."

b. Standard Embedded Computer Resources (ECR) have been successfully utilized in a wide variety of tactical digital systems in aircraft, ships and submarines. Applications include fire control; signal processing; navigation; and command, control and communications systems.

c. The rationale for the requirement to use standard ECR in tactical digital systems is based on the need to stem ECR proliferation, achieve an acceptable level of supportability, and reduce costs over the life cycle of systems. Standardization, together with sound life cycle configuration management and logistics support practices, will significantly improve the reliability and maintainability of tactical digital systems while minimizing

Subj: Standard Embedded Computers, Displays, Peripherals, and Input/Output Interfaces

ECR related costs. Furthermore, standard ECR will reduce both cost and schedule risks in development and acquisition of new tactical digital systems.

6. Policy. Only those Navy standard and/or planned standard embedded computers, displays, peripherals, and I/O interfaces specified in paragraph 7 of this TADSTAND shall be used in initial development and for each major upgrade of applicable systems.

7. Standards and Planned Standards. Each equipment or I/O interface listed below is a standard or planned standard for those environments for which it is qualified or planned to be qualified. Except for interfaces internal to a computer, all computer and peripheral interconnections in tactical digital systems shall be standard I/O interfaces.

a. The following are designated as standard embedded computers, displays, and peripheral equipment:

Nomenclature	Program and Acquisition Office
AN/AYK-14, computer	PMA-533 (NAVAIR)
AN/UYK-7, computer	PMS-408 (NAVSEA)
AN/UYK-20, computer	PMS-408 (NAVSEA)
AN/UYS-1, signal processor	PMA-264 (NAVAIR)
AN/UYA-4, display	PMS-408 (NAVSEA)
AN/UYQ-21, display	PMS-408 (NAVSEA)
AN/UYH-2, disk	PMS-408 (NAVSEA)
AN/UYH-3, disk	PMS-408 (NAVSEA)
RD-358/UYK, magnetic tape unit	PMS-408 (NAVSEA)
AN/USH-26, cartridge magnetic tape unit	PMS-408 (NAVSEA)
AN/USQ-69, alphanumeric display	PMS-408 (NAVSEA)
OJ-326/UYK, submarine display	PMS-408 (NAVSEA)
IP-1181, submarine display	PMS-408 (NAVSEA)

Subj: Standard Embedded Computers, Displays, Peripherals, and Input/Output Interfaces

Note:

(1) The AN/AYK-14 was developed as a family of baselined shop replaceable assemblies (SRA) that may be configured into weapon replaceable assemblies (WRA) to meet user embedded computer requirements. The SRAs are also available for direct embedding in user developed WRAs.

b. The following are designated as planned standard computers:

Nomenclature	Program and Acquisition Office
AN/UYK-44, computer	PMS-408 (NAVSEA)
AN/UYK-43, computer	PMS-408 (NAVSEA)
AN/UYS-2, signal processor	PMS-408 (NAVSEA)

Notes:

(1) The AN/UYK-43, Navy Embedded Computer System (NECS), is being developed as a family of highly reliable, high performance successors to the AN/UYK-7. The AN/UYK-43 will be software compatible with the AN/UYK-7.

(2) The AN/UYK-44 Militarized Reconfigurable Processor (MRP) is being developed as a highly reliable, low cost, power, size, and weight processor for direct embedding in equipment. A packaged, stand-alone Militarized Reconfigurable Computer (MRC) version of the AN/UYK-44 is also being developed. The AN/UYK-44 MRP and MRC will be software compatible with the AN/UYK-20.

(3) The AN/UYS-2 Enhanced Modular Signal Processor (EMSP) is being developed as a highly reliable, high performance successor to the AN/UYS-1 for signal processing applications.

c. The following are designated as standard I/O interfaces:

Nomenclature	Principal Application	Cognizant Office
MIL-STD-1397	Surface and Airborne Tactical Digital Systems	PMS-408 (NAVSEA)
MIL-STD-188-114	Tactical Digital Communications Systems (synchronous and asynchronous)	PME-110/231 (NAVELEX)

Subj: Standard Embedded Computers, Displays, Peripherals, and Input/Output Interfaces

Electronic Industries Association Standard RS-232-C	Tactical Digital Systems	PME-110/231 (NAVELEX)
MIL-STD-1553A & B	Airborne Serial Multiplex Bus	AIR-533 (NAVAIR)
MIL-A-85232	Proteus Digital Channel	PMA-264 (NAVAIR)
NAT-STD-4153 NATO STANAG	Surface Tactical Digital Systems (10 MHZ serial asynchronous)	SEA-61X (NAVSEA)
NAT-STD-4156 NATO STANAG	Surface Interior Electrical & Electronic Communication Systems (1-3 MHZ serial synchronous)	SEA-61X (NAVSEA)

8. Configuration Management. Strict configuration management and control of standard ECR will be exercised by the respective development offices or follow-on cognizant acquisition, maintenance, or support offices under the guidance of established Configuration Control Boards (CCBs) in accordance with reference (f). Such offices will maintain an effective failure feedback system for problem identification and prioritized corrective action in the form of Engineering Change Proposals (ECPs). Reference (f) requires that prior to or concurrent with ECP approval, the impact upon integrated logistic support, as well as the overall estimated cost impact, be considered. Reference (f) further requires that funding authorization be issued for the scheduled implementation of a change when an ECP is approved. For cases in which total funding authorizations to complete the ECP in all equipments and provide the necessary integrated logistic support cannot be made concurrent with ECP approval, the ECP must be reconsidered for reduction in scope or disapproval. For ECR under development, the development office will ensure that appropriate configuration management and control procedures are established under a cognizant CCB in accordance with reference (f).

9. Waivers

a. It is recognized that, in some cases, strict adherence to this TADSTAND could be technically infeasible, economically prohibitive, or operationally impracticable. When an exception to this TADSTAND is considered to be in the best interests of the Navy, a TADSTAND waiver may be granted by the CHNAVMAT. An approved waiver will be effective only until the next major upgrade of the system concerned. When a major upgrade is planned, a new waiver request, if warranted, must be submitted.

b. Waiver requests related to computer, display, peripheral equipment, or I/O standards shall be submitted to CHNAVMAT (Attn: MAT 08Y) via the

Subj: Standard Embedded Computers, Displays, Peripherals, and Input/Output Interfaces

SYSCOM responsible for the development of the system for which the exception is being requested. Each request will be considered on a case-by-case basis. In order to preclude implied waivers, a waiver is required for each specific element of a developing system or subsystem for which an exception is deemed necessary. An approved waiver from this TADSTAND does not imply waiver from the other TADSTANDS. To minimize the fiscal or schedule impact of this TADSTAND on projects, cognizant agencies are enjoined to conduct liaison with the CHNAVMAT (MAT 08Y) prior to commitment to a specific course of action that could potentially result in a request for a TADSTAND waiver.

c. When non-standard equipments are directed by higher authority, a CHNAVMAT approved TADSTAND waiver is still required. Total life cycle costs, including logistics and software support, will be a critical factor in the consideration of such a waiver request. Based on the justification provided in the waiver request, CHNAVMAT will make a recommendation to higher authority concerning directed use of the non-standard versus standard equipments or grant the waiver.

d. A waiver request shall include the following information:

(1) Name, function(s), and operating description of system for which waiver is requested.

(2) Platform(s) on which system is to be installed.

(3) All embedded computer resources (computers, displays, peripherals, and I/O interfaces) and functions of each as well as system block diagram(s) depicting the interconnection of these resources.

(4) Storage and I/O requirements, and throughput parameters.

(5) Software constraints (e.g., timing and space).

(6) Environmental requirements and/or constraints on the embedded computer resources.

(7) Reasons why standards and/or planned standards cannot be used, including supporting rationale.

(8) Proposed substitute(s), together with supporting rationale, showing that the proposed substitute(s) meet the special requirements.

(9) Data (e.g., costs, performance, schedule) on using the proposed substitute(s) compared with using required standards and/or planned standards. The following areas shall be addressed:

(a) Acquisition (hardware, software, and firmware).

Subj: Standard Embedded Computers, Displays, Peripherals, and Input/Output Interfaces

(b) Integrated Logistic Support (ILS) data for life of the system (e.g., training, spare parts, documentation, life cycle maintenance).

(c) Testing.

(10) Reliability and maintainability requirements and demonstrated tests and operational data.

(11) Safety in compliance with reference (g).

(12) Other testing conducted or to be conducted.

(13) Data as in item (9) for any device(s) required to interface the proposed non-standard digital processing hardware with other hardware installed in the same platform.

(14) Data as in item (9) for alternative design(s) using required standards and/or planned standards.

10. Inquiries. Inquiries concerning the application or interpretation of this and other TADSTANDs should be addressed to:

Chief of Naval Material (Attn: MAT 08Y)
Navy Department
Washington, D. C. 20360

Phone: Autovon 222-3966; Commercial (202) 692-3966

J. G. Williams Jr.
J. G. WILLIAMS, JR.

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TADSTAND C

"COMPUTER PROGRAMMING LANGUAGE STANDARDIZATION POLICY TACTICAL DIGITAL SYSTEMS"

ABSTRACT

- Promulgates policy for the standardization of computer programming languages used in the development, acquisition, deployment, and support of tactical digital system.
- Defines when low level code may be used.
- Defines both approved and planned approved programming languages.
- Defines approved programming language preprocessor.

DEPARTMENT OF THE NAVY
HEADQUARTERS NAVAL MATERIAL COMMAND
WASHINGTON, D.C. 20360

IN REPLY REFER TO

08Y/OLM
Ser 232
T-9
2 July 1980

TACTICAL DIGITAL STANDARD (TADSTAND) C

From: Chief of Naval Material

Subj: Computer Programming Language Standardization Policy for Tactical Digital Systems

Ref: (a) NAVMATINST 5430.60 of 10 July 1978 (with effective changes); Headquarters Naval Material Command Organization Manual
(b) CNM ltr 08Y/BWS Ser 231 of 2 July 1980; Standard Embedded Computers, Computer Peripherals, and Input/Output Interfaces (TADSTAND B)
(c) CNM ltr 09Y/JER Ser 130 of 29 May 1973; Standard Shipboard Tactical Digital Processors and Program Language (TADSTAND 1 (Revision 1))
(d) CNM ltr 08Y/DCR Ser 230 of 2 July 1980; Standard Definitions for Embedded Computer Resources in Tactical Digital Systems (TADSTAND A)
(e) DoD Instruction 5000.2 of 19 March 1980; Major System Acquisition Procedures
(f) SECNAVINST 5230.4 of 3 May 1976; Department of the Navy Automatic Data Processing Program
(g) DoD Instruction 5000.31 of 24 November 1976; Interim List of DoD Approved High Order Programming Languages (HOL) (under revision)
(h) SECNAVINST 5200.32 of 11 June 1979; Management of Embedded Computer Resources in Department of Navy Systems

1. Purpose. In accordance with reference (a), this TADSTAND promulgates policy for the standardization of computer programming languages used in the development, acquisition, deployment, and support of tactical digital systems. This TADSTAND, in conjunction with reference (b), supersedes reference (c). Reference (b) cancels reference (c).

2. Definitions. The following terms used in this TADSTAND are defined in reference (d):

a. Applications Software

b. Embedded Computer (EC)

c. Embedded Computer Resources (ECR)

d. Hardware-Intensive Application

e. Low Level Code

f. Major Upgrade

Subj: Computer Programming Language Standardization Policy for Tactical Digital Systems

g. Planned Standard

h. Programming Language

i. Programming Language Preprocessor

j. Pseudo Code

k. Standard

l. Support Software

m. Tactical Digital Systems

3. Applicability.

a. This TADSTAND applies to all tactical digital systems under the cognizance of the Naval Material Command. This TADSTAND also applies to development programs under the cognizance the Naval Material Command that are ultimately intended to be employed as tactical digital systems or as components thereof. Except as noted in paragraph 3.b below, this TADSTAND applies to all phases of tactical digital system acquisition, including initial concept formulation and requirements definition, design, development, installation, production, and post-development support throughout the service life of the system.

b. In the specific case of major system acquisitions that are based on reference (e), the provisions of this TADSTAND need not be applied prior to the Demonstration and Validation phase. In these instances, acquisition managers must ensure that contractors are aware that the provisions of this TADSTAND will be applied to all phases of the acquisition commencing with the Demonstration and Validation phase.

c. Unless otherwise specified, the provisions of this TADSTAND apply to the development of both applications software and support software.

d. Except as noted in paragraph 3.f.(1) below, the provisions of this TADSTAND apply to those applications for which a waiver has been granted for the use of a non-standard embedded computer.

e. The provisions of this TADSTAND are not to be applied retroactively to systems for which a language commitment has already been made. All language commitments made prior to the effective date of this TADSTAND must have been in compliance with applicable portions of reference (c). Otherwise, a waiver request must be submitted within 90 days from the effective date of this TADSTAND. In those instances where systems were in compliance with reference (c) but are not in compliance with this TADSTAND, the provisions of this TADSTAND need not be applied until the next major upgrade of those applicable systems.

f. Excluded from the provisions of this TADSTAND are:

(1) Hardware-intensive applications authorized to use non-standard microprocessors. In these cases, where Navy software modification or maintenance is not required, language selection should be based on an appropriate balance of cost, schedule and performance trade-offs.

(2) Software developed for use with automatic data processing assets as defined and administered under reference (f).

(3) Those special purpose languages that do not fall within the category of a programming language as used in this TADSTAND (e.g., requirements definition languages, design specification languages, automatic test languages, job control languages, and simulation languages).

