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Software Engineering Exercise Guidelines

July 1989



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Prepared for Deputy for Product Assurance and Acquisition
Logistics, Electronic Systems Division, AFSC, United
States Air Force, Hanscom Air Force Base, Massachusetts

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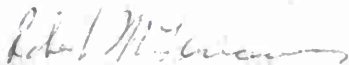
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This technical report has been reviewed and is approved for publication.



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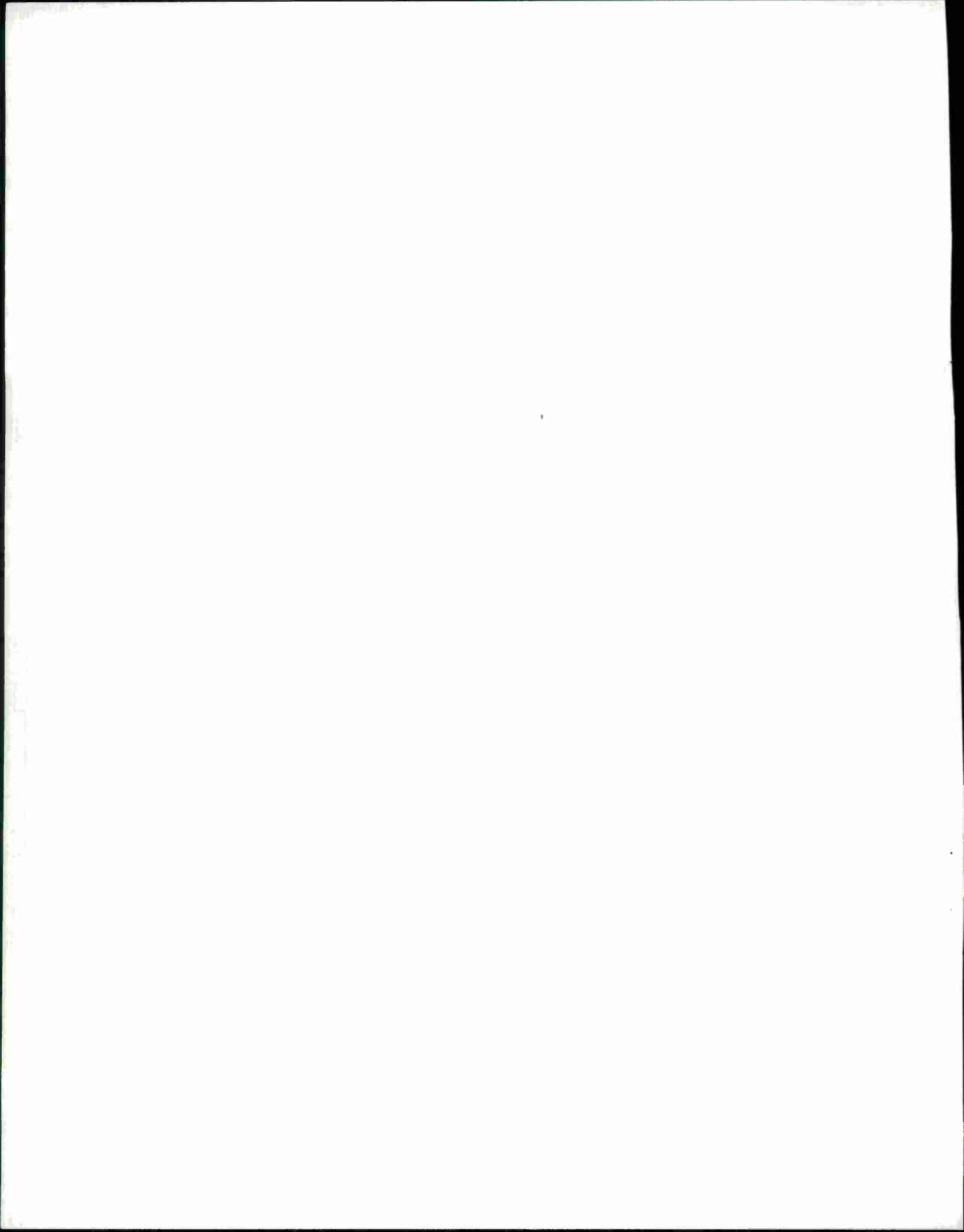
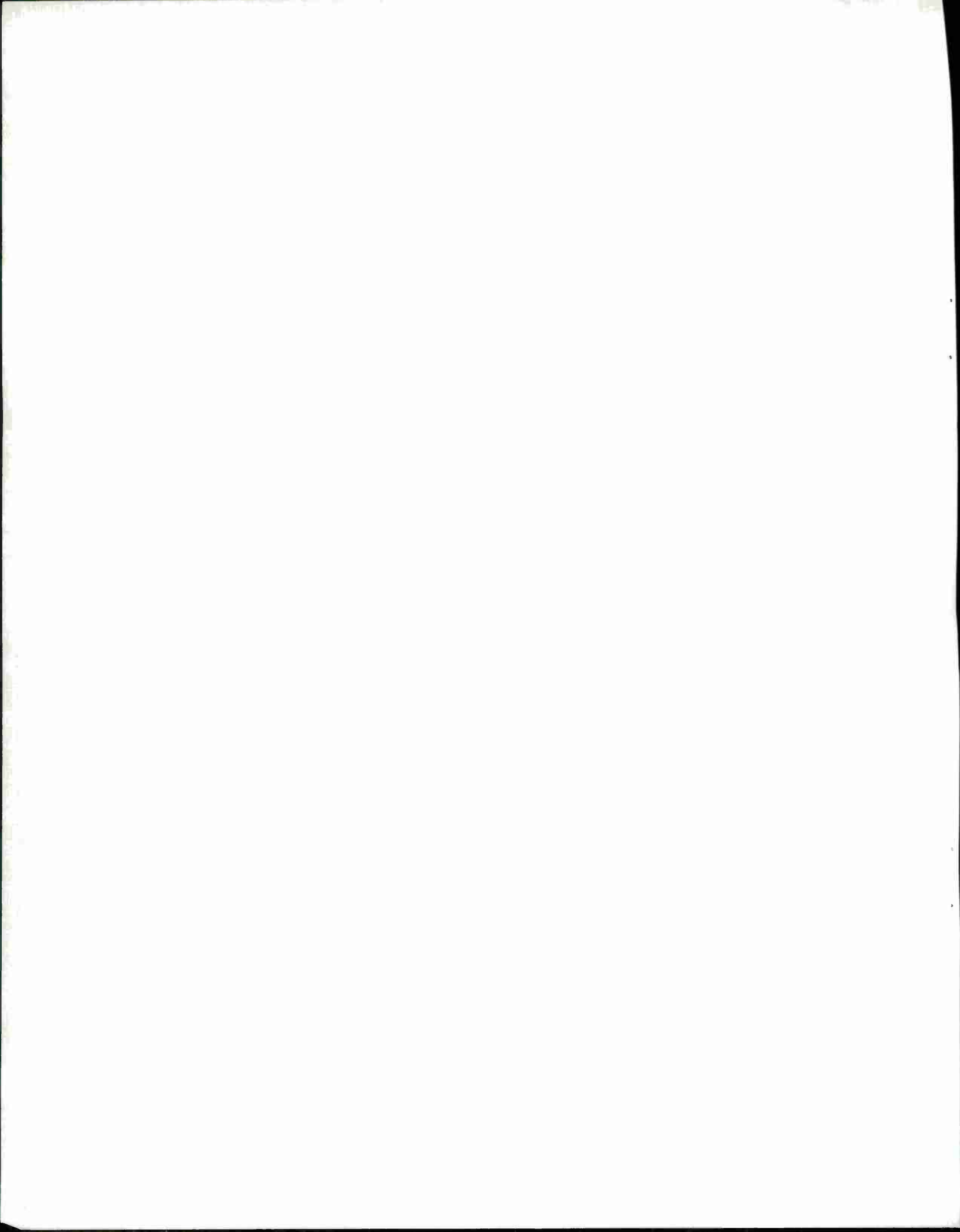


