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SOFTWARE ACQUISITION MANAGEMENT GUIDEBOOK: STATEMENT OF WORK PREPARATION

JANUARY 1977

Prepared for

COMPUTER SYSTEMS ENGINEERING DIRECTORATE
ELECTRONIC SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
Hanscom Air Force Base, Bedford, Massachusetts

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CONTRACTING
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STATEMENT OF WORK
WORK BREAKDOWN STRUCTURE

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

This report is one of a series of guidebooks for software acquisition management. The guidebooks are being prepared for use by Air Force Program Office personnel responsible for planning and managing the development of software. This guidebook covers the preparation of Statements of Work (SOWs) for acquisition of Electronic Systems that include software.

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REVIEW AND APPROVAL

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

William J. White

WILLIAM J. WHITE, Capt, USAF
Project Engineer

John T. Holland

JOHN T. HOLLAND, Lt Col, USAF
Techniques Engineering Division

FOR THE COMMANDER

Frank J. Emma

FRANK J. EMMA, Colonel, USAF
Computer Systems Engineering Directorate

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PREFACE

This report is one in a series of guidebooks intended to help Program Office personnel in software acquisition management. The contents of the guidebooks will be revised periodically to reflect changes in software acquisition policies & practices, and feedback from users.

This guidebook has been prepared under the direction of the Electronic Systems Division (ESD), Air Force Systems Command (AFSC), Computer Systems Engineering Directorate (MCI). Contributions were made by the following ESD personnel: Major Lee Burner (DRT) and Captain W. J. White (MCI) (Project Officer).

The Software Acquisition Management Guidebook series is currently planned to cover the following topics. (National Technical Information Service accession numbers for those already published are in parentheses).

1. Project Guide to Content Requirement and Audience Needs (AD-A019124)
2. Regulations, Specifications & Standards (AD-A016401)
3. Contracting for Software Acquisition (AD-A020444)
4. Monitoring and Reporting Software Development Status (AD-A016488)
5. Statement of Work Preparation
6. Reviews and Audits
7. Configuration Management
8. Requirements Specification
9. Software Documentation Requirements (AD-A027051)
10. Verification
11. Validation and Certification
12. Overview of the Series
13. Computer Program Maintenance
14. Software Quality Assurance
15. Software Cost Estimating and Measuring
16. Software Development and Maintenance Facilities
17. Life Cycle Events

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1. INTRODUCTION

This guidebook explains the preparation of Statements of Work* (SOWs) and describes other components of Requests for Proposal (RFPs) for acquisition of Electronic Systems that comprise, or include, software (i.e., computer programs, computer data bases and their documentation). Electronic Systems are one of seven types of system identified in MIL-STD-881A, Work Breakdown Structures for Defense Materiel Items. A substantial number of ESD-managed systems are Electronic Systems.

A RFP is a formal document, sent to each of a list of prospective contractors, which describes a group of supplies or services to be procured from industry under Negotiated Procurements**, outlines terms and conditions acceptable to the Government, and solicits proposals consistent with this information. The companies that submit proposals are termed Offerers. The SOW is that part of a RFP which describes the scope of the work that the Government wants done by the selected contractor. Other parts of the RFP of particular software relevance are the Guidance to Offerers; the Proposal Evaluation Criteria; the Government-proposed contract terms and conditions; the Delivery Schedule; the Contract Data Requirements List (CDRL); and most important, the Specifications, which define what is to be built or bought. After possible change during contract negotiations, the SOW, the Delivery Schedule, the CDRL and the Specifications become part of the contract with the winning Offerer, and thus spell out the obligations of both Government and contractor.

1.1 Purpose

The guidebook has been prepared for use by Air Force Program Office (PO) personnel in general and a person termed the Software Director in particular. The Software Director is the military officer or civilian within the Program Office who assists the Program Manager (PM) in planning and managing software development activities. As such, the Software Director is one member of an Air Force program management team that includes technical, procurement, legal, data management, configuration management, and other specialists whose combined efforts are necessary for the successful completion of an acquisition program. Different individuals (e.g., the Engineering Division director) may perform the Software Director's functions in different Program Offices, or these functions may be split among different persons. However, with appropriate compensation for such variations in organization, this guidebook's contents apply unchanged.

Unlike a directive, this guidebook does not prescribe what must be done. Instead, it identifies issues and pitfalls; references relevant sections of

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* The guidebook capitalizes specialized terminology. See Section 1.3.

** Paragraph 2.3.1 of ESD-TR-75-365, An Air Force Guide to Contracting for Software Acquisition, explains Negotiated Procurements vs. Formally Advertized Procurements. The latter, which require completely detailed specifications, are inappropriate for typical software-related system acquisition.

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appropriate Regulations, Specifications and Standards; and suggests alternative approaches. Any questions that may arise over the feasibility or legality of suggestions made herein should be referred for decision to the Program Manager or to the appropriate Procuring Contracting Officer (PCO).

Existing Regulations, Specifications and Standards define no special types of SOW or RFP for software development. Also, software and equipment follow similar acquisition processes. Nevertheless, there are significant differences between systems that include software development and those that do not. These differences should be reflected during preparation of SOWs and other RFP components. For example, the replication of software, unlike equipment, entails no manufacture. Again, the relative ease of incorrect and hard to trace software modification requires special emphasis on control of computer program Versions (see Section C2.1.1). This guidebook attempts to highlight these differences and their implications.

1.2 Scope

The guidebook introduces software-related SOW preparation for Electronic Systems acquired within the framework of the 800-series of Air Force regulations and manuals. The 800-series covers the research, design, development, engineering, testing, and production of tactical & strategic systems for the operational inventory. The 800-series normally governs acquisition of computers and software which are embedded in a weapons or command and control system. Some of this software (e.g., Application Programs) may be built expressly for the weapons or command and control system. Some (e.g., certain Operational Executives) may be modified versions of off-the-shelf software. A third subset (e.g., Compilers, Assemblers) may consist of unaltered off-the-shelf software. In contrast, the acquisition of off-the-shelf, commercially marketed data processing equipment and its associated support ("non-functional") software for business-like applications (e.g., payrolls, logistics, personnel records, management reporting) is normally governed by the 300-series of Air Force regulations and manuals. (ESD-TR-75-91, Software Acquisition Management Guidebook: Regulations, Specifications and Standards, Chapter 2, further compares the 300-series and the 800-series). This SOW guidebook does not address acquisitions managed in accordance with the 300-series, although its principles may apply there and elsewhere.

The guidebook emphasizes preparation and review of software-related SOW material for the Full-Scale Development Phase* of major Command, Control and Communication systems that include software, equipment and other components. This type of SOW is illustrated and discussed because it is usually more complex than any other, and because the effects of errors and omissions in the procurement packages for Full-Scale Development of such Major Defense Systems* are typically very costly. However, software-related matters that should be considered during preparation of Conceptual Phase* and Validation Phase* SOWs are addressed throughout the guidebook.

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* Software Acquisition Management Guidebook: Life Cycle Events (LCEG) explains Major Defense Systems, their Acquisition Life Cycle phases, and the Computer Program Life Cycle Phases of the software they involve.

This guidebook emphasizes SOW preparation more than most other aspects of RFP development because the latter typically encounter fewer software-peculiar problems. Consequently, existing general guidance for RFP preparation* requires relatively little augmentation. However, overall RFP structure, CDRL contents, and some aspects of the Specifications, are discussed in some depth, because of their close relationships to SOW preparation. As a rule, the guidebook avoids duplicating material found in the readily-accessible documents that it references. Instead, it provides a framework for their use with specific emphasis on software.

1.3 Conventions

The Regulations, Specifications and Standards on which this guidebook is largely based use many terms drawn from ordinary English in special ways. These directives define acronyms for some of these terms but not for others. Where acronyms are used, they help make clear the special meanings intended, but where no acronym is used confusion may arise. To minimize this problem in the guidebook, terms used in special ways are capitalized. These special terms are usually defined in the guidebook section where they first occur, in references cited there, or in the Life Cycle Events guidebook. The guidebook uses acronyms in common parlance, and certain others for brevity. Each is defined where first used, and repeated in the List of Abbreviations.

Readers can distinguish the direction, advice, and other options interspersed in the guidebook by noting the following conventions. To designate mandatory action (e.g., action prescribed by applicable Regulations, Specifications and Standards), the guidebook employs "must" or "shall". In contrast, "should" or "it is recommended that", identify action recommended by the authors, while "may" and "might" connote other optional actions.

1.4 Plan

Section 2 treats planning for SOW preparation, emphasizing the actions required for SOW development and approval, and a SOW's relation to the other components of the RFP. Section 3 contains model Full-Scale Development Phase SOW paragraphs that prescribe software-related work, and commentary on these paragraphs. Appendices A-C discuss other topics closely related to SOW preparation: Work Breakdown Structures (WBSs), the Source Selection Plan, and other portions of the RFP. The guidebook also includes a List of Abbreviations and a list of pertinent references.

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* Especially AFSCP 70-3, Request for Proposal Preparation Guide.

1.5 How to Use this Guidebook

Use of the SOW guidebook in two main ways is anticipated:

a. as a tutorial on SOW preparation for persons relatively inexperienced in the acquisition of large systems that include software;

b. as an introduction to the mechanics of software-related SOW preparation for those otherwise quite familiar with the acquisition of large systems.

The first type of user should first review thoroughly the Life Cycle Events guidebook (LCEG). Section 2 of the SOW guidebook should then be read, with excursions through Appendices A-C as each is first referenced. Finally, Section 3 should be studied as a realistic SOW model in the light of this background.

The second type of user should at least scan the Life Cycle Events guidebook, with special attention to its tables, as a compact source of information about Acquisition Life Cycle and Computer Program Life Cycle events, activities and products that should be considered in composing his SOW. This type of user should then use Section 3 of the SOW guidebook as a guide to the SOW preparation process, referring to the Appendices and to the model SOW for specific information needed. The rather extensive cross-referencing among the guidebook's main sections and appendices is intended to facilitate this approach.

2. PLANNING FOR SOW PREPARATION

Considerable planning by Government personnel must precede Major Defense System Validation Phase and Full-Scale Development Phase SOW preparation. First, the system to be acquired must be defined well enough to permit reasonable assessment of the overall effort and costs involved. Next, this effort must be roughly scheduled, and the Government participants' roles established. Then groups of tasks must be identified, for performance by contractors. A similar group of tasks for each participating Government organization must be defined. The basic procurement approach must be decided, including whether the system will be segmented, the number of contractors desired and the roles of each.* Each such group of tasks, and the group of all tasks, must be represented respectively in a Preliminary Contract Work Breakdown Structure (Preliminary CWBS) and a Project Summary WBS (see Appendix A), and referenced in other planning documents (e.g., the Program Management Plan (PMP), which is written in response to the Program Management Directive (PMD)). A Source Selection Plan (see Appendix B) must be prepared and approved. Finally, an RFP (see Appendix C), including a SOW, must be developed for each planned contract, and analogous memoranda of agreement must be worked out among the Government participants. The narrative and tables in LCEG Sections 2 through 8, plus appropriate directives referenced there, should be consulted as a basis for these agreements.

The Computer Resources Integrated Support Plan (CRISP) is an agreement about computer resources among the Government participants.** It is analogous to major portions of the contract negotiated between the Government and each contractor. The CRISP defines generally the work to be done by each participating Government organization (e.g., a Using Command computer program development group). However, this definition of work allocation may not be clear enough to prevent potential misunderstandings about specific responsibilities, which are at least as likely among Government participants as between Government and contractor. Therefore, it is strongly recommended that a SOW specifying each Government participant's computer-related work be negotiated and made an appendix to the CRISP.

Subsequent paragraphs on planning for SOW preparation stress the Validation and Full-Scale Development Phases of a Major Defense System. This information may be tailored to SOW preparation for other Major Defense System Acquisition Life Cycle phases and for Less-Than-Major System acquisitions.

SOW preparation planning for other than Major Defense System Validation Phase and Full-Scale Development Phase work can be less elaborate (see LCEG Sections 3, 6, and 7). In particular, a SOW for the initial definition of a system must necessarily be written in rather general terms.#

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* ESD-TR-75-365, paragraph 2.2, discusses the major issues.

** See LCEG Section 4.4.2 and AFR 800-14, Acquisition and Support Procedures for Computer Resources in Systems, Vol. II, paragraph 3-8.

\# E.g., see AFSCP 800-6, Statement of Work Preparation Guide, Chapters 3-5.

A SOW should:

a. define precisely all the work desired from the contractor (or equivalent Government organization) that is not inherent in or required by any other contractual attachment;

b. name the product(s) of each task;

c. define or imply no unwanted task or product;

d. reference the contract's Delivery Schedule (see Section C2.3) for an appropriate Period of Performance or completion date for each task, and an appropriate delivery date for each product other than Data (i.e., documentation or Computer Programs);

e. rely on the CDRL (see Section C2.7) to establish the form, content, and delivery requirements for Data;

f. be consistent with the Preliminary CWBS (see Section A4.4) and the CDRL; and

g. be consistent with program objectives (e.g., as stated in the PMD).

Subsequent subsections interpret these objectives, state general requirements for SOW preparation, suggest actions helpful to a good SOW's preparation, and provide guidance for definition of Configuration Items (CIs) for Validation Phase contracts. The model Full-Scale Development Phase SOW paragraphs and related commentary in Section 3 provide further guidance. Some requirements and other guidance stated elsewhere in this guidebook are repeated here for easy reference.

2.1 General SOW-Preparation Requirements

The requirements stated below apply generally to SOWs for Validation Phase and Full-Scale Development Phase contracts. Where directed they also apply to SOWs for other types of contract.

2.1.1 SOW Paragraph Correspondence to Preliminary CWBS Elements

Each SOW must correspond in structure and substance to the planned contract's Preliminary CWBS (see Section A4.4) to whatever depth the latter is defined. That is:

a. a separate SOW paragraph must be prepared corresponding to each Preliminary CWBS Element;

b. each such SOW paragraph's task description must define work consistent in scope with the corresponding Preliminary CWBS Element; and

c. each such SOW paragraph and the corresponding Preliminary CWBS Element must bear the same Program Breakdown Code (PBC) (see Section A3), and should normally bear the same name.

As a result, a SOW must have an hierarchical structure like a WBS.

A SOW will normally define tasks in greater detail than the lowest-level Preliminary CWBS Elements. The SOW subparagraphs defining these tasks may be nested to any depth. A contractor can and normally should be required to segregate and report costs by the lowest-level Extended CWBS Elements defined. (See Section A4.6).

2.1.2 SOW Paragraph and CLIN Correspondence

Each SOW paragraph (at and above some level) that prescribes contract effort must correspond to a CLIN (i.e., a Contract Line Item or Subline Item) of the same name (see Section C2.1). A SOW paragraph that calls for acquisition of a CPCI must also correspond to an Exhibit CLIN (see Section C2.1.2). The same CLIN or Exhibit CLIN may correspond to more than one CPCI, but 1-1 correspondence is preferable (see Section C2.1). Such correspondence is assured if the Preliminary CWBS and the SOW structures are coordinated (see Section A4.4), and if the CLIN descriptions are based on a completed SOW (see Section C2.2).

2.1.3 SOW Incorporation of PBCs

Each Validation Phase or Full-Scale Development Phase SOW paragraph that prescribes contract effort must be identified by the PBC of the corresponding Preliminary CWBS Element. Each such SOW paragraph should also be assigned an index (e.g., 5.1.1.2) that identifies uniquely its position in the SOW's hierarchic structure. Each SOW paragraph that does not correspond to a Preliminary CWBS Element should also be assigned an index, but no PBC. For example, Exhibit 1 paragraph 5.1.5.1 corresponds to Preliminary CWBS Element A1061 and thus contains this PBC. However, Exhibit 1 paragraph 5.1.5.1.1 is a subparagraph of paragraph 5.1.5.1 for which no corresponding Preliminary CWBS Element exists. Thus, paragraph 5.1.5.1.1 contains no PBC.

2.1.4 SOW Paragraph to CPCI Correspondence

A separate SOW paragraph must call for acquisition of each Computer Program Configuration Item (CPCI). (See Section C2.1).

2.1.5 SOW Paragraph to CDRL Entry Correspondence

Each Data Item (see Section C2.7) to be delivered under the planned contract (including software storage media) must be identified in a CDRL entry. This CDRL entry must define the Data Item (e.g., by Data Item Description (DID) reference) and, except for software storage media, must prescribe the terms for its delivery. The same CDRL entry may define more than one Data Item (e.g., several CPCIs' Computer Program Product Specifications) as long as that CDRL entry defines them all correctly and precisely. In addition, one or more specific Armed Services Procurement Regulations (ASPR) or SOW paragraphs must call for the work that results in the preparation of each Data Item. The CDRL entry must reference these paragraphs by paragraph index or PBC. Both the SOW and the CDRL entry must identify the Data Item by the same name. In addition, the SOW paragraph

should reference the Data Item by name, and may reference the CDRL entry by its sequence number. However, current ESD policy* prohibits a SOW paragraph from prescribing Data Item structure or content, and from incorporating a DID reference.

2.1.6 Completion Dates and Periods of Performance

CLIN completion dates and Periods of Performance should be included in the Delivery Schedule and referenced there from the SOW paragraphs. Data Item delivery dates must be included in CDRL entries, except that the special CDRL entry that represents each CPCI must reference the Delivery Schedule for the CPCI delivery date(s). (See Section C2.1.2 and Section C2.3). The SOW itself may contain neither delivery dates nor Periods of Performance. This mandatory approach concentrates all date-related SOW requirements, which simplifies their writing and cross-checking for feasibility.

2.1.7 Enforcement of Proposed Plans

A Special Provision of the contract (see Section C2.5) is necessary to require a contractor to follow a plan (e.g., a System Engineering Management Plan (SEMP), a Computer Program Development Plan (CPDP)) contained in his proposal. A SOW paragraph should call for updating each such plan, and the CDRL should state its required delivery dates.

2.2 General Suggestions for SOW Preparation

Although not requirements, several practices described below are recommended as aids to developing sound SOWs.

First, those charged with SOW preparation should assemble and study the appropriate background material to be sure they understand the system's objectives and requirements, plus the planned contract's objectives. In particular, the latest Decision Coordinating Paper (DCP)** (if any) and PMD should be reviewed for objectives and specific direction. The PMP should be studied to understand the overall acquisition management approach, and each participant's role. The latest Project Summary WBS or Summary Program Breakdown Structure (PBS) (see Sections A4.2 and A4.3), and the essentials of any related contracts, existing or planned, should be reviewed to understand the interactions of other program-related activities with the planned contract. The Life Cycle Events Guidebook, especially Tables 1-4, should be examined as a source of potential SOW tasks and related products. Critical milestones should be spelled out in a master schedule. Finally, the other portions of the planned contract's RFP (see Appendix C) should be understood, especially the Specifications.

Second, a draft Preliminary CWBS must be prepared (see Section A4.4) and (for ESD-managed programs) coordinated with the Cost Analysis Division (ACC).

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* AFSCR 310-1/ESD Sup. 1, Management of Contractor Data, paragraph 3.q.

** DCPs are prepared only for Major Defense Systems. See LCEG, Section 2.

Third, for ESD-managed programs, the SOW preparation task should be discussed with the Directorate of Acquisition Support (DR) to obtain current information on SOW-related policy and other guidance.

Fourth, the latest versions of all Regulations, Specifications, Standards, and DIDs, whose application to SOW-specified tasks and related Data Items is planned, should be reviewed to determine their applicable sections and to decide on appropriate modifications. As a rule, Air Force and lower level command regulations, manuals, and pamphlets should not be referenced in a SOW. However, this rule may be overlooked whenever it would entail incorporating voluminous material explicitly in the SOW. (e.g., see model SOW paragraph 3). Military specifications and standards may be freely referenced. Specific and appropriate references are essential to clear, precise, and appropriate SOW task descriptions. Similarly, understanding the applicable DIDs is essential to relevant Data Item definitions. SOW and CDRL references that are too broad risk misinterpretation of the scope of effort and products desired. On the other hand, SOW and CDRL provisions that restate requirements contained in the System Specification, in Development Specifications, or in appropriate Regulations, Specifications, Standards or DIDs risk inconsistency and entail parallel updating.

Fifth, previously prepared SOWs and related CDRL entries should be acquired and their relevant paragraphs, if any, considered as models for related tasks under the planned contract. However, these model SOW paragraphs and related CDRL entries should be reviewed critically, screened, and carefully modified to avoid including in the planned contract's SOW inconsistent, excessive, and otherwise inappropriate provisions. These model SOWs and CDRL entries should be discussed with persons familiar with their contracts' performance histories, to reveal any problems attributed to defective SOW provisions. The Model Full-Scale Development Phase SOW paragraphs in Section 3 are one source of possibly relevant SOW material. ESD 800-4, Statement of Work Preparation Guide, Change 1, is another source. This contains 42 short sections on different potential SOW tasks. Each section includes model SOW paragraphs, suggestions for preparing such paragraphs, or both. Table 1 shows these tasks' titles & PBCs, and assesses the usual relevance of each to software-related SOW preparation. As Table 1 states, tasks deemed irrelevant or only marginally relevant to software should be considered more relevant if their accomplishment should require software. For example, if a system's Support Equipment included software-controlled Automated Test Equipment, the Support Equipment SOW task would be of primary importance to the Software Director.

Sixth, experts on particular types of desired effort or products should be consulted about the related SOW paragraphs and CDRL entries. If possible, these persons should prepare initial drafts of the SOW paragraphs and related CDRL entries in their areas of expertise, using or adapting model SOW paragraphs where appropriate. Corresponding SOW paragraphs, and proposed CDRL entries, should always be prepared in parallel. Special CDRL entries must specify the delivery of CPCIs and their Versions (see Section C2.1.2).

Seventh, a small group of key Program Office personnel, including the Software Director, should review these drafts, alter them appropriately, and

Table 1

NORMAL* SOFTWARE RELEVANCE OF POTENTIAL SOW TASKS

SOW Task Title**	ESDP 800-4 Task**	Software Relevance (See KEY)*	PEC##
Aerospace Environment	9	I	1061E
Availability	40	P	1061Q
Communications Long L ies	15	I	1061M
Computer Program Man ment#	2	P	4210
Configuration Management	22	P	1062C
Program/Contract Work Breakdown Structure	20	P	1062AA
Cost Information Syste s#	18	S	1062AB
Cost/Schedule Control System#	19	P	1062AC
Data Management#	35	S	1070
Design, Development and Fabrication#	4	P	1010
Electromagnetic Compatibility	11	I	1061G
Human Factors and Training#	34	S	1064, 1020
Integrated Logistics Support	27	M	1063
Initial Spare/Repair Parts Provisioning#	38	I	9600
Integration of Analyses and Related Computer Support	39	S	1062D
Life Cycle Costs	ASPR	S	1062AD
Maintainability	6	P	1061B
Manufacturing Management	21	I	1062B
Nomenclature	8	M	1061D
Parts Control & Standardization Program#	7	M	1061C
Photographic Documentation	25	I	1062F
Preoperational Maintenance#	32	M	1063E
Preoperational Supply Support	28	I	1063A
Preservation, Packaging, Packing & Marking#	29	S	1063B
Quality/Program/Inspection System#	24	P	1062E
Radio Frequency Management	16	I	1061N
Real Property Facilities#	37	I	1082
Reliability	5	P	1061A
Schedule Management	17	P	1062AE
Security	12	S	1061J
STINFO	26	M	1062G
Support Equipment#	33	M	9200
Survivability/Vulnerability	13	S	1061K
System Engineering Management#	3	P	1061
System Safety	14	S	1061L
Technical Orders#	36	P	1071
Test and Evaluation#	1	P	1050
Transportability	10	I	1061F
Transportation	30	I	1063C
Travel	31	I	1063D

Table 1 (Concluded)

SOW Task Title##	ESDP 800-4 Task##	Software Relevance (See KEY)*	PBC##
Value Engineering - Program Requirements Clause#	23	P	1061P
Value Engineering - Incentive Program Clause#	3	S	1061

KEY

I = Irrelevant

M = Marginal. However, the Software Director should review this task statement to avoid surprises.

S = Substantial. The Software Director should influence and coordinate on this task statement to assure consistency.

P = Primary. The Software Director should prepare the software-related Sections, and should review the entire task statement, as a matter of prime concern.

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* Normally irrelevant (I) or marginally relevant (M) task descriptions (see KEY) should be carefully reviewed and coordinated by the Software Director if their accomplishment entails the use or development of software.

** Per ESDP 800-4 (Change 1), Attachment 1.

\# This title differs from the Standard WBS Element Name. See Table A-1.