4. <u>Background</u>.

a. Reference (g) establishes CMS-2, SPL/I, and FORTRAN as DoD approved high order programming languages (HOLs) and assigns control of CMS-2 and SPL/I to the Department of the Navy. Reference (h) establishes the requirement that CMS-2 and SPL/I be used to develop applications software.

b. The rationale for the requirement to use standard HOLs is based on improved maintainability and cost effectiveness over the life cycle of the system. Standardization, together with sound life cycle management practices, will result in a significant reduction to the spiraling costs for developing, testing, and maintaining tactical digital systems. The importance of this issue is obvious in view of the substantial expenditures within the Navy for embedded computer resources, particularly applications software for tactical digital systems.

5. <u>Policy</u>.

a. Only those Navy standard HOLs, associated language implementations (compilers and their support systems), and Navy standard programming language preprocessors specified in paragraphs 6.a and 6.b below will be used in applicable systems, unless a waiver is obtained.

b. Consistent with the underlying objectives to achieve life cycle supportability and reliability at lowest cost, low level code may be used without a waiver in the following instances:

Subj: Computer Programming Language Standardization Policy for Tactical Digital Systems

(1) Low level code may be used for required machine oriented functions where the programming language does not provide high level support (e.g., Input/Output instructions, etc.)

(2) Low level code may be used for software functions which require special optimizing or fine-tuning in order to meet performance requirements, and that are not subject to significant life cycle modification (e.g., executives, interrupt handlers, math routines, etc.)

In all other instances, low level code will not be used, unless a waiver is obtained.

c. When low level code is used, with or without a waiver, all documentation for purposes of maintenance and future modifications will be maintained at the HOL level (e.g., pseudo code) with supporting documentation also at the low level. In addition, all low level code must be encapsulated within Procedure structures that are capable of being called with the standard HOL calling mechanisms. Acquisition agencies must maintain a record of such usage in order to support periodic review by the Tactical Embedded Computer Program Office for the purpose of determining requirements for improvement of the standard HOLs.

6. Approved Navy Standards. Effective this date, project and acquisition managers and other development and support activities shall use the approved Navy standards identified below. In each case the standard is defined by the most recent official version of the designated document.

a. Programming Languages

(1) CMS-2Y — CMS-2Y Programming Reference Manuals, M-5044 and M-5049, FCDSSA, San Diego, Ca.

Note: The CMS-2Y(20) and CMS-2Y(642) dialects are not approved for use in new applicable systems.

(2) CMS-2M — CMS-2M Computer Program Performance Specification, NAVSEA 0967 LP-598-2210 (formerly NAVELEX 0967-LP-598-2210)

(3) SPL/I — SPL/I Language Reference Manual, 5490-163:EF:vjs, NRL, Washington, D.C.

Note: Since SPL/I has language features that require executive services, the definition of the Common Real-time Operating System (CROS) is considered to be a part of SPL/I and is therefore designated as an SPL/I configuration item. CROS is specified by "Common Real-time Operating System (CROS) Program Performance Specification", NRL, Washington, D.C.

(4) Ada — Ada Language Reference Manual

Restriction: The Ada language is currently designated as a planned Navy standard language. Use of the Ada language in applicable systems is not authorized until formally designated as a Navy standard language or an explicit waiver is obtained.

b. Programming Language Preprocessors.

(1) SPL/I/CMS-2 Preprocessor — SPL/I/CMS-2 Preprocessor Program Performance Specification, NAVSEA 0967-LP-598-2540

c. Other Programming Languages.

(1) FORTRAN — ANS FORTRAN ANSI X3.9-1978

Restriction: FORTRAN is not approved for use in the development of applications software (vice support software) unless a reference (b) waiver has been granted for the use of a non-standard embedded computer.

7. Deviations.

a. It is recognized that, in some cases, strict adherence to this TADSTAND could be technically infeasible, economically prohibitive, or operationally impracticable. When a deviation is considered to be in the best interests of the Navy, a TADSTAND waiver may be granted by the Chief of Naval Material (CNM). An approved waiver will be effective only until the next major upgrade of the system concerned. When a major upgrade is planned, a new waiver request, if warranted, must be submitted.

b. Waiver requests shall be submitted to CNM (Attn: MAT 08Y) via PMS-408 or PMA-533, as appropriate. Each request will be considered on a case-by-case basis. In order to preclude implied waivers, a waiver is required for each specific element of an applicable system or subsystem for which a deviation is deemed necessary. In particular, this TADSTAND should be reviewed whenever a waiver to the provisions of reference (b) is contemplated. To minimize the fiscal or schedule impact of this TADSTAND on projects, cognizant agencies are enjoined to conduct liaison with the Chief of Naval Material (MAT 08Y) prior to commitment to a specific course of action that could potentially result in a request for a TADSTAND waiver.

c. A waiver request shall include the following information:

(1) Name, function(s), and operating description of system for which waiver is requested.

(2) Platform(s) on which system is to be installed.

Subj: Computer Programming Language Standardization Policy for Tactical Digital Systems

(3) All embedded computer resources (computers, peripherals, displays, I/O interfaces, etc.) and functions of each as well as system block diagram(s) depicting the interconnection of these resources.

(4) Storage and I/O requirements, and throughput parameters.

(5) Software constraints (e.g., timing and space).

(6) Reasons why standards cannot be used, including supporting rationale, documentation, etc.

(7) Proposed substitute(s), together with supporting rationale, documentation, etc., showing that the proposed substitute(s) meet the special requirements.

(8) Data (costs, performance, schedule, etc.) on using the proposed substitute(s) compared with using required standards. The following areas shall be addressed:

(a) Acquisition (hardware, software, and firmware).

(b) Integrated Logistic Support (ILS) data for life of the system (training, documentation, life cycle maintenance, etc.).

(c) Testing.

8. Inquiries. Inquiries concerning the application or intrepretation of this and other TADSTANDs should be addressed to:

Chief of Naval Material (Attn: MAT 08Y)
Navy Department
Washington, D. C. 20360

Phone: Autovon 222-3966; Commercial (202) 692-3966

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TADSTAND D

"RESERVE CAPACITY REQUIREMENTS FOR TACTICAL DIGITAL SYSTEMS"

ABSTRACT

- Establishes reserve capacity requirements for embedded computers.
- Defines reserve requirements for the following:
  - Main memory
  - Secondary storage
  - Throughput
  - Number of Input/Output Channels
  - Input/Output Channels throughput.

DEPARTMENT OF THE NAVY
HEADQUARTERS NAVAL MATERIAL COMMAND
WASHINGTON, D.C. 20360

IN REPLY REFER TO

08Y/RJH
T-9
Ser 239
2 July 1980

TACTICAL DIGITAL STANDARD (TADSTAND) D

From: Chief of Naval Material

Subj: Reserve Capacity Requirements for Tactical Digital Systems

Ref: (a) NAVMATINST 5430.60 of 10 July 1978; Headquarters Naval Material Command Organization Manual
(b) CNM ltr 09Y/CFH Ser 134 of 9 May 1972; Standard Reserve Capacitiy Requirements for Digital Combat System Processors (TADSTAND 5)
(c) CNM ltr 08Y/DCR Ser 230 of 2 July 1980; Standard Definitions for Tactical Embedded Computer Resources (TADSTAND A)
(d) DoD Instruction 5000.2 of 19 March 1980; Major System Acquisition Procedures
(e) DoD Directive 5000.29 of 26 April 1976; Management of Computer Resources in Major Defense Systems
(f) SECNAVINST 5200.32 of 11 June 1979; Management of Embedded Computer Resources in Department of Navy Systems

1. Purpose. In accordance with reference (a), this TADSTAND is promulgated to establish reserve capacity requirements for embedded computers (ECs) in Tactical Digital Systems under the cognizance of the Naval Material Command. This TADSTAND supersedes reference (b).

2. Cancellation. Effective this date, reference (b) is cancelled.

3. Definitions. The following terms are defined in reference (c):

a. Embedded Computer (EC)

b. Main Memory

c. Secondary Storage

d. Tactical Digital Systems

4. Applicability.

a. This TADSTAND applies to all tactical digital systems under the cognizance of the Naval Material Command. This TADSTAND also applies to development programs under the cognizance the Naval Material Command that are ultimately intended to be employed as tactical digital systems or as components thereof. Except as noted in paragraph 4.b below, this encompasses all phases of the life cycle of tactical digital systems including design, development, production, installation, major upgrade, and operational support throughout the service life of the system.

Subj: Reserve Capacity Requirements for Tactical Digital Systems

b. In the specific case of major system acquisitions that are based on reference (d), the provisions of this TADSTAND need not be applied prior to the Demonstration and Validation phase. In these instances, acquisition managers must ensure that contractors are aware that the provisions of this TADSTAND will be applied to all phases of the acquisition commencing with the Demonstration and Validation phase.

c. The provisions of this TADSTAND are not to be applied retroactively. All existing systems must have been in compliance with reference (b). Otherwise, a waiver request must be submitted within 90 days from the effective date of this TADSTAND. For those instances in which systems were in compliance with reference (b) but are not in compliance with this TADSTAND, the provisions of this TADSTAND need not be applied until the system is modified, as provided in paragraph 6.a below.

5. Background.

a. Reference (e), as implemented by reference (f), establishes DoD policy for the management and control of computer resources during the development, acquisition, deployment, and support of major Defense systems. These policies are applicable to all Defense systems except general purpose, commercially-available ADP systems that are subject to other regulations.

b. ECs have been employed successfully in a wide range of tactical digital systems for surface ships, submarines, and aircraft. Applications using ECs include missile, gun, and underwater fire control; signal processing; navigation; and command, control, and communications.

c. Failure to specify and/or maintain adequate reserve capacities in memory, throughput, and input/output of ECs during development and initial acquisition has all too frequently resulted in delivery of systems to the fleet that have no reserve capacity for change, update, and growth. Costly reprogramming or the introduction of additional embedded computers are then the only solutions that will satisfy new system requirements.

d. Reference (b) was developed in 1972 to deal with the multitude of problems that resulted from the historical lack of reserve capacity in the development of tactical digital systems.

6. Policy.

a. Reserve capacity requirements shall be applied to the first production delivery to the fleet of a new system or a modified system that incorporates new ECs or hardware modifications to ECs already in the system.

b. These reserve capacity requirements shall also apply to a system when installed on a new platform if any modifications, hardware or software, are required for such an installation.

Subj: Reserve Capacity Requirements for Tactical Digital Systems

c. If the system has multiple configurations, the reserve capacity requirements shall apply to all configurations individually.

d. Capacities reserved for future growth, when the growth requirements are known prior to acquisition commitment to the configuration of a new or modified system, shall not be included in the reserve required by this TADSTAND. Reserve capacity requirements specified by this TADSTAND are for future growth requirements that are not known at the time of acquisition commitment and first production delivery.

7. Reserve Capacity Requirements. Effective this date, project and acquisition managers, and other development and support activities, shall comply with the reserve capacity requirements identified below.

a. Main Memory. Main memory shall have a 20% reserve capacity, as a minimum. The reserve capacity shall be measured at peak main memory loading of the EC during its operational missions. Peak main memory loading shall include all programs and data required for successful operational mission execution. The reserve capacity need not be physically installed in the EC, but no cabinet, chassis, or backplane modifications shall be required for its installation, except in the case of the AN/UYK-7 as follows: reserve capacity may include conversion of AN/UYK-7 single density magnetic core memory to AN/UYK-7 double density mated film memory even though this conversion requires backplane modifications.

b. Secondary Storage. Secondary storage shall have a 20% reserve capacity, as a minimum. The reserve capacity shall be measured at peak secondary storage loading of the EC, with all secondary storage information included, during its operational missions. When secondary storage consists of multiple units and/or types of units, the reserve capacity shall apply to the sum total of all secondary storage reserve capacity. The reserve capacity need not be physically installed, but no cabinet, chassis, or backplane modifications shall be required for its installation.

c. Throughput. Central processor throughput shall have a 20% reserve capacity, as a minimum. The reserve capacity shall be expressed as a percentage of available capacity at full operational loading over a specific period of time, as determined by operational mission characteristics. In the case of cyclic applications, such as some signal processing applications, this period would be the time between availability of successive input data buffers.

d. Number of Input/Output Channels. The number of reserve input/output channels shall be 18.75% (3/16) of those available, as a minimum. The reserve channels need not be physically installed in the EC, but no cabinet, chassis, or backplane modifications shall be required for their installation.

e. Input/Output Channel Throughput. Input/output channels shall each have a 20% reserve capacity in throughput, as a minimum. The reserve capacity shall be expressed as in paragraph 7.c above.

8. Deviations.

a. It is recognized that, in some cases, strict adherence to this TADSTAND could be technically infeasible, economically prohibitive, or operationally impracticable. When a deviation is considered to be in the best interests of the Navy, a TADSTAND waiver may be granted by the Chief of Naval Material (CNM).

b. Waiver requests shall be submitted to CNM (Attn: MAT 08Y) via PMS-408 or PMA-533, as appropriate. Each request will be considered on a case-by-case basis. In order to preclude implied waivers, a waiver is required for each specific element of a developing system or subsystem for which a deviation is deemed necessary. To minimize the fiscal or schedule impact of this TADSTAND on projects, cognizant agencies are enjoined to conduct liaison with the Chief of Naval Material (MAT 08Y) prior to commitment to a specific course of action that could potentially result in a request for a TADSTAND waiver.

c. A waiver request shall include the following information:

(1) Name, function(s), and operating description of system for which waiver is requested.

(2) Platform(s) on which system is to be installed.

(3) All embedded computer resources (computers, peripherals, displays, I/O interfaces, etc.) and functions of each as well as system block diagram(s) depicting the interconnection of these resources.

(4) Storage and I/O requirements and throughput parameters.