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SECTION 1

OVERVIEW

CONCEPT

The Software Engineering Exercise (SEE) is a risk reduction measure designed to be used during the source selection process as part of the technical evaluation of offerors. It is considered to be an effective discriminator in reducing the risks normally associated with a software acquisition. The SEE encompasses the development and administration of an exercise (test problem) that is implemented by an offeror in a restricted time period (usually less than a month). The exercise problem typically addresses one or more software risk areas and is designed to be evaluated quickly in order to minimize its schedule impact. The SEE normally requires the offerors to submit a draft Software Development Plan (SDP) with their proposals, because the ability to follow the SDP is a major concern of the SEE.

While the SEE is designed to assist in the technical evaluation during a source selection, it may also be applied after contract award; for example, as a work task in a Concept Definition (CD) phase contract prior to Full-Scale Development (FSD), or as an early FSD phase task. When used in these ways, the SEE provides an early indication of a contractor's ability to implement his SDP and provides an early focus on potential problem areas.

The purpose of this document is to provide guidance in the implementation of a SEE; it is not a standard for performing one. There are too many variables, including number of offerors, size of contract, risk areas, and type of contract (CD, FSD, demonstration, preproduction) to specify only one SEE method. The guidance contained in this document is meant to cover the major SEE activities; the acquisition agent can select from and modify these activities to tailor a SEE for a particular application. If time and staff are limited, trade-offs may be made to reduce the effort to perform a SEE (streamlining of the SEE is discussed in section 2.)

The decision to use the SEE should take into account many factors such as the number and severity of software risks in the procurement, the cost of the SEE in terms of program staff and schedule, the cost to bidders (the SEE may be particularly burdensome to small companies forcing them out of the competition), the availability of experienced program office software staff, and some factors mentioned above such as size of procurement, number of bidders, and type of contract. This document provides insight into the effort, time, and skills required to implement a SEE, and in that way is an input to the SEE decision process.

OBJECTIVES

Source Selection

When used during a source selection, the SEE helps the Government determine if offerors have the software engineering capability to implement their proposals. It provides a means to evaluate each offeror's software development process including their requirements analysis approach, design methods, and facility with the proposed or required design and implementation languages. It requires the offerors to apply their proposed SDP and the prescribed tools and techniques, and to demonstrate their ability to apply modern software engineering practices to a problem. The problem itself usually focuses on software risk areas of the development so that offerors may illustrate their knowledge and expertise in pertinent technology areas.

Once the source selection is completed and an offeror selected, the exercise results may be used further to alert the Government to areas requiring special attention after contract award. Typically, it is not discovered until the first delivery of a Software Requirements Specification (SRS) that the contractor does not have the same expectations for product quality as the Government. If such inconsistencies exist, they may be addressed by amendments to the Statement of Work (SOW) requiring the contractor to enhance his software development process; these might include changes to his software development standards, documentation standards, training requirements, or tools.

It is recommended that the SEE process include a dry run of the exercise problem by the Government prior to its delivery to the offerors. This activity can improve the quality of an acquisition by identifying potential acquisition problems that can be addressed by clarifications or changes to the specification, SOW, schedule, or other contractual documents. The dry run has also been found to be a most effective (and cost-effective) way of training the Government team in current software engineering methods and software acquisition practices that it will apply not only during the evaluation of SEE products, but during FSD. It is therefore important that the team that conducts the dry run and evaluates the SEE products continues on the program after contract award.

After Contract Award

If the SEE is not used as part of the source selection process, it may be used after contract award to provide early visibility into potential problems the contractor may have in implementing his SDP. It establishes an early understanding between the contractor and the Government of the expected quality of delivered products including the SRSs and subsequent design documents. Also, the exercise problem can accomplish some early contract task, such as a prototyping exercise, considered necessary for the system's development. When used during a CD phase, the results may be used during the subsequent FSD phase source selection if no new offerors are introduced.