\#\# Prefix this code by the letter code (i.e., A,B,...) for the source of the product or service, if known. See AFSCM 173-4, Program Breakdown Structure and Codes, paragraph 3-3a and Figures 5-3 through 5-8.

compile them into an integrated SOW and proposed CDRL consistent with the Preliminary CWBS. This group should assure the SOW's precisions, completeness, internal consistency, and consistency with the other RFP sections. Elimination or alteration of CDRL entries by the Data Requirements Review Board (see Section C2.7) may entail SOW, Preliminary CWBS, and other RFP modifications, to retain consistency and to assure that the RFP continues to satisfy program goals. For ESD-managed programs, coordination of the complete SOW draft with the Directorate of Acquisition Support (DR), and with the Computer System Engineering Directorate (MCI), is required. If, during SOW preparation, changes to the draft Preliminary CWBS are deemed desirable, these must be coordinated with the Cost Analysis Division (ACC).

2.3 Configuration Item (CI) Definition

SOWs for Full-Scale Development Phase contracts must reflect the system's CI definition incorporated in the Allocated Baseline, which is the major Validation Phase product (see LCEG, Section 4.3.1). However, a SOW for Validation Phase work may need to include a CI definition task, which should yield an Authenticated System Specification, and a Development Specification for each of the system's CIs to be developed. The following is provided as a partial aid to drafting this task statement.

The number and composition of a system's CIs is a critical design issue, because the Government's technical monitoring activities focus mainly on CIs. For example, each CPCI developed normally requires the developer to prepare an individual Computer Program Product Specification (see LCEG, Section A4), an individual Test Plan, and related Test Procedures. Each CI usually undergoes individual design reviews. One or more WBS Elements (see Appendix A) must also be defined for each CI, for use in cost reporting and analysis.

A system of many CIs has many formally defined interfaces. The separate reports, other documents, and other monitoring activities required can support good Government visibility into, and control of, the development process.

However, if a system is partitioned into too many CIs, the large number of document review, Engineering Change Proposal (ECP) processing, and other monitoring activities entailed may fragment insight and cause excessive delays, significantly impeding development progress. Independent or sequential Government monitoring of individual CIs may partly ignore the needs of closely related CIs, so that decisions made about one CI may adversely affect another. Conducting joint design reviews for the members of each closely related set of CIs, and employing the same Government personnel to monitor all the set's members, can improve overall visibility. Nevertheless, even thorough design review rarely prevents subsequent discovery of some necessary changes in CI scope or external CI interfaces. Such changes require formal ECP preparation and Configuration Control Board (CCB) action during development, activities that typically consume weeks or months. Largely because of its greater quantity of baselined information (e.g., inter-CI interface definitions in Development Specifications), a multi-CI system may require more ECPs during its development than a system of fewer CIs. Similarly, the effort needed to review and coordinate revisions to Product Specifications, Test Plans, Test Procedures and other required documents

depends significantly on the number of documents reviewed as well as on the scope of each. Like ECP processing, document review can entail long elapsed times, because comments must typically be solicited from many reviewers, formally coordinated, and reflected in one or more revisions before approval. Thus, a multi-CI system's development may suffer more delay from Government monitoring activities than a system of fewer CIs.

Somewhat different problems can arise if a system's CIs are few, but ill-defined. This situation exists to the extent that one CI contains processes that interact more strongly with other CIs than with one another. A system of ill-defined CIs is most likely when CI definition occurs hastily without adequate preliminary design and design validation (see LCEG, Section 4.3.2). Here the inter-CI interfaces, although few, are complex. As a result, the larger scope of the individual CI design reviews will still fail to spot many inconsistencies among CIs. Also, the complex internal workings of large, ill-defined CIs discourages learning and discovery of internal flaws. Both factors encourage overlooked design errors during document study and design reviews. These oversights lead later to many ECPs and to progressively more expensive repairs, depending on when each error is detected.

We know of no well-defined procedure to specify an optimum set of CIs. However, the guidelines stated below should help define a good set of CPCIs, although they are incomplete.

a. Assign processes that interact strongly (e.g., in many or complex ways) to the same CPCI.

b. Assign processes with little or no interaction to different CPCIs.

c. Allocate to different CPCIs processes that will execute in different computers.

d. Assign to different CPCIs processes whose development can feasibly be finished at significantly different times, if such phased development will expedite overall system development.

e. Allocate to different CPCIs software to be separately procured.

f. Include in each CPCI no more than an individual Government monitor can efficiently track, assuming reasonable working relationships between him and the types of personnel who will manage and develop the CPCI.

It should be clear that applying these guidelines entails much preliminary design and analysis. Guidelines a, b, d, and f may also apply to equipment CIs, as does guideline e if "equipment" is substituted for "software".

Even when a system has many small CIs, WBS definition must generally extend below the CI level, to the Computer Program Component (CPC) or major routine level, in order to yield data adequate for both thorough contractor performance monitoring and to sound future software cost estimation. Such detailing of WBS Elements below the CI level is best done by the development

organization, with Program Office concurrence. It should be done as the detailed design of each CI unfolds, and incorporated in the Extended Contract WBS (see Section A4.6).

One common error in system definition is failure to specify as CPCIs certain essential Support Software (e.g., Executive, equipment and software diagnostics, software development and maintenance aids, test drivers, test data generators, data collection and data reduction programs)*. As a result, the Government may lack normal control of and visibility into this software's functional & design characteristics, and may even lack the right to use the software throughout the system's lifetime. Such rights of control, visibility and permanent use can be critical; e.g., to validating test results, to testing Deployment Phase software modifications. If use of proprietary Operational or Support Software is planned, the Computer Program Development Plan (see LCEG, Section 4.4.5) should detail its use in the system. Furthermore, the appropriate contract should specifically provide for delivery of that proprietary software with satisfactory documentation and rights of duplication & use (see Section C2.5.4).

Another common error is failure to prescribe precisely the system's interfaces with its operators (e.g., terminal users). These interfaces should be considered requirements, not design options, because a good man-machine interface is quite heavily influenced by detailed operational requirements.

Special problems may arise when use is planned of existing software (e.g., the Executive, a compiler, diagnostics) that was developed, perhaps for commercial use, independent of standard Air Force configuration control, testing and documentation practices. Although incorporating such software, where appropriate, may save significant development time and cost, this software or its documentation may be somewhat deficient for the intended Air Force application. Thus, during the Validation Phase, all such existing software should be tested, and its documentation reviewed, against system requirements. Plans should then be made to upgrade or augment this software and its documentation during the Full-Scale Development Phase, to correct deficiencies. For example, if use of a commercially available Executive is planned, this Executive should be allocated functional, design, interface, performance and test requirements. The Executive should then be tested for ability to satisfy all its allocated requirements. Again, the Executive's documentation should be reviewed against the needs of the planned Air Force system's operators, development programmers, and maintenance programmers to assure its satisfactory organization and content. Existing commercial documentation need not conform precisely to Air Force documentation standards (e.g., for Type B5 and Type C5 specifications per MIL-STD-490, Specification Practices and MIL-STD-483(USAF), Configuration Management Practices for Systems, Equipment, Munitions, and Computer Programs. However, these standards should be reviewed for factors appropriate to judging existing documentation against expected needs. Note that the Government may need to acquire Limited Rights to this existing software, and Restricted Rights to its documentation (see Section C2.5.4) in order to use or upgrade them.

* Table A-3 identifies many such types of Support Software.

3. MODEL FULL-SCALE DEVELOPMENT PHASE SOW TASKS

Section 3 incorporates a table of contents, and the software-related paragraphs, of a hypothetical Full-Scale Development Phase SOW. This SOW is presumed to prescribe the work desired from a single contractor (at the system level) to develop a postulated one-of-a-kind digital communications message switch, termed the Central Distribution System (CDS). The SOW-prescribed tasks include interfacing the CDS with numerous local and remote digital data sources and sinks.

Since the hypothetical planned contract covers site activation, support equipment, administrative data, etc., as well as software acquisition, computer equipment acquisition, systems engineering, etc , some of the SOW paragraphs are either irrelevant or only marginally relevant to the development of software and its integration into the total system. The model SOW includes the headings of such SOW paragraphs, but may not include their text. Other paragraphs with sometimes significant software impact are represented either by skeleton text or by complete text. In the skeleton text dots (i.e., "...") replace each missing sequence of words which are deemed irrelevant or only marginally relevant to software. The SOW paragraphs most important to software are incorporated in full and are also asterisked.

The model SOW paragraphs refer to certain other documents (e.g., the CDRL, the Preliminary CWBS Dictionary (see Section A3), specifications), which the RFP containing the SOW would normally include. Development of models of these documents has been beyond the scope of this guidebook's preparation effort. However, Section 3 partly compensates for their lack by stating the model SOW's chief assumptions, and by including other relevant background material.

Table 2 depicts the Specification Tree (normally part of the System Specification) for the hypothetical CDS. The CDS is presumed to connect about 250 local and remote data sources and sinks, ranging from low-speed terminals through computers. Table 2 includes 15 CPCIs for three computers, in part so that the model SOW paragraphs can address multiple CPCI, multiple Functional Area, and multiple software source issues. In practice, defining fewer CPCIs might be advantageous, as discussed in Section 2.3. However, distinct real-time vs. off-line Executives would still be desirable for a system like the CDS, unless the off-line Executives were shown able to support adequate real-time response times. Figure 1, "Central Distribution System Functional Block Diagram", shows the CDS Functional Area interfaces and the CIs that comprise each.

Table 3 contains the Approved Summary Program Breakdown Structure assumed for the CDS acquisition program. The corresponding Preliminary CWBS is contained, essentially, in Table 4, the model SOW's table of contents, because the model SOW reflects the Preliminary CWBS structure. The RFP would include both the Approved Summary PBS and the Preliminary CWBS plus their Dictionaries. Exhibit 1 contains the model SOW task statements.

Table 2

SPECIFICATION TREE: CENTRAL DISTRIBUTION SYSTEM*

Central Distribution System (CDS)
- External Exchange (EE) Functional Area
  - Special Communications Interface Equipment (SCIE) CI
  - Communications Computer (CC) CI
  - CC Real Time Executive (CCEX) CI
  - CC On-Line Diagnostics (CCOD) CI
  - CC Application Program (CCAP) CI
  - CC Facility Software (CCFS) CI
    - (Off-Line Executive)
    - (Assembler)
    - (Off-Line Diagnostic & Maintenance Software)
    - (Utilities)
- Hub Functional Area
  - Hub Processor (HP) CI
  - Hub Real-Time Executive (HEX) CI
  - Hub On-Line Diagnostics (HOD) CI
  - Hub Application Program (HAP) CI
    - (Message Switching & Processing)
    - (Message Logging & Retrieval)
    - (System Status and Control)
    - (Central Tables)
  - Hub Facility Software (HFS) CI
    - (Off-Line Executive)
    - (Compiler)
    - (Assembler)
    - (Off-Line Diagnostic & Maintenance Software)
    - (Utilities)
  - System Design Aids (SDA) CI
    - (System Design Data Base)
    - (System Design Data Base Management Program)
    - (System Performance Simulation Program)
  - System Test Software (STS) CI
  - System Exercise Software (SES) CI
- Internal Exchange (IE) Functional Area
  - Internal Exchange Interface Equipment (IEIE) CI
  - Internal Exchange Computer (IEC) CI
  - IE Real-Time Executive (IEEX) CI
  - IE On-Line Diagnostics (IEOD) CI
  - IE Application Program (IEAP) CI
  - IE Facility Software (IEFS) CI
    - (Off-Line Executive)
    - (Assembler)
    - (Off-Line Diagnostic & Maintenance Software)
    - (Utilities)

* Table entries contained entirely within parentheses are not CIs; instead they indicate the contents of CIs.

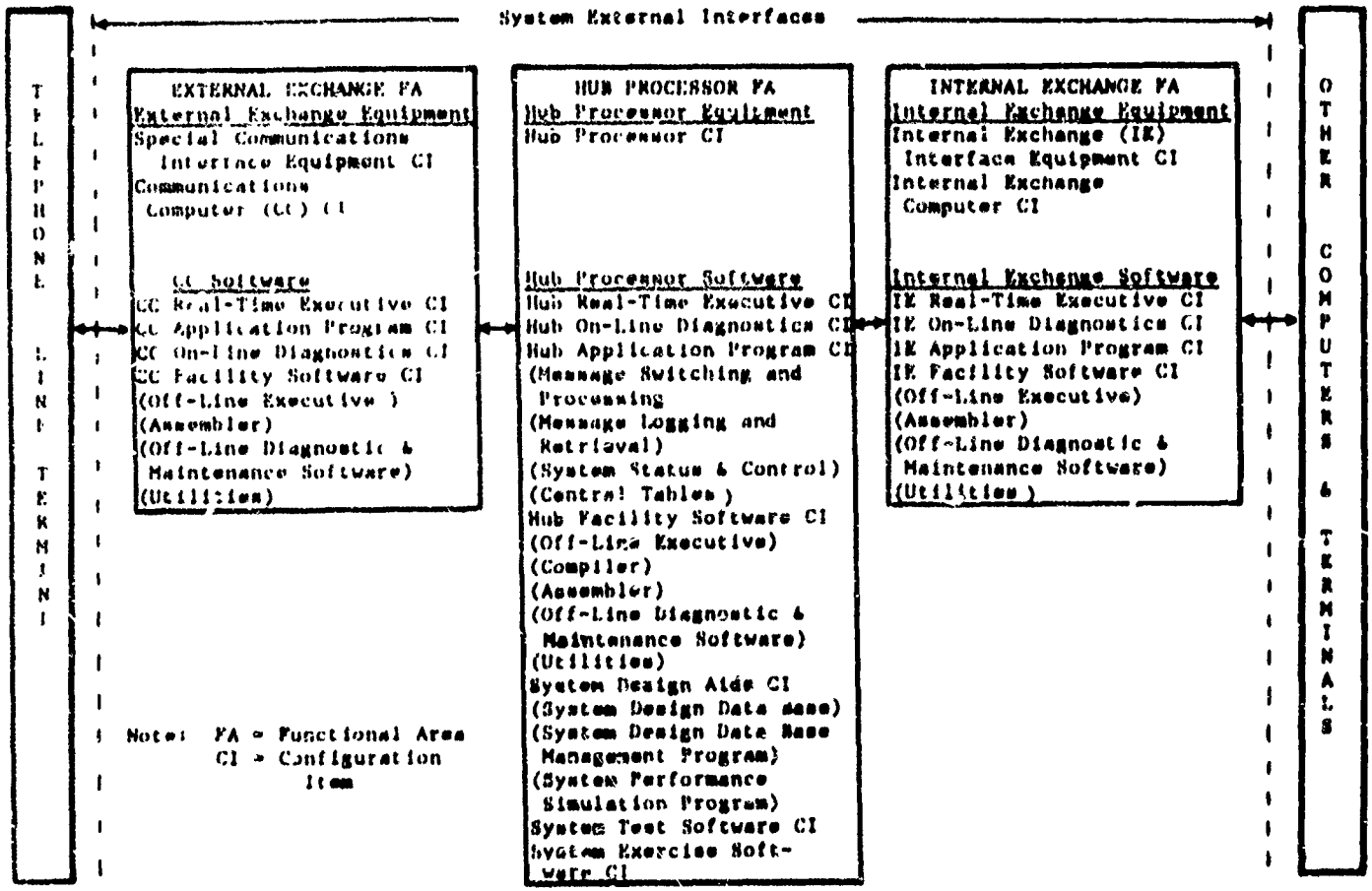

Figure 1. Central Distribution System Functional Block Diagram

Table 3

APPROVED SUMMARY PBS: CENTRAL DISTRIBUTION SYSTEM

PEC	Level	Element Name
1000	1	Central Distribution System
1010	2	Prime Mission Product
3110	3	Communications
4110	3	Automatic Data Processing Equipment
4210	3	Computer Programs
1110	3	Integration and Assembly
1020	2	Training
1021	3	Equipment
1027	3	Facilities
1029	3	Services
1040	2	Peculiar Support Equipment & Maintenance
1041	3	Organizational/Intermediate
1044	3	Depot
1050	2	Systems Test and Evaluation
1051	3	Development Test and Evaluation
1053	3	Operational Test and Evaluation
1056	3	Test and Evaluation Support
1057	3	Test Facilities
1060	2	System Program/Project Management
1061	3	Systems Engineering Management
1062	3	Supporting Project Management Activities
1063	3	Integrated Logistics Support
1064	3	Crew/Human Factors
1070	2	Data
1071	3	Technical Publications
1072	3	Engineering Data
1073	3	Management Data
1074	3	Data Repository
1080	2	Operational/Site Activation
1081	3	Contractor Technical Support
1083	3	Site Conversion
1084	3	System Assembly, Installation & Checkout on Site
1085	3	ADP Support Facilities

3.1 Major Assumptions

The model SOW paragraphs reflect the following major assumptions.

a. The CDS is a one-of-a-kind Major Defense System. Thus, its acquisition entails no Production Phase. However, other Major Defense System Acquisition Life Cycle requirements apply.

b. The hypothetical planned contract covers Full-Scale Development Phase work only. Prior (i.e., Conceptual Phase and Validation Phase) effort has produced a system design represented in a complete Allocated Baseline and a corresponding Authenticated System Specification (termed the CDS System Specification) that have been validated through extensive simulation and analysis. Consequently, proposed modification of Development Specifications by Offerors is not encouraged. (See LCEG, Sections 4.3.1 and 4.3.2 for justification of these assumptions).

c. The Allocated Baseline includes a Computer Program Development Specification for the Government-Furnished (GFP) System Design Aids CPCI and for each CPCI that requires development, plus a Development Specification for each equipment CI to be developed. The Authenticated System Specification incorporates a defined equipment configuration, including specific models, types and numbers, for each computer to be acquired for the system. Development Specifications are presumed unnecessary for commercially acquired equipment and software. However, contractor preparation of Product Specifications for such commercially acquired equipment and software is presumed. The RFP incorporates the Authenticated System Specification, the Allocated Baseline, and a Computer Program Product Specification for the GFP CPCI.

d. Validation Phase work has developed a complete set of the prescribed planning documents identified in LCEG, Section 4.4. Each Offeror's preparation of an initial version of the SEMP and of the CPDP as part of his proposal, and the subsequent incorporation of the winning Offeror's SEMP and CPDP in his contract after Government approval, is also presumed.

e. The Full-Scale Development Phase effort is not segmented. I.e., the SOW defines the work to be done by a single, prime, contractor (who may subcontract some of the work). This SOW encompasses all required Full-Scale Development Phase effort.

Other assumptions are mentioned in the general and specific comments below.

3.2 General Comments on the Model SOW

As required, the SOW's paragraph structure corresponds to the Preliminary CWBS, except for the SOW's introductory paragraphs (i.e., Exhibit 1 paragraphs 1. - 4.). Maintaining this correspondence tends to increase SOW bulk, because otherwise a single SOW paragraph could often prescribe the tasks applicable to

several Preliminary CWBS Elements. To counter this adverse tendency, and to minimize introducing inadvertent inconsistencies, the model SOW typically prescribes in a higher-level paragraph work applicable to a group of Elements, and omits equivalent language from the lower-level paragraphs corresponding to these Elements.

Conformance to WBS definitions sometimes causes closely related work to be prescribed in widely separated paragraphs. For example, Preliminary Design Reviews (PDRs) and Critical Design Reviews (CDRs) are prescribed under paragraph 5.1.1, Prime Mission Product, while the closely related System Design Reviews (SDRs) are called for in subparagraphs of paragraph 5.1.5.1, Systems Engineering Management.

In other cases tasks assigned to one SOW paragraph (WBS Element) might alternately be assigned to another. For example, system test planning, prescribed under Systems Test & Evaluation (paragraph 5.1.4) might have been prescribed under Systems Engineering Management (paragraph 5.1.5.1).

Each CWBS Element's Extended PBC (see Section A3) is incorporated in the corresponding SOW paragraph as part of the SOW paragraph's title. Each SOW paragraph is also assigned an indexed paragraph number (e.g., 5.1.1.4, 5.1.6) which precisely indicates its position in the SOW's paragraph tree. Use of this numbering system in addition to PBCs for paragraph identification is recommended because the PBCs comprise an obscure and somewhat irregular numbering system. For instance, gaps in the sequence of prescribed PBCs could make difficult the detection of omitted SOW paragraphs. Also, SOW paragraphs (e.g., subparagraphs) that do not correspond to CWBS Elements may not be assigned PBCs.

A major effort has been made to reference rather than to restate in SOW paragraphs information contained in relevant paragraphs of Regulations, Specifications and Standards, and in the hypothetical RFP's specifications, CDRL and Delivery Schedule. This may make the SOW itself somewhat obscure. However, in practice both Government and contractor users of the SOW would have the referenced material available, and should read each SOW paragraph concurrently with its references, as reviewers of the model SOW are urged to do. The chief advantages of the approach selected are reduction in inconsistency and greatly reduced SOW bulk.

3.3 Specific Comments

Comments on specific model SOW paragraphs, preceded by "NOTE:", follow the paragraphs to which they refer.

Table 4

TABLE OF CONTENTS: MODEL FULL-SCALE DEVELOPMENT PHASE SOW

SOW Paragraph	PBC*	Level	Paragraph Title
1.	-	-	OBJECTIVES
2.	-	-	SCOPE
3.	-	-	SOW RELATIONSHIP TO THE CWBS
4.	-	-	RELATED DOCUMENTS
5.	-	-	CONTRACTOR TASKS
5.1	1000	1	Central Distribution System
5.1.1	1010	2	Prime Mission Product
5.1.1.1	3110	3	Communications
5.1.1.1.1	3111/111	4	Special Communications Interface Equipment (SCIE) CI
5.1.1.1.2	3111/131	4	Internal Exchange Interface Equipment (IEIE) CI
5.1.1.2	4110	3	Automatic Data Processing Equipment
5.1.1.2.1	4112/112	4	Communications Computer (CC) CI
5.1.1.2.2	4111/121	4	Hub Processor CI
5.1.1.2.3	4112/132	4	Internal Exchange (IE) Computer CI
5.1.1.3	4210	3	Computer Programs
5.1.1.3.1	4212/113	4	CC Real-Time Executive CI
5.1.1.3.2	4215/114	4	CC On-Line Diagnostics CI
5.1.1.3.3	4211/115	4	CC Application Program CI
5.1.1.3.4	421Z/116	4	CC Facility Software CI
5.1.1.3.5	4212/122	4	Hub Real-Time Executive CI
5.1.1.3.6	4215/123	4	Hub On-Line Diagnostics CI
5.1.1.3.7	4211/124	4	Hub Application Program CI
5.1.1.3.8	421Z/125	4	Hub Facility Software CI
5.1.1.3.9	421E/126	4	System Design Aids CI
5.1.1.3.10	421F/127	4	System Test Software CI
5.1.1.3.11	421J/128	4	System Exercise Software CI
5.1.1.3.12	4212/133	4	IE Real-Time Executive CI
5.1.1.3.13	4215/134	4	IE On-Line Diagnostics CI
5.1.1.3.14	4211/135	4	IE Application Program CI
5.1.1.3.15	421Z/136	4	IE Facility Software CI
5.1.1.4	1110	3	Integration & Assembly
5.1.1.4.1	1114	4	System External Interfaces
5.1.1.4.2	1111/11	4	EE Functional Area Integration
5.1.1.4.3	1112/12	4	Hub Functional Area Integration
5.1.1.4.4	1113/13	4	IE Functional Area Integration
5.1.2	1020	2	Training
5.1.2.1	1021	3	Equipment
5.1.2.2	1027	3	Facilities
5.1.2.3	1029	3	Services
5.1.3	1040	2	Peculiar Support Equipment & Maintenance
5.1.3.1	-	3	Maintenance Concept
5.1.3.2	-	3	Built-in Test Equipment (BITE)
5.1.3.3	1041	3	Organizational/Intermediate

Table 4 (Continued)