(5) Software constraints (e.g., timing and space).

(6) Environmental requirements and/or constraints on the embedded computer resources.

(7) Estimated or known reduction of the reserve capacity requirements.

(8) Cause of reduction from the reserve capacity requirements.

(9) Impact in terms of system performance, cost, and schedule if waiver from requirements is not approved.

(10) Known or anticipated requirements for usage of memory, throughput, and input/output for future upgrades.

Subj: Reserve Capacity Requirements for Tactical Digital Systems

9. Inquiries. Inquiries concerning the application or intrepretation of this and other TADSTANDs should be addressed to:

Chief of Naval Material (Attn: MAT 08Y)
Navy Department
Washington, D. C. 20360

Phone: Autovon 222-3966; Commercial (202) 692-3966

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TADSTAND E

TO BE RELEASED. ONCE RELEASED, WILL SUPERCEDE TADSTANDS 2, 3 AND 9.

ABSTRACT

- Will require software documentation development, and testing in accordance with MIL-STD-1679.

DEPARTMENT OF THE NAVY
HEADQUARTERS NAVAL MATERIAL COMMAND
WASHINGTON, D.C. 20360

TADSTAND E
MAT 08Y
25 May 1982

TACTICAL DIGITAL STANDARD E

From: Chief of Naval Material

Subj: Software Development, Documentation, and Testing Policy for Navy Mission Critical Systems

Ref: (a) NAVMATINST 5430.60A of 9 November 1981; Headquarters Naval Material Command Organization Manual
(b) CNM ltr 09Y:JDC Ser 299 of 1 November 1974; Standard Specification for Tactical Digital Computer Program Documentation (TADSTAND 2 (Revision 1))
(c) CNM ltr 09Y:JDC Ser 304 of 5 November 1974; Standard Requirements for Inter-Digital Processor Interface Documentation (TADSTAND 3 (Revision 1))
(d) CNM ltr 09Y/WAP Ser 260 of 18 August 1978; Software Quality Testing Criteria Standard for Tactical Digital Systems (TADSTAND 9)
(e) CNM ltr 08Y/DCR Ser 230 of 2 July 1980; Standard Definitions for Embedded Computer Resources in Tactical Digital Systems (TADSTAND A)
(f) CNM ltr Ser 00/0991 of 3 November 1981: Standard Navy Tactical Embedded Computer Resources (TECR); use of in all phases of system developments
(g) NAVMATINST 5200.27A of 18 April 1973; Transfer of Navy Tactical Digital System Software Responsibility; procedures for
(h) NAVMATINST 4130.2A of 19 July 1976; Configuration Management of Computer Software
(i) SECNAVINST 3560.1 of 8 August 1974; Tactical Digital Systems Documentation Standards
(j) MIL-STD-1679 (NAVY); Weapon System Software Development

1. Purpose. In accordance with reference (a), this TADSTAND promulgates standardization policy for the development, documentation, and testing of software used in the development, acquisition, deployment, and support of Navy mission critical systems. This TADSTAND supersedes TADSTANDs 2, 3, and 9 (references (b), (c), and (d)), which covered specifications for tactical digital computer program documentation, requirements for inter-digital processor interface documentation, and software quality testing criteria, respectively.

2. Cancellation. Effective this date, TADSTANDs 2, 3, and 9 are cancelled.

Subj: Software Development, Documentation, and Testing Policy for Navy Mission Critical Systems

3. Definitions

a. Mission Critical Systems are those systems which are required for the conduct of the military mission of the Department of Defense. This definition includes systems related to:

(1) Intelligence activities.

(2) Cryptology activities related to National security.

(3) Command and control of military forces.

(4) A weapon or weapon system.

(5) The direct fulfillment of military or intelligence missions, but not routine administrative or business applications.

This definition also includes tactical digital systems, as defined in TADSTAND A, reference (e), as well as those "ADPE" or "ADP" systems required for the direct support of mission critical systems.

b. Mission Critical Computer Resources (MCCR) are those computer resources required for the conduct of the military mission of the Department of Defense. This definition includes embedded computer resources, as defined in TADSTAND A, used in mission critical systems, as well as those "ADPE" or "ADP" resources required for the direct support of mission critical systems.

c. Tailoring is the process by which individual requirements (sections, paragraphs, or sentences) of a specification, standard, or data requirement are evaluated to determine the extent to which they are most suitable for a specific system, and the modification or deletion of some requirements to ensure that each achieves an optimal balance between operational needs and cost.

d. The following terms are defined in TADSTAND A:

(1) Embedded Computer (EC)

(2) Embedded Computer Resources (ECR)

(3) Major Upgrade

(4) Software (application and support)

(5) Standard

(6) Tactical Digital System

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4. Applicability

a. This TADSTAND applies to all mission critical systems under the cognizance of the Chief of Naval Material (CHNAVMAT) that use embedded computer resources. This TADSTAND also applies to mission critical development programs under the cognizance of CHNAVMAT that are ultimately intended to be employed as mission critical systems or as components thereof.

b. In accordance with reference (f), this TADSTAND applies to all phases of system acquisition (i.e., initial concept formulation and requirements definition, design, development, installation, production, and post deployment support throughout the service life of the system), regardless of funding or acquisition category.

c. The provisions of this TADSTAND are not to be applied retroactively to systems for which computer software development, documentation, or testing commitments have already been made. However, commitments made prior to the effective date of this TADSTAND must have been in compliance with the superseded TADSTANDs (see paragraph 1 above). Compliance includes conformance to previously designated standards or a CHNAVMAT approved waiver. Otherwise, a waiver request must be submitted within 60 days of the effective date of this TADSTAND.

5. Background

a. There is a growing concern over the high cost of software development and life cycle support within the Department of Defense. The reliability and supportability of many of these systems are also matters of concern. Part of the problem has been the difficulty in establishing meaningful system operational and performance requirements for software, supported by objective test criteria for determining the correctness of the software. Also lacking are adequate management controls which govern the software development, acquisition, and life cycle support process. Program and acquisition managers must have clear and detailed guidance in order to specify uniform computer software development, documentation, and life cycle support requirements in system specifications and statement of work documents. Initial steps in correcting the problem areas were taken by CHNAVMAT in the issuance of TADSTANDs 2, 3, and 9, and NAVMAT Instructions 5200.27A and 4130.2A, references (g) and (h).

b. TADSTANDs 2 and 3 invoked SECNAVINST 3560.1, reference (i), as the required standard for documenting both tactical digital computer programs and inter-digital processor interfaces within a computer program. SECNAVINST 3560.1 has not been uniformly implemented, however, because of a lack of direction on specific Data Item Descriptions (DIDs) for tactical digital software documentation. As a result, there has been a proliferation of Unique Data Item Descriptions (UDIDs).

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c. TADSTAND 9 invoked standard software quality testing criteria for tactical digital systems. TADSTAND 9 was primarily concerned with the final software testing to be conducted on a program prior to acceptance of the program by the Navy, rather than the full range of requirements covering the complete software development process. TADSTAND 9, therefore, applied more to Navy software acquisition managers than to software contractors.

d. NAVMATINST 5200.27A promulgated policies and procedures for transitioning software from the development phase of the life cycle to the support phase. NAVMATINST 4130.2A delineated the responsibilities of Navy Systems Commanders and Program Managers regarding configuration management of software and related documentation.

e. Subsequent to issuance of TADSTANDS 2, 3, and 9, CHNAVMAT developed the reference (j) military standard MIL-STD-1679 (Navy), Weapon System Software Development, which complements these three TADSTANDs and is duplicative of them in some areas. MIL-STD-1679 establishes minimum uniform requirements covering the complete development process of weapon system software, including program test, quality assurance, and program acceptance criteria. The DIDs listed in MIL-STD-1679 are specifically designed to control the software development process and obtain the documentation that is required for effective configuration management and post deployment support of mission critical system software. Additionally, MIL-STD-1679 can be invoked by reference in Navy software development contracts, tasking agreements, and specifications.

6. <u>Policy</u>. For applicable mission critical systems:

a. All software shall be developed, documented, tested, and supported in accordance with the provisions of MIL-STD-1679 (Navy), Weapon System Software Development.

b. MIL-STD-1679 and its companion DIDs shall be invoked in all new contracts, tasks, agreements, etc., for the development, documentation, or testing of all software. MIL-STD-1679 shall also be invoked in new contracts, tasks, agreements, etc., for modification or revision to existing software.

c. The invoking of MIL-STD-1679 on any organization under contract or tasking arrangement to perform any part of the software development effort shall not relieve the Navy development activity or acquisition manager (e.g., Procuring Agent/Agency, Program Manager) from further responsibility regarding the requirements of this TADSTAND. Ultimate responsibility for ensuring that the principles and requirements of MIL-STD-1679 are adhered to rests with the Navy development activity or acquisition manager.

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d. The software quality testing criteria delineated in MIL-STD-1679, paragraph 5.10 (Program Acceptance), shall be satisfied prior to initial operational use or fleet introduction of the system and for all subsequent major upgrades, including site dependent configuration variations within a major upgrade, throughout the life cycle of the system.

e. MIL-STD-1679, except for Section 6 (Miscellaneous), constitutes the minimum requirements for all software development. Therefore, with the exception of Section 6, tailoring of MIL-STD-1679 is not allowed. Specific guidelines for tailoring Section 6 are covered in paragraph 6.f below.

f. Except as specified below, the DIDs listed in MIL-STD-1679, Section 6, constitutes the minimum set of required software documentation. This minimum set is required for the majority of applicable Navy systems and subsystems, characterized by such systems as NTDS, AEGIS, TRIDENT CCS, AN/SLQ-32, etc. In some instances, however, depending primarily on system size and/or complexity, it may not always be appropriate to develop the complete minimum set of software documentation. In these instances, limited tailoring of MIL-STD-1679, Section 6, and the individual DIDs, is allowed as follows; however, in no case will such tailoring result in the development of a new DID, i.e., a UDID.

(1) The Interface Design Specification is not required when there is no interface with other systems or subsystems.

(2) The Program Design Specification may be tailored such that the unique elements of the Program Design Specification and the Program Description Document are contained in the Program Design Specification, and the Program Description Document is then not required.

(3) The Computer Program Test Plan may be tailored such that the unique elements of the Computer Program Test Plan, the Computer Program Test Specification, and the Computer Program Test Procedures are contained in the Computer Program Test Plan, and the Computer Program Test Specification and Computer Program Test Procedures are then not required.

(4) The System Operator's Manual may be tailored such that the unique elements of the System Operator's Manual and the Operator's Manual are contained in the Systems Operator's Manual, and the Operator's Manual is then not required.

(5) In NAVAIR systems for which Naval Aviation Training and Operating Procedures Standardization (NATOPS) documentation is provided, the Systems Operator's Manual and the Operator's Manual are not required.

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g. The minimum required documentation set specified in MIL-STD-1679 may be expanded to meet specific project requirements; however, all documents developed in addition to those described in MIL-STD-1679 shall be in accordance with SECNAVINST 3560.1.

h. Transfer of software responsibility from a development activity to a support activity will be accomplished in accordance with the provisions of NAVMATINST 5200.27A.

i. Configuration management of software and related documentation will be in accordance with the provisions of NAVMATINST 4130.2A.

7. Waivers.

a. It is recognized that, in some cases, strict adherence to this TADSTAND could be impracticable or economically prohibitive. When an exception to this standard is considered to be in the best interests of the Navy, a TADSTAND E waiver may be granted by CHNAVMAT. However, proceeding with a software development in violation of this TADSTAND without first obtaining a waiver from CHNAVMAT may result in unforeseen schedule and/or financial impact on the project due to possible waiver disapproval. To avoid the adverse impact which may result in such cases, cognizant agencies are encouraged to conduct liaison with CHNAVMAT (MAT 08Y) prior to commitment to a specific course of action that could potentially result in a request for a TADSTAND E waiver.

b. TADSTAND E waiver requests shall be submitted to the Chief of Naval Material. Each approved waiver will be effective only until the next major upgrade of the system concerned. When a major upgrade is planned, a new waiver, if warranted, must be approved by CHNAVMAT. Each request will be considered on a case-by-case basis. In order to preclude implied waivers, a waiver is required for each specific element of an applicable system or subsystem for which an exception is deemed necessary.

c. A TADSTAND E waiver request shall include the following information:

(1) Point(s) of contact for technical and management information, including name(s), phone number(s), and location(s).

(2) Name, function(s), and operating description of the system for which the waiver is requested.

(3) Platform(s) on which system is to be installed.

(4) All mission critical computer resources and functions of each as well as system block diagram(s) depicting the interconnection of these resources.

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Mission Critical Systems

(5) Approved software development schedules, together with significant milestones.

(6) Estimated size (number of computer words) of program(s) to be developed.

(7) Reasons (e.g., cost, performance, schedule) for requesting the waiver, including supporting rationale. Cost figures, if used, must reflect the total system life cycle, as opposed to development cost only.

(8) Proposed alternative(s), if applicable, together with supporting rationale.

8. <u>Inquiries</u>. Inquiries concerning the application or interpretation of this and other TADSTANDs should be addressed to:

Chief of Naval Material (Attn: MAT 08Y)
Navy Department
Washington, D. C. 20360

Phone: Autovon 222-3966; Commercial (202) 692-3966

J. G. WILLIAMS, JR.

Distribution: (see next page)

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MIL-STD-1679 (NAVY)

"WEAPON SYSTEM SOFTWARE DEVELOPMENT"

ABSTRACT

- Contains the requirements for the design and development of weapon system software.
- Establishes uniform requirements for the development of weapon system software.
- "Strict adherence will ensure that the weapon system software so developed possesses the highest degree of reliability and maintainability feasible."