SECTION 2

SEE PREPARATION

PLANNING

This section describes the activities necessary to conduct a SEE. Schedule, cost, and staffing requirements must be carefully estimated and planned so that the scope of the SEE does not exceed the project's budgets. The schedule and cost associated with SEE tasks varies significantly depending upon whether the SEE is used in a source selection or after contract award, and upon the effort necessary to develop and dry run the SEE problem. Figure 1 is an example of a nominal SEE schedule utilizing two to three staff. However, as mentioned in the previous section, there are many procurement variables (size, risks, etc.) that can influence the scope of the various SEE activities and the SEE should be tailored accordingly. Trade-offs that may reduce the effort required are discussed at the end of this section under Streamlining.

Experience has shown that more effort may be required to conduct a SEE than is anticipated, particularly the preparation and dry run of the SEE problem. There are tasks associated with the dry run that are not readily apparent; for example, in addition to the effort required to prepare the problem products during the dry run (SRSs, Software Design Documents (SDDs), etc.), it may be necessary to develop a draft SDP (the SEE is used to verify the use of the SDP). It may also be necessary to acquire computer tools and to train the dry run team (for example, in requirements analysis techniques, design methods, and Ada); and to resolve problems with contractual documents (specification, SOW, Instructions for Proposal Preparation (IFPP)) that are brought to light by the dry run. Each of these potential tasks must be planned, and trained personnel and computer resources made available.

The following tasks outline the process of preparing a SEE and are discussed individually in the following paragraphs. Next to each task is an estimated range of the number of staff months (SM) required for each task; the wide variation is a function of the number of software risk areas, size of procurement, type of contract, streamlining effected, and other procurement variables.

- Preparing the Draft Problem Specification (1-5 SM)
- Dry Run of the Problem (2-10 SM)
- Preparing the Input to RFP Documents (1-3 SM)
 - IFPP
 - Evaluation Criteria
- Preparing the SEE Package (2-5 SM)
 - Detailed Instructions for the Offerors
 - Final Problem Specification

PREPARING THE PROBLEM SPECIFICATION

The first step in conducting a SEE is to develop the exercise problem. The problem may require the offerors to analyze performance requirements; illustrate their design method; illustrate their knowledge of one or more high-risk areas; and to use the software engineering tools, methods, and techniques contained in their SDPs. The problem must be relevant to the software risks of the system

NOTE: This is only an example! Actual schedules may vary significantly as a function of the tailoring of the SEE and of the scope of the exercise problem.