SOS Paragraph	PBC*	Level	Paragraph Title
5.1.3.4	1044	3	Depot
5.1.4	1050	2	Systems Test & Evaluation
5.1.4.1	-	3	System Test Planning
5.1.4.2	1051	3	Development Test & Evaluation (DT&E)
5.1.4.2.1	1051A	4	System Functional Testing
5.1.4.2.2	1051B	4	System Performance Testing
5.1.4.2.3	1051C	4	Reliability, Maintainability & Availability Testing
5.1.4.2.4	1051D	4	Security Testing
5.1.4.3	1053	3	Operational Test & Evaluation (OT&E)
5.1.4.4	1056	3	Test & Evaluation Support
5.1.4.5	1057	3	Test Facilities
5.1.5	1060	2	System Program/Project Management
5.1.5.1	1061**	3	Systems Engineering Management
5.1.5.1.1	-	4	System Failure & Recovery Analysis
5.1.5.1.2	-	4	Throughput & Response Time Analysis
5.1.5.1.3	-	4	System Design Adjustment & Maintenance
5.1.5.1.4	-	4	Planning for Change
5.1.5.1.5	-	4	Planning for System Deployment
5.1.5.1.6	-	4	SEMP Maintenance
5.1.5.1.7	-	4	CPDP Maintenance
5.1.5.1.8	-	4	System Design Reviews
5.1.5.1.9	-	4	Additional Effort
5.1.5.1.10	1061A	4	Reliability
5.1.5.1.11	1061B	4	Maintainability
5.1.5.1.12	1061C	4	Parts Control
5.1.5.1.13	1061D	4	Nomenclature
5.1.5.1.14	1061G	4	Electromagnetic Compatibility
5.1.5.1.15	1061J	4	Security
5.1.5.1.16	1061K	4	Survivability/Vulnerability
5.1.5.1.17	1061L	4	System Safety
5.1.5.1.18	1061M	4	Communications Long Lines
5.1.5.1.19	1061P**	4	Value Engineering
5.1.5.1.20	1061Q	4	Availability
5.1.5.2	1062	3	Supporting Project Management Activities
5.1.5.2.1	1062A	4	Program Management
5.1.5.2.1.1	1062AA	5	Program/Contract Work Breakdown Structure
5.1.5.2.1.2	1062AB	5	Cost Information System
5.1.5.2.1.3	1062AC	5	Cost Schedule Systems
5.1.5.2.1.4	1062AD	5	Life Cycle Costs
5.1.5.2.1.5	1062AE	5	Schedule Management
5.1.5.2.2	1062B	4	Manufacturing Management
5.1.5.2.3	1062C	4	Configuration Management
5.1.5.2.4	1062D	4	Integration of Analyses and Related Computer Support

Table 4 (Concluded)

SOW Paragraph	PBC*	Level	Paragraph Title
5.1.5.2.5	1062E	4	Quality/Inspection
5.1.5.2.6	1062G	4	STINFO
5.1.5.3	1063	3	Integrated Logistics Support
5.1.5.3.1	1063A	4	Preoperational Supply Support
5.1.5.3.2	1063B	4	Packaging
5.1.5.3.3	1063C	4	Transportation
5.1.5.3.4	1063D	4	Travel
5.1.5.3.5	1063E	4	Maintenance
5.1.5.3.6	1063G	4	Limited Spares/Repair Parts Provisioning
5.1.5.4	1064	3	Crew/Human Factors
5.1.5.4.1	1064A	4	Human Engineering
5.1.5.4.2	1064C	4	Manpower/Personnel Requirements
5.1.5.4.3	1064D	4	Human Factors Test & Evaluation
5.1.6	1070	2	Data
5.1.6.1	1071	3	Technical Publications
5.1.6.2	1072	3	Engineering Data
5.1.6.2.1	1072E	4	Engineering & Configuration Documentation
5.1.6.2.2	1072H	4	Human Factors
5.1.6.2.3	1072R	4	Related Design Requirements
5.1.6.2.4	1072S	4	System/Subsystem Analysis
5.1.6.2.5	1072T	4	Test
5.1.6.3	1073	3	Management Data
5.1.6.3.1	1073A	4	Administrative Management
5.1.6.3.2	1073F	4	Financial
5.1.6.3.3	1073L	4	Logistic Support
5.1.6.3.4	1073P	4	Procurement/Production
5.1.6.4	1074	3	Data Repository
5.1.7	1080	2	Operational/Site Activation
5.1.7.1	1081	3	Contractor Technical Support
5.1.7.2	1083	3	Site Conversion
5.1.7.3	1084	3	System Assembly, Installation & Checkout on Site
5.1.7.3.1	1084A	4	Operational Site Checkout
5.1.7.3.2	1084B	4	CPDF Checkout
5.1.7.3.3	1084C	4	CPMF Checkout
5.1.7.4	1085	3	ADP Support Facilities
5.1.7.4.1	1085A	4	CPDF
5.1.7.4.2	1085B	4	CPMF

* Prefix this code with the letter (i.e., A, B, C...) assigned to the contract. E.g., A1062C is the PBC for the Configuration Management task under the Acquisition program's first contract.

** See Table 1, final two entries.

Exhibit 1

MODEL FULL-SCALE DEVELOPMENT PHASE SOW PARAGRAPHS

1. OBJECTIVES

The overall objective of this contract is to develop and install at the National Command Center, as prescribed in the contract's Delivery Schedule, an operable, common, collection and dissemination center for digital messages, termed the Central Distribution System (CDS). The CDS will provide the National Command with capability for handling a greater diversity and volume of traffic than it can today, with substantially increased throughput and reduced delivery times.

2. SCOPE

This Statement of Work (SOW) covers the detailed design, development, assembly, integration, documentation, installation, and test of a single CDS. The SOW also covers contractor assistance in training, evaluation, and pilot operation of the CDS. The CDS shall comprise both equipment and software, including some commercial items and some Government-Furnished Property (GFP), able to meet the requirements of the CDS System Specification and the other, related, specifications identified therein.

3. SOW RELATIONSHIP TO THE CWBS

The Contract Work Breakdown Structure (CWBS), also included in this contract, graphically portrays the work to be accomplished, consistent with the contract's scope (SOW paragraph 2). The CWBS also incorporates a Dictionary, which defines the scope of each CWBS Element. The CWBS and this SOW's task descriptions (contained in SOW paragraph 5) are assigned Extended Program Breakdown Codes (PBCs) per AFSCM 173-4, Program Breakdown Structure and Codes and ESDP 800-4, Statement of Work Preparation Guide, including Change 1. (Each task description's paragraph heading includes the task's PBC if the paragraph corresponds to a CWBS Element). Cost accounting coding and Configuration Identification shall be kept consistent with this coding scheme.

4. RELATED DOCUMENTS

The Specifications, Contract Data Requirements List (CDRL), Delivery Schedule, military specifications and standards, Data Item Descriptions (DIDs), Government-approved portions of the contractor's proposal, and other documents, to the extent that they are referenced in this SOW subsequently, or in referenced portions of documents referenced therein, further define the work required under this contract. In particular, the Delivery Schedule and CDRL define the requisite Periods of Performance and delivery dates applicable to all SOW-defined tasks and their products. These related documents are

either included in this Request for Proposal (RFP) or may be obtained from the Procuring Contracting Officer (PCO).

5. CONTRACTOR TASKS

The contractor shall perform the following tasks, and shall segregate the costs of all such effort by the lowest-level CWBS Element to which the effort applies.

*5.1 PBC A1000. Central Distribution System

Design & develop (or otherwise acquire), and integrate, install, & test, the equipment and software necessary to meet the requirements of the CDS System Specification, plus those of the several related Configuration Item (CI) Development Specifications and other specifications, attached to or referenced in the contract. Perform related services including training, System Test planning, Systems Engineering, and maintenance of the CDS equipment and software developed or otherwise acquired. Support Government Program Management and Site Activation effort. Provide and operate needed support equipment peculiar to the CDS. Generate and provide related documentation and other relevant Data as specified in the Contract Data Requirements List (CDRL) incorporated in the contract. Perform these tasks consistent with the CDS System Specification, the System Engineering Management Plan (SEMP), the Computer Program Development Plan (CPDP), the Test & Evaluation Master Plan (TEMP), the Training Plan, and the Delivery Schedule, all incorporated in the contract. This paragraph encompasses subsequent paragraphs 5.1.1 - 5.1.7.4, and their subparagraphs.

*5.1.1 PBC A1010. Prime Mission Product

Design & develop (or otherwise acquire), and install & test, each of the equipment CIs and Computer Program Configuration Items (CPCIs) identified in the CDS System Specification to meet this specification's requirements, and those of the other specifications referenced therein. Integrate these CIs into Functional Areas (FAs), and the FAs into a CDS able to meet all CDS System Specification-prescribed requirements.

*5.1.1a Generation of Specifications. Generate a draft and a final Product Specification for each equipment CI, and a Computer Program Product Specification for each CPCI developed, and for each CPCI acquired from a commercial source, except as otherwise provided in subsequent paragraphs. Document the intra-CI interfaces in the CPCIs' Computer Program Product Specifications and the equipment CIs' Product Specifications. Also include among each Product Specification's Quality Assurance provisions a Verification Matrix that shows by paragraph reference how each of the Product Specification's design requirements is to be satisfied. Document the interfaces among CIs, the interfaces among FAs, and the CDS' external interfaces in Engineering Drawings, as prescribed in MIL-STD-483(USAF). Update each of these documents after its delivery to reflect changes to the corresponding CIs; e.g., as a result of integration and testing.

*5.1.1b CI Design Reviews and Tests. Plan and conduct a Preliminary Design Review (PDR), a Critical Design Review (CDR), and Preliminary Qualification Tests (PQTs) for each CI developed, and Formal Qualification Tests (FQTs), a Functional Configuration Audit (FCA), a Formal Qualification Review (FQR), and a Physical Configuration Audit (PCA) for each CI developed or commercially acquired, as specified in MIL-STD-483(USAF), Configuration Management Practices for Systems, Equipment, Munitions, and Computer Programs, Appendix XII, in MIL-STD-1521(USAF), Technical Reviews and Audits for Systems, Equipment, and Computer Programs, and in the contract's Delivery Schedule. The PQT's need only assure the correct operation of each CI's parts and collect data unobtainable later, as specified in MIL-STD-483(USAF). Prepare and deliver a draft and a final Test Plan, plus draft and final Test Procedures, for each CI developed or acquired commercially. Conduct tests for each CI per the TEMP and the CI's Government-approved Test Plan & Test Procedures. Document the results of the CI tests in Test Reports. Notify the Government, on request, of the results of informal contractor-run tests, and identify all informal test reports in the monthly Data Accession List/Internal Data (see paragraph 5.1.6c).

NOTE: MIL-STD-1521(USAF) should be reviewed and its requirements carefully tailored to the needs of each system's design and acquisition approach. Such tailoring has not been attempted here because it would entail elaborate explanation of system assumptions. Also, see ESD-TR-75-85, An Air Force Guide for Monitoring and Reporting Software Development Status, for further discussion of design reviews and tests, including considerations that tailoring should reflect.

NOTE: Three related System Design Reviews (SDRs) are prescribed in paragraph 5.1.5.1.8. This and other separation of closely related tasks result from SOW paragraph conformance to prescribed WBS Element definitions.

*5.1.1c Guidance. Perform this task in consonance with the SEMP, CPDP, TEMP, a Government-approved System Test Plan, Government-approved System Test Procedures, the Training Plan and the Delivery Schedule. This task encompasses the work prescribed in paragraphs 5.1.1.1 - 5.1.1.4.4 and their subparagraphs. This task excludes the effort encompassed by paragraphs 5.1.2 - 5.1.7.4 and their subparagraphs.

5.1.1.1 PBC A3110, Communications.

5.1.1.1.1 PBC A3111/111, Special Communications Interface Equipment (SCIE) CI. Design, develop, fabricate, assemble, and test the SCIE CI to meet its allocated CDS System Specification requirements and the requirements of its Development Specification.

5.1.1.1.2 PBC A3111/131, Internal Exchange Interface Equipment (IEIE) CI. Design, develop, fabricate, assemble and test the IEIE CI to meet its allocated CDS System Specification requirements and those of its Development Specification.

*5.1.1.2 PBC A4110, Automatic Data Processing Equipment. Purchase from their manufacturers the equipment comprising each of the Communications

Computer (CC) CI, the Hub Processor CI, and the Internal Exchange Computer CI, and their design- and user-oriented documentation, as defined in the CDS System Specification. Assemble and integrate each such CI, and test it against its requirements, as defined in the CDS System Specification and in its Government-approved Test Plan/Procedures. Report any failures to satisfy these requirements, or inadequate documentation. Propose plans to correct such deficiencies or to avoid them during CDS application. Modify and implement these plans as directed by the Government. Arrange maintenance for each equipment CI by its supplier during the contract period. Base each CI's Product Specification, to the maximum feasible extent, on its supplier's specifications and engineering drawings, augmented by the corrections and workarounds planned or implemented to correct any deficiencies detected.

NOTE: Under the assumed acquisition concept, the Government is responsible for any failure of the equipment configuration to meet mission requirements, provided the equipment's performance satisfies Government-approved tests. However, Validation Phase system design verification is presumed to have minimized the risk of such failure (see LCEG Sections 4.3.1 and 4.3.2). Thus, the testing prescribed in paragraph 5.1.1.2 is intended to assure the purchased equipment's satisfactory performance.

*5.1.1.2.1 PBC A4112/112. Communications Computer (CC) CI. See paragraph 5.1.1.2.

*5.1.1.2.2 PBC A4111/121. Hub Processor CI. See paragraph 5.1.1.2.

*5.1.1.2.3 PBC A4112/132. Internal Exchange (IE) Computer CI. See paragraph 5.1.1.2.

*5.1.1.3 PBC A4210. Computer Programs. Develop or acquire, test, document, and maintain throughout the contract period, each of the CPCIs identified below. Compile a Computer Programming Manual and a Users' Manual (Computer Program) for each, and update them to reflect any changes made to the CPCIs during the contract. Include in each Computer Program Product Specification a matrix that shows which of the CPCI's Computer Program Components (CPCs) implement each of the Functions defined in its Computer Program Development Specification (or other definitive sources, if the CPCI has no Computer Program Development Specification).

*5.1.1.3a Software to be Developed. Design, develop, document, test, update, and maintain each of the following CPCIs, to satisfy the Computer Program Development Plan (CPDP), the CPCI's allocated CDS System Specification requirements, and the requirements of its Computer Program Development Specification. Deliver incremental CPCI Versions and their documentation (e.g., Version Description Documents) as specified in the CPDP. Specify in these CPCI's Test Plans and Test Procedures the tests to be performed on each Version.

PBC	Name
A4212/113	CC Real-Time Executive CI

A4215/114	CC On-Line Diagnostics CI
A4211/115	CC Application Program CI
A4212/122	Hub Real-Time Executive CI
A4215/123	Hub On-Line Diagnostics CI
A4211/124	Hub Application Program CI
A421F/127	System Test Software CI
A421J/128	System Exercise Software CI
A4211/135	IE Application Program CI

NOTE: The System Test Software CI and the System Exercise Software CI are presumed defined to operate on all Hub Processor configurations appropriate to CDS system test and exercise, respectively. Also see note on paragraph 5.1.4.1.

*5.1.1.3.1 PBC A4212/113. CC Real-Time Executive CI. See paragraph 5.1.1.3a.

*5.1.1.3.2 PBC A4215/114. CC On-Line Diagnostics CI. See paragraph 5.1.1.3a.

*5.1.1.3.3 PBC A4211/115. CC Application Program CI. See paragraph 5.1.1.3a.

*5.1.1.3.4 PBC A4212/116. CC Facility Software CI. Acquire from the MYTIMINI Corporation the components of the CC Facility Software CI, comprising the CC Off-Line Executive, the CC Assembler, the CC Off-Line Diagnostic & Maintenance Software, and the CC Utilities. Also acquire their design- and user-oriented documentation.

NOTE: This paragraph assumes the Government's right to use this software and its documentation throughout the CDS' lifetime as a result either of standard software supplier contract terms or a special agreement. Obtaining adequate Government rights to use design documentation (e.g., Operating System coding and logic manuals) has been a problem in some past acquisitions. Hence, the appropriate agreements should be assured (e.g., by negotiation) before equipment selection, and certainly before directing a development contractor to use the selected software.

*5.1.1.3.4a Testing and Maintenance. Test each of these programs to assure its compliance with its CDS System Specification-defined requirements. Report any failures to meet these requirements, and propose plans for correcting their causes or avoiding them in the CDS application. Modify and implement such plans as directed by the Government. Maintain this software during the contract period.

NOTE: This software is presumed to have been tested during the Validation Phase as a basis for its selection and for allocating its system requirements (see LCBG, Section 4.3.1). Thus, the testing prescribed in the model SOW paragraph is mainly intended to detect any defective copies or wrong Versions.

*5.1.1.3.4b CPCI Product Specification Generation. Base each CI's Computer Program Product Specification, to the maximum extent possible, on equivalent MYTIMINI Corporation documentation, with appropriate adjustment for corrections and workarounds devised as a result of testing.

NOTE: The CDRL entry calling for preparation of these CPCI Product Specifications should (directly or by DID reference) allow deviation from strict (i.e., MIL-S-83490, Specifications, Types, and Forms, Form 1) format requirements, as long as all essential information and useful format is prescribed. Use of the looser MIL-S-83490 Form 2 or Form 3 standards should be considered to restrain costs.

*5.1.1.3.5 PBC A4212/122. Hub Real-Time Executive CI. See paragraph 5.1.1.3a.

*5.1.1.3.6 PBC A4215/123. Hub On-Line Diagnostics CI. See paragraph 5.1.1.3a.

*5.1.1.3.7 PBC A4211/124. Hub Application Program CI. See paragraph 5.1.1.3a.

*5.1.1.3.8 PBC A421Z/125. Hub Facility Software CI. Acquire from Megathere Information Systems, Inc. (MIS), each of the following software packages, and their user- and design-oriented documentation: Off-Line Executive, JOVIAL (J3) Compiler, Assembler, Off-Line Diagnostic & Maintenance Software, and Utilities. These comprise the Hub Facility Software CI.

*5.1.1.3.8a Testing and Maintenance. Test each such Hub Facility Software CI computer program to assure its compliance with CDS System Specification requirements. Report any failures to meet these requirements and propose plans to correct their causes or to avoid them in the CDS application. Modify and implement such plans as directed by the Government. Maintain this software during the contract period.

*5.1.1.3.8b CPCI Product Specification Generation. Base the Hub Facility Software CI's Computer Program Product Specification on MIS documentation to the maximum feasible extent.

NOTE: See notes on paragraph 5.1.1.3.4. and its subparagraphs.

*5.1.1.3.9 PBC A421E/126. System Design Aids CI. Accept from the Government as Government-Furnished Property (GFP) the System Design Aids CI and its documentation, for use as prescribed in other paragraphs of this SOW.

NOTE: The GFP System Design Aids CI is presumed to include a discrete-event simulator, i.e., the System Performance Simulation Program, a System Design Data Base, and a System Design Data Base Management Program, all developed

before and during the Validation Phase mainly to help formulate and validate system design alternatives (see LCBG, Table 1, Sets J & O; Table 2, Set E; and Sections 3.3, 4.3.1, and 4.3.2). The model SOW directs the Full-Scale Development Phase contractor to accept, use, and extend these tools to promote continuity and efficiency in system design evolution and assessment. Specific uses of the System Design Aids CI are mentioned in paragraphs 5.1.5.1.2 and 5.1.5.1.3. This, or any other, GFP software imposed on a contractor should be thoroughly tested and well documented to avoid contractor claims that its deficiencies impair contractor performance.

*5.1.1.3.10 PBC A4215/127. System Test Software CI. See paragraph 5.1.1.3a.

*5.1.1.3.11 PBC A421J/128. System Exercise Software CI. See paragraph 5.1.1.3a.

*5.1.1.3b IE Equivalents of CC Software. The following IE CPCIs should be identical to the corresponding CC CPCIs:

IE PBC	IE CI Name	CC PBC	CC CI Name
A4212/133	IE Real-Time Executive	A4212/113	CC Real-Time Executive
A4215/134	IE On-Line Diagnostics	A4215/114	CC On-Line Diagnostics
A421Z/136	IE Facility Software	A421Z/116	CC Facility Software

Make a copy of each of the CC CPCIs, assign it the corresponding IE CPCI identification, and test it to assure its correct operation. Report any failures to meet these requirements and prepare plans to correct their causes or to avoid them in the CDS application. Modify and implement such plans as directed by the Government. Maintain this software during the contract period. Prepare its Product Specification as an Addendum Specification based on its CC CPCI counterpart.

NOTE: See notes under paragraph 5.1.1.3.4 and its subparagraphs. Similar deviation from MIL-S-83490 Form 1 should be allowed.

*5.1.1.3.12 PBC A4212/133. IE Real-Time Executive CI. See paragraph 5.1.1.3b.

*5.1.1.3.13 PBC A4215/134. IE On-Line Diagnostics CI. See paragraph 5.1.1.3b.

*5.1.1.3.14 PBC A4211/135. IE Application Program CI. See paragraph 5.1.1.3a.

*5.1.1.3.15 PBC A421Z/136. IE Facility Software CI. See paragraph 5.1.1.3b.

NOTE: Special CDRL entries must be provided to call for delivery of the computer storage media containing all CPCI Versions to be provided by the contractor (see guidebook Section C2.1.2).

*5.1.1.4 PBC A1110. Integration & Assembly. Integrate the three FAs defined in the CDS System Specification into a functioning whole able to satisfy all CDC System Specification-defined requirements. Correct any incompatibilities among the FAs.

*5.1.1.4.1 PBC A1111. System External Interfaces. Correct any incompatibilities between the CDS and the external systems with which it interfaces. Identify all CDS System Specification changes thereby entailed.

*5.1.1.4.2 PBC A1111/11. EE Functional Area Integration. Correct any incompatibilities among the interfacing EE CIs: the SCIE, CC, CC Real-Time Executive, CC On-Line Diagnostics, CC Application Program and CC Facility Software. Identify all changes in specifications and Engineering Drawings thereby entailed.

*5.1.1.4.3 PBC A1112/12. Hub Functional Area Integration. Correct any incompatibilities among the interfacing Hub CIs: the Hub Processor, Hub Real-Time Executive, Hub On-Line Diagnostics, Hub Application Program, Hub Facility Software, System Design Aids, System Test Software, and System Exercise Software. Identify all changes in specifications and Engineering Drawings thereby entailed.

*5.1.1.4.4 PBC A1113/13. IE Functional Area Integration. Correct any incompatibilities among the interfacing IE CIs: the IEIE, IE Computer, IE Real-Time Executive, IE On-Line Diagnostics, IE Application Program, and IE Facility Software. Identify all changes in specifications and Engineering Drawings thereby entailed.

5.1.2 PBC A1020. Training

The Air Training Command (ATC) will procure Type 1 (i.e., contractor) special training courses on CDS Operation, Equipment Maintenance, System Analysis & Simulation, System Exercise, and Software Maintenance & Modification, for an initial cadre of Using Command personnel and ATC instructors. These Government personnel will already be qualified in their respective Air Force specialties. Plan for such training, which will be conducted under separate contract with ATC. Develop a syllabus for each course, and schedule the courses consistent with availability of personnel and required equipment. Assume that the courses will be independent of one another and that each will be attended by at least two ATC instructors plus the numbers of Using Command personnel of each skill category estimated necessary to operate, exercise, maintain, and modify the CDS as a result of the Crew/Human Factors task (paragraph 5.1.5.4). Generate a Technical Report containing all assumptions, plans, syllabi, course schedules, and other pertinent information about this training.

5.1.2.1 PBC A1021. Equipment. Plan the availability of all equipment and other materials necessary for each course session, including the equipment

maintenance and spare parts for the equipment to be used in training. Minimize the equipment to be purchased or developed expressly to conduct Type 1 training.

5.1.2.2 PBC A1027. Facilities. Plan use of adequate classroom, computer, communications and display facilities at the contractor's plant and at the National Command Center for the courses identified in paragraph 5.1.2.

5.1.2.3 PBC A1029. Services. Identify instructors for the courses identified in paragraph 5.1.2, and specify their qualifications. Identify any other services required.

5.1.3 PBC A1040. Peculiar Support Equipment and Maintenance

5.1.3.1 Maintenance Concept.

5.1.3.2 Built-In Test Equipment (BITE).

5.1.3.3 PBC A1041. Organizational/Intermediate.

5.1.3.4 PBC A1044. Depot.

*5.1.4 PBC A1050. Systems Test & Evaluation

Conduct and support a System Test and Evaluation program per the CDS System Specification; the TEMP; and as described in the following subparagraphs. CDS System Test and Evaluation shall include:

a. the effort and other costs of adapting and using computer programs to obtain and validate engineering data on the behavior of the CDS;

b. the detailed planning, conduct and support of system tests;

c. preparation of a Government-approved System Test Plan and Government-approved System Test Procedures;

d. the reduction of System Test data;

e. the preparation and distribution of System Test Reports;

f. the costs of all equipment and material consumed during System Tests; and

g. the effort and other costs entailed to design & produce, or purchase, and to maintain models, fixtures and instrumentation explicitly to support System Testing.

This task excludes the test-related activites defined in paragraphs 5.1.1, 5.1.2, 5.1.3, 5.1.5, 5.1.6 and 5.1.7 and their subparagraphs

NOTE: General planning for system-level DT&E may also be considered a Systems Engineering Task (see paragraph 5.1.5.1) per MIL-STD-499A(USAF), Engineering Management.