MIL-STD-1679 (NAVY)
1 December 1978

MILITARY STANDARD

WEAPON SYSTEM
SOFTWARE DEVELOPMENT

AMSC NO. 23033

FSC IPSC

DEPARTMENT OF DEFENSE
Washington, DC 20360

Weapon System Software Development

MIL-STD-1679 (Navy)

1. This Military Standard is approved for use by the Department of the Navy and is available for use by all Departments and Agencies of the Department of Defense.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to:

Chief of Naval Material
ATTN: NAVMAT 09Y
Washington, DC 20360

by using the self-addressed Standardization Document Improvement proposal (DD Form 1426) appearing at the end of this document or by letter.

FOREWORD

1. This standard contains requirements for the design and development of weapon system software which are applicable in government contracts. A standard specifically addressing weapon system software is necessary because of factors concerning this software which are not common to general software, or which carry a significantly different degree of emphasis. Major factors are:

a. Criticality of performance. The combat capability of weapon systems and the combat survivability of combatant units of the operating forces depend, in part, upon the effective operation of the weapon system software. Therefore, extraordinary efforts are justified in the development phase to ensure maximum reliability and maintainability. Special emphasis shall be placed on the accuracy and effective operation of the software.

b. Changing operational requirement. Weapon system software implements weapon system operations and doctrine in areas susceptible to many changes of performance requirements. These changes often impact the software and need expeditious implementation. This demands that weapon system software be designed to facilitate efficient change, sometimes at the expense of technical design efficiency. Continuation of an efficient change capability over the operational life of the weapon system also requires detailed documentation describing the software. Proposed changes and their total impact must be easily discernible and capable of being implemented by personnel not associated with the original development effort.

c. Life-cycle cost. Development and implementation of changes to weapon system software over the operational life of the weapon system are costly. The design of the software during development must be strongly influenced by factors which will reduce life-cycle cost. Among these are various standardization requirements, such as those imposed upon program design, languages, and intersystem and intrasystem interfaces. An additional benefit of these standardization requirements is to ensure that changes developed and implemented in one system will have applicability in other systems.

2. Data Item Descriptions (DIDs) applicable to this standard are listed in Section 6. These are essentially the same as previously used descriptions of data customarily required in connection with weapon system software development. The majority have been extracted from official military documentation standards. Others have been developed through the experience gained by military and commercial software developing activities.

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FIGURES

1. SCOPE

1.1 Purpose. This standard establishes uniform requirements for the development of weapon system software within the Department of Defense. Strict adherence to the provisions of this standard will ensure that the weapon system software so developed possesses the highest degree of reliability and maintainability feasible.

1.2 Application. When invoked in a specification or statement of work, these requirements shall apply to the weapon system software (including firmware) which is developed either alone or as a portion of a weapon system or subsystem development. The contractor is responsible for invoking all the applicable requirements of this Military Standard on any and all subcontractors he may employ.

2. REFERENCE DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on the date of invitation for bids or request for proposal form a part of this standard to the extent specified herein.

a. DOD-STD-480A; Configuration Control - Engineering Changes, Deviations and Waivers.

b. MIL-STD-481; Configuration Control - Engineering Changes, Deviations and Waivers (Short Form).

c. Headquarters Naval Material Command; "Tactical Data Systems Glossary", (Defense Documentation Center Accession Number AD-A056868.)

d. ANSI 3.12 - 1970; Vocabulary for Information Processing.

e. NAVSO ADP Glossary (NAVSO P-3097).

(Copies of specifications, standards, drawings and publications required by contractors in connection with specific procurement functions should be obtained from the procuring agency or as directed by the contracting officer.)

2.2 Other publications. None.

3. DEFINITIONS

3.1 Weapon system. Any system or subsystem contributing to the combat capability of the operating forces - land, air, sea and undersea sensor systems, command and control systems, intelligence systems, communications systems, ship and aircraft control systems, navigation systems and certain associated ground based systems are included. Systems or subsystems serving both the individual unit and those supporting a tactical commander fall within the definition. Logistic support systems and ADP systems devoted to management functions are excluded only if their operations do not impact weapon systems. When used in the phrase "weapon system software" (as in this standard), a digital weapon system is implied.

3.2 Weapon system software. The totality of software (programs, firmware and data bases) associated with a weapon system. Weapon system software includes that software which is in the weapon system, in the test and maintenance equipment for the weapon system, in the trainer equipment for the weapon system and includes the support software used to develop, test and support the weapon system software. This definition of weapon system software is independent of the type of physical storage media in which the software resides. Within the context of this Military Standard, weapon system software is equivalent to and synonymous with the software portion of "Embedded Computer Resources".

Also, within the context of this standard, the terms "program", "computer program" and "digital processor program" are considered to be synonymous and are used interchangeably as is grammatically appropriate with no distinction intended. These terms (program, etc.) are equivalent to weapon system software or one independent part of the software of a weapon system, depending upon the complexity of any particular weapon system. Within this standard, unless specifically stated otherwise, software is equivalent to weapon system software. The term "digital processor" implies a digital computer, whether micro, mini, or full size.

Weapon system software is categorized as follows.

3.2.1 Operational. Operational computer programs provided to a unit of the operating forces which contribute to the performance of the unit's mission.

3.2.2 Test and maintenance. Programs provided to the user/operator unit of the operating forces as tools to assist in the planned maintenance, fault diagnosis and isolation, operational readiness verification and system alignment checkout of the weapon system or its components. These programs may be used to check out and certify the equipment and total system at installation, re-installation or after maintenance. They are also used periodically in accordance with prescribed maintenance procedures to maintain the system throughout its operational life.

3.2.3 Trainer. Programs utilized to train crew, operators and maintenance forces in the operation and maintenance of the weapon system.

3.2.4 Support. All programs used in the development, testing and support of operational, test and maintenance, and trainer programs. Support programs include, but are not limited to:

a. Compilers, assemblers, linkage editors, builders, librarians and loaders required to generate machine code and to combine subprograms and their hierarchical components into a complete computer program.

b. Debugging programs.

c. Stimulation and simulation programs.

d. Data extraction and data reduction programs.

e. Programs used for management control, configuration management, or documentation generation and control during development.

f. Test programs used in weapon system software development.

3.3 Component. A software component is a subset of the weapon system software. Weapon system software can be hierarchically broken down into components of program, subprogram, module and procedure or routine. A program refers to the weapon system software or one independent part of the software of a weapon system, depending upon the complexity of any particular weapon system. Subprogram refers to a major functional subset of a program and is made up of one or more modules. A module is an independently compilable software component. Modules are comprised of one or more procedures or routines.

3.4 Development. As applied to the life-cycle of weapon system software in this standard, development encompasses the span of time and effort which is applied to, and which results in, weapon system software from initiation of the effort through delivery and acceptance by the procuring agency.

3.4.1 Development facility. Within the context of this standard, the development facility refers to the physical site where the contractor produces the weapon system software.

3.4.2 Procuring agent/agency. As used in this standard, the procuring agent or agency refers to that Government office, with contract and project directive administration authority, which has prime responsibility for and authority over the development effort.

3.4.3 Program manager. As used in this standard, the program manager is the Government official designated by proper authority as having responsibility for the development of the weapon system. In most cases, the program manager and the procuring agent are one and the same; the former being a governmental management title while the latter is a contractual designation.

3.4.4 Contractor. As used in this standard, contractor refers to any organization under contract or tasking arrangement with the Government to perform any part of the weapon system development effort.

3.4.5 Development monitor. A development monitor is a representative, Government or commercial, of the program manager authorized to monitor the development effort in accordance with specific terms of the monitoring task or contract.

3.4.6 Test facility. As used in this standard, the test facility is a physical location designated as the site for acceptance testing or integration testing of the weapon system software.

3.5 Operational support. As applied to the life-cycle of weapon system software in this standard, operational support encompasses the span of time and effort from acceptance for operational use through the operational life of the system.

3.5.1 Software support activity. The software support activity is that organization designated to maintain and support the weapon system software during the operational support phase of the life-cycle.

3.6 Specifications. Within the context of this standard, when used in regard to weapon system software, specifications are documents intended to describe, clearly and accurately, the essential features and requirements of the subject computer program. Specifications are categorized into four types.

3.6.1 Program performance specification. The program performance specification describes the technical, operational, and performance requirements of the weapon system software and defines and specifies all the functional requirements, plus all the design constraints and standards to ensure proper development and maintenance of the weapon system software.

3.6.2 Program design specification. The program design specification describes the technical design of the weapon system software necessary to implement the technical, operational, performance, and functional requirements described in the program performance specification.

3.6.3 Test specification. The test specification describes the test criteria and the methods to be used in a specific test to assure that the performance and design specifications have been satisfied. The test specification identifies the capabilities or program functions to be tested and identifies the test environment.

3.6.4 Interface design specification. The interface design specification describes the interdigital processor message traffic when two or more digital systems are interfaced at the on-line interdigital processor level.

3.7 Baseline. As used in this standard, a baseline is comprised of all documents, program materials, and the development support library which make up the complete representation of the weapon system software at a specific stage of its development.

3.8 Tactical Data Systems Glossary. Definitions of operational and technical terms used in this standard in regard to the weapon system software development are included in references 2.1c, d and e.

3.9 Errors.

3.9.1 Software error. An occurrence, during the execution of a program, attributable to software which fails to satisfy the program performance specification or fails to perform as designed.

3.9.2 Documentation error. An occurrence in the documentation which fails to reflect the operational requirements or accurately describe or support the software.

3.9.3 Intermittent error. An error which cannot be reproduced consistently when the same procedures and environment are duplicated.

3.10 Software Change Proposal (SCP). A Software Change Proposal (SCP) is a proposed change to the weapon system software or its documentation which would alter the approved baseline software or documentation which is under configuration control.

3.11 Software Trouble Report (STR). A Software Trouble Report (STR) is a report that the weapon system software is not in conformance with the approved baseline documentation which is under configuration control.

3.12 Software Enhancement Proposal (SEP). A Software Enhancement Proposal (SEP) is a proposed change to the weapon system software or its documentation or its interfaces which is not an STR or SCP and is functionally transparent to all portions of the weapon system that are not directly addressed by the SEP.

3.13 Use of "shall", "will", "should" and "may". Within the context of this Military Standard, "shall" is used to express a provision that is binding; "should" and "may" are used to express nonmandatory provisions; "will" is used to express a declaration of purpose or intent.

3.14 Reduced capability mode. After experiencing the loss of one or more equipments or equipment parts, system operation continues in a configuration which compensates for the losses but at a level below system designed capability.

3.15 Patch (Low level language). A change made to the object program after it is assembled or compiled.

3.16 Program stop. A program stop is defined as any termination of program execution which requires that the program, or a portion thereof, be reloaded, restarted, or reinitialized.

4. GENERAL REQUIREMENTS

4.1 Software development management. The contractor shall plan and implement procedures to control the development process and provide visibility to management and the Government over the development process. The contractor's organization shall be structu ed to provide positive control over development processes and resources utilized. Weapo system software shall be subject to the same rigorous discipline that is normally applie to hardware during development.

4.2 Design requirements. The contractor shall determine the weapon system software design, as tasked by the procuring agency. It is the responsibility of the contractor t ensure that this proposed design meets the program performance specifications. The design shall completely satisfy all requirements but shall not exceed the requirements without procuring agency approval. Design complexity and the interdependencies of subprograms, modules, procedures and routines shall be minimized.

4.3 Program generation. Weapon system software shall be coded in one of the high ord programming languages (HOLs) approved for use by the Department of Defense unless a specific waiver has been previously granted to the procuring agency by proper authority. The programs shall be capable of being generated by government owned support software an the contractually delivered support software.

4.4 Quality assurance. The contractor shall develop and implement procedures and pra tices to ensure that all requirements of the contract, including this Military Standard as contractually invoked, are complied with fully. The quality assurance program shall be part of the management reporting system during all phases of software development. The contractor's quality assurance program shall utilize specification reviews, design reviews, monitoring, auditing, and testing among other techniques to ensure compliance with contract technical requirements. In addition, quality control procedures shall be used to examine and determine compliance with requirements in order to ensure that contract technical and performance requirements have been met.

4.5 Configuration management. The contractor shall establish and implement the disciplines of configuration management; namely configuration identification, configuration control, and configuration status accounting. The contractor shall be cognizant of the requirement for long-term life-cycle support of the weapon system software. The appropriate degree of configuration management shall be applied to ensure completely accurate correlation between descriptive documentation and the program in order to facilitate post-delivery maintenance by software support personnel. The contractor shall plan and implement configuration management procedures to identify software elements (configuration items) requiring control, to define and control change implementation processes, to track development and change status, and to ensure documentation is changed to reflect current status of the software.

This standard contains the contractor's internal configuration management requirements. These shall complement the contractor's associated requirements for interfacing with the procuring agency when proposed engineering changes affect government controlled configuration identification. This interface shall be in accordance with appropriate contract requirements and reference 2.1a or 2.1b.

4.6 Subcontractor control. The contractor is responsible for assuring that all software, documentation and programming materials procured from his subcontractors conform to the contract requirements. Therefore, this Military Standard shall be invoked on all subcontractors involved in the development of weapon system software.

4.7 Deviations and waivers. All weapon system software and software documentation shall be developed and delivered in exact conformance with all the requirements of this Military Standard, other applicable standards, and applicable weapon system software documentation and specifications, as contractually invoked unless a deviation or waiver has been previously processed and approved by the procuring agency in accordance with reference 2.1a or 2.1b. The extent of any variance from exact conformance to all applicable requirements shall only be that which is specifically authorized by formally approved deviations or waivers.

5. DETAILED REQUIREMENTS

5.1 Program performance requirements. The contractor shall determine the detailed program performance requirements for the weapon system software. The contractor shall utilize the basic descriptive requirements and design information provided by the procuring agency to create the program performance requirements. This information may be augmented by studies, analyses, visits to operational units, and surveys as necessary. The program performance requirements are subject to the review and approval of the procuring agent.

5.1.1 Supporting information for program performance requirements. The contractor shall utilize, as a minimum, those items available of the following to determine the program performance requirements:

a. System performance requirements.

b. System design specifications.

c. Equipment design specifications.

d. Interface design specifications.

e. Operational standards, doctrine, and tactics.

f. System design standards.

5.1.2 Computer program performance analysis. In determining the performance requirements, the contractor shall investigate and analyze in detail all areas relating to the performance requirements of the weapon system software.

5.1.2.1 Mission areas. The contractor shall investigate the mission areas, primary and secondary, and supporting tasks of the operational user or platform for the weapon system.

5.1.2.2 Functions. The contractor shall define the major functions or groupings of the program necessary to meet the system performance requirements.

5.1.2.3 Applicable documentation for program performance requirements. The contractor shall identify all documents which define or constrain the program performance requirements. Definitions of applicable terms and abbreviations not consistent with or not included in reference document 2.1c shall be indicated and defined by the contractor.

5.1.2.4 Weapon system description. The contractor shall examine the relationship of all components in the weapon system which affect the weapon system software or the program performance requirements. The contractor shall determine how the computer program interfaces with other components to perform required functions.

a. Peripheral equipment identification. The contractor shall identify all equipment with which the program will interface.

b. Interface identification. The contractor shall identify all other digital programs or systems with which the program will interface.

5.1.2.5 Functional description. The contractor shall analyze the major functions and the functional relationships of the program with interfacing equipments and other programs.

a. Equipment descriptions. The contractor shall identify the requirements imposed on the program by each interfacing equipment, the purpose of the equipment, and the use of options and controls.

b. Block diagrams. The contractor shall generate diagrams of equipment and program relationships with internal and external data flow.

c. Intersystem interface. The contractor shall determine the interfaces with other systems and shall be cognizant of the performance requirements and design specifications of all systems which will interface with the system under development. Each contractor shall be aware of the purpose of the interface and the data to be exchanged. Data quantity, frequency, rate, format, content, scaling requirements and conventions shall be developed. In fulfilling this assignment, the contractor may be tasked to participate with other development contractors as a team to design the intersystem interfaces so that the performance requirements of all systems are met. If interface conflicts are uncovered such that an individual system's ability to perform in accordance with its requirements is adversely affected, the interface design team shall recommend to the procuring agency the necessary modifications to the systems or their interface to overcome the deficiency. If no solution can be agreed upon, the team shall recommend modification of the system performance requirements to the procuring agent.

d. Function description. The contractor shall establish the performance of each function supported by the program, its purpose, and functional design.

5.1.2.6 Detailed functional requirement. The contractor shall delineate the performance of each function by detailing its narrative, logical, and mathematical descriptions.

a. Inputs. The contractor shall define all inputs (external and internal) including their source, format, method of reception, quantity, timing, range, and scaling.

b. Processing. The contractor shall generate textual and, as appropriate, mathematical descriptions of the processing requirements of each function, including functional parameters and geometric diagrams.

c. Outputs. The contractor shall define all outputs (internal and external) including their method of transmission and timing, meaning, format, destinations, range, and scaling.

d. Special requirements. The contractor shall identify all requirements imposed by higher-level constraints or by exigencies of the function.

5.1.2.7 Adaptive parameters. The contractor shall identify those parameters which reflect the system environment, system parameters, and system capacities and which can be modified without altering the logic of the operational function.

5.1.3 System resources. The contractor shall define the computer memory, computer processing time, and input and output resource budgets and their projected utilization for the weapon system. If the weapon system under development has more than one digital processor, the contractor shall define these resource values for each digital processor.

5.2 Program design requirements. The contractor shall develop the detailed program design requirements in accordance with the detailed program performance requirements approved by the procuring agency and shall comply with other design constraints and standards as specified by the procuring agency. The requirements shall be translated into program design in a systematic top-down method. The design shall be a hierarchical structure of identifiable programs, subprograms, modules, procedures, and routines. The highest level of control logic resides at the top of the hierarchy; the computational or algorithmic functions reside at the lower levels. The program shall be divided into constituent parts and then these parts broken down into their constituents. Each level of design development (or breakdown) is continued until a level is reached where there is no subservient level. Levels shall be structured so that a lower level does not call on a higher level.

The contractor shall define the assumptions, the programming approach for implementing the computer program and shall define the program architecture. As early as possible in the design phase, the proposed program architecture shall be verified as to its capability to support the computational load imposed by maximum operation of all functions required to be simultaneously serviced. This verification may require extensive modeling and simulation and shall, in all cases, be completed prior to design implementation and coding.

The program design shall be subject to review and approval by the procuring agency. Prior to submission of the detailed design to the procuring agency for review, a design walk-through shall be conducted. This design walk-through shall be accomplished by one or more technically qualified persons in conjunction with the originator or originators of the detailed design.

5.2.1 Supporting information for program design requirements. The contractor shall utilize, as a minimum, those items available of the following to determine the program design:

a. System operational design documents.

b. Program performance specifications.

c. Interface design specifications.

d. Programming reference manuals.

e. Equipment technical manuals.

f. Specified programming standards and conventions.

g. Specified utility/support software documents.

5.2.2 Computer program design analysis. In determining the detailed computer program design, the contractor shall investigate and analyze in detail the following areas relating to the computer program.

5.2.2.1 Applicable documentation for program design requirements. All documents which constrain, define, or influence the program design shall be analyzed. The contractor shall define all design terms and abbreviations used to describe the program design.

5.2.2.2 Functional allocation. The allocation of functions and tasks to be performed by the subprograms and their modules shall be defined. All performance requirements shall be satisfied in their entirety in this allocation.

5.2.2.3 Program functional flow. The flow of program data and control in all required modes of program operation shall be determined. A functional description of all inputs, outputs and processing for each subprogram shall be defined.

a. Program interrupt control. The source, purpose, type, predicted rate of occurrence, and required control response for each external and internal interrupt shall be determined from the analysis.

b. Subprogram reference control. The control logic, assignment of priorities and permissible cycle times for each subprogram shall be determined from the analysis.

c. Special control features. Unique control requirements which affect the design of the control logic shall be identified.

5.2.2.4 Resource allocation and reserves. Memory storage, input and output channels, and processing time requirements for each subprogram shall be determined. Total system memory, input and output channels, and processing time reserves of at least 20 percent shall exist at the time of program acceptance by the procuring agency.

5.2.2.5 Design constraints. The constraints of the specific programming language to be used and the constraints of the specific support software to be used shall be defined by the contractor.

5.2.2.6 Data base design. During the computer program design, the contractor shall take into account all data used by two or more subprograms.

5.2.3 Intersystem interface. The contractor shall determine the interfaces with other systems and shall be cognizant of the performance requirements and design specifications of all systems which will interface with the system under development. Each contractor shall be aware of the purpose of the interface and the data to be exchanged. Data quantity, frequency, rate, format, content, scaling requirements, and conventions shall be developed. In fulfilling this assignment, the contractor may be tasked to participate with other development contractors as a team to design the intersystem interfaces so that the performance requirements of all systems are met. If interface conflicts are uncovered such that an individual system's ability to perform in accordance with its requirements is adversely affected, the interface design team shall recommend to the procuring agency the necessary modifications to the systems or their interface to overcome the deficiency. If no solution can be agreed upon, the team shall recommend modification of the system performance requirements to the procuring agent.

5.3 Programming standards. The following design and coding standards shall apply to the development of weapon system software.

5.3.1 Control structures. Programs should be designed and shall be coded using only the five basic control structures presented in figures 1A - 1E. They are: the SEQUENCE of operations (assignment, add,...), IF THEN ELSE (conditional branch to one of two operations and return), DO WHILE (operation repeated while a condition is true), DO UNTIL (operation repeated until a condition is true) and CASE (operation which provides the transfer of program control to a specific location within a compile-time system). Structured programs of any degree of complexity can be developed if they can be broken down into individual control structures.

5.3.2 Included/copied segments. Included/copied segments shall be written in HOL only, unless a specific waiver has been previously granted to the procuring agency by proper authority. Any program logic within a given structural segment shall utilize only those control structures specified in paragraph 5.3.1. When the segment contains executable statements, the entry to the segment shall be the first executable statement and the exit shall be the last executable statement.

5.3.3 Entry-exit structure. Each module, procedure, routine, or source code segment shall have a single entry and single exit structure. (See figure 1F)

5.3.4 Program traceability. Programs shall be designed and coded such that upon interrupt or termination, the values of the various parameters, indices and other local variables as of the last usage are recoverable.

5.3.5 Self-modification. Program self-modification of instructions during execution shall be prohibited.

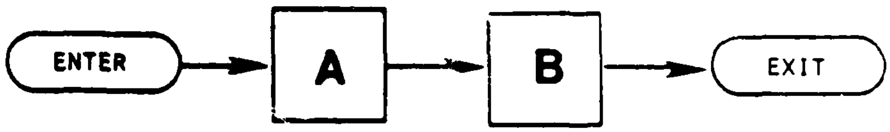
5.3.6 Recursive programs. Recursive procedures or routines shall not be used unless the target computer has a stack oriented architecture.

5.3.7 Size. The procedures or routines which make up a module shall not exceed an average of one hundered executable HOL statements per procedure or routine and shall not exceed a maximum of two hundred executable statements in any procedure or routine. Each independently executable HOL statement, whether free-standing, part of a complex statement or in an included/copied segment counts as one executable statement.

5.3.8 Branching. Branching statements (GO TO's) may be used only with the approval of the procuring agency. Branching statements, if approved, shall only pass control to a statement that is in the same procedure or routine. Each GO TO must pass control only forward of its point of occurrence. (Backward jumps generated by the compiler are permitted).

FIGURE 1A.

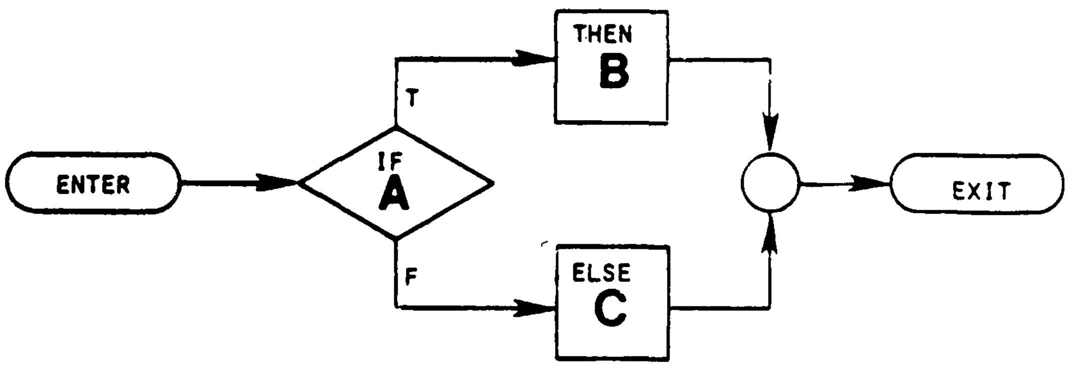
SEQUENCE: Process A, Process B.



Control flows from process A to the next in sequence, process B.

FIGURE 1B.

IF THEN ELSE: If condition A THEN process B, ELSE process C.



The flow of control will return to a common point after executing either process B or C. A predicates the conditional execution. If control is to skip a process pending the condition of A, then the flow chart can be modified thusly:

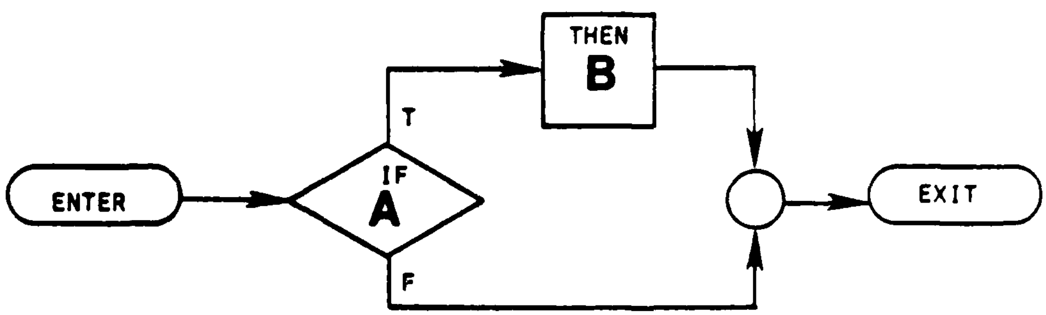
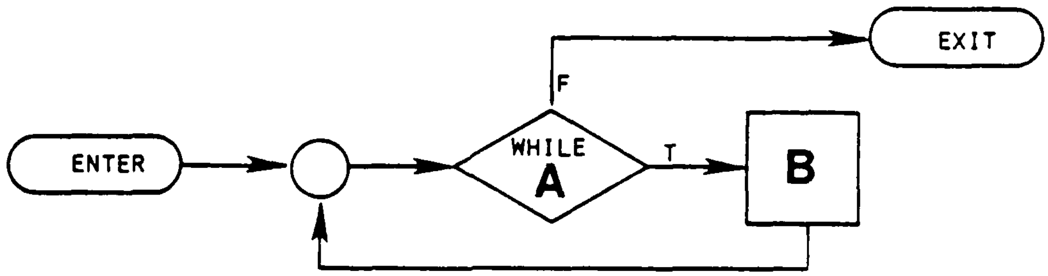


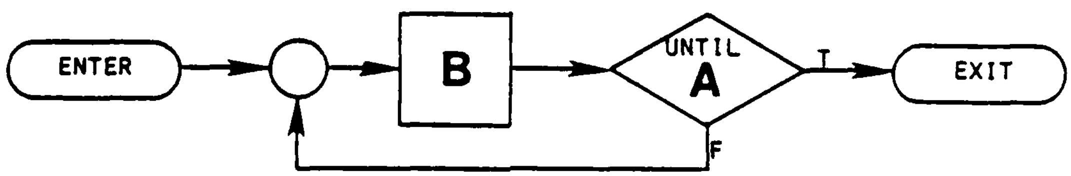
FIGURE 1. Control structures.