*5.1.4.1 System Test Planning. Develop and maintain a System Test Plan, subject to Government approval of the original and all changes (e.g., to reflect CDS System Specification changes and TEMP changes). Incorporate appropriate provisions governing Government/contractor relations, mutual responsibilities, and notification about schedule changes, deviations, and other problems. Develop concrete System Test Procedures, to implement the System Test Plan, and to meet the Quality Assurance provisions of the CDS System Specification. Plan the specific system-level tests, per MIL-STD-499A(USAF), Engineering Management, paragraph 10.1.3, with the help of the Flow Path Identifier in the System Test Software CI (see SOW paragraph 5.1.1.3.10). Also, incorporate unsatisfied CI test requirements from the equipment CI Product Specifications' and Computer Program Product Specifications' statements of system-level testing requirements, from the CIs' Final Test Reports, from the CIs' FCA, PCA, and FQR minutes, and from any other reports that indicate the need for specific testing or retesting. Plan the system-level tests and System Test Procedures to make maximum effective use of the System Test Software's workload generation, automated test sequencing, and data reduction capabilities. Schedule the System Tests, subject to Government approval. Refer to the System Test Software's Computer Program Development Specification for definition of this CPCI's capabilities.

NOTE: Use of extensive System Test Software to automate in part the System Testing process is assumed. Such test aids should include routines to identify transaction flow paths, to generate test workloads, to time critical functions, to trace and count executions of flow paths, to store expected results and compare them with actual results, to control automatically test presentation, test result collection and test sequencing (including actions normally initiated by operators), and to reduce test results. An appropriately designed package could speed up testing by orders of magnitude compared to typical ad hoc testing methods, allowing tests to be performed more quickly and cheaply. Their use would also reduce considerably the number of occasions on which a "cast of thousands" must be present for System Tests. Development of the System Test Software by the Full-Scale Development Phase contractor is assumed. This software is further assumed to comprise a CPCI subject to the same Government control, testing, and documentation as other CPCIs, to assure its satisfactory quality (which is normally well worth the cost of such formality). Alternately, the System Test Software might be prepared during the Validation Phase and its use imposed as GFI on the Full-Scale Development Phase contractor. Where feasible, this alternative is attractive, because it would eliminate or reduce possible problems of the System Test Software's late delivery, novelty, and low initial reliability. A third alternative would impose on the Full-Scale Development contractor one or more standard GFP test aids. Mixtures of these alternatives should also be considered. Any test software imposed as GFP should be thoroughly tested and well documented before delivery to a contractor.

*5.1.4.2 PBC A1051, Development Test & Evaluation (DT&E). Conduct and support system-level DT&E of the CDS, as defined in the TEMP. This task

includes the detailed planning, conduct, and support of tests to verify that CDS engineering design and development are complete; that the functional, performance, design and interface requirements of the CDS System Specification have been achieved; and that the CDS engineering design is practical, reliable, maintainable, secure, and safe for operational use. System-level DT&E shall emphasize the CDS's ability to satisfy the following objectives:

a. perform each of its Functions within the required response time, under each specified workload, while meeting the Function's accuracy requirements;

b. meet its human factors requirements;

c. meet its security requirements;

d. operate correctly with the data processing and communication systems defined as its external interfaces; and

e. suffer faults, and consequently undergo reconfiguration and correct recovery of its data and control, as necessary to meet its Probability of Success requirements.

System-level DT&E shall also verify that the CDS' user-oriented documentation (e.g., its Positional Handbooks) are correct and otherwise effective tools for their intended users. This task excludes testing of the CIs and FAs acquired or developed, and integrated, under tasks prescribed in paragraph 5.1.1 and its subparagraphs, except to ascertain their behavior as part of the overall CDS, and except to conduct CI and FA testing infeasible under those tasks.

*5.1.4.2.1 PBC A1051A. System Functional Testing. Conduct tests of each Function defined in the CDS System Specification to verify that all CDS functional requirements have been satisfied (e.g., that correct inputs yield correct results). Functional testing shall include, in part:

a. the transfer and processing of transactions (e.g., messages, interrupts, data base subsets) through the different CIs;

b the transfer of messages across the CDS external interfaces;

c. tests of human operators interfacing with the CDS equipment; and

d. exercise of the system deployment options (paragraph 5.1.5.1.5).

*5.1.4.2.2 PBC A1051B. System Performance Testing. Conduct tests of each Function defined in the CDS System Specification under each workload there prescribed, to verify the system's ability to correctly complete each Function within its required response times. Conduct saturation tests of each applicable subset of these functions, as defined in the CDS System Specification, to predict realistic CDS workload-handling capacity limits.

NOTE: The CDS System Specification is presumed to contain well-defined quantitative system performance requirements for each of a representative set

of workloads also well-defined there, including workloads representative of all critical operational situations. In aggregate, these workloads should thoroughly expose CDS system capacity. The corresponding quantitative performance requirements should have been established as feasible, as well as needed, during Validation Phase simulation and analysis (see LCDG, Section 4.3.2).

5.1.4.2.3 PBC A1051C. Reliability, Maintainability & Availability Testing. Conduct tests supplementary to those performed under the Reliability, Maintainability, and Availability tasks (see paragraphs 5.1.5.1.10, 5.1.5.1.11, and 5.1.5.1.20). These tests shall establish whether observed CDS Reliability, Maintainability, Availability and Probability of Success values are within their CDS System Specification-defined limits.

*5.1.4.2.4 PBC A1051D. Security Testing. Perform inspections, analyses, demonstrations, and tests, per the System Test Plan and the System Security Plan, to verify the system's ability, as prescribed in the CDS System Specification, to accept, store and route, without compromise and without violation of other specified requirements, multi-level classified traffic including Top Secret....

NOTE: The security requirements of the CDS and its components are presumed defined as part of the Allocated Baseline and the CDS System Specification. However, the contractor should also be required to prepare a Security Subsystem Design Analysis Report to identify the specific criteria for test and evaluation of the security controls, and to summarize these criteria in a CPDP update. This requires the development, verification, and documentation of a precise description, or model, of the security controls, and an allocation and precise specification of those controls to Computer Program Components (CPCs). The contractor should also be required to carry out and fully document analyses and tests which completely verify that the design and implementation of the security controls meet the requirements of the model. Detailed direction to the contractor must be provided as part of the SOW. In addition, appropriate and timely Government visibility into the contractor's security controls design and verification process must be specified. Careful attention to explicit detail in the preparation of the SOW in this area can substantially reduce the security certification risk and potential delay. The ellipses (i.e., "...") in model SOW paragraph 5.1.4.2.4 and in paragraph 5.1.5.1.15 indicate appropriate points for insertion of such requirements.

5.1.4.3 PBC A1053. Operational Test & Evaluation (OT&E). Support Initial OT&E (IOT&E), to be conducted by an Air Force Test Team in three phases, as defined in the TEMP. Provide equipment maintenance, software maintenance, and operator support, plus all needed documentation, consumable materials and spare parts, during each phase defined below.

5.1.4.3a Phase 1. Schedule forty hours of CDS time for Phase 1 IOT&E sessions in 1-2 hour blocks among intervals of System Functional Testing (paragraph 5.1.4.2.1). Identify these blocks in a master test schedule and notify the Government of each at least two working days before the block is to become available. The Government will use these blocks mainly for initial familiarization with the CDS.

5.1.4.3b Phase 2. After successful System Functional Testing, provide a period of ten consecutive working days during which the Government will operate the CDS. Provide the same configuration of CDS equipment and software used by the contractor to perform successful System Functional Testing. During the 10-day period the Government will test the CDS' human interfaces. Should the configuration become unavailable for any reason during the 10-day period, extend Phase 2 at no change in contract terms for the period it was unavailable.

5.1.4.3c Phase 3. Upon successful conclusion of DT&E the Government will conduct 30 consecutive working days of IOT&E. Provide for the Government's use the complete operational CDS equipment and software configuration. Should the configuration become unavailable for any reason, extend Phase 3 at no change in contract terms for the time the configuration was unavailable.

NOTE: IOT&E planning and conduct is presumed accomplished by the Using Command and the Implementing Command, based on the TEMP (see LCEG, Section 4 4.3).

5.1.4.4 PBC A1056. Test & Evaluation Support. Provide the services, documentation, spare parts, special instrumentation, consumable materials, and other items needed to operate and maintain the CDS during all CDS System Test and Evaluation periods.

*5.1.4.5 PBC A1057. Test Facilities. See paragraph 5.1.7.

*5.1.5 PBC A1060. System Program/Project Management

Perform all functions necessary to the technical control, support engineering, and business management of the contract. Plan, direct, and control the development, assembly, integration, and testing of the CDS to assure that its requirements are met. Coordinate and assure the adequacy and consistency of the tasks performed under paragraphs 5.1.1 - 5.1.4.5 and 5.1.6 - 5.1.7.4 and their subparagraphs. This task excludes systems engineering and program management effort devoted explicitly to Level 3 and lower-level Elements of the Prime Mission Product.

*5.1.5.1 PBC A1061. Systems Engineering Management. Perform the Systems Engineering management and Systems Engineering activities necessary to implement the technical requirements of the contract, including the Specifications, the CDRL, this SOW, the Delivery Schedule, and the contract's other technical attachments. Provide maximum Systems Engineering support to software development and acquisition, integration, test, and documentation. Plan, direct, and control, in accordance with the Government-approved SEMP, a totally integrated engineering effort, including Design Engineering, Specialty Engineering, Security Engineering, System Analysis and Test Engineering. Maintain the CDS System Specification consistent with Government-approved CWBS extensions and Government-approved design changes. Maintain the CPDP, the SEMP, the GFP System Design Aids CPCI (paragraph 5.1.1.3.9) and its documentation per Government direction. This task encompasses system design optimization (including Cost Effectiveness Analysis), intrasystem and

intersystem compatibility analysis, system security analysis, System Failure and Recovery Analysis, and System Throughput and Response Time Analysis.

*5.1.5.1.1 System Failure & Recovery Analysis. Based on the contract's Specifications, results of the Reliability Program, (paragraph 5.1.5.1.10), results of the Maintainability Program (paragraph 5.1.5.1.11), results of the Computer Programs task (paragraph 5.1.1.3), and results of the Integration & Assembly task (paragraph 5.1.1.4), develop, maintain, document and employ a system failure and recovery model to store, calculate, and display, for each mode of CDS failure: unique failure mode identification; probability of occurrence; possible causal mechanism(s); effects on the system before reconfiguration; method(s) of detection; estimated detection time(s); method(s) of immediate reconfiguration (e.g., to a degraded mode of operation); estimated time(s) needed to recovery full capability, including reconfiguration, data base restoral, and computer program rerun times; method(s) of restoring such full capacity; and any system down time entailed in such restoral. Document the results in periodic Technical Reports. Keep computer program development personnel aware of all design problems exposed and all suggested design improvements, as these are discovered. Monitor development & integration of all CIs & FAs to assure satisfaction of requirements related to detection & recovery from failure. Provide input to the Availability analyses (paragraph 5.1.5.1.20).

NOTE: A task of this kind should be included in the prime contract SOW for Full-Scale Development of every system with complex failure modes. Ideally, such analyses should be well underway by the end of the Validation Phase, and applied during Validation Phase system design verification (see LCEG, Section 4.3.2). If so, the model should be imposed on the prime Full-Scale Development Phase contractor as GFP, and his SOW should provide for his maintenance, extension, and use of it. If the model is implemented as a computer program, it must be so defined in the SOW and the CDRL.

*5.1.5.1.2 Throughput & Response Time Analysis. Continue and extend the Government-furnished Validation Phase Throughput & Response Time Analyses (used to validate the CDS' Authenticated System Specification and Allocated Baseline), to reflect the further detailing of, and changes to, the system design during Full-Scale Development. Learn the Government-furnished System Performance Simulation Program (SPSP), a discrete-event simulator which is part of the System Design Aids CI. Study the related Government-furnished technical reports describing the methods and limitations of these analyses and their results. Modify the SPSP to reflect both further design detail and higher-level changes in both system design and in prescribed workloads, wherever such changes could affect CDS throughput or response times. Keep a SPSP Version consistent with the System Design Data Base wherever the latter changes, as prescribed in paragraph 5.1.5.1.3. Exercise the SPSP to ascertain the effects of such changes. Similarly, predict the effects of proposed changes as a basis for their consideration. Supplement use of the SPSP by appropriate mathematical analyses. Control any changes to the SPSP and its documentation per the procedures defined in the CPDP. Keep the SPSP and its documentation consistent, and in good condition. At specific Government request provide up to five designated Government personnel with machine-readable copies of each SPSP Version, and its documentation, for their own

use. Provide periodic briefings and Technical Reports explaining SPSP changes, methods of analysis and current system performance predictions. At Government request, analyze hypothetical changes in system configuration, workloads, and use. Provide current predictions of response (i.e. throughput, times for each CDS System Specification-defined Function, as required by the Availability task (paragraph 5.1.5.1.20).

NOTE: The continued use throughout the Full-Scale Development Phase of the performance simulation and analysis techniques developed during the Validation Phase is strongly recommended as the most effective way normally available to predict and correct system performance problems as early as possible. To wait to detect such problems until system-level DT&E, or until IOT&E, risks unnecessarily high costs for major redevelopment effort. To allow a Full-Scale Development Phase contractor to discard proven Validation Phase techniques, and to substitute his own, risks new performance predictions that are difficult to verify and to compare with known results.

*5.1.5.1.3 System Design Adjustment & Maintenance. Adjust the allocation of requirements & computer resources among the system's FAs, CIs, & Computer Program Components (CPCs) as necessary to eliminate predicted performance problems, to enhance testability, or to allow successful implementation. Use the SPSP (see paragraph 5.1.5.1.2) to explore the effects of potential allocation changes. Such adjustment will require Government approval when it entails changing baselined specifications. Maintain and extend the GFP System Design Data Base, using the GFP System Design Data Base Management Program to represent correctly all changes to, and further detailing of, the CDS system design subsequent to contract award. (Both the System Design Data Base and the System Design Data Base Management Program are part of the System Design Aids CI.) For each CPCI and CPC for which an Extended CWBS Element (see paragraph 5.1.5.2.1.1) is defined, incorporate in the System Design Data Base the computer, the programming language, the current estimated (or verified) size, execution time, Version, Computer Program Life Cycle Phase, and test status (i.e., total number of tests defined, currently passed, currently failed, and currently pending). Using the System Design Data Base Management Program as an aid, prepare periodic Technical Reports depicting graphically and in tabular form the current system design and its estimated development status. Reflect all approved design changes in CDS System Specification revisions, in Development Specification revisions, or in addenda to the corresponding commercial specifications, for CIs that have Development specifications), and in Product Specification revisions.

NOTE: See paragraph 5.1.5.2.1.1 and it's note for explanation of the recommended Development CPCI CWBS Element breakdown and for the uses of the corresponding cost and sizing data.

*5.1.5.1.4 Planning for Change. Plan to accommodate CDS workload increases and decreases, and other requirements changes, as the need arises. Assess the impacts of potential workload increases and design changes on system performance & integrity. Identify thresholds for equipment configuration changes. Design changes to implement new requirements. Assess the cost and schedule impacts of proposed design changes. Generate Technical

Reports reflecting these analyses. Prepare Engineering Change Proposals (ECPs) reflecting recommended changes. Allocate approved changes among future versions of the CDS. Allot a maximum of six man-years of technical effort per year to this task.

NOTE: This paragraph explicitly recognizes the need for an activity to assess the impact of proposed new requirements on the system design, to assess other proposed design changes, to prepare ECPs, and to schedule approved changes for minimal impact on system development.

5.1.5.1.5 Planning for System Deployment. Plan options for the scheduling and allocation of the CDS' resources among its users to provide them acceptable service in both normal and degraded modes of operation, and to meet the CDS System Specification's requirements. Plan the transitions among these modes, and their management. Incorporate results of the System Failure & Recovery Analysis (paragraph 5.1.5.1.1).

5.1.5.1.6 SEMP Maintenance. If necessary, reorganize the SEMP to correspond to the tasks defined by paragraph 5.1.5.1 and its subparagraphs. Update and maintain the SEMP per MIL-STD-499A(USAF) and Government direction.

NOTE: A CDRL entry must specify delivery of the SEMP revisions.

5.1.5.1.7 CPDP Maintenance. Complete, update and maintain the CPDP, subject to Government approval of all changes (e.g., redefinition or rescheduling of CPCI Versions). Manage the Computer Programs and the Integration & Assembly tasks (paragraphs 5.1.1.3 and 5.1.1.4) in accordance with the CPDP.

NOTE: The CPDP, included in the contractor's proposal and made a part of the contract, is presumed to contain a complete initial definition of the system's CPCI Versions and their delivery dates. A CDRL entry must provide for preparation and delivery of each CPCI Version, and another CDRL entry for the Version's documentation (e.g., Version Description Documents). Another CDRL entry must specify preparation and delivery of the CPDP revisions.

*5.1.5.1.8 System Design Reviews. Conduct the following System Design Reviews (SDRs) as specified in MIL-STD-499A(USAF) paragraphs 10.1.6 & 10.1.6.2, and in MIL-STD-1521(USAF), Appendix B, except as specified below. Contractor failure to complete any of these SDRs to the Government's satisfaction within one month of its inception shall be deemed sufficient ground for Government termination of the contract.

*5.1.5.1.8a Initial SDR. Conduct an initial SDR within three months of contract award and prior to any CDS CI PDRs. The initial SDR shall assure contractor understanding of the Allocated Baseline and review the contractor's overall CDS system design and his system development plans. Government certification that this SDR has been completed to the Government's satisfaction shall precede continued system development.

*5.1.5.1.8b Intermediate SDR. Conduct an intermediate SDR after all CDS CI CDRs have been conducted, and before more than 25% of the total estimated

code of the CPCIs to be developed has been written. This SDR shall demonstrate by analysis the system design's completeness, consistency, and ability to meet all CDS System Specification requirements.

*5.1.5.1.8c Final SDR. Conduct a final SDR after completion of all CDS CIs' PCAs and of all its CPCIs' PCAs. The final SDR shall precede, and shall assure, the CDS's readiness for system-level testing.

NOTE: The proposed second and third SDR aim to reduce design incompatibility among the system's many components. This is typically a severe problem in the development of large systems in which CI-level design reviews are conducted sequentially and often independently. Also, see notes under paragraph 5.1.1b.

5.1.5.1.9 Additional Effort. In addition to the tasks prescribed by other subparagraphs of SOW paragraph 5.1.5.1, perform as modified below the Systems Engineering effort defined in the indicated paragraphs of MIL-STD-499A(USAF):

10.1.2 Program Risk Analysis

10.1.4 Decision and Control Process

10.1.5 Technical Performance Measurement (TPM)

10.1.5.1 Parameters

10.1.5.2 Planning

10.1.5.3 Implementation of TPM

10.1.5.4 Relating TPM to Cost and Schedule Performance Measurement

10.1.6 Technical Reviews. Substitute "co-chairman with the Government" for "chairman" in the third sentence.

10.1.6.3 Preliminary Design Review

10.1.6.4 Critical Design Review

10.1.7 Subcontractor/Vendor Reviews

10.1.8 Work Authorization

10.1.9 Documentation Control

10.2.4 Synthesis

10.2.6 Life Cycle Cost Analysis

10.2.7 Optimization

10.2.7.1 Trade-off Studies

10.2.7.2 System/Cost Effectiveness Analysis

10.2.7.3 Effectiveness Analysis Modeling

Perform the Technical Performance Measurement activities (MIL-STD-499A(USAF) paragraph 10.1.5 and its subparagraphs) consistent with the related activities defined in SOW paragraph 5.1.5.1 and its other subparagraphs, avoiding duplication of effort.

NOTE: This model SOW paragraph illustrates incorporating provisions of Regulations, Specifications, and Standards by reference. This is easy but potentially dangerous, as discussed in guidebook Section 3.2.

5.1.5.1.10 PBC A1061A. Reliability. Plan and implement a Reliability Program covering all developed, purchased and GFP equipment in accordance with.... Identify and report all equipment failure modes that could cause any form of system failure, breach of system integrity, or breach of system security. Estimate the probability of each such failure mode & state how it can be detected manually or automatically.

NOTE: Development of failure mode data under the Reliability and the Maintainability tasks is prerequisite to their use in effective System Failure & Recovery Analysis (see paragraph 5.1.5.1.1), and in the design, development, and assessment of system failure & recovery procedures (see paragraph 5.1.5.1.5, Planning for System Deployment) and software.

5.1.5.1.11 PBC A1061B. Maintainability. Plan and implement a Maintainability Program in accordance with.... Identify and report for each equipment failure mode the appropriate type(s) of preventive and corrective maintenance, the estimated mean repair time(s), and how the repaired (or replaced) equipment would be reintroduced into the CDS configuration.

NOTE: Development of failure mode data under the Reliability and the Maintainability tasks is prerequisite to their use in effective System Failure & Recovery Analysis (see paragraph 5.1.5.1.1), and in the design, development, and assessment of system failure & recovery procedures (see paragraph 5.1.5.1.5, Planning for System Deployment) and software.

5.1.5.1.12 PBC A1061C. Parts Control.

5.1.5.1.13 PBC A1061D. Nomenclature.

5.1.5.1.14 PBC A1061G. Electromagnetic Compatibility.

5.1.5.1.15 PBC A1061J. Security. Plan, establish, and maintain a Security Engineering Program to meet the system's security requirements as defined in the CDS System Specification. Develop a corresponding System Security Plan. Perform and document a Clandestine Vulnerability Analysis. Prepare a System Security Standard....

NOTE: See note under paragraph 5.1.4.2.4.

5.1.5.1.16 PBC A1061K. Survivability/Vulnerability.

5.1.5.1.17 PBC A1061L. System Safety.

5.1.5.1.18 PBC A1061M. Communications Long Lines.

5.1.5.1.19 PBC A1061P. Value Engineering. Develop a Value Engineering Plan per MIL-V-38352, Value Engineering Program Requirements, to establish, maintain, control, and monitor Value Engineering (VE) throughout the CDS' lifetime. Conduct the planned VE program to maximize overall CDS operational utility at minimal cost. Identify in the VE plan high-cost areas where major VE effort will be applied. Also identify any redundant tasks or subtasks prescribed or implied under terms of this contract. Conduct VE studies analyzing the potential cost savings and the corresponding estimated performance changes likely to result from promising CDS requirements changes and design modifications. Prepare and submit Value Engineering Change Proposals (VECPs) per Armed Services Procurement Regulation (ASPR) 7-104.3(b), included in this contract's General Provisions. Generate VE progress reports per MIL-V-38352, paragraph 3.5.2.

*5.1.5.1.20 PBC A1061Q. Availability. Establish and maintain a data base of factors necessary to compute Inherent Availability, Observed Availability, Inherent Probability of Success, and Observed Probability of Success, as defined in the CDS System Specification. Obtain these factors, and changes to them, from the results of the Reliability, Maintainability, System Failure & Recovery Analysis, and Throughput & Response Time Analysis tasks. Compute an Inherent Availability and an Observed Availability for the CDS as a whole, for each FA, and for each different other portion of the system used to perform CDS System Specification-defined Functions. Compute an Inherent Probability of Success and an Observed Probability of Success for each such Function, based respectively on the Inherent Availability and on the Observed Availability of the subset of CDS equipment needed, and on the predicted (or observed) time required, for the system to perform the Function, considering both normal and failure-recovery situations. Compare the results of these calculations with the corresponding quantitative performance requirements stated in the CDS System Specification. Incorporate the results in monthly Technical Performance Measurement Reports. Use the results in design optimization, Cost Effectiveness, and system integrity analyses.

5.1.5.2. PBC A1062. Supporting Project Management Activities. Designate a full-time Program Manager to insure proper control and coordination of the work performed, consistent with the contract requirements. Wherever pertinent, provide effective organizational interfaces between software activities and other management and engineering activities. Insure that any subcontractor and vendor products and services comply with the appropriate subset of this contract's requirements. This task includes all contract management, cost & schedule management, business and administrative planning, organizing, directing, coordinating, controlling, and approval actions designed to accomplish overall project objectives which are not included under Systems Engineering Management (paragraph 5.1.5.1). This task excludes related activities explicitly required to prepare Elements of the Prime Mission Product.

5.1.5.2.1 PBC A1062A. Program Management. Per the Government-approved general approach submitted as part of the contract proposal, plan, organize, direct, coordinate, control, and approve actions of contractor personnel as necessary to accomplish overall program objectives. Keep contract planning, management, status reporting, and cost reporting consistent with the Extended CWBS (see paragraph 5.1.5.2.1.1). Conduct monthly program reviews alternately at the contractor's and at the Government's facilities. For each monthly program review generate Presentation Material that covers technical status, threat status, schedule status, problems, software development status, reliability, tradeoffs, and other significant activities. Include in the briefing charts for each program review a current organization chart that incorporates the names of all key personnel and any key personnel changes.