FIGURE 1C. DO WHILE: DO WHILE condition A, process B



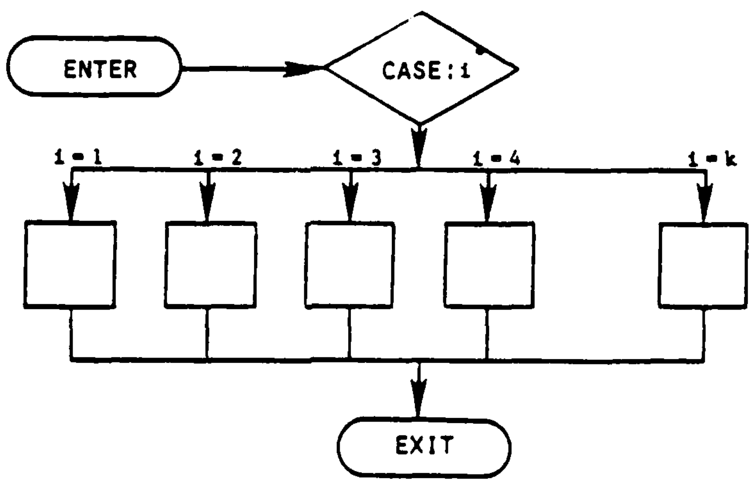
The DO WHILE structure is a loop in which the condition A is evaluated. If found to be true, then control is passed to process B and the condition A is evaluated again. If condition A is false, then control is passed out of the loop.

FIGURE 1D. DO UNTIL: DO UNTIL condition A, Process B.



The DO UNTIL structure is similar to the DO WHILE -- except that the test of condition A is performed after process B has executed. Thus the DO UNTIL loop will be performed once regardless of the value of condition A.

FIGURE 1E. CASE: Based on Case conditional i, process i.



Control is passed to process k based on the value of i.

FIGURE 1. Control structures (continued)

FIGURE 1F. Nesting of Control Structures.

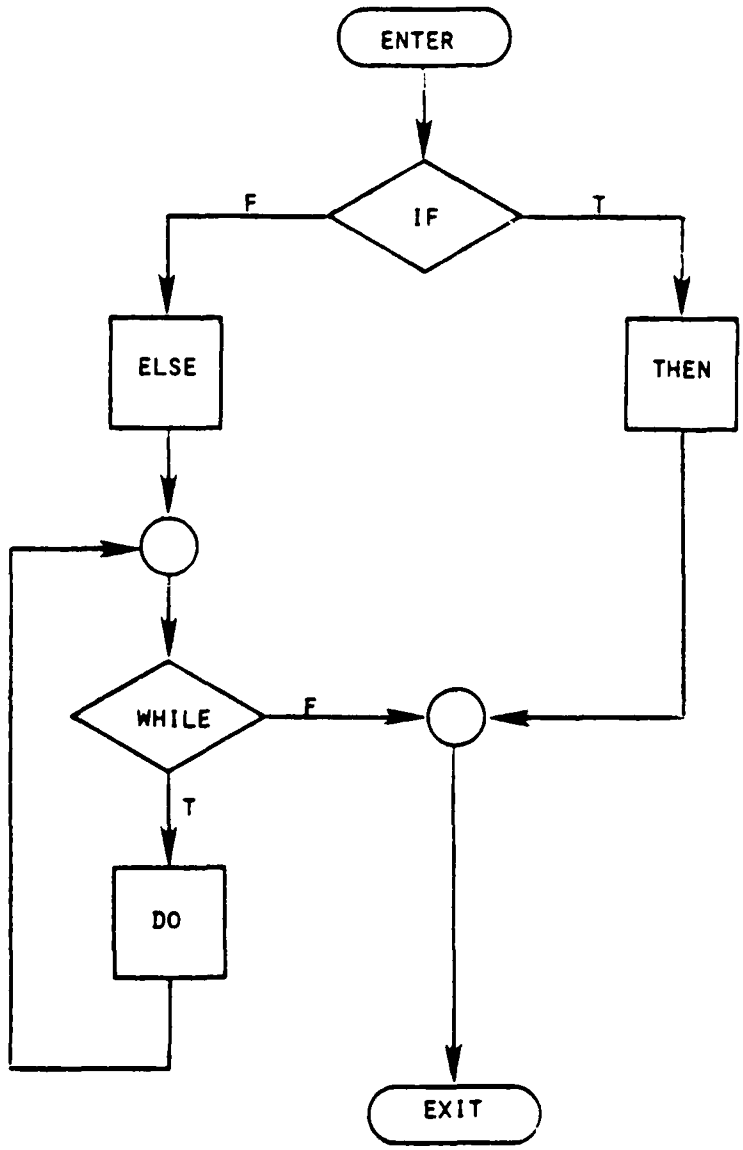


FIGURE 1. Control structures (continued)

5.3.9 Relocatability. Programs shall be built in the form of relocatable object modules.

5.3.10 Indentation. Program structural indentation shall be used to improve readability and clarity.

5.4 Programming conventions. The following programming conventions shall be utilized in all weapon system software.

5.4.1 Symbolic parameterization. All values used in the weapon system software which are constant throughout the weapon system design but which may be affected by environment changes (e.g., sensor output limits, maximum range of weapons, maximum number of targets handled, data storage limits) shall be treated as symbolic parameters in the design. Duplication of symbolic parameters shall be minimized through use of common source of values. When duplication is necessary, common symbolic parameter identification nomenclature shall be used and comments will point to location of duplicates. Symbolic parameters shall be grouped at the beginning of each subprogram. Comments shall provide a definition and the location of all parameters. Special symbolic parametric definition features of the high level language and compiler shall be used.

5.4.2 Naming. Naming conventions shall be uniform throughout the weapon system software. Program, subprogram, module, procedure, routine and data names shall be uniquely chosen to identify the applicable function performed and their position in the hierarchical logic structure in relation to other components of the weapon system software being developed.

5.4.3 Numerical conventions. Numerical conventions shall be established by the contractor so that they are uniform throughout the program.

5.4.3.1 Symbolic constants and variables. Constants and variables entering into numerical computations shall follow the constraints set forth in paragraph 5.4.1.

5.4.3.2 Mixed mode expression. Mixed mode numerical operations shall be avoided whenever possible, but when determined to be necessary, they shall be completely described in comments.

5.4.3.3 Grouping. Parentheses or other subexpression delimiters shall be used where necessary to clarify the order of evaluation of compound expressions.

5.4.3.4 Significant digits. The number of significant digits as output shall not be greater than the number of significant digits as input. The effect of truncation performed shall be considered in applying this convention. Sufficient significant digits shall be used in calculations to yield a minimum of computational error, and rounding by the programmer shall not occur until the final computational step. The degree of computational error shall be analyzed to determine if systems accuracy requirements are fulfilled.

5.4.4 Narrative description. A narrative description shall describe the history and identify the functions of each hierarchical component of the weapon system software.

5.4.4.1 Abstracts. Each component shall include at the beginning of the executable coding a textual description of its inputs, outputs, function or task, and algorithms; a list of other components called; and a list of all calling components. In addition to general explanations, to assist understanding, precise references to the appropriate statement labels and data-names shall be included in each module, procedure and routine descriptive abstract. The descriptive abstract shall define the allowed and tolerable range of values for all inputs and shall define the allowed and expected range of values for all outputs. A history of the original and updating programmer names, the activity or commercial company name and the activity or company division code or billet identifier with dates completed shall be included.

5.4.4.2 Comment statements. In order to facilitate program comprehension, comment statements shall be used throughout the program code. Comment statements are non-executable (i.e., they have no effect on program executions) and are used to provide documentation and clarification of the logic, data, variables, and algorithms. Each source statement shall be self-defined or defined by a comment phrase to a level understandable by a person not associated with the original development effort. Logical groups of comment phrases may be included in a single comment statement. General comments on groups of source statements performing logical functions shall be included on separate comment statements.

5.4.5 Source record format.

5.4.5.1 Execution efficiency. Subject only to the interest of readability, clarity and maintainability, source statements shall be optimized for execution efficiency. For maximum memory efficiency, common routines or procedures should be used instead of included/copied source code blocks whenever practicable.

5.4.5.2 Source code segment includes/copy. When repetitive segments of source code are required in the program being developed, they should be coded only once as a structural source code block, thereafter being referenced/utilized upon each occurrence by appropriate INCLUDES or COPY features, or constructs of the source HOL compiler.

5.4.5.3 Source statement. A source statement shall not be compound or complex in structure except as necessary to support the control structures defined in paragraph 5.3.1.

5.4.6 Flow charts. There is no requirement that flow charts be a deliverable item.

5.5 Program production. The contractor shall generate the program in a top-down, well-controlled manner. Top-down implementation requires that units of code that depend on the operation of other units be developed after the unit upon which they depend. Programming shall commence with the highest levels which shall then be tested extensively and placed under configuration management and library control before descending downward in the design to the programming of subordinate levels. This methodology will permit orderly integration of units of code into an evolving computer program. Incremental development of software will result which allows for well-controlled incremental testing where the higher control structures are tested most often.

Programming conventions, program design rules and programming standards shall be promulgated to and followed by all levels of program production personnel. The contractor shall ensure programmers are skilled in the use of the specified language and compiler capabilities. Standard procedures shall be developed for programmers to follow in use of coding forms, submission of compile requests, reports of progress and associated listings. Efficient and effective control of the program during coding and test is required.

A code walk-through review of each program component shall be conducted prior to submission of the component for compilation. This review shall be conducted by one or more technically qualified persons in conjunction with the originator of the code under review.

5.5.1 Program production organization. The contractor shall implement a program production organization that facilitates the top-down design, coding, integration, and testing of the program.

5.5.2 Resource management. The contractor shall be responsible for management of computer system resources (e.g., main memory, mass storage, processor time, input/output controller(s), and input/output channel(s)). He shall determine the original assignment of system resources through analysis and modeling. The contractor shall monitor the utilization of the assigned resources as program development progresses. A minimum reserve of 20 percent capacity shall exist in each resource area at the time of program acceptance by the procuring agency.

5.5.3 Language. Weapon system software shall be coded in one of the high order programming languages (HOLs) approved by the Department of Defense unless a specific waiver has been previously granted to the procuring agency by proper authority.

5.5.4 Library usage and control. The contractor shall establish procedures for producing, updating and controlling source and object libraries of the software under development. All initial programs and development changes shall be maintained in both source and object format. All patches shall be maintained in maintenance and patch logs and on patch tapes until incorporated in the patch-free source program. Patches shall, as a minimum, be identified by: patch production date, programmer producing the patch, the program component that the patch is applicable to, the corresponding problem number or identification, the test that revealed the problem, the testing that certifies the integrity of the patch, and the problem that necessitated the patch.

5.5.5 Sequence numbering. Each source record in each smallest independently compilable unit of code shall contain a sequence number so that it can be uniquely identified. Sequence numbers shall be in sequentially increasing order beginning with and differing by some multiple of ten.

5.5.6 Listings. Listings related to the program shall meet the standards specified herein.

5.5.6.1 Program listings. For acceptance as a deliverable, the listing of a compiled program shall include source language statements and comments with resulting object machine instructions interspersed appropriately (together with actual or equivalent assembler statements, if available). Relative location of instructions and operands shall be exhibited together with statement labels and identification numbers. All descriptions of referenced procedures, routines and data shall be included in conjunction with this listing and arranged for convenient access.

5.5.6.2 Cross-reference listing. A cross-reference listing shall be produced relating each data name to the location of every other statement referring to it, and relating each routine to the location of every other routine calling upon it. The list shall be exhibited as a sequential table in alphanumeric order.

5.5.7 Load maps. The contractor shall describe the format, method and location in which the various components and portions thereof are loaded in the weapon system computers and, if applicable, stored on disks or other storage devices. This mapping shall include delineating all of the portions of the program that are to be concurrently resident in the device in question and the location and size of each portion of the program. If the system has more than one defined configuration or mode of operation for the software, the contractor shall describe this information for each configuration or mode.

5.6 Program regeneration. All weapon system software delivered by the contractor shall be capable of being regenerated from Government owned support software and the contractually delivered support software.

5.7 Program operation. The contractor shall determine the procedures for the operation of the weapon system software. Procedures shall be described in terms understandable to operational personnel. Program operation procedures shall be subject to the approval of the procuring agency.

5.7.1 Program operation analysis. In determining program operation procedures, the contractor shall investigate and define in detail the following areas.

5.7.1.1 Non-functional operation. Minimal processor and peripheral equipment requirements, equipment set-up for system operation, program set-up, special parameter entering requirements, standby/operate procedures, monitoring procedures, and recovery procedures shall be defined.

5.7.1.2 Functional operation. Individual operator and station functions; coordinated station procedures; all human factor aspects, modes and procedures necessary for each console or station operator to perform his function in support of system operation; the function of every control button, switch, readout and display affected by or affecting the system; and all constraints imposed on operator actions shall be defined.

5.8 Program test. The contractor shall determine the scope of tests required to ensure that the program being developed meets all specified technical, operational, and performance requirements and the acceptance criteria. The contractor shall be responsible for accomplishing all development testing. Test planning shall include development of:

a. Program acceptance criteria.

b. Levels of testing to verify performance.

c. Internal procedures for scheduling and conducting tests.

d. Detailed procedures for testing at each level.

e. Reporting procedures of test results.

All test plans, specifications, and procedures shall be subject to review and approval by the procuring agency. The procuring agency shall be kept advised of all test schedules and shall be permitted to witness all tests with designated Government or contractor representatives. The contractor shall provide all supporting software necessary to conduct, control, and record tests. The contractor shall define any special support software necessary to satisfactorily test the software being developed. The contractor shall identify to the procuring agency any GFE or GFI required to support the test progtam early enough to allow the procuring agency to obtain and deliver any such requirements without impacting the development and testing schedule.

The contractor shall provide or ensure the availability of adequate facilities for conducting all required tests. The procuring agency shall have the option of specifying the facility that should be used to conduct any portion of the test program.

The contractor shall prepare test reports showing quantitative results of all tests. Such reports shall be signed by a representative of the contractor. Any formal or informal approval of the testing results by the procuring agency representative during the course of software production shall not be construed as a guarantee of the acceptance of the finished product. Testing shall consist of the following:

a. Module tests.

b. Subprogram tests.

c. Program performance tests.

d. System(s) integration tests.

5.8.1 Module tests. Each module shall have completed a code walk-through prior to being subjected to developmental testing. Developmental testing shall be adequate to determine compliance with the applicable technical, operational and performance specifications. As a minimum, module testing shall be performed to:

a. Ensure error-free compile/assembly of the coded module.

b. Ensure that the coded module fully satisfies the detailed performance and design requirements and that all code to be delivered has been exercised.

c. Exercise the module in terms of input/output performance with the results satisfying the applicable detailed performance and design requirements.

5.8.2 Subprogram tests. Modules shall have passed the module tests prior to being subjected to subprogram testing. The modules shall be integrated individually into particular subprograms. Subprogram tests shall be adequate to determine compliance with the applicable technical, operational and performance requirements. As a minimum, subprogram testing shall be performed to:

a. Ensure error-free linkage of the modules.

b. Ensure that the subprogram fully satisfies the detailed performance and design requirements.

c. Exercise the subprogram in terms of input/output performance with the results satisfying the applicable detailed performance and design requirements.

d. Ensure the subprogram level man-machine interfaces.

e. Ensure the capability of the subprogram to handle properly and survive erroneous inputs.

5.8.3 Program performance tests. All subprograms shall have passed the subprogram tests prior to program performance testing. The subprograms shall be integrated individually until all subprograms have been integrated into the program. These tests shall be adequate to determine compliance with the applicable technical, operational and performance requirements. As a minimum, program performance testing shall be performed to:

a. Ensure the total man-machine interface.

b. Ensure proper system initiation, data entries via peripheral devices, program loading, restarting, and the monitoring and controlling of system operation from display consoles and other control stations as applicable.

c. Ensure the proper interfacing of all equipment specified in the program performance requirements.

d. Ensure the capability of the program to satisfy all applicable system and program performance requirements.

e. Ensure the capability of the system to handle properly and survive erroneous inputs.

5.8.4 System(s) integration test. In instances where the developed program is an element of a larger system involving the integration of two or more programs, the contractor(s) shall be required to participate in total system integration testing. Integration testing may be conducted at facilities other than the development facility, such as a land-based test site. Each contractor shall provide technical support to the integration testing as required.

5.8.5 Software trouble reporting. The contractor shall develop and implement internal procedures for handling and reporting all software or software related problems identified. In addition to the categories and priorities described below, a code shall be utilized to indicate the status of each Software Trouble Report (STR) as it progresses through the correction cycle. All STRs shall be verified for accuracy and correctness and submitted on standard forms.

The contractor shall maintain a complete set of software problem data files throughout the duration of the contract and make this information available to the procuring agency or its authorized representative upon request.

5.8.5.1 Software trouble report category. Software problems shall be classified by category as follows:

a. Software trouble (S). The software does not operate according to supporting documentation and the documentation is correct.

b. Documentation trouble (D). The software does not operate according to supporting documentation but the software operation is correct.

c. Design trouble (E). The software operates according to supporting documentation but a design deficiency exists.

d. Logic trouble (L). The software has a logical error with no directly observable operational symptom but with the potential of creating trouble.

5.8.5.2 Software trouble report priority. Software errors are prioritized by severity as follows:

a. Priority 1 - An error which prevents the accomplishment of an operational or mission essential function in accordance with official requirements (e.g., causes a program stop), which interferes with an operator to the extent that the operator prevents the accomplishment of an operational or mission essential function, or which jeopardizes personnel safety.

b. Priority 2 - An error which adversely affects the accomplishment of an operational or mission essential function in accordance with official requirements so as to degrade performance and for which no alternative work-around solution exists; or which interferes with an operator to the extent that the operator adversely affects the accomplishment of an operational or mission essential function so as to degrade performance and for which no alternative work-around solution exists. (Reloading or restarting the program is not an acceptable work-around solution.)

c. Priority 3 - An error which adversely affects the accomplishment of an operational or mission essential function in accordance with official requirements so as to degrade performance and for which there is a reasonable alternative work-around solution; or which interferes with an operator to the extent that the operator adversely affects the accomplishment of an operational or mission essential function so as to degrade performance and for which there is a reasonable alternative work-around solution. (Reloading or restarting the program is not an acceptable work-around solution.)

d. Priority 4 - An error which is an operator inconvenience or annoyance and does not affect a required operational or mission essential function.

e. Priority 5 - All other errors.

5.8.5.3 Software trouble report disposition. The contractor shall determine the initial status of each STR when it is reported and shall monitor and record any and all changes of the status of each STR. When all appropriate action concerning an STR has been completed, the contractor shall determine and record the final disposition of the STR.

5.9 Quality assurance. The contractor shall implement quality assurance procedures to verify in each stage of the development that the product program will meet the current performance specifications approved by the procuring agency. The contractor shall implement quality assurance procedures to validate the accuracy, correctness and performance of the product programs, to verify the accuracy and conformance of program documentation to the requirements of this Military Standard and to ensure that all procedures incumbent on the contractor are properly and completely followed. The procedures shall be open to review by the procuring agency or its authorized representative. The implementation and functioning of the procedures shall also be open to inspection by the procuring agency or its authorized representative.

5.9.1 Quality assurance organization. The quality assurance organization shall include provisions for addressing all the following facets of quality assurance.

5.9.1.1 Reporting level. The contractor's quality assurance organization shall have corporate reporting responsibility external to the developing/engineering group to assure an objective evaluation of conformity and progress.

5.9.1.2 Participation in audits. The contractor's quality assurance organization shall present and shall conform with procedures for independent quality audits that should take place throughout the development phase starting with design development and ending with test, certification, delivery and acceptance which measure system conformance with technical and management requirements and standards.

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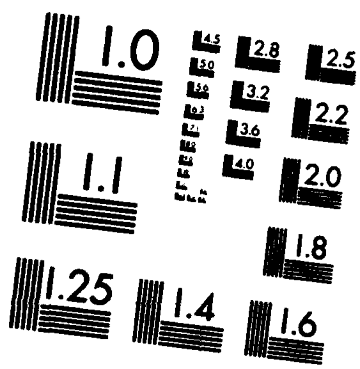

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5.9.1.3 Design reviews. The contractor's quality assurance organization shall participate in design reviews and design walk-throughs utilizing procedures to assure completeness and accuracy of presented materials and to assure timely and correct completion of action assignments.

5.9.1.4 Program design. The detailed performance requirements for the weapon system software shall be audited and examined to ensure that they are able to satisfy the operational requirements, operational standards and system performance specifications, as may be provided by the procuring agency. The detailed design of the weapon system software shall be examined to ensure complete compliance with the performance requirements specified by the procuring agency.

5.9.1.5 Program coding. Coding shall be examined to ensure complete compliance with the detailed program design and specified programming conventions and standards. Listings for developmental components of the program shall be thoroughly desk-checked before testing.

5.9.1.6 Tests. The contractor's quality assurance organization shall witness tests to assure conformance with approved procedures. Quality assurance activities shall include record-keeping, maintenance, control of test materials, and conflict/discrepancy resolution.

5.9.1.7 Deliverable items. The contractor's quality assurance organization shall provide quality procedures and shall monitor conformance with all procedures to assure contractual correctness of all deliverable items.

5.9.1.8 Reporting. The contractor's quality assurance organization shall utilize both interdepartmental and intradepartmental reporting chains to assure prompt reporting of the results of quality related activities. Quality assurance shall follow up any noted discrepancy/action assignment to assure timely and complete correction of the problem.

5.9.1.9 Authority. When conflict exists between quality assurance and other contractor functions at a specific task/management level, the conflict shall be resolved successively at the next higher level.

5.10 Program acceptance. In addition to any criteria specified by the procuring agency, program acceptance shall be predicated upon satisfaction of system reserve requirements, successful completion of the software quality test, the priority and number of unresolved software and documentation errors and the number of existing patch words.

5.10.1 Reserve requirements for program acceptance. Total system memory, input and output channels, and processing time reserves of at least twenty percent shall exist at the time of program acceptance by the procuring agency.

5.10.2 Software quality test requirements for program acceptance. Prior to program acceptance, the program shall have successfully completed the software quality test. This test is intended to exercise all of the functions of the software for a period of time in order to demonstrate that the software is reasonably free of serious or numerous errors. Under this test, the software is to be stressed to the limits of its designed capacities and beyond in order to ensure that degradation at the point of saturation is not catastrophic.

5.10.2.1 Test environment. The software quality test shall be conducted in the environment specified by the procuring agency. Normally, the software quality test shall be conducted in the ultimate user environment for which the system and program were designed. If the ultimate user environment cannot be used for the stress portion of the software quality test, the alternate test site for the stress portion shall be a fully integrated facility equipped with the same hardware found in the ultimate user environment. The remainder of the software quality test requirements must still be met in the ultimate user environment including the length of test as specified below.

The software quality test shall be conducted by a testing activity designated by the procuring agency and independent of the procuring agency and the development contractor(s).

5.10.2.2 Software to be tested. The software to be used in this test shall be the current approved configuration item. It shall have been compiled with the standard DOD support software specified by the procuring agency.

5.10.2.3 Software quality test documentation. All software documentation deliverables for the software being tested shall be available to the testing activity in their final form at the time this test is conducted.

5.10.2.4 Software quality test program operation. At the start of this test the program(s) under test shall be loaded, initialized and started and shall not be stopped until scheduled test completion. When testing an integrated system, subsystems shall operate simultaneously throughout this test as they are intended to do during normal usage operations. Any stop of the program under test, for whatever reason, shall constitute failure to meet the software quality test requirements. For programs with auto-recovery capabilities, any interruption in program execution which invokes the auto-recovery feature shall be treated as a program stop.

5.10.2.5 Software quality test duration. The length of time for this test will vary depending on the complexity of the program and the mission of the system under test. For those programs which are of such complexity that all of the testing requirements and the intent of this standard cannot be satisfied within the minimum periods prescribed below, the length of time for this test shall be extended as determined by the testing activity, or the requirement, if any, specified in the program performance specification or a higher level document. Initial system setup time to establish normal operating conditions shall not be included as part of the testing period.

a. For systems that are designed to operate continuously or for more than one day at a time when the system is placed into operation, the minimum length of time for this test shall be 25 continuous hours.

b. For systems that are not designed to operate continuously or for more than one day at a time, the minimum length of time for this test shall be the length of time required to fulfill the system's mission(s) including any premission or postmission periods or the length of time it takes to complete the test requirements of this standard, whichever is longer. The testing period shall be continuous.

5.10.2.6 Software quality test input data. The program(s) under test shall be subjected to normal and abnormal input data in such a way as to exercise all functions and all interfaces. The test shall be designed to exercise in random order, as specified in approved test procedures, variations of all modes of operation following scenarios of typical normal, as well as abnormal, system operation which demonstrate compliance with operational requirements. Legal and illegal inputs shall be made to test program integrity.

5.10.2.7 Software quality test stress testing. For certain periods during the test as prescribed by the testing activity, the software shall be required to operate at saturation levels which stress the software's capabilities in terms of response times and data handling capacity. Attempts shall be made to exceed every data rate and data volume capacity. Such stress shall be generated through inputs from manual or automated interfaces. There shall be at least three distinct stress periods and the total time spent on stressing the system shall represent at least one-third of the total length of the test. Methods of stressing the system shall include, but are not limited to:

a. Provide more information to be processed than the processor is designed to accommodate.

b. Saturate the data transfer capabilities by requiring more data to be transferred in and out of memory, peripherals, subsystems, and interfacing systems than the system was designed to accommodate.

c. Exceed assigned storage area capacities, e.g., buffers, tables and scratch areas.

5.10.2.8 Software quality test reduced capability testing. For systems designed to operate in a reduced capability mode(s) due to hardware failure(s), each possible reduced capability mode shall be validated by causing actual physical degradation of the hardware, e.g., secure power to a piece of equipment. Correct processing of the failure shall be validated including the capability to return to a normal mode of operation. Scenarios while operating in the reduced capability mode(s) shall demonstrate compliance with formal specifications. The duration of system operation in the reduced capability mode shall be determined by the testing activity.