5.1.5.2.1a Management System. Approximately thirty days after contract award, demonstrate to the Government the contractor's management systems that will be used to insure the traceability and visibility required for effective management of the contract effort. Those management systems shall provide the Government each month with the data required to assess actual versus planned accomplishment with respect to completion of work within mutually agreed cost & scheduled goals. Deviations from these goals shall require monthly reports on the problems, which describe remedial actions and expected dates of solution. Report work completion information monthly in Program Milestones and Cost Performance Reports. The Program Milestones shall report on the Elements of both the Delivery Schedule and the CDRL. Generate monthly a Configuration Index (Computer Program) and a Change Status Report (Computer Program) for each CPCI.

NOTE: Contractor reporting of development status has been barely satisfactory in some previous acquisition programs. Typically the information reported is 6-8 weeks old when received by Program Office technical monitoring personnel, and may also reflect biased contractor views on the status of questionable items (e.g., whether the contractor has satisfactorily completed a controversial PDR action item). Thus, in lieu of, or in addition to, the monthly status reporting prescribed in this model SOW paragraph, a Program Manager should consider having his own computer-based status accounting system. Of course, careful Government monitoring of the contractor-provided portion of this system's input data would be essential to its success.

NOTE: In addition to conventional status data, consideration should be given to requiring contractors to report monthly the types of information about personnel, coding & documentation, development facility use, and other facilities, listed in ESD-TR-75-85, An Air Force Guide for Monitoring and Reporting Software Development Status, Appendix III, Section 12, as aids to realistic assessment of software development status. If (in contrast to this model SOW) a software development contractor should be required to establish a Programming Support Library (PSL) as defined in Volumes V, VI, and IX of RADC-TR-74-300, Structured Programming Series, his SOW should also require his reporting PSL data comparable to the above.

*5.1.5.2.1.1 PBC A1062AA. Program/Contract Work Breakdown Structure.

*5.1.5.2.1.1a CWBS Updating. With Government approval, update the CWBS (extended as defined below), to reflect any contractual changes or Government direction that may occur during performance of this contract which affect the definition of supplies or services provided under it. Keep the CWBS consistent with the overall CDS program's Summary Program Breakdown Structure (PBS). Recommend to the Government appropriate PBS changes.

*5.1.5.2.1.1b CWBS Extension. Extend the CWBS and its Dictionary to lower levels during performance of this contract to provide concrete cost accounting data consistent with the contractor's Government-approved Cost/Schedule Control System (see paragraph 5.1.5.2.1.3).... Define a separate Extended CWBS Element (and a corresponding Extended CWBS Dictionary entry) for each distinct combination of:

a. each CPC of each CPCI to be developed (see paragraph 5.1.1.3a); and

b. each of the six phases (i.e., Analysis, Design, Coding and Checkout, Test and Integration, Installation, and Operation and Support) of the Computer Program Life Cycle.

Define the Computer Program Life Cycle phase boundaries identically for all CPCIs, consistent with AFR 800-14, Acquisition and Support Procedures for Computer Resources in Systems, Vol. II, paragraphs 2-8 and 5-2 through 5-5.

NOTE: See the notes following paragraph 5.1.5.2.1.1e.

*5.1.5.2.1.1c Supplementary Computer Programs Cost Breakdown. In addition, provide the following supplementary breakdown of all software-related effort and costs across the entire CDS:

PBC	Supplementary Software Category Name
4210	Computer Programs (analysis, design, coding, checkout: purchase or rental costs only)
4220	Software-peculiar training
4240	Equipment needed specifically for software development or maintenance
4250	Testing of software
4260	Software-peculiar management and engineering
4270	Software documentation
4285	Software development and maintenance facilities
4290	Other software-related costs
4200	Summary of all software-related costs

Provide this breakdown, by CPCI where appropriate, in addition to the standard breakdown defined in the Extended CWBS. Whenever software-related activities share facilities, supplies, or services, used to develop other portions of the CDS, apportion the costs of these shared facilities, supplies, or services equitably among Computer Programs and their other uses, per Government-provided guidelines.

*5.1.5.2.1.1d PBC Assignment. Assign PBCs to all extensions of the CWBS per ...

NOTE: The ellipsis (i.e., "...") should be replaced in an actual SOW by this guidebook's Table A-3 plus specific direction as to its application (see Section A3).

*5.1.5.2.1.1e Government Approval. All CWBS extensions, PBC assignments, and other changes, and apportioning of shared costs, whether contractor-proposed or Government-directed, shall require specific Government approval.

NOTE: These provisions for CWBS updating, extension and supplementary cost breakdown are made to support collection of accurate and relevant software cost data throughout the performance of the contract. Such information (e.g., the composition of CPCIs to be developed) may be unknown when the contract is negotiated or may subsequently change.

NOTE: The definition of cost accounting categories for the CPCs is recommended as an initial step to accumulate a data base of software development performance data that can be applied across contracts for more accurate cost estimation and quality control. Besides cost data, information about each CPC's programming language, computer, size, execution time, development time, and test history should also be collected (see paragraph 5.1.5.1.3). This information should be centrally collected, evaluated, and disseminated to the Software Directors of all Program Offices acquiring systems that include software. As data from several acquisition programs is accumulated and analyzed, standard, comparable software type categories should be established for all systems. Where comparable data cannot be collected at the CPC level, further breakdown of CPCs will be necessary.

NOTE: The Air Force should soon establish precise standard definitions of the Computer Program Life Cycle phases to facilitate comparison of development costs, schedules, and technical performance, since the AFR 800-14, Vol. II definitions are somewhat vague. When such better definitions become available, SOWs should prescribe their use, rather than directing contractors to define the phase boundaries, even with Government concurrence.

NOTE: Government approval of all Extended CWBS Element definitions is prescribed in the model SOW to facilitate specification of useful cost accounting categories, comparable across systems. Central coordination of such categories is essential to the collection of comparable data during different acquisitions. For ESD-managed programs, the Cost Analysis Division (ACC) is responsible for this coordination.

5.1.5.2.1.2 PBC A1062AB. Cost Information System.

*5.1.5.2.1.3 PBC A1062AC. Cost Schedule Systems. Control cost & schedule performance measurement using a single, formal, integrated Government-approved system with a common data base that will serve both the contractor's internal management requirements and the Government's needs for cost information, as these are specified in the contract and elsewhere in this SOW (see paragraphs 5.1.5.2.1.1 and 5.1.5.1.3). Use the Extended CWBS as a framework for this management system. Generate monthly Cost Performance Reports for each Extended CWBS Element.

5.1.5.2.1.4 PBC A1062AD. Life Cycle Costs. Establish and maintain a Life Cycle Cost (LCC) program as defined below. The LCC program shall aim to control development of a CDS able to meet all its technical requirements at minimum LCC, and within the contract-specified LCC goal.... Estimate for each CPCI the cost elements required by the Government-furnished LCC Model, and document the specific estimating methods used.... Compute monthly LCC estimates for the CDS, each CI and each FA, using the LCC Model.... Conduct an LCC review as part of the monthly program management review (see SOW paragraph 5.1.5.2.1). At each LCC review report current cost and performance estimates, and identify all changes from the previous month's LCC estimates. Explain all differences in assumptions, estimation methods, and other factors that account for the differences.... Assure that all engineers and managers understand the LCC program's goals, its methods, and their own LCC-related responsibilities.... Identify and report the impact on LCC of each related set of Engineering Change Proposals.

5.1.5.2.1.5 PBC A1062AE. Schedule Management. See paragraph 5.1.5.2.1.

5.1.5.2.2 PBC 1062B. Manufacturing Management.

*5.1.5.2.3 PBC A1062C. Configuration Management. Appoint a single manager responsible for conducting Configuration Management. Configuration Management includes all effort necessary to identify, audit, maintain, and control the configuration of CDS equipment, software, and related specifications. Prepare a Configuration Management Plan (CMP) per MIL-STD-483(USAF), Appendix I, defining the contractor organization and procedures for Configuration Management. After Government approval of the CMP, establish and maintain a Configuration Management program per the CMP and MIL-STD-483(USAF), MIL-STD-490, Specification Practices, MIL-STD-1521(USAF), and MIL-S-83490. Maintain a current Functional Configuration Identification (FCI) and Allocated Configuration Identification (ACI) by preparing ECPs to specifications, and Engineering Change Orders (ECOs) to Engineering Drawings, and by processing all Government-approved configuration changes against the CDS System Specification, the Development Specifications, and the related Engineering Drawings incorporated in this contract. Develop a Product Baseline comprising the Government-approved Product Specifications and related Engineering Drawings prepared under this contract or provided as GFP.

5.1.5.2.4 PBC 1062D. Integration of Analyses and Related Computer Support.

NOTE: The anticipated revision (i.e., Change 1) to ESDP 800-4 explains this model SOW paragraph, which should prescribe the automated management information tools to be used during performance of the contract.

*5.1.5.2.5 PBC A1062E. Quality/Inspection....Establish and maintain a Software Quality Assurance (QA) program per the CPDP and MIL-S-52779(AD), Software Quality Assurance Program Requirements. The Government reserves the right to approve the contractor's software QA procedures and to verify or perform any inspections or tests that it deems necessary. Incorporate in the CPDP the Software QA Program Plan requirements of MIL-S-52779(AD) paragraph 6.2.1.e.

5.1.5.2.6 PBC A1062G. STINFO.

5.1.5.3 PBC A1063. Integrated Logistics Support.... Store and account for all CPCIs and their documentation until the contract terminates.

5.1.5.3.1 PBC A1063A. Preoperational Supply Support.

5.1.5.3.2 PBC A1063B. Packaging. Comply with Section G of the contract, and with Section 5 (Preparation for Delivery) of the CDS System Specification and of each CI's Development Specification (if any) and Product Specification.

5.1.5.3.3 PBC A1063C. Transportation.

5.1.5.3.4 PBC A1063D. Travel.

5.1.5.3.5 PBC A1063E. Maintenance.

5.1.5.3.6 PBC A1063G. Limited Spares/Repair Parts Provisioning.

5.1.5.4 PBC A1064. Crew/Human Factors. Plan and conduct a Human Factors program per.... Perform task and skill analyses to identify the tasks required to operate, exercise, maintain, and modify the CDS equipment and software. Establish the skills and estimate the time that each such task entails. Estimate the numbers, skill categories and skill levels of the personnel needed to perform each task, assuming continuous CDS operation, and Organic Maintenance by Government personnel. Document the results in a Human Operator/Critical Tasks Analysis Report. Generate a Positional Handbook for each CDS operational position and maintain it to reflect all pertinent system changes during the contract.

5.1.5.4.1 PBC A1064A. Human Engineering.

5.1.5.4.2 PBC A1064C. Manpower/Personnel Requirements.

5.1.5.4.3 PBC 1064D. Human Factors Test & Evaluation.

*5.1.6 PBC A1070. Data

5.1.6a Deliverable Data. Provide the Data (e.g., reports and machine-readable computer storage media) specified in the CDRL included in the contract, granting the Government Unlimited Rights to them as specified in ASPR 7-104.9, Rights in Data and Computer Software. Recommend additions to, and deletions from, the CDRL. Number and mark per MIL-STD-483(USAF), Appendix IX, all Data of the types specified therein. Account for the costs of this Data in the categories defined in paragraphs 5.1.6.1 - 5.1.6.4 and their subparagraphs. For each Data item (specified by a CDRL entry) this task includes only the effort that can be reduced or eliminated, or that will not be incurred, if the Data Item were eliminated. The task includes the effort to acquire, write, assemble, reproduce, package and ship Data Items with their CDRL-prescribed content and format. The task also includes the effort necessary to reformat, reproduce, and ship any Data obtained from the contractor's own records or from commercial sources, but required by the CDRL in a different format.

5.1.6b Data Management Organization. Establish a single organization, and designate a prime focal point, for Data management activity. Develop and maintain the controls necessary to assure delivery of each Data Item and prevent unwarranted duplication of Data.

*5.1.6c Government Access to Non-Deliverable Data. Provide the Government access to any internal Data, formal or informal, generated under this contract. Such internal Data includes, but is not limited to, memoranda, worksheets, design sketches, or computer-produced listings prepared by or for contractor or subcontractor personnel. Prepare and deliver monthly a Data Accession List/Internal Data, which identifies all such internal Data by author, source organization, title, date, and identification number. Allow Government personnel to examine any Data Items on the list and provide up to ten copies of each Data Item specifically requested. Government use of such internal Data shall be limited to legitimate purposes of CDS development, training, modification, and maintenance.

*5.1.6.1 PBC A1071. Technical Publications. Technical publications comprise all Data Items whose CDRL entries specify their preparation per Data Item Descriptions (DIDs) defined in category M of the DoD Authorized Data List, Index of Data Item Descriptions (TD-3). This contract's technical publications include Positional Handbooks, Users Manuals, Computer Programming Manuals, and Catalog and Glossary of Computer Programs and Programming Documentation. Propose any additional computer-related technical publications deemed requisite and, if they are approved by the Government, incorporate their identification in the CPDP.

5.1.6.2 PBC A1072. Engineering Data. This group comprises all Data Items whose CDRL entries specify their preparation per DIDs defined in TD-3 categories E, H, R, S and T.

5.1.6.2.1 PBC A1072E. Engineering & Configuration Documentation. All Data Items prepared per TD-3 category E DIDs comprise this category. These include the CPDP, specifications, ECPs, and the CPCIs themselves.

5.1.6.2.2 PBC A1072H. Human Factors. All Data Items prepared per TD-3 category H DIDs comprise this category.

5.1.6.2.3 PBC A1072R. Related Design Requirements. All Data Items (e.g., the System Security Plan) prepared per TD-3 category R DIDs comprise this category.

5.1.6.2.4 PBC A1072S. System/Subsystem Analysis. All Data Items, (e.g., Technical Reports, Subsystem Design Analysis Reports, the SEMP) prepared per TD-3 category S DIDs comprise this category.

5.1.6.2.5 PBC A1072T. Test. All Data Items (e.g., Test Plans, Test Procedures, Test Reports) prepared per TD-3 category T DIDs comprise this category.

5.1.6.3 PBC A1073. Management Data. All Data Items prepared per TD-3 category A, F, L, P or V DIDs comprise this category.

5.1.6.3.1 PBC A1073A. Administrative Management. All Data Items (e.g., the Program Milestones, the Data Accession List/Internal Data) prepared per TD-3 category A DIDs comprise this category.

5.1.6.3.2 PBC A1073F. Financial. All Data Items (e.g., Cost Performance Reports) prepared per TD-3 category F DIDs comprise this category.

5.1.6.3.3 PBC A1073L. Logistic Support. All Data Items (e.g., logistics plans) prepared per TD-3 category L or V DIDs comprise this category.

5.1.6.3.4 PBC A1073P. Procurement/Production. All Data Items prepared per TD-3 category P DIDs comprise this category.

5.1.6.4 PBC A1074. Data Repository. Maintain a master engineering specification and drawing repository service for Government-approved documents that belong to the Government. Maintain each document at the latest approved level by incorporating approved change orders. Similar effort required for the contractor's internal specification/drawing control system is excluded.

5.1.7 PBC A1080. Operational/Site Activation

Perform the tasks prescribed in paragraphs 5.1.7.1 - 5.1.7.4 and their subparagraphs.

5.1.7.1 PBC A1081. Contractor Technical Support. Participate in a Government-conducted site survey at the National Command Center to determine CDS site conversion requirements. Provide consultants to this team. Staff the Computer Program Development Facility (CPDF) and the Computer Program Maintenance Facility (CPMF) per the CPDP. (See paragraph 5.1.7.4).

5.1.7.2 PBC A1083. Site Conversion. A Government-led team will perform site conversion at the National Command Center, to include preparation of the operational site and the CPMF.

*5.1.7.3 PBC A1084. System Assembly, Installation & Checkout on Site.

*5.1.7.3.1 PBC 1084A. Operational Site Checkout. Assemble, install, and check out the CDS at the operational site prior to its system-level testing.

5.1.7.3.2 PBC 1084B. CPDF Checkout. Check out the CPDF equipment and software per the CPDP to assure their proper operation.

*5.1.7.3.3 PBC 1084C. CPMF Checkout. Check out the CPMF equipment and software to assure their proper operation. Perform these activities per the CPDP.

5.1.7.4 PBC A1085. ADP Support Facilities.

*5.1.7.4.1 PBC 1085A. Computer Program Development Facility (CPDF). Provide at the contractor's plant an equipment and software configuration, and related support facilities, for the development, integration, and non-system-level DT&E of all CDS software, per the CDS System Specification and the CPDP.

NOTE: The CDS System Specification is presumed to define the CPDF equipment configuration and software configuration. The CPDP is presumed to prescribe other CPDF requirements (e.g., schedules, support organization).

*5.1.7.4.2 PBC A1085B. Computer Program Maintenance Facility (CPMF). Upon completion of DT&E, move the CPDF equipment, software and related facilities to the National Command Center, where it shall comprise the CPMF.

NOTE: See the Software Acquisition Management Guide: Software Development and Maintenance Facilities for more detail on requirements and tool descriptions.

APPENDIX A

WORK BREAKDOWN STRUCTURES

Knowledge of Work Breakdown Structures (WBSs) is prerequisite to SOW preparation because WBS and SOW structures must at least partly correspond (see Section 2.1.1) and because identical codes (see Section 2.1.3) must identify corresponding SOW paragraphs and the Elements of certain WBSs. Each WBS Element represents a well-defined task or product, or a hierarchical aggregation of these, to be developed or otherwise acquired during the system's existence. Some WBS Elements prescribe, or include, the development of software.

MIL-STD-881A prescribes preparation of several types of WBS during planning for acquisition of Major Defense Systems and many Less-Than-Major Systems. The criteria for mandatory application of MIL-STD-881A include an estimated Research, Development, Test, and Evaluation cost greater than $10 million. AFSCM 173-4, Program Breakdown Structure and Codes, supplements MIL-STD-881A for programs managed by AFSC (e.g., Electronic Systems), if prescribed by the PMD or by AFSC Form 56.* AFSCM 173-4 requires preparation of Program Breakdown Structures (PBSs). These are generally consistent with the WBSs prescribed by MIL-STD-881A, but are somewhat more elaborate.** This guidebook applies the term WBS generically to both, except where it must distinguish them.

A1. What WBSs Are

Basically, a WBS is a hierarchical (i.e., tree-structured) representation of the tasks and the products (e.g., equipment, software, data) that comprise an acquisition. A WBS depicts the chief order in which these tasks and products will be aggregated for purposes of cost accounting. The single highest-level WBS Element represents the overall collection of tasks and products; e.g., a Command, Control, and Communications system as a whole. The second-level Elements represent the whole's major parts. The depth (i.e., number of levels) of a particular WBS depends on its type. The depth of a WBS also depends on the level of detail at which the Government wishes to monitor and control development effort. In some types of WBS certain branches extend more deeply than others. In every WBS the Elements at the same level are disjoint (i.e., they represent non-overlapping groups of tasks and products). Table A-1 illustrates a three-level WBS of even depth. Table A-2 shows a deeper WBS in which some of the branches extend to fewer levels than others.

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* AFSCM 173-4, paragraph 1.3. Paragraph 1.5 says that AFSCM 173-4 does not apply to basic research, exploratory development, engineering studies or to program wide management support.

** AFSCM 173-4, paragraph 2-2 explains the main structural differences.

Table A-1

ELECTRONIC SYSTEM SUMMARY WORK BREAKDOWN STRUCTURE*

Level	Element Name
1	Electronics System
2	Prime Mission Equipment
3	Integration and Assembly
3	Sensors
3	Communications
3	Automatic Data Processing Equipment
3	Computer Programs
3	Data Displays
3	Auxiliary Equipment
2	Training
3	Equipment
3	Services
3	Facilities
2	Peculiar Support Equipment
3	Organizational/Intermediate (Including Equipment Common to Depot)
3	Depot (Only)
2	Systems Test and Evaluation
3	Development Test and Evaluation
3	Operational Test and Evaluation
3	Mockups
3	Test and Evaluation Support
3	Test Facilities
2	System/Program Management
3	Systems Engineering
3	Project Management
2	Data
3	Technical Publications
3	Engineering Data
3	Management Data
3	Support Data
3	Data Depository
2	Operational/Site Activation
3	Contractor Technical Support
3	Site Construction
3	Site/Ship/Vehicle Conversion
3	System Assembly, Installation & Checkout on Site
2	Common Support Equipment
3	Organizational/Intermediate (Including Equipment Common to Depot)
3	Depot (Only)
2	Industrial Facilities
3	Construction/Conversion/Expansion
3	Equipment Acquisition or Modernization
3	Maintenance
2	Initial Spares and Initial Repair Parts
3	(Specify by allowance list, grouping, or hardware Element)

* MIL-STD-881A, Appendix B.

A2. WBS Uses

Prior to RFP preparation, WBSs are used to define the roles and primary products of an acquisition's Government participants, and to define groups of tasks appropriate for contractors.[8] Also, costs are estimated for the Elements of certain types of WBS and aggregated as a basis for planning and program approval. Later, actual costs are accumulated over time for each Element. This information is summarized in required reports to higher headquarters. The program's cost history by Element can also be used to identify problem areas needing special Program Office attention. These cost histories can also help to develop successive projections of costs to complete the acquisition and its parts. Ultimately, such cost histories can be used to estimate the costs of similar activities and products on other programs, provided the corresponding Element definitions are comparable. Thus, appropriate definition of WBS Elements is quite important. Application of this principle to software is especially important if we are to have a sound quantitative basis for estimating the costs of software for future systems.

Although a WBS depicts the principal order for summing its Elements' costs, other cost breakdowns and orders of aggregation are often desirable. Among these other cost accounting categories are:

a. System configuration grouping (i.e., system, Segment (if any), Functional Area, CI, equipment component or CPC, and possible further breakdowns);

b. Acquisition Life Cycle phase or Computer Program Life Cycle phase;

c. Type of product (e.g., operational Executive, application program, compiler (by programming language), utilities); and

d. Standard accounting categories (e.g., direct labor, materials, computer rental, overhead(s)).

Cost information in several other categories may be desired, prescribed, collected, and summarized. The unambiguous and efficient processing of such multi-dimensional information requires definition of each lowest-level WBS Element as a cell in a n-dimensional array, where each dimension corresponds to an order of aggregation. Each such Element must also be assigned a corresponding key by which the data collected for the Element may be extracted, sorted, and summarized. This need can be satisfied in part by appropriate use of current Program Breakdown Codes (PBCs) (see Section A3). However, major revision of the PBCs, now under study, will be necessary to encode all desired categories. In addition, other information usually collected separately from cost data (e.g., CPC size and execution time data) must be associated with the right Elements' cost data if meaningful comparisons are to be made.

[8] AFSCM 173-4, paragraph 4-2c.(2).

A3. Element Definitions and Codes

The activities or products that comprise each Element must be well-defined. The definitions of the Elements at the first three levels (termed Level 1, Level 2 and Level 3) are prescribed in MIL-STD-881A appendices. AFSCM 173-4 extends the prescribed levels, and defines additional Elements. It also assigns standard PBCs to these prescribed Elements, and states rules for forming PBCs for acquisition-specific Elements. The PBCs are designed to support uniform cost accounting across systems. Each of the five AFSCM 173-4 attachments identifies a set of standard Elements, includes their official definitions, and presents their PBCs. The anticipated revision (i.e., Change 1) of ESDP 800-4, Statement of Work Preparation Guide, incorporates additional standard WBS Elements and their PBCs. These should be used, where appropriate, in ESD-managed programs. Table A-2 compiles the standard Electronic System WBS Elements from these three sources and includes the corresponding PBCs.

The Program Office must identify lower-level Elements (and any non-standard higher-level Elements desired), prepare these Elements' definitions, and assign them PBCs consistent with the standard Elements' PBCs. AFSCM 173-4, Chapter 3, explains PBC structure and requirements for deriving PBCs for program-specific lower-level Elements. Some codes, identified as "Restricted" in the AFSCM 173-4 attachments, may not be used without Hq. AFSC (ACC) approval, per AFSCM 173-4 paragraph 5-2.b(10). For ESD-managed programs, ESDP 800-4 (Change 1) supplements these rules.

For WBS Elements which are subsets of the Prime Mission Product, ESDP 800-4 (Change 1) defines Extended PBCs, each comprising a main portion formed per AFSCM 173-4 rules plus a suffix that indicates the Element's position in the system configuration. This suffix, called a Configuration Identifier, specifies the position of each software, equipment and integration Element in the Configuration Tree (e.g., the Specification Tree) in contrast to its position in the WBS. A Configuration Identifier consists of "/" followed by one or more digits or letters. The first of these specifies the Element's System Segment (if any), or otherwise the system as a whole. The second (if any) digit or letter specifies the Functional Area (see LCEG, Section 4.3) to which the Element applies. Any third digit or letter indicates which Configuration Item within that Functional Area to which the Element applies. Successive digits or letters should be used for any Elements that apply to CI components (e.g., CPCs) or further CI breakdowns. The digits 1-9, and then the letters A-H, J-N, and P-Z, should be used as successive values of each Configuration Identifier position. Table A-2 and Table A-3 footnotes illustrate Extended PBC formation. Table 4 and Exhibit 1 contain several additional examples of Extended PBCs.