5.10.2.9 Software quality test and maintenance support programs. On-line organization level hardware maintenance support programs shall be demonstrated during test periods of nominal loading when such a capability exists. For maintenance programs designed to operate only when the operational program is off line, the demonstration of these maintenance support programs will not be included as part of the test of the operational software, but as a separate demonstration to the satisfaction of the testing activity. The priority and number of unresolved software and documentation errors and the number of existing patch word requirements shall apply.

5.10.2.10 Errors during test. Occurrence of a software error of a priority one or two severity during the software quality test shall require correcting the error and repeating the test in its entirety. Occurrence of an intermittent software error of a priority one or two severity shall require that the particular operation(s) be repeated several times to the satisfaction of the testing activity and that the full test then be repeated in its entirety.

5.10.3 Software quality test limitations. Specified below are error and patch limits relevant to the programs undergoing the software quality test. These limits shall be satisfied prior to the commencement of the test. In addition, errors detected during the test which cause this criteria to be exceeded shall invalidate the test; an individual test may continue to run to its planned completion in order to uncover any additional errors. In those tests where the error limits are exceeded, the test shall be rerun in its entirety. In those tests where the patch limits are exceeded, consequently requiring source level changes and recompilation or assemblage, the test shall be rerun it its entirety.

5.10.3.1 Error limits. The following error limits apply.

a. The number of unresolved software errors (excluding documentation errors) shall not exceed the following: (see paragraph 5.8.5.2 for definition of priorities)

Severity	Limits
Priority 1 and 2 (high)	Zero
Priority 3 (medium)	One per 70K of machine instruction words or fraction thereof.
Priority 4 and 5 (low)	One per 35K of machine instruction words or fraction thereof.

b. Intermittent errors shall be included in the count of software errors and receive no special consideration.

c. The number of unresolved technical errors in all of the deliverable documentation shall not exceed the sum of three, plus one for every 25K of machine instructions or fraction thereof. For example, a program having 300K machine instructions: 3 + 12 = 15 allowable documentation errors.

d. All software errors discovered during the software quality test shall be documented.

5.10.3.2 Patch limits. The following patch limits apply.

a. The total number of patch words in a program shall not exceed 0.005 times the total machine instruction words in the program.

b. There shall be no patching of errors while the software quality test is in progress.

c. Patches which correct software errors are permitted only if they have been incorporated into the configuration item and are automatically applied during the load process.

d. The only other patches that may be in a program during the software quality test are those which are considered required for testing purposes and they shall be specifically set forth in the test procedures. Caution should be exercised that these patches do not interfere with the validity of the software quality test results. These patches shall not be counted against the patch limits established above.

e. All patches shall be documented.

5.11 Configuration management. The contractor shall develop and implement internal procedures to ensure the positive identification, control and status accounting of the configuration of the weapon system software, the detailed program performance requirements and the detailed design requirements during all phases of the development effort. The contractor shall ensure that such procedures are integrated with the configuration management procedures addressing the total weapon system. Procedures shall provide:

a. Positive identification of all program components.

b. Rapid, comprehensive and accurate treatment of proposed changes to components under configuration control.

c. Comprehensive implementation of approved changes and dissemination of corrected documentation and program changes.

d. Accurate records of status of all proposed changes.

e. Verifications of change control, identification and status accounting of the descriptive documentation and program materials.

5.11.1 Configuration identification.

5.11.1.1 Baselines. The contractor shall establish internal baselines representing the approved configuration identification of the weapon system software. Internal baselines shall be established to ensure orderly transition from one software development phase to the next. Internal baselines shall be established at those points where it is necessary to define internal departure points for future changes in performance, design, and related technical requirements.

5.11.1.2 Documentation identification. The contractor shall establish titling, labeling, numbering, and cataloging procedures for all computer software documentation and program materials which satisfy the following criteria:

a. Denotes the component to which it applies.

b. Describes the purpose of the document.

c. Defines the baseline which it is a part of, or in support of.

d. Denotes the serial, edition and change status of the document.

The compilation date shall be indicated as part of the identifier for each delivered component. Sequence numbering of all source records in a module shall be structured so future changes to any component can be properly noted.

5.11.2 Configuration control. The contractor shall establish procedures for the formal control of all documents, program materials and the development support library. These procedures shall include bringing each component of the software under configuration control. These procedures shall also include the establishment and functioning of a software configuration control board and the methods and formats for submission and acting on software change proposals, software enhancement proposals and software trouble reports.

5.11.2.1 Software changes. During software development, changes proposed by the contractor to the software (including descriptive documentation) which is under configuration control by the contractor or the Government or both, shall be submitted to the appropriate software configuration control board(s) as either Software Change Proposals (SCP) or Software Enhancement Proposals (SEP) depending on the classification of the changes. All SCPs or SEPs which have cost, interface, or schedule impact shall be attached to a form DD1692 (Engineering Change Proposal, page 1) completed and numbered in accordance with reference 2.1.a and submitted to the procuring agency.

5.11.2.2 Documentation changes. Procedures for controlling the preparation and dissemination of changes to documentation to reflect approved and implemented SCPs, SEPs, and STRs shall be developed. Such procedures shall be designed to insure the simultaneous promulgation of the descriptive documentation and program materials.

5.11.2.3 Software Configuration Control Boards (SCCB). Each baseline plus approved changes from those baselines shall be under the formal control of a responsible board. The board shall identify and maintain the complete and current description of each component of the weapon system software. The board shall consider all proposed changes to the baseline and take appropriate action on each proposal. Each proposal shall be analyzed and evaluated in the following areas:

a. Operational impact.

b. Technical design impact.

c. Resource requirements (e.g., cost, personnel, time).

For all approved changes, the board shall ensure implemented changes are reflected in all baseline documentation. The contractor's SCCB shall implement procedures which reconcile the configuration status accounting reports and the status of the software with the approved baseline(s) and its approved changes.

5.11.3 Configuration status accounting. The contractor shall establish procedures to enable the generation of periodic status reports on all components under configuration management. These procedures shall identify all SCPs, SEPs, and STRs in preparation, in review, and in the current stage of implementation. These procedures shall confirm the incorporation of approved configuration changes. These procedures shall identify all disapproved and deferred SCPs, SEPs, and STRs.

5.12 Management control. The contractor shall determine and implement a management system for the development effort which is acceptable to the procuring agency. The management of the development shall emphasize efficiency and economy. Clear lines of authority and responsibility shall be established. The management system shall provide for the coordination of all facets of the development under a master schedule of events and milestones. The detailed performance requirements, the program architecture and the detailed program design will be subject to review by the procuring agency at scheduled milestones in the program development cycle. Milestone dates shall be established for demonstrations of evolving software capabilities. Such demonstrations are intended to provide the necessary visibility for project management and meaningful output for product validation. The management system shall provide a capability to monitor the progress of the development by means of regular status reports, reviews and audits. The managenent system, including planning and procedural guidance for the development effort, shall be compiled in an overall plan for visibility, formalization, control and coordination of the development.

5.12.1 Management organization. The contractor may use an internal organization of his own choice, subject only to the requirements from this standard which are invoked by the procuring agency. The contractor shall designate an overall manager for the development effort. The functions of design, production and test shall be given organizational visibility. The relationship of all support functions, both full-time and part-time, required to support the development effort shall be clearly defined. The responsibilities of all subcontractors, if used, shall be clearly visible to the procuring agency.

5.12.2 Resource requirements. The contractor shall determine his resource requirements in the three areas of personnel, facilities, and equipment. Planning shall be completed early enough to permit orderly acquisition, installation, and training (if applicable) of resources on an optimum schedule to prevent delay and to avoid dead-time. Reusability, permanency, or length of project and convenience of location shall be weighed. The procuring agency may direct the use of government or other facilities. Planning shall be responsive to schedule changes. The contractor shall avoid sharp fluctuations in personnel requirements by judicious shifting of personnel as development tasks change.

The contractor shall consider the cost-effectiveness of commercial equipment to assist in the development where appropriate. The possibility of continuing use of the equipment by the Government during the operational support phase of the software life-cycle shall be a consideration. Where weapon system equipment is government-furnished or government-specified, the contractor shall be responsible only for the cost-effectiveness of its use and maintenance, not its acquisition. The contractor shall implement a system of management monitoring of utilization in the areas of personnel, facilities, and equipment considering both quantity and cost. Actual utilization rates shall be compared to predicted rates at least monthly. The procuring agency may specify more frequent comparison. Variations shall be expeditiously investigated and corrective action initiated. Personnel stability and productivity shall be measured regularly.

5.12.3 Status reviews. Status reviews may be requested by the procuring agency at regular intervals during the development effort. The contractor shall be able to provide at these reviews the current status, progress, and problems occurring in the development effort within the purview of the contractor.

5.12.3.1 Status review subjects. The contractor shall address the following subjects, as appropriate to the stage of the development effort, in each status review:

a. Organizational changes, managerial personnel changes

b. Design status

c. Development schedule status (milestone prognosis)

d. Coding status

e. Software Trouble Report (STR) status

f. Software Change Proposal (SCP) status

g. Software Enhancement Proposal (SEP) status

h. Integration schedule status

i. Testing status

j. Deliverables

k. Progress on previous problems

l. New action items/problems

m. Delinquencies: governmental, outside contractor, subcontractor, and internal

n. Manpower utilization

o. Facilities utilization

p. Computer system resource utilization (see 5.5.2)

q. Financial summary.

5.11.3.2 Status review subject items. Within each subject area, the contractor shall cover the following items, as applicable:

a. The schedule updated to the end of this reporting period.

b. Major difficulties encountered and plans to overcome them, including: Tasks/units that are currently behind schedule (or have anticipated schedule changes), their effects on completion of the project, and steps being taken to remedy schedule delays.

c. Other information which defines cause and effect of significant changes on the contract schedule.

d. Problems which actually or potentially will cause deviation from contractual requirements.

e. Summary of meetings and conferences held during the reporting period, including action items with due dates for both the contractor and the procuring agency. Current status of action items shall be included until reported closed.

5.12.3.3 Documentation reviews. Documents and programming materials, as specified, shall be scheduled for detailed review prior to approval or acceptance. The purpose of the review shall be to:

a. Verify that the subject documents and programming materials comply completely and accurately with the program performance and design requirements of higher level documents and programming materials and all other standards and constraints imposed by the procuring agency.

b. Verify the accuracy and completeness of the documents and programming materials by checking for all components, their correct cross-reference, and editorial accuracy.

The review shall be in two stages: a preliminary working-level review followed by a formal (or critical) review after changes resulting from the preliminary review have been entered. Reviews shall be scheduled by the contractor, with the concurrence of the procuring agency, and in accordance with milestones in the software development plan. The procuring agency may designate other activities to participate in the review. The contractor shall distribute drafts of review documents and programming materials to each designated activity sufficiently in advance of the scheduled preliminary review to allow adequate internal review by each activity. The contractor shall distribute a corrected version of the review documents and programming materials after completion of the preliminary review. The critical review for the acceptance or approval of the documents and programming materials shall expeditiously follow the distribution of the corrected version.

5.12.3.4 Special reviews. Special reviews may be scheduled by the procuring agency at major milestones or events in the development effort not covered by documentation reviews or status reviews. A special review of the test program as developed shall be conducted. The contractor shall furnish the same support for special reviews as for status reviews.

5.12.4 Inspections and audits. The procuring agency may employ a physical inspection to determine the contractor's conformance with contractual requirements. As a minimum, areas of interest include documentation controls, deliverable data items, government-imposed standards, and the following:

a. Facilities. The development and test facilities may be inspected for contractual conformity at any time during the life of a software system development contract.

b. Configuration management. Contractor conformance with the approved software configuration management requirements may be audited through examination of records and attendance at software configuration control board meetings.

c. Internal standards. The procuring agency may audit the contractor's conformance with internal standards of software development and control.

d. Quality assurance. The procuring agency may audit and inspect the contractor's conformance with the approved software quality assurance requirements.

6. MISCELLANEOUS

6.1 Contract Data Requirements. The following list of Data Item Descriptions shall be utilized if the procuring agent desires to order data that is generated from having invoked pertinent work tasks that are established within this standard. Such data must be specified on the Contract Data Requirements List, DD Form 1423.

		MIL-STD-1679 (Navy) Corresponding Section
a. Interface Design Specification (IDS)	DI-E-2135	5.1.2.4b, 5.1.2.5c/5.2.3
b. Program Performance Specification (PPS)	DI-E-2136	5.1
c. Program Design Specification (PDS)	DI-E-2138	5.2
d. Program Description document (PDD)	DI-S-2139	5.3/5.4/5.5
e. Data Base Design Document (DBD)	DI-S-2140	5.2.2.6
f. Program Package Document	DI-S-2141	5.3/5.4/5.5
g. Computer Program Test Plan	DI-T-2142	5.8
h. Computer Program Test Specification	DI-E-2143	5.8
i. Computer Program Test Procedures	DI-T-2144	5.8
j. Computer Program Test Report	DI-T-2156	5.8
k. Operator's Manual (OM)	DI-M-2145	5.7
l. System Operator's Manual (SOM)	DI-M-2148	5.7
m. Software Quality Assurance Plan	DI-R-2174	5.9
n. Software Configuration Management Plan (SCMP)	DI-E-2175	5.11
o. Software Development Plan	DI-A-2176	5.12
p. Software Change Proposal (SCP)/Software Enhancement Proposal (SEP)	DI-E-2177	5.11.2.2
q. Computer Software Trouble Report (STR)	DI-E-2178	5.8.5

Custodians:

Navy - NM

Review Activities:

Navy - AS, EC, MC, OS, SH

User Activities:

Navy - NM, AS, EC, MC, OS, SH

Preparing Activity:

Navy - NM

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