Table A-3 contains Interim Standard PBCs for identifying the type and the Computer Program Life Cycle phase (see LCEG, Section 8) of each Computer Programs WBS Element subset (i.e., each CPCI, CPC, etc.). The Interim Standard PBCs have the form: s421xx[y], where

s is a code (i.e., A, B, . . .) that identifies the software's supplier;

4211 identifies the Element as a software product;

xx is an alphanumeric code (which excludes the letters "I" & "O") that designates the software type; and

y when used, is an alphabetic code (i.e., A-F) that identifies the Computer Program Life Cycle phase to which the Element applies; if y is not used, the Element is presumed to encompass all such phases covered by the contract.

Each position of "xx" may assume 24 alphabetic values. Also, the first "xx" position may assume 9 numeric values but the second "xx" position may not, per AFSCM 173-4, Chapter 3. Thus, this code can represent 33 x 24 or 792 different software types. Since Table A-3 defines fewer than 70 software types, there is plenty of room for potential expansion.

The Interim Standard PBCs should be applied to all costs associated with the design and development of new software, and to the purchase or rental of commercial software.

In addition, contractors should be required to break down and report the same costs by the following software analogs of the standard WBS Level 2 categories applied to the entire system, i.e.:

PBC	Supplementary Software Category Name
4210	Computer programs (analysis, design, coding, checkout: purchase, or rental costs only)
4220	Software-peculiar training
4240	Equipment required specifically for software development or maintenance
4250	Testing of software
4260	Software-peculiar management and engineering
4270	Software documentation
4285	Software development and maintenance facilities
4290	Other software-related costs
4200	Summary of all software-related costs.

Wherever meaningful, this breakdown should extend to the lowest of the CPCI level, the Functional Area level, or the System Segment level, and should be encoded by suffixing one-, two-, or three-character Configuration Identifiers, respectively, to the basic PBC. E.g., PBC 4250/2 would encode Segment-level software testing costs associated with the system's second Segment.

Whenever the software-related activities share facilities, supplies or services used to develop other portions of the system, the contractor should be directed to apportion their costs equitably among the system's different product categories (e.g., Communications, Computer Programs, Automatic Data Processing Equipment, Sensors). To encourage consistent apportionment across acquisition programs, each Program Office should coordinate proposed apportionment rules with the staff organization responsible for central collection and dissemination of cost accounting data. For ESD-managed programs, coordination with the Cost Analysis Division (ACC) and the Computer Systems Engineering Directorate (MCI) is required.

The Interim Standard Software Types and PBCs in Table A-3 are termed "interim" because they are likely to change as software cost data, and related experience, accumulate. After such further development, their standardization in a future revision of AFSCM 173-4 is planned. An analogous definition of type codes for Firmware (PBC 4310) is currently under consideration.

The complete set of Element definitions for a particular WBS are termed its Dictionary.

The Intermediate Command Cost Analysis Division (ACC) must be consulted about all proposed new and modified PBC assignments, Element definitions, and WBS structures (see Section 2.2). This is especially important because the decisions made about these matters can subtly effect cost accounting, visibility into contractor activities, and Government control of these activities.

A4. WBS Types and Evolution

MIL-STD-881A (paragraphs 4 & 5) identifies seven types of WBS and prescribes their development sequence. In its paragraph 5-2, AFSCM 173-4 defines a PBS analog of each WBS type prescribed by MIL-STD-881A and mandates a very similar development process for them. The chief differences between PBSs and MIL-STD-881A WBSs are:

a. some differences in the names of prescribed Elements;

b. the assignment of PBCs to PBS Elements (MIL-STD-881A prescribes none);

c. the mandatory inclusion of certain prescribed Level 4 and Level 5 Elements in some PBSs.

Subsequent subsections describe the analogous pairs of MIL-STD-881A WBSs and AFSCM 173-4 PBSs, their uses, and their differences. Both members of a pair are discussed, because either may apply to a particular acquisition, depending on the program's type, size, & importance, and on specific direction. Because AFSCM 173-4 identifies some of the same types of PBS by different terms, this guidebook uses the term that seems most standard.

Table A-2

ELECTRONIC SYSTEM STANDARD WBS ELEMENTS

Level	PBC*	Element Source#	Name Source#	Standard Element Name
1	1000	1,2,3	1	Electronic System##
2	1010##	1,2,3	3	Prime Mission Product
3	1110	1,2,3	1	Integration and Assembly
3	2110	1,2,3	1	Sensors
3	3110	1,2,3	1,3	Communications
3	4110	1,2,3	1	Automatic Data Processing Equipment
3	4210@	1,2,3	1,3	Computer Programs
3	4310@@	3	3	Firmware
3	5110	1,2,3	1	Data Displays
3	6110	1,2,3	1	Auxiliary Equipment
3	8110	2,3	2	Air Vehicle
2	1020	1,2,3	1,3	Training
3	1021	1,2,3	1,2,3	Equipment
3	1027	1,2,3	1,2,3	Facilities
3	1029	1,2,3	1,3	Services
2	1040	1,2,3	3	Peculiar Support Equipment & Maintenance (incl. Maintenance Concept)
3	1041	1,2,3	2,3	Organizational/Intermediate
3	1044	1,2,3	2,3	Depot
3	1049	2	2	Other
2	1050	1,2,3	1	Systems Test and Evaluation
3	1051	1,2,3	1,2,3	Development Test & Evaluation
3	1053	1,2,3	1,2	Operational Test and Evaluation
3	1052	3	3	Combined DT&E and OT&E
3	1055	1,2	1	Mockups
3	1056	1,2,3	1,2	Test and Evaluation Support
3	1057	1,2,3	1,2	Test Facilities
3	1059	2	2	Other System Tests
2	1060	1,2,3	3	System Program/Project Management
3	1061%	1,2,3	3	Systems Engineering Management
4	1061A	3	3	Reliability
4	1061B	3	3	Maintainability
4	1061C	3	3	Parts Control
4	1061D	3	3	Nomenclature
4	1061E	3	3	Aerospace Environment
4	1061F	3	3	Transportability
4	1061G	3	3	Electromagnetic Compatibility
4	1061H	3	3	Radar Frequency Management
4	1061J	3	3	Security
4	1061K	3	3	Survivability/Vulnerability
4	1061L	3	3	System Safety
4	1061M	3	3	Communications Long Lines
4	1061N	3	3	Radio Frequency Management
4	1061P%	3	3	Value Engineering
4	1061Q	3	3	Availability

Table A-2 (Continued)

Level	PBC*	Element Source†	Name Source†	Standard Element Name
3	1062	1,2,3	2,3	Supporting Project Management Activities
4	1062A	3	3	Program Management
5	1062AA	3	3	Program/Contract Work Breakdown Structure
5	1062AB	3	3	Cost Information System
5	1062AC	3	3	Cost Schedule Systems
5	1062AD	3	3	Life Cycle Costs
5	1062AE	3	3	Schedule Management
4	1062B	3	3	Manufacturing Management
4	1062C	3	3	Configuration Management
4	1062D	3	3	Integration of Analyses and Related Computer Support
4	1062E	3	3	Quality/Inspection
4	1062F	3	3	Photographic Documentation
4	1062G	3	3	STINFO
3	1063	3	3	Integrated Logistics Support
4	1063A	3	3	Preoperational Supply Support
4	1063B	3	3	Packaging
4	1063C	3	3	Transportation
4	1063D	3	3	Travel
4	1063E	3	3	Maintenance
4	1063G	3	3	Limited Spares/Repair Parts Provisioning
3	1064	3	3	Crew/Human Factors
4	1064A	3	3	Human Engineering
4	1064B	3	3	Biomedical/Life Support Equipment
4	1064C	3	3	Manpower/Personnel Requirements
4	1064D	3	3	Human Factors Test & Evaluation
2	1070	1,2,3	1,3	Data
3	1071	1,2,3	1,2	Technical Publications
3	1072	1,2,3	1,2,3	Engineering Data
4	1072E	2	2	Engineering & Configuration Documentation
4	1072H	2	2	Human Factors
4	1072R	2	2	Related Design Requirements
4	1072S	2	2	System/Subsystem Analysis
4	1072T	2	2	Test
3	1073	1,2,3	1,2,3	Management Data
4	1073A	2	2	Administrative Management
4	1073F	2	2	Financial
4	1073L	2	2	Logistic Support
4	1073P	2	2	Procurement/Production
3	NONE	1	1	Support Data
3	1074	1,2,3	3	Data Repository
2	1080	1,2,3	1,3	Operational/Site Activation

Table A-2 (Concluded)

Level	PBC*	Element Source#	Name Source#	Standard Element Name
3	1081	1,2,3	1,2,3	Contractor Technical Support
3	1082	1,2,3	1,2,3	Site Construction
3	1083	1,2,3	2,3	Site Conversion
3	1084	1,2,3	1,2,3	System Assembly, Installation and Checkout on Site
3	1085@@	3	3	ADP Support Facilities
3	1089	2	2	Other Site Activation
2	9200	1,3	1,3	Common Support Equipment
3	NONE	1,3	1	Organizational/Intermediate (Including Equipment Common to Depot)
3	NONE	1	1	Depot
2	NONE	1	1	Industrial Facilities
3	NONE	1	1	Construction/Conversion/Expansion
3	NONE	1	1	Equipment Acquisition or Modernization
3	NONE	1	1	Maintenance
2	9600	1,3	3	Initial Spares & Repair Parts
3	NONE	1	1	(Specify by Allowance List, Grouping or Hardware Element)

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* Prefix this code with the letter (i.e., A,B,...) assigned to the source of the product or service when this letter is known. See AFSCM 173-4, paragraph 3-3a and Figures 5-3 through 5-8.

\# Source Code: 1 = MIL-STD-881A, Appendix B.
2 = AFSCM 173-4, Attachment 4, Section C, Part 1.
3 = ESDP 800-4, (Change 1), Figure 2-1.

** Substitute the specific system's name for this Standard Element name.

\#\# For ESD-managed programs, append a Configuration Identifier to the PBCs for equipment, software, and integration Elements representing products or services applied to distinct System Segments, CIs, CI components, etc. A Configuration Identifier consists of "/" followed by one or more digits or letters that specify the Element's position in the System Configuration. A PBC and its Configuration Identifier form an Extended PBC. For example, the Extended PBC "B1111/21" would identify integration of the CIs in the first Functional Area of a system's second System Segment.

@ Apply Table A-3's Interim Standard PBCs to lower-level Computer Programs Elements.

@@ Use of this PBC is tentative pending revision of ESDP 800-4.

§ See last two entries in Table 1.

Table A-3

INTERIM STANDARD SOFTWARE TYPES AND PBCs*

PBC**	Type Index #	Type of Software
4210	-	Computer Programs
4219	1.	Operational Software##
4211	1.1	Application Software##
4212	1.2	Operational Executive##
4212A	1.2.1	Computer Resource Management
4212B	1.2.2	Computer Operator Interface
4212C	1.2.3	Other Terminal Operator Interface
4212D	1.2.4	Special Device Interface
4212E	1.2.5	Other Input or Output
4212F	1.2.6	Error Handling/Reconfiguration/Recovery
4212G	1.2.7	Multi-Computer Configuration Control Protocol
4212H	1.2.8	Performance Monitoring & Data Collection
4213	1.3	Operational Data Base Management##
4213A	1.3.1	On-Line Data Base Retrieval & Updating
4213B	1.3.2	On-Line Data Base
4214	1.4	Operational Exercise or Training
4214A	1.4.1	Control of Exercise Sequencing
4214B	1.4.2	Operator Performance Data Collection
4215	1.5	On-Line Equipment Diagnostic
421Z	2.	Support Software##
421A	2.1	Operating System##
421AA	2.1.1	Computer Resource Management
421AB	2.1.2	Computer Operator Interface
421AC	2.1.3	Other Terminal Operator Interface
421AD	2.1.4	Other Input or Output
421AE	2.1.5	Error-Handling/Reconfiguration/Recovery
421AF	2.1.6	Performance Monitoring & Data Collection
421B	2.2	Computer Equipment Maintenance##
421BA	2.2.1	Off-Line Diagnostic
421C	2.3	Software Development & Maintenance##
421CA	2.3.1	Higher-Order Language Compiler
421CB	2.3.2	Assembler
421CC	2.3.3	Debugging
421CD	2.3.4	Loader or Editor
421D	2.4	Off-Line Data Base Management##
421DA	2.4.1	Data Base Definition
421DB	2.4.2	Data Base Initialization or Updating
421DC	2.4.3	Data Base Retrieval & Output Formatting
421DD	2.4.4	Data Base Restructuring
421DE	2.4.5	Off-Line Data Base
421E	2.5	System Design & Modification##
421EA	2.5.1	System Design Data Base
421EB	2.5.2	System Design Data Base Processor
421EC	2.5.3	System Performance Simulation
		Performance Data Reduction & Analysis

Table A-3 (Concluded)

PBC**	Type Index #	Type of Software
*421F	2.6	System Test Software##
*421FA	2.6.1	Test Case Generation
*421FB	2.6.2	Test Presentation, Control & Data Recording
*421FC	2.6.3	Test Data Reduction
*421FD	2.6.4	Test Analysis
*421G	2.7	Utilities##
*421GA	2.7.1	Media Conversion or Format Translation
*421GB	2.7.2	Sort/Merge
*421GC	2.7.3	Program Library Maintenance
*421H	2.8	Adaptation Software##
*421HA	2.8.1	Equipment or Software Configuration Data
*421HB	2.8.2	System Generation
*421J	2.9	Off-line Exercise or Training##
*421JA	2.9.1	Scenario Preparation
*421JB	2.9.2	Data Reduction
*421JC	2.9.3	Exercise/Training Analysis
*421K	2.10	Project Management##
*421KA	2.10.1	Project Event Status Accounting
*421KB	2.10.2	Schedule Maintenance/Projection
*421KC	2.10.3	Financial Accounting

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* Apply to each WBS Element the PBC that best defines the software product (i.e., CPCI, CPC, or major routine) to be acquired.

** Prefix this code with the letter (i.e., A, B, C...) assigned to the software's supplier, if known (see AFSCM 173-4, paragraph 3-3a and Figure 5-3 through 5-8). If the Element's definition limits it to a particular Computer Program Life Cycle phase (see LCEG, Section 8), if necessary pad the code with "*" to six characters. Then suffix it with a letter (i.e., A-F) that represents that phase's position in the sequence of phases. Then, to form an Extended PBC, append a Configuration Identifier, i.e., "/" plus index digits or letters that define the WBS Element's position in the system configuration. For instance, PBC B*215*2/132 identifies the Design phase of an On-Line Equipment Diagnostic Program in a system procured from the acquisition program's second source. This computer program is also the second CI of the third Functional Area of the system's first Segment (if any) or otherwise of the system itself. The Configuration Identifier must contain four characters to designate a CPC, and five to designate a major CPC part. See Table 4 for other examples.

\# Indicates the software type's position in this type classification tree. Not directly related to WBS Level.

Code as this type of software:
1. similar software not otherwise defined by a Table A-3 PBC; or
2. aggregates of other components of this type.

A4.1 Category Summary WBSs and Summary Management Structures

MIL-STD-881A defines seven WBSs which it terms Category Summary WBSs, for Aircraft Systems, Electronic Systems, Missile Systems, Ordnance Systems, Ship Systems, Space Systems, and Surface Vehicle Systems, respectively. Each Category Summary WBS consists of a complete set of Level 1, Level 2, and Level 3 Elements and their definitions, appropriate to systems of that category. Only the Electronic System Summary WBS includes an explicit software Element (i.e., Computer Programs). Software-related activities and products are aggregated with other types of activities and products in other Electronic System Summary WBS Elements, and in Elements of the other six Category Summary WBSs. Table A-1 depicts the Electronic System Summary WBS. The single Level 1 Element always represents the entire system being acquired, including equipment, software, and data, plus effort such as training, testing and systems engineering needed to develop and install it. Such a whole system might be a Major Defense System, or an elaborate software system procured separately for execution on computing equipment previously acquired. The Level 2 Elements in a Category Summary WBS are the Prime Mission Product plus the major categories of effort or auxiliary products normally associated with its acquisition and support. The Level 3 Elements are standard subdivisions of the Level 2 Elements.

AFSCM 173-4 (paragraph 5-3a) terms Summary Management Structures the PBS equivalents of the Category Summary WBSs. There are five such categories: Aircraft, Electronics, Ordnance, Space, and Missiles. These are equivalent to five of the seven MIL-STD-881A categories. Each is defined in Section C, Part 1 of a separate AFSCM 173-4 attachment. Unlike the Category Summary WBSs, the AFSCM 173-4 Summary Management Structures define a PBC for each of their Elements.

The Summary Management Structures use somewhat different names than the MIL-STD-881A appendices to identify equivalent Elements (e.g., "Communication Equipment - Total" vs. "Communications"), although the usually minor differences permit matching equivalent Elements. The Summary Management Structures also define a few Level 4 and Level 5 Elements (e.g., "Engineering and Configuration Documentation" under Level 3 "Data - Total"). More troublesome are omission of some Elements defined in MIL-STD-881A Category Summary WBSs (e.g., "Support Data"), and inclusion of other Elements (e.g., "Other System Tests") missing from Category Summary WBSs. These discrepancies will presumably be rectified in the next version of AFSCM 173-4. (The current version is 29 months older than MIL-STD-881A). ESDP 800-4 (including Change 1) contains standard WBS Elements that partially bridge the gap. Table A-2, which combines the Electronic System Summary WBS, The Electronic System Summary Management Structures, and the Standard ESDP 800-4 WBS Elements, indicates their similarities and differences.

A4.2 Preliminary Project Summary WBS and Preliminary Summary PBS

MIL-STD-881A (paragraph 5.1.1) directs the Department of Defense (DoD) Component (e.g., the Air Force) in charge of an acquisition to prepare during the Conceptual Phase a Preliminary Project Summary WBS encompassing all program activities, as a basis for program approval. A Preliminary Project

Summary WBS is compiled by selecting from one or more of the Category Summary WBSs the subset of Elements pertinent to the planned system. Like its sources, the result is normally a three-level structure. However, it may contain Elements at or below Level 4 if based on appropriate Systems Engineering effort.

A Preliminary Summary PBS is the AFSCM 173-4 equivalent of the Preliminary Project Summary WBS. (See, e.g., AFSCM 173-4, Figure 5-2). AFSCM 173-4 directs its compilation by selecting appropriate Summary Management Structure Elements. As a result, the Preliminary Summary PBS may contain Elements below Level 3. For ESD-managed programs, Table A-2 may be a convenient source of such Elements.

The Program Office Cadre, if formed, compiles the Preliminary Project Summary WBS or Preliminary Summary PBS. Otherwise the Intermediate Command planning staff does so. At ESD, coordination with the Cost Analysis Division (ACC) is required. AFSCM 173-4 directs that the Preliminary Summary PBS and its Dictionary be included in the RFP for each planned post-Conceptual Phase contract.

A4.3 Approved Project Summary WBS and Approved Summary PBS

Each of these Summary WBSs is developed from its preliminary counterpart (see Section A4.2) as a result of review and approval actions. For a Major Defense System such action includes Defense Systems Acquisition Review Council (DSARC) consideration and the Program Decision (see LCEG Section 3.4). The approved version can thus be expected by the early Validation Phase. This approved version must be included in all RFPs for Full-Scale Development Phase contracts. Per MIL-STD-881A (paragraph 4.9), the Elements of the Approved Project Summary WBS or Approved Summary PBS must be defined to relate easily to the Contract Line Items (see Section C2.1), CIs, Government-Furnished Property (GFP), Preliminary Contract WBS Elements (see Section A4.4), and SOW tasks, or aggregations of each.

A4.4 Preliminary Contract WBS

Both MIL-STD-881A and AFSCM 173-4 use the same term for this type of WBS. The Program Office must prepare a different Preliminary CWBS for each planned contract (or equivalent Government interagency memorandum of agreement) from the appropriate Project Summary WBS or Summary PBS version by: (1) selecting a subset of the source's Elements, and (2) subdividing an appropriate subset of these into Level 4, Level 5, and possibly lower-level Elements. AFSCM 173-4, in Figures 5-3 through 5-7, illustrates the process. All branches of the Preliminary Contract WBS need not have the same depth. For Validation Phase contracts, the Preliminary Project Summary WBS or the Preliminary Summary PBS must normally be used as the primary basis for the Preliminary Contract WBS, since the approved version is unavailable. For Full-Scale Development Phase and later phase contracts the Approved Project Summary WBS or the Approved Summary PBS will be used instead. The appropriate Preliminary CWBS must also be included in the RFP for each planned contract.

For ESD-managed programs, Table A-2 should be reviewed as a source of standard lower-level Elements that may be appropriate to a Preliminary Contract WBS. In addition to standard Elements, Elements representing system-specific breakdowns of the Prime Mission Product and its Level 3 components (e.g., Computer Programs) must be prepared. For example, the CIs, if already defined, must be identified as Preliminary CWBS Elements. For a Validation Phase contract, the CIs will not normally be known. However, for a Full-Scale Development Phase contract, the CI definition should be available as part of the Allocated Baseline (see LCEG, Section 4.3.1).

In addition, Elements covering certain CI subsets, and distinct Elements for each of the integration, training, peculiar support equipment, test, engineering, management, data, etc., associated explicitly with certain of the system's product Elements, may be desirable. The recent Precision Emitter Location Strike System (PELSS) procurement (an Aeronautical System Division product) defined such distinct support Elements at several levels in its Preliminary CWBS.

For ESD-managed programs, Table A-3 should be consulted as an aid to preparing PBCs for Elements defining software products (e.g., CPCIs or their subsets). To obtain unambiguous software development cost data, a separate Element should be defined for each Computer Program Life Cycle phase (see LCEG Section 8) of each software product to be developed. This breakdown may be included in the Preliminary CWBS or the winning Offeror may be required to extend the CWBS accordingly (see Section A4.6).

Properly defining a Preliminary CWBS for each planned contract is a crucial acquisition planning activity, and an essential prerequisite to SOW preparation. The Preliminary CWBS is very much influenced by the system design, and by concepts of system acquisition management, operation, training, and maintenance. Because of their close relationship, the Preliminary CWBS may change during SOW preparation.

A4.5 Contract WBS (CWBS)

The CWBS for each contract is developed from the corresponding Preliminary CWBS by Government negotiation with the winning Offeror. Per MIL-STD-881A (paragraph 5.3.2), any contractor-proposed changes require the Program Manager's approval, and must be consistent with the Approved Project Summary WBS or Approved Summary PBS. The CWBS becomes part of the contract. The negotiated CWBS Elements should correspond to, rather than cross, the contractor's existing management and cost accounting categories, if the Government deems these categories adequate. To use a management and cost accounting structure familiar to the contractor is less expensive than imposing a new one, and will probably yield more accurate data.

A4.6 Extended CWBS

Each contractor may extend his CWBS by further defining Elements at lower levels to serve his own management objectives. However, his costs must be traceable by the Government to the lowest level Elements he defines. He need not report costs routinely at this level, unless his contract so directs,

but must be able to assemble the information at Program Office request. However, this reporting is most likely to be realistic if routine, and if the Extended CWBS categories reflect both the contractor's internal accounting system and (where appropriate) the actual structure of the CIs under development.

To collect sound software cost data as a basis for future software cost estimates (see Section A2), software development cost data should be accumulated separately for each CPCI to be developed under the contract, and for their Computer Program Components (CPCs). This data should be further segregated by Computer Program Life Cycle phase (see LCEG, Section 8). To assure routine Government acquisition of this information, a SOW task should direct the contractor to extend the CWBS accordingly, and to report the corresponding software development costs in monthly Cost Performance Reports, separately for each such Extended CWBS Element.

A similar need exists for software size and timing data, as a basis for estimating the performance of future software. Hence, a SOW task should require size and execution time data for each CPCI and CPC defined in the Extended CWBS. (See Exhibit 1, paragraphs 5.1.5.1.3 and 5.1.5.2.1.1). Ultimately, experience may show that this data must be collected for portions of CPCs (i.e., individual routines) if such data is to be comparable.

A4.7 Project WBS and Extended PBS

The Program Office is responsible for developing these by aggregating all Extended CWBS Elements with the Approved Project Summary WBS Elements or Approved Summary PBS Elements that represent work from all the development organizations. MIL-STD-881A (paragraph 5.4) directs development of this WBS (which when complete fully depicts the entire acquisition). This development must begin when the first contract is awarded, continue as subsequent contracts are awarded (and as the program changes), and be complete by the end of Full-Scale Development.

APPENDIX B

THE SOURCE SELECTION PLAN

AFR 70-15, Source Selection Policy and Procedures (paragraph 2-2) prescribes preparation and approval of a Source Selection Plan (SSP) as a prerequisite to RFP completion and release. Paragraph 2-2 further defines SSP content, and responsibilities for its development. The SSP must contain the approach and Government organization, plus the criteria and schedule for proposal evaluation and contractor selection.

Per AFR 70-15 (paragraph 1-3v), the SSP must be approved by the Source Selection Authority (SSA). For Air Force-managed Major Defense Systems, AFR 70-15 (paragraph 1-5) prescribes the Secretary of the Air Force as the SSA, unless the Secretary of Defense directs otherwise. The Secretary of the Air Force may delegate this authority, but not below the level of an AFSC Division Commander (e.g., Commander, ESD).

A lower-ranking person may be appointed as the SSA for a Less-Than-Major System proposal evaluation. AFR 70-15 (in paragraphs 1-3w, 1-3y and 1-7b) also prescribes formation of a Source Selection Advisory Council (SSAC). The SSAC must partially develop proposal evaluation criteria*, appoint a Source Selection Evaluation Board (SSEB), analyze the results of each proposal's evaluation, and otherwise advise the SSA. Detailing of proposal evaluation criteria and proposal evaluation itself are the SSEB's prime responsibilities.

SSP preparation is a Program Office Cadre responsibility, with help from prospective SSEB members who are not Program Office personnel. Because its approval may require considerable time, the SSP for contract(s) to begin during the Validation Phase should be submitted for approval during the Conceptual Phase (see LCEG, Table 1, Set U). When contracting is planned to start no earlier than Full-Scale Development, the SSP should be submitted as early as possible in the Validation Phase.

Per AFR 70-15 (paragraph 2-2), the SSP must normally include at least the following:

a. an introduction outlining the system, and the group of supplies and services to be procured under each planned contract;

b. screening criteria to eliminate unqualified Offerers before proposal evaluation, while assuring adequate competition;

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* See AFR 70-15, paragraphs 3-2 through 3-5, and ESD-TR-75-365, paragraph 3.3, for guidance about proposal evaluation criteria, including standards and examples.

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c. Basic Evaluation Criteria (subject to further SSAC detailing), tailored to vital aspects of each procurement, and specifically addressing high risks and technical uncertainties; the relative importance of each Basic Evaluation Criterion must also be stated;

d. the Source Selection organization (e.g.; SSA; SSAC; SSEB; recommended members by organization, and by name where possible);

e. evaluation procedures, including the SSEB's rating methods and the SSAC's proposal evaluation approach;

f. plans for evaluating costs, including identification of the Preliminary CWBS items whose costs will be evaluated, plus methods to be used for independent Government cost estimation.

g. a schedule of Source Selection activities;* and

h. the procurement approach, directly correlated with the Procurement Plan;** this must cover planned type(s) of contract, incentives, and special clauses.

Per AFR 70-15 (paragraph 2-2), the SSP must also comply with any PMD direction regarding Source Selection.

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* AFR 70-15, Attachment 1 lists 32 events to be included in this schedule. Paragraph 1-15 allows at most 18 weeks to complete Source Selection, beginning with receipt of the Offerer's formal proposals, unless the SSA authorizes more time.

** Air Force ASPR Supplement 1-2100.50, and ESD-TR-75-365, paragraph 2.3.3.

APPENDIX C

REQUESTS FOR PROPOSAL

A Request for Proposal (RFP) is a formal document used by the Air Force to solicit proposals from a Source List of potential contractors. If there are to be two or more contracts, a separate RFP and a separate Source Selection (see Appendix B) are required for each, unless parallel competitive contracts are awarded to perform the same tasks. Each RFP describes a group of supplies and services wanted, states conditions for their acquisition, and solicits proposals accordingly.

AFR 70-15, which explains the Major Defense System Source Selection process for both Validation Phase and Full-Scale Development Phase contracts, should be reviewed before RFP preparation. This directive imposes certain requirements on RFP structure and content,* and explains how the responses to an RFP (i.e., the Offerers' proposals) should be evaluated. The policies and procedures of AFR 70-15 may also be tailored for use in Less-Than-Major System acquisition programs, or AFSCR 70-9, Source Selection Procedures, and AFSCR 80-15 R&D Source Selection Policy and Guidance, may be applied.

RFP preparation is a joint responsibility of the Procuring Contracting Officer and the Program Office, but requires SSAC, and SSEB participation and concurrence.** Program Office personnel, including the Software Director, are responsible for drafting and reviewing the major portions of each RFP. For ESD-managed programs, review by the Computer Systems Engineering Directorate (MCI) is also required.

A RFP for a software-related Validation Phase or Full-Scale Development Phase contract consists of three volumes, plus a possible fourth volume containing any classified information. In addition, a brief Executive Summary letter is sent to each Offerer with the RFP. This, signed by the Program Manager, should highlight the RFP's major points in 2-3 pages. The principal components of an RFP are described below.

ASPR 3-501 describes a Uniform Contract Format (UCF) to be used in Negotiated Procurements (see Section 1). RFP structure must correspond closely to the UCF, as indicated in Table C-1#, to facilitate negotiating contracts that differ little from evaluated proposals. There are four RFP Volumes, sometimes called Parts.## Each is discussed below. AFSCP 70-4, the standard forms mentioned below, and the other references cited, should be consulted for further details.

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* AFR 70-15, paragraph 2-4, has examples.

** AFR 70-15, paragraphs 1-7b, 1-7d and 2-4a.

\# Table C-1 is adapted from AFSCP 70-4, Figures 2-1 and 2-2.

AFSCP 70-4 uses the term Volume, while standard RFP forms (e.g., Form 33) use the term Part.

Table C-1

UNIFORM CONTRACT FORMAT vs. RFP FORMAT

UNIFORM CONTRACT FORMAT		RFP FORMAT			
		Vol. I	Vol. II	Vol. III	Vol. IV
Part and Section	Title	Proposal Preparation Instructions	Model Contract	Attached Documents & References	Classified Parts
I	General Instructions				
A	Cover Sheet	X			
B	Contract Forms and Representations, Certifications, and other Statement of Offeror or Quoter	X			
C	Solicitation Instructions and Conditions, and Notice to Offerors	X			
D	Evaluation Factors for Award	X			
II	The Schedule				
E	Supplies/Services and Prices		X		
F	Description/Specifications		X		
G	Preservation/Packaging/Packing		X		
H	Deliveries or Performance		X		
I	Inspection and Acceptance		X		
J	Special Provisions		X		
K	Contract Administration Data				
III	General Provisions				
L	General Provisions		X		
IV	List of Documents and Attachments				
M	List of Documents/Exhibits, and other Attachments			X	
-	Attachments				
	Statement of Work (SOW)			X	
	Contract Data Requirements List (CDRL)		X		
	Specifications			X	
	Engineering Drawings			X	
	Contract Security Classification Specification (DD Form 254)			X	
	Project Summary WBS or Summary PBS (Preliminary or Approved Version)			X	
	Preliminary Contract WBS			X	

C1. RFP Volume I - Proposal Preparation Instructions

Volume I is sometimes termed the Instructions for Offerers or the Instructions for Proposal Preparation (IFPP). It consists of the four main parts described in Sections C1.1 - C1.4.

C1.1 Cover Sheet (DD Form 1707)

This contains information such as the name and identification number assigned to the potential contract, the issuing Government office, and the Government's official point of contact with Offerors.

C1.2 Contract Forms and Representations, etc.

This consists principally of the Solicitation, Offer and Award (Standard Form 33) plus possible supplementary material. It identifies all parts of the RFP, specifies terms for delivery of the proposal, and contains a number of questions pertinent to the proposed contract to be answered by each Offerer.

C1.3 Solicitation Instructions and Conditions

This, comprising Standard Form 33A plus supplementary material, must guide the Offerers on:

a. type of proposal expected;

b. definition of information to be included;

c. proposal format, including packaging by volumes and sections;*

d. ways Offerers can get questions answered;

e. mechanics of proposal submission, revision and evaluation;

f. the bases for contract award;

g. grounds for rejecting a proposal as unacceptable;

h. order of information precedence if RFP portions conflict;

i. instructions for CDRL preparation (see Section C2.7);

j. security;

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* AFSCP 70-4, paragraph 3-6, has extensive specific suggestions.

k. type of contract planned;*

l. ASPR sections incorporated by reference;

m. number of proposal copies; and

n. any proposal size limitations.

For example, the IFPP should spell out clearly and precisely how each Offerer is expected to state and format his technical proposal, primarily to assure receipt of comparable proposals from the different Offerers. Each Offerer's pertinent qualifications and experience, his management structure, and his cost & pricing data should be requested in comparable terms. The IFPP may also impose a proposal page number limit to constrain the costs of proposal preparation and the effort of proposal evaluation.

For a contract involving non-trivial software development, the IFPP should require delivery of a CPDP, prescribe its content and format,** and state that the winning Offerer's CPDP (after possible change during negotiation) will bind the contractor. This IFPP provision will let the government evaluate the CPDP during Source Selection, as a principal indicator of the Offerer's competence to develop the software contracted for. The same provision in the contract will permit Government enforcement of the winning Offerer's CPDP during software development.

For a contract that includes Systems Engineering effort, the IFPP should also require each Offerer to prepare a SEMP, to become binding on the winner, as outlined in LCEG, Section 4.4.6.

If the acquisition plan allows Offerers to propose changes to the validated system design (see LCEG, Section 4.3.2), the IFPP should spell out the types of possible modifications allowed, the evidence necessary to support them, and the standards to be applied to their evaluation.

C1.4 Evaluation Criteria

Per AFR 70-15 (paragraph 1-7b), preparation of General Evaluation Criteria is a SSAC responsibility, but Program Office personnel usually prepare the drafts. This RFP section should state in general terms the criteria the Government plans to use to evaluate the proposals, and the relative importance of each aspect of the proposal (e.g., price, technical

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* E.g.; Firm Fixed Price (FFP); Fixed Price Incentive Firm (FPIF); Cost Plus Fixed Fee (CPFF); Cost Plus Incentive Fee (CPIF); Cost Plus Award Fee (CPAF).

** AFR 800-14, Vol. II, paragraph 3-9 and Data Item Description (DID) (U) DI-E-695/ESD, Computer Program Development Plan, define the CPDP. However, the RFP should contain a modified version of this DID, to cover application-specific requirements, and to eliminate requirements for information to be provided elsewhere in the proposal. DID modification is discussed in ESD-TR-76-159.

merit). The RFP should identify any non-obvious technical risks. Offerers should also be asked to identify factors in their proposals that are critical to acquisition or system success. The General Evaluation Criteria should include consideration of such critical factors and of high-risk proposal provisions.

Currently, the following software capabilities are likely to have high technical risk:

a. certifiably correct control of access to data of different security classification and in different "need to know" categories;

b. automatic detection and correct reporting of equipment and software errors; and

c. automatic reconfiguration and recovery of the system from errors, including transition to and from degraded modes of operation.

The RFP should ask Offerers to address the technical risks concerning each of these items, if included in the system design required or proposed.

The risks of cost and schedule overruns typically overshadow technical risks in software development. Therefore, the RFP should require Offerers to address cost and schedule risks in their proposals, with reference to their proposed CPDPs (see Section C1.3).

The RFP must also state the importance to evaluation of factors extraneous to the proposal itself, which AFR 70-15 (paragraphs 3-2d & 2-4e) terms General Considerations. These factors include the Offeror's past performance.

Neither the Detailed Evaluation Criteria to be applied by the SSEB, nor the exact weights to be attached to each criterion by the SSAC, should be revealed to Offerors. Nevertheless, the RFP's General Evaluation Criteria should be as informative as possible, in order to elicit the best possible proposals, to minimize misunderstandings, and to avoid claims by losing Offerers that their proposals were treated unfairly. Refer to AFR 70-15, paragraphs 2-4a, 3-3, and Attachment 2, for further direction.

Preparation of a good set of General Evaluation Criteria for the RFP should be based on carefully considered Detailed Evaluation Criteria. Thus, the latter should normally be developed before the RFP is released, and must be compiled before receipt of contractor proposals, per AFR 70-15, Attachment 1. For this reason, Basic Evaluation Criteria must be included in the SSP (see Appendix B) which must be approved by the SSA before the RFP is issued. The RFP General Evaluation Criteria, and their relative importance, must be consistent with the Basic Evaluation Criteria approved by the SSA.

C2. RFP Volume II - Model Contract

The Model Contract comprises a description of the supplies and services to be provided by the contractor, the Delivery Schedule, the Contract Terms and Conditions, Contract Administration Data, and the CDRL. Basically, the Model Contract is the Government's initial contract proposal. It is subject to change during the negotiations that are later conducted with each qualifying Offerer.

AFR 70-15 (paragraph 1-4h) mandates inclusion of a Model Contract in a Validation Phase or Full-Scale Development Phase RFP. Such inclusion is intended to define clearly to Offerers what the Government desires, and to limit negotiation to possible alteration of specific Model Contract Provisions. Use of a tailored Model Contract can also assure appropriate and consistent contractual provisions governing issues common to many acquisition programs. Subsequent subsections discuss those Model Contract sections most relevant to software-related SOW preparation. In addition, review of ASPR 3-501, and of an actual contract for a Major Defense System or a Segment of one, is recommended prior to SOW preparation.

C2.1 Supplies and Services

This, Model Contract Section B, lists the major groups of supplies and services to be provided. Each such group is termed a Contract Line Item and is represented by a unique name and serial number (e.g., 0001, 0002). Some Contract Line Items are broken down into major parts called Subline Items. Each Subline Item must have a unique name, and a serial number (e.g., 0002AA, 0002AB) formed by appending an alphabetic suffix to its Contract Line Item's serial number. Section B includes a quantity, and depending on the type of contract planned may include a price, for each Subline Item, and for each Contract Line Item that has no Subline Items. Hereafter, Subline Items, and Contract Line Items without Subline Items, are both termed CLINs. The prices, and the overall contract targets, ceiling, or costs and fee agreed on, become part of the negotiated contract's Section B. To avoid potential contract enforcement problems, each CLIN must be described by a specific SOW paragraph and Preliminary CWBS Element of the same name. Usually, CLINs cover relatively high-level aggregations of supplies and services. When this is so, CLINs will correspond to SOW paragraphs that encompass lower-level SOW paragraphs.

Appropriate definition of CLINs depends on several other considerations, including the following. Supplies and services to be delivered at different times to different places, or to which different acceptance criteria apply, should normally be identified as different CLINs. To support maximum Government influence on software development, every CPCI should be identified as a distinct CLIN. Every CPCI should also be represented by an Exhibit CLIN; i.e., a CLIN which identifies a CDRL Entry (see Section C2.1.2). In aggregate, the Exhibit CLINs must reference all CDRL entries.

C2.1.1 CPCI Version Definition. Release of more than one Version of certain CPCIs under development is often desirable. For example, early

delivery of an austere Version of an Operational Executive CPCI may be essential to timely and realistic testing of concurrently developed Application CPCIs. Each such Version must be documented, and subjected to acceptance testing, adequate to its intended uses. Because software is easily but not always correctly changed, and because such changes are hard to detect, each Version's storage media and documentation must also be clearly and consistently labelled.

Per MIL-STD-483(USAF) (paragraphs 80.10-80.12) each Version of a CPCI must be defined in a Version Description Document (VDD). A VDD includes unique Version identification, storage media identification, Functions incorporated (cross-referenced to specifications and listings), site adaptation parameters (if any), interfacing equipment and software (and how affected), operational impact, installation procedures, and known and possible errors. A precise Version description also requires correct listings of the Version's coding, and may require other documentation. Refer to DI-E-3121, Version Description Document (Computer Programs) for further information about VDDs.

If they can be well-defined before or during contract negotiation, the incremental Versions of CPCIs may be identified as separate CLINs. However, correct early Version definition is improbable, and would entail explicit contract modification if a Version or its delivery requirements later changed. Also, separate CLINs imply separate WBS Elements, CIs, and CDRL entries. Thus, defining incremental Versions as CLINs is not recommended.

Greater flexibility can be achieved if the Supplies and Services section of the contract instead defines a single CLIN for all Versions of each CPCI. In addition, the contract's Description/Specifications (see Section C2.2) should identify each Version. The contract's Delivery Schedule (see Section C2.3) should state when each is deliverable. The contract's Inspection and Acceptance provisions (see Section C2.4) should specify the terms of these Versions' delivery. Related SOW paragraphs must call for their Versions' preparation. Finally, the CDRL must define both the documentation required and the software storage media. Clearly, these separate RFP provisions should be coordinated for completeness and consistency.

C2.1.2 Dual Identification of Software. Besides identification as a CLIN, each CPCI must also be represented by an Exhibit CLIN and by a CDRL entry (see Section C2.7) defined by (U) DI-E-129, Computer Software/Computer Program/Computer Data Base Configuration Item(s). The CDRL entry requirement* satisfies an ASPR** that aims to assure the Government Unlimited Rights (discussed in Section C2.5.4) to procured software and its documentation developed under a contract. Including software in the CDRL satisfies a view of software as a kind of data, while including software among the CLINs

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* Stated in ASPR 9-603, Rights in Computer Software Acquired Under Contract.

** ASPR 7-104.9, Rights in Data and Computer Software.

reflects its function as a mechanism. Clearly, the dual representations should be made consistent.

C2.2 Description/Specifications

This, Model Contract Section F, identifies the documents to which the services and supplies contracted for must conform. It also contains a separate short description of each CLIN, including identification of any CPCI Versions, if the CLIN represents a CPCI. To facilitate reference, the CLIN description should also include the PBC of the corresponding Preliminary CWBS Element, or identify the corresponding SOW paragraph by paragraph number or PBC. The Description/Specification should not be confused with the Specifications (e.g., the System Specification), which are contained in RFP Volume III, or if classified in RFP Volume IV.

The conformance documents listed in Section F should include all applicable specifications and the SOW, and may specify inclusion of the final negotiated version of the contractor's technical proposal. Including the proposal in the negotiated contract is normally desirable; it can make a contract clearer than one which lacks the proposal. However, proposal inclusion may introduce hidden inconsistencies and undesirable constraints. These should be minimized by careful review and modification of the proposal, since they can otherwise cause controversy during development. Such controversy can occur despite an appropriate Order of Precedence (see Section C2.5.1) that allows the Specifications, etc., to override conflicting proposal provisions. If the Offerer's technical proposal is included, a special provision describing its effect should be included in Model Contract Section J (see guidebook Section C2.5).

Clearly, inconsistencies between the CLIN descriptions and the corresponding SOW task descriptions should be minimized. Consistency is most likely if the CLIN descriptions are prepared with minimal changes from the appropriate paragraphs of the final SOW.

C2.3 Deliveries or Performance

This, Model Contract Section H, prescribes for each CLIN (or CPCI Version) a desired delivery date (for a deliverable item) or Period of Performance (for a service). A Period of Performance can be defined to begin or to end at a fixed date. Alternatively, some Periods of Performance can be defined relative to others, or to other events. Section H is often called the Delivery Schedule. It is typically a major item of negotiation.

Groups of supplies and services wanted at different times should normally be defined as separate CLINs in Model Contract Section B. However, note that a separate delivery date should be established in the Delivery Schedule for each Version of a CPCI which is a single CLIN, for the reasons discussed in Section C2.1.1. To avoid possible inconsistency, SOW definitions of tasks should reference the Delivery Schedule, rather than incorporate delivery dates and Periods of Performance. Similarly, the special CDRL entry representing each CPCI (see Section C2.1.2) must reference the Delivery Schedule for the CPCI's delivery date(s).

C2.4 Inspection and Acceptance

This, Model Contract Section I, includes conditions governing the delivery and acceptance of the CLINs and other deliverables (e.g., CPCI Versions). These conditions should include F.O.B. point, plus office(s) and site(s) for each delivery. For each CPCI Version, the conditions should also include the Version identification and the corresponding VDD, plus the number of copies of the Version and the number of copies of its VDD, to be delivered to each site.

To minimize deliveries of defective software, each Version should be appropriately tested before delivery, as a condition of its acceptance. If the Version incorporates extensive modifications, and if it is to be used operationally, a complete FQT should be required. The applicable testing should be specified in the CPCI's Test Plan and Test Procedures, normally prepared and approved after contract award. Model Contract Section H should reference the Test Plan and Test Procedures. Note that the Test Plan and Test Procedures for a CPCI to be delivered in Versions must accurately reflect each Version's definition. A certificate of satisfactory testing should accompany each Version on delivery. The Model Contract should define the form of these certificates and the signatures required. Normally DD Form 250 is used.

C2.5 Special Provisions

This, Model Contract Section J, typically contains important provisions not covered by standard contract clauses. Among these are: identification of the type of contract (e.g., CPIF, CPFF), a statement giving the Procuring Contracting Officer or his designee the sole right to direct contractor effort, definition of any contract options, the Order of Precedence, conditions governing contractor use of GFP, and definition of relationships among Government participants and contractors.

If the contract is to provide less than Unlimited Government Rights to data (i.e., documents and computer programs) produced under the contract, these rights will be set forth in Special Provisions. If any of these topics (e.g., Unlimited Government Rights to Data), is fully covered by a standard clause, the General Provisions (see Section C2.6) instead of the Special Provisions will contain that clause.

To permit its enforcement, each contractor-prepared plan (e.g., the CPDP, the SEMP) to be followed must be identified in the Special Provisions and included among the Attached Documents of the negotiated contract. A SOW paragraph must provide for updating each such plan (see Section 2.1.7) and a CDRL entry must call for preparation of its revisions (see Section C2.7).

C2.5.1 Order of Precedence. The Order of Precedence defines the way any inconsistencies among parts of the contract (including documents incorporated by reference) shall be resolved. That is, if provisions of two Sections of a contract conflict, the provision in the higher precedence Section will be deemed correct. The usual Order of Precedence is: the Schedule, General Provisions, the Specifications, the SOW (see Section 2), and the contractor's proposal (if included in the contract). Other Orders of Precedence are

permissible. For example, the System Specification should normally be given higher precedence than any Segment Specification, and a Segment Specification higher precedence than the corresponding Computer Program Development Specifications, to assure that any conflicts in specifications are resolved in favor of higher-level requirements. Note that the Order of Precedence will not resolve conflict within any of its defined categories. For example, the Order of Precedence could not decide between two conflicting paragraphs of the same SOW, unless these paragraphs were distinguished by the Order of Precedence.

While a defined Order of Precedence is an essential backup device to resolve conflict, every effort should be made to prevent conflict. Referencing other documents for information that is well-defined, instead of paraphrasing or summarizing it, is one valuable conflict-prevention technique. This also reduces the need for concurrent updating to reflect changes. For example, the SOW should reference Specification paragraphs rather than redescribe software to be developed. If a referenced specification no longer precisely describes what is wanted, it should be updated rather than incorporate the changes (or conflicting requirements) in the SOW.

C2.5.2 Government-Furnished Property (GFP). The GFP provisions should identify all items of GFP (including Government-furnished software or computer time) to be used by the contractor as development aids. They should also designate all GFP with which equipment or software to be developed under the contract must interface. In addition, they should specify the pertinent documentation to be made available and state when, where and under what conditions the contractor can use each GFP item. For example, the GFP provisions should include any Government-owned Operational Executive software with which contractor-developed Application Software will interface. Great care should be taken to identify GFP precisely, and to define correctly its interfaces with equipment or software to be developed under the contract. Otherwise, errors and omissions in GFP definition may support contractor claims against the Government.

C2.5.3 Working Relationships. The Special Provisions should define the working relationships of two or more contractors who must interface their products or tasks. For example, if the acquisition involves Independent Validation and Verification (V&V), the V&V contractor's role should be spelled out by enabling clauses in the development contractor's contract, and vice versa. Similarly, if Government contract management includes FCRC (e.g., MITRE) support, the Special Provisions should specify the intended FCRC-contractor relationships (e.g., by including one of the three optional standard MITRE enabling clauses). Finally, the Special Provisions should permit Government visibility (vs. control) into any subcontractors' activities. For example, the Special Provisions should direct a prime contractor to notify the Government of important meetings (e.g., PDRs, CDRs, FQTs) involving his subcontractors. These provisions should grant the Government the right to attend all such meetings. Also, the CDRL should specify contractor delivery to the Government of the most pertinent subcontractor-produced documents.

C2.5.4 Government Rights to Data. Inadequate provisions for Government rights to data produced under a contract have caused trouble and expense in several acquisitions. The contract should thus specify the type of rights (i.e., Unlimited, Limited, or Restricted) desired for each group of data.

As a rule the contract should grant the Government Unlimited Rights to all documents and software specified in the CDRL. ASPR 7-104.9 defines Unlimited Rights to include the rights of use, disclosure, duplication or distribution, for any purpose, by Government personnel or others.

ASPR 7-104.9 also defines Limited Rights and Restricted Rights. The Government should negotiate Limited Rights to other contractor-owned documents, and Restricted Rights to contractor-owned software, if needed to facilitate system development or management under the contract. For example, Restricted Rights to the contractor-owned compilers, diagnostics, and other Support Software to be used in the system during any phase of the Acquisition Life Cycle, plus Limited Rights to their documentation, are normally essential to effective Government use and maintenance of that software. Again, Limited Rights to use certain contractor-owned scenarios developed under a non-Government contract might be negotiated to support tests under the planned contract. However, any data needed for other current or future systems should be provided under the CDRL, with Unlimited Rights if economically feasible, considering all intended uses. In negotiating Limited Rights and Restricted Rights, Government representatives should try to avoid restrictions that could hamper the data's appropriate use at any time during the system's Acquisition Life Cycle. Since the effects of restrictions can be subtle, each proposed restriction should be discussed with the Government's technical managers, including the Software Director.

Before any data is procured, the contractor should certify that he has not previously delivered such data (under another contract)! Also, the Government should independently check (e.g., by search of the Defense Documentation Center (DDC) and the Air Force Logistics Command (AFLC) Software Library) that it does not already own such data or rights to them. The Government should also check to be sure that the data is not in the public domain!

The contract should also allow Government access to all unofficial documents (e.g., memoranda, design sketches, worksheets, non-deliverable versions of coding) produced through any effort exerted under the contract. The contractor should be required to identify all such informal documentation in a CDRL-defined Data Accession List deliverable monthly. DI-A-3027, Data Accession List/Internal Data, defines the Data Accession List. A SOW task should prescribe Data Accession List generation. These provisions should grant to designated Government personnel (e.g., those monitoring software development) the right, on demand, to inspect, review or copy any documents identified in a Data Accession List, provided the use and further dissemination of the information thus obtained is limited to legitimate purposes of this acquisition.

C2.6 General Provisions

This, Model Contract Section L. typically lists the standard ASPR contract clauses incorporated by reference in the Model Contract. These clauses give the Government important rights; e.g., to change or terminate a contract, to approve subcontracts. As an example, Table C-2 depicts the set of ASPR clauses in the Model Contract of a recent RFP. However, this example should not be used as a model, since the appropriate set of ASPR clauses and their dates may differ significantly among acquisition programs. The General Provisions also include other standard clauses (e.g., Restrictions on Printing, Release of Information) or incorporate them by reference. Finally, Section L includes any required and approved tailoring of standard clauses.

C2.7 Contract Data Requirements List (CDRL)

The CDRL is one of several Model Contract attachments. Others, such as the Specifications, the Preliminary CWBS (see Section A4.4) and the SOW, are included in RFP Volume III, or in RFP Volume IV if classified.

The CDRL defines the documentation and the software storage media deliverable under the contract. These are termed Data Items. All instances of each Data Item are defined in a sequence-numbered CDRL entry.*, ** Primarily, each Model Contract CDRL entry:

a. specifies the Data Item's title (and subtitle, if any);

b. identifies the Data Item Description (DID) that prescribes the Data Item's content and format, and indicates whether this DID is modified;

c. specifies the one or more SOW or ASPR paragraphs that call for the Data Item's preparation;

d. defines how often the Data Item must be delivered (e.g., once monthly);

e. specifies (e.g,. for periodic reports) the dates as of which each version of the Data Item should be prepared;

f. states the dates of the Data Item's initial submission and of any subsequent submissions;

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* ASPR 20-306, Data Item Sequence Numbering System, prescribes the assignment of sequence numbers to CDRL entries.

** Until recently all CDRL entries were prepared using a standard form, DD Form 1423, and associated preparation instructions. Currently, DD Form 1423 is being supplanted by new forms for which preparation instructions are undergoing review.

Table C-2

AN EXAMPLE SET OF ASPR CLAUSES

Reference Number	ASPR Paragraph	Clause Title	Date of Clause
1.	7-103.1	Definitions	1962 Feb
2.	7-103.2	Changes	1958 Jan
3.	7-103.3	Extras	1949 Jul
4.	7-103.4(a)	Variation in Quantity	1949 Jul
5.	7-103.5(a)	Inspection	1958 May
6.	7-103.5(b)	Variation of Above Clause #5 for Incentive Contracts Only	1962 Mr
7.	7-103.6	Title and Risk of Loss	1968 Jun
8.	7-103.7	Payments	1958 Jan
9.	7-103.8	Assignment of Claims	1962 Feb
10.	7-103.9	Additional Bond Security	1949 Jul
11.	7-103.10(a)	Federal, State, and Local Taxes	1971 Nov
12.	7-103.11	Default	1969 Aug
13.	7-103.12(a)	Disputes	1958 Jan
14.	7-103.13(a)	Renegotiation	1959 Oct
15.	7-103.14	Discounts	1968 Jun
16.	7-103.16(a)	Contract Work Hours and Safety Standards Act - Overtime Compensation	1971 Nov
17.	7-103.17	Walsh-Healey Public Contracts Act	1958 Jan
18.	7-103.18(a)	Equal Opportunity	1972 Aug
19.	7-103.19	Officials Not To Benefit	1949 Jul
20.	7-103.20	Convenant Against Contingent Fees	1958 Jan
21.	7-103.21(b)	Termination for Convenience of the Government	1974 Oct
22.	7-103.22	Authorization and Consent	1964 Mar
23.	7-103.23	Notice and Assistance Regarding Patent and Copyright Infringement	1965 Jan
24.	7-103.24	Responsibility for Inspection	1968 Sep
25.	7-103.26	Pricing of Adjustments	1970 Jul
26.	7-103.27	Listing of Employment Openings	1973 Sep
27.	7-104.3	Buy American Act	1964 May
28.	7-104.4	Notice to the Government of Labor Disputes	1958 Sep
29.	7-104.6	Filing of Patent Applications	1969 Dec
30.	7-104.9(a)(b)	Rights in Technical Data and Computer Software	1974 Nov
31.	7-104.9(h)	Technical Data - Withholding of Payment	1974 Apr
32.	7-104.9(i)	Identification of Technical Data	1972 Apr
33.	7-104.9(n)	Data Requirements	1972 Apr

Table C-2 (Continued)

Reference Number	ASPR Paragraph	Clause Title	Date of Clause
34.	7-104.9(p)	Restrictive Markings on Technical Data	1974 Apr
35.	7-104.12	Military Security Requirements	1971 Apr
36.	7-104.14(a)	Utilization of Small Business Concerns	1958 Jan
37.	7-104.15	Examination of Records by Comptroller General	1971 Mar
38.	7-104.16	Gratuities	1952 Mar
39.	7-104.17	Convict Labor	1974 Apr
40.	7-104.18	Priorities, Allocations and Allotments	1974 Apr
41.	7-104.20(a)	Utilization of Labor Surplus Area Concerns	1970 Jun
42.	7-104.21(a)	Limitation on Withholding of Payments	1958 Sep
43.	7-104.23(a)	Subcontracts	1974 Apr
44.	7-104.24(a)(c)	Government Property (Fixed Price)	1968 Sep
45.	7-104.32	Duty-Free Entry - Canadian Supplies	1971 Feb
46.	7-104.36(a)	Utilization of Minority Business Enterprises	1971 Nov
47.	7-104.38	Required Sources for Miniature and Instrument Ball Bearings	1971 Jul
48	7-104.39	Interest	1972 May
49.	7-104.41(a)	Audit by Department of Defense	1974 Apr
50.	7-104.45(a)	Limitation of Liability	1974 Apr
51.	7-104.62	Material Inspection and Receiving Report	1969 Dec
52.	7-104.68	Marking of Shipments	1968 Jun
53.	7-104.77(f)	Government Delay of Work	1968 Sep
54.	7-104.82	Payment of Interest on Contractors' Claims	1972 May
55.	7-105.3(c)	Stop Work Order	1971 Apr
56.	7.105.4	Report of Shipment (Repship)	1968 Jun
57.	7-104.9(o)(1)	Warranty of Technical Data	1974 Oct
58.	7-104.29(a)	Price Reduction for Defective Cost or Pricing Data	1970 Jan
59.	7-104.40	Competition in Subcontracting	1962 Apr
60.	7-104.42(a)	Subcontractor Cost or Pricing Data	1970 Jan
61.	7-104.44(a)(1)	Value Engineering Incentive	1974 Apr
62.	7-104.71	F.O.B. Destination	1960 Apr

Table C-2 (Concluded)

Reference Number	ASPR Paragraph	Clause Title	Date of Clause
63.	7-104.75	Diversion of Shipment Under F.O.B. Destination Contracts	1971 Nov
64.	7-104.76	F.O.B. Destination - Evidence of Shipment	1968 Jun
65.	7-104.83	Cost Accounting Standards	1974 Jan
66.	7-104.86	Notification of Changes	Undated
67.	7-104.89	Engineering Change Proposals	Undated
68.	7-104.90	Change Order Accounting	Undated
69.	7-105.2	Approval of Contract	1949 Jul

g. contains the distribution list (i.e., the Data Item's recipients, the number of copies each should receive, and the total number of copies); and

h. states any requirement for Government review and approval of the data item before its final publication and acceptance.

Each Model Contract CDRL entry also includes blank fields for Offerer estimates of the Data Item's price and number of pages. The price must be based on the Offerer's estimates of his costs to develop, reproduce, and distribute the Data Item, over and above the costs he would otherwise occur if the Data Item were not required.* The contractor's proposal must provide this information. (Usually the RFP states that a proposal that lacks these price estimates may be rejected as non-responsive).

A Data Item's title (and subtitle, if any) must agree with those in the SOW paragraph(s) prescribing its preparation, in order to avoid ambiguity. To maximize SOW/CDRL consistency, a proposed CDRL entry should be prepared for each Data Item (or set of identically defined Data Items) planned to result from the effort of each SOW paragraph. The same CDRL entry may define more than one Data Item (e.g., several CPCIs' Computer Program Product Specifications) provided that CDRL entry correctly defines them all. These CDRL entries and the SOW should be developed in parallel, by the same persons. Preparation of proposed CDRL entries is facilitated by using AFSC Form 40, explained in AFSCR 310-1. This provides room both for outlining and for justifying the CDRL entry. The latter is necessary because each proposed Data Item is subject to formal challenge on grounds of cost-effectiveness by a Data Requirements Review Board, per AFR 310-1, Management of Contractor Data.

As discussed in Section C2.1.2, each CPCI must be represented by an Exhibit CLIN and by a special CDRL entry as well as by a normal CLIN. This special CDRL entry must not specify delivery dates. Instead, it must reference the Delivery Schedule. When several successive Versions of a CPCI are to be delivered, a normal CDRL entry should prescribe the corresponding VDDs (see Section C2.1.1) and a special CDRL entry should specify the corresponding storage media. (See Section 2.1.2).

Each enforceable contractor-prepared plan (e.g., the CPDP, the SEMP) to be delivered or modified under the contract must be defined by a CDRL entry.

Wherever a modified DID prescribes a CDRL entry's form and content, the DID identification must indicate this (e.g., by appending "/M" to the DI number). The modifications themselves must be stated in the CDRL entry itself, or on backup sheets attached to the CDRL.

CDRL preparation and DID modification are further described in ESD-TR-76-159, An Air Force Guide to Software Documentation Requirements, in AFSCR 310-1 (including ESD Supplement 1), and in AFR 310-1.

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* GPO Form 1971 0-428-580, Instructions for Completing DD Form 1423.

C3. RFP Volume III - Attached Documents and References

The Attached Documents and References should include the SOW, the Specifications, the appropriate Project Summary WBS or Summary PBS, the Preliminary CWBS, their Dictionaries, any applicable Engineering Drawings, DD Form 254 (Contract Security Classification Specification), all enforceable contractor-prepared plans, and any other documents that provide background information essential to the particular contract. Except for the CDRL (part of RFP Volume II), these comprise the usual contents of UCF Volume III.

The Attached Documents and References should also include copies of any unique, modified or Research and Development (R&D) DIDs referenced in CDRL entries. Other referenced documents (e.g., the ASPR clauses, military standards) which Offerers may be presumed to possess, or which can be obtained from standard sources, are normally omitted from the RFP. Whenever the RFP omits a referenced document, Offerers should be given rapid access to it on request, subject to compliance with security regulations. An Offerer's Library, if established for the acquisition, can satisfy this need.

Appendix A describes WBSs and their Dictionaries. Sections 2 and 3 treat SOW requirements. Sections C3.1 - C3.2, respectively, discuss the Specifications, Engineering Drawings, and DD Form 254.

C3.1 The Specifications

Not to be confused with the Description/Specifications (see Section C2.2), the Specifications (e.g., the System Specification) are the RFP attachments that define the system and its parts. Thus, the Specifications are an essential part of a RFP for a contract that includes software development, since the effort contracted for is best defined relative to Specification provisions.

A RFP may include software-related specifications of several levels and types*, depending on the contractual approach, on the Acquisition Life Cycle Phase (see LCEG, Sections 2-6), and on the types of work and product being contracted for. Table C-3 depicts the structure and contents of the more important types of software-related specifications. LCEG, Appendix A summarizes them.

C3.2 Engineering Drawings

These typically describe equipment (e.g., portions of a graphical display device), a site (e.g., a command post layout, a computer installation), or interfaces (e.g., between systems). Such Engineering Drawings are necessary for the development of any software that must interface with equipment, the persons operating it, or other software, unless the interface is otherwise precisely defined (e.g., in Computer Program Development Specifications). See ESD-TR-76-159 for further details.

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* MIL-S-83490, Specifications, Types and Forms, and MIL-STD-490, paragraphs 3.3 & 3.4.3, briefly define the different prescribed specification types. ESD-TR-76-159 also discusses several types of specification

Table C-1

OUTLINES OF SOFTWARE-RELATED SPECIFICATION TYPES

Para Graph	Type A* System or Segment	Type B5** Computer Program Development	Type C5# Computer Program Product
1	Scope	Scope	Scope
1.1		Identification	
1.2		Functional summary	
2	Applicable documents	Applicable documents	Applicable documents
3	Requirements	Requirements	Requirements (technical description)
3.1	System definition	Computer program definition	Functional allocation description
3.1.1	General description	Interface requirements	
3.1.1.1		Interface block diagram	
3.1.1.2		Detailed interface definition	
3.1.2	Missions		
3.1.3	Threat		
3.1.4	System diagrams		
3.1.5	Interface definition		
3.1.6	Government furnished property list		
3.1.7	Operational and organizational concepts		
3.2	Characteristics	Detailed functional requirements	Functional description
3.2.1	Performance characteristics	Function (first Function's name)	CPC (first CPC's name)

Table C-1 (Continued)

Paragraph	Type A* System or Segment	Type B5** Computer Program Development	Type C5# Computer Program Product
3.2.1.1		Inputs	Description: (first CPC's name)
3.2.1.2		Processing	Flow chart: (first CPC's name)
3.2.1.3		Outputs	Interfaces: (first CPC's name)
3.2.1.4		(Function, Inputs, Processing & Outputs are repeated for each other Function)	Data organization: (first CPC's name)
3.2.1.5			Limitations: (first CPC's name)
3.2.1.6			Listing: (first CPC's name) (The seven sections above are repeated for every other CPC)
3.2.n		Special requirements	
3.2.n.1		Human performance	
3.2.n.2		Government-furnished property list	
3.2.2	Physical characteristics		
3.2.3-5	Reliability, maintainability & availability		
3.2.6	System effectiveness models		
3.2.7	Environmental conditions		
3.2.8	Nuclear control requirements		
3.2.9	Transportability		
3.3	Design and construction	Adaptation	Storage allocation

Table C-I (Continued)

Paragraph	Type A* System or Segment	Type B5** Computer Program Development	Type C5# Computer Program Product
3.1.1	Materials, processes & parts	General environment	Data base characteristics
3.1.2	Electromagnetic radiation	System parameters	
3.1.3	Nameplates & product markings	System capacities	
3.1.4-6	Workmanship, interchangability & safety		
3.1.7	Human performance/ human engineering		
3.1.8	Computer programming		
3.4	Documentation		Computer program functional flow diagram
3.4.1			Program interrupts
3.4.2			Logic of subprogram reference
3.4.3			Special control features
3.5	Logistics		
3.6	Personnel and training		
3.7	Functional area characteristics		
3.8	Precedence		
4.	Quality assurance provisions	Quality assurance provisions	Quality assurance
4.1	General	Introduction	Test plan/procedure cross-reference index

Table C-3 (Concluded)

Paragraph	Type A* System or Segment	Type B5** Computer Program Development	Type C5ø Computer Program Product
4.1.1	Responsibility for tests	Category I test	
4.1.2	Special tests & examinations	Computer programming test & evaluation	
4.1.3		Preliminary qualification tests	
4.1.4		Formal qualification tests	
4.1.5		Category II system test program	
4.2	Quality conformance inspections	Test requirements	Other quality assurance provisions
4.3		Acceptance test requirements	
5.	Preparation for delivery	Preparation for delivery	Preparation for delivery
5.1			Preservation and packaging
5.2			Markings
6.	Notes	Notes	Notes
10, 20, etc.	Appendices I, II, etc. (if any)	Appendices I, II, etc. (if any)	Appendices I, II, etc. (if any)

*Per MIL-STD-490, Appendix I, and MIL-STD-483(USAF), Appendix III
**Per MIL-STD-490, Appendix VI, and MIL-STD-483(USAF), paragraph 60.4.
øPer MIL-STD-490, Appendix XIII, and MIL-STD-483(USAF), paragraph 60.5

C3.3 Contract Security Classification Specification

Consisting of DD Form 254 plus possible attachments, this states the security requirements applicable to the contract. For example, it prescribes the level(s) of security clearance required of contractor personnel working on the contract.

C4. RFP Volume IV - Classified Parts of the RFP

Any classified attachments, or other classified provisions of the RFP, will be contained in Volume IV, and referenced from their usual places. For example, Volume IV would contain a classified System Specification, any classified Segment Specifications, and any classified Development Specifications or Product Specifications.

LIST OF ABBREVIATIONS

Abbreviation	Definition
ACI	Allocated Configuration Identification
ADP	Automated Data Processing
AFLC	Air Force Logistics Command
AFSC	Air Force Systems Command
ASPR	Armed Services Procurement Regulations
ATC	Air Training Command
BA/PA	Budget Authorization/Program Authorization
BITE	Built-in Test Equipment
CCB	Configuration Control Board
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CI	Configuration Item
CLIN	Contract Line Item or Subline Item
CMP	Configuration Management Plan
CPAF	Cost Plus Award Fee
CPC	Computer Program Component
CPCI	Computer Program Configuration Item
CPDP	Computer Program Development Plan
CPFF	Cost Plus Fixed Fee
CPIF	Cost Plus Incentive Fee
CPMF	Computer Program Maintenance Facility
CRISP	Computer Resources Integrated Support Plan
CWBS	Contract Work Breakdown Structure
DCP	Decision Coordinating Paper
DDC	Defense Documentation Center
DID	Data Item Description
DoD	Department of Defense
DODD	Department of Defense Directive
DODI	Department of Defense Instruction
DSARC	Defense Systems Acquisition Review Council
DT&E	Development Test and Evaluation
ECO	Engineering Change Order
ECP	Engineering Change Proposal
ESD	Electronic Systems Division
FA	Functional Area
FCA	Functional Configuration Audit
FCI	Functional Configuration Identification
FCRC	Federal Contract Research Center
FFP	Firm Fixed Price
FOT&E	Follow-on Operational Test and Evaluation
FPIF	Fixed Price Incentive Firm
FQR	Formal Qualification Review
FQT	Formal Qualification Test
GFP	Government-Furnished Property
IFPP	Instructions for Proposal Preparation
IOT&E	Initial Operational Test and Evaluation
LCC	Life Cycle Cost

LIST OF ABBREVIATIONS (Concluded)

Abbreviation	Definition
LCEG	Software Acquisition Management Guidebook: Life Cycle Events
OT&E	Operational Test and Evaluation
PBC	Program Breakdown Code
PBS	Program Breakdown Structure
PCA	Physical Configuration Audit
PCO	Procuring Contracting Officer
PDR	Preliminary Design Review
PM	Program Manager
PMD	Program Management Directive
PMP	Program Management Plan
PQT	Preliminary Qualification Test
PO	Program Office
PSL	Programming Support Library
PWBS	Program Summary Work Breakdown Structure
QA	Quality Assurance
R&D	Research and Development
RFP	Request for Proposal
SA	Supplemental Agreement
SCN	Specification Change Notice
SDR	System Design Review
SEMP	System Engineering Management Plan
SOW	Statement of Work
SRR	System Requirements Review
SSA	Source Selection Authority
SSAC	Source Selection Advisory Council
SSEB	Source Selection Evaluation Board
SSP	Source Selection Plan
STINFO	Scientific and Technical Information
T&E	Test and Evaluation
TBD	To be Determined
TEMP	Test & Evaluation Master Plan
TPM	Technical Performance Measurement
UCF	Uniform Contract Format
V&V	Validation and Verification
VDD	Version Description Document
VE	Value Engineering
VECP	Value Engineering Change Proposal
WBS	Work Breakdown Structure

REFERENCES*

DEPARTMENT OF DEFENSE PUBLICATIONS

ASPR Section IX** Part 6	Rights in Computer Software Acquired Under Contract
ASPR Section XX** Part 3	Contract Exhibits and Data Item Sequence Numbering System
TD-3 1 November 1975	DoD Authorized Data List, Index of Data Item Descriptions

MILITARY SPECIFICATIONS AND STANDARDS

MIL-S-52779(AD) 5 April 1974	Software Quality Assurance Program Requirements
MIL-S-83490 30 October 1968	Specifications, Types and Forms
MIL-STD-480 30 October 1968	Configuration Control - Engineering Changes, Deviations and Waivers
MIL-STD-483(USAF) including Notice 1 1 June 1971	Configuration Management Practices for Systems, Equipment, Munitions, and Computer Programs
MIL-STD-490 including Change 2 18 May 1972	Specification Practices
MIL-STD-499A(USAF) 1 May 1974	Engineering Management
MIL-STD-881A 25 April 1975	Work Breakdown Structures for Defense Materiel Items
MIL-STD-1521(USAF) including Change 2 2 January 1975	Technical Reviews and Audits for Systems, Equipment, and Computer Programs
MIL-V-38352 including Amendment 1 20 January 1965	Value Engineering Program Requirements

AIR FORCE AND SUBORDINATE COMMAND DIRECTIVES

AF ASPR Supplement 1-2100.50	Procurement Plan

AFR 70-15 16 April 1976	Source Selection Policy and Procedures
AFR 80-45 26 March 1971 AFSC Sup. 1 4 February 1976 ESD Sup. 1 10 Nov. 1971	Distribution Statements on Technical Documents
AFR 310-1 including Change 1 14 June 1971	Management of Contractor Data
AFR 800-14, Vol. II 26 September 1975	Acquisition and Support Procedures for Computer Resources in Systems
AFSCM 173-4 24 November 1972	Program Breakdown Structure and Codes
AFSCP 70-4 30 May 1975	Request for Proposal Preparation Guide
AFSCP 800-6 18 August 1972	Statement of Work Preparation Guide
AFSCR 70-9 16 August 1974 ESD Sup. 1 20 October 1975	Source Selection Procedures
AFSCR 80-15 31 December 1974	R&D Source Selection Policy and Guidance
AFSCR 310-1 11 March 1974 ESD Sup. 1 10 October 1974	Management of Contractor Data
ESDP 800-4 1 December 1975 including Change 1 (to be published)	Statement of Work Preparation Guide

DATA ITEM DESCRIPTIONS

DI-A-3027	Data Accession List/Internal Data
DI-E-129	Computer Software/Computer Program/ Computer Data Base Configuration Item(s)

DI-E-695/ESD — Computer Program Development Plan

DI-E-3121 — Version Description Document (Computer Programs)

OTHER

Joseph T. Connolly, Software Acquisition Management Guidebook: Regulations, Specifications and Standards, ESD-TR-75-91 (MTR-3080, Contract F19628-75-C-0001, The MITRE Corporation, Bedford, Mass.), October 1975.

S. R. Hagan and C. W. Knight, An Air Force Guide for Monitoring and Reporting Software Development Status, ESD-TR-75-85 (MTR-3051, Contract F19628-75-C-0001, The MITRE Corporation, Bedford, Mass.), September 1975.

N. E. Bolen, An Air Force Guide to Contracting for Software Acquisition, ESD-TR-75-365, (MTR-3118, Contract F19628-76-C-0001, The MITRE Corporation, Bedford, Mass.), January 1976.

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* The Regulations, Specifications, Standards and DIDs cited are those in effect when the research for the guidebook was completed. Since that time new versions of, or changes to, some of them have been issued. Readers who want to consult the latest version of, or changes to, a reference should check official sources.

** Also see Table C-2 for other ASPR clauses referenced.