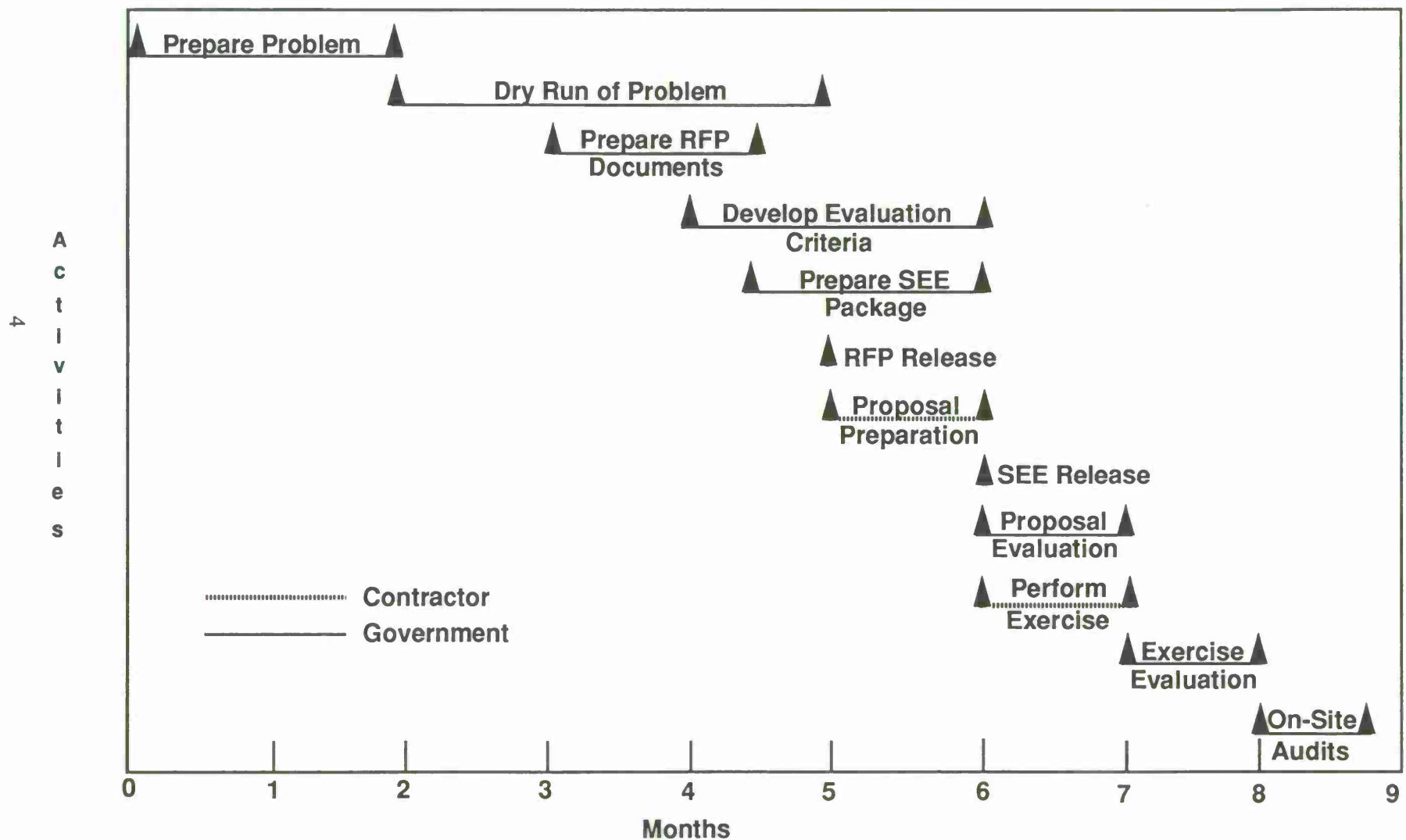


Figure 1. Example SEE Schedule

being acquired and restricted enough to allow requirements analysis, design, and possibly some coding to be accomplished in the time allocated (usually three to four weeks).

DRY RUN OF THE PROBLEM

A dry run of the exercise problem is usually conducted to develop nominal solutions to the problem, to discover any shortcomings and unintended ambiguities, to develop detailed instructions for the offeror, to develop problem evaluation criteria, and to gain knowledge to evaluate the SEE products more effectively. Indirect (but perhaps equally important) objectives are to develop team skills in requirements analysis methods, design methods, design languages, the implementation language (if specified), and applicable standards such as DOD-STD-2167A. The following paragraphs discuss the major tasks associated with preparing the dry run.

Tools and Methods

The first step of the dry run is to select the tools and methods to be used and to become familiar with their use. These might include required standards (DOD-STD-2167A, MIL-STD-490, and others), requirements analysis methods, design methods (structured, object oriented, etc.), design representation techniques (such as Buhr diagrams), a program design language, and an appropriate software development environment. If the team is not familiar with one or more of the tools and methods to be employed, appropriate education and training activities must be arranged (see team training below).

Schedule

The example schedule in figure 1 assumes a nominal problem development effort and a new team with limited experience in the problem and with the tools and methods to be used. The time required to accomplish the dry run should take into account any necessary team training and any necessary refinement and clarification of the problem specification resulting from the dry run.

Team Training

If the dry run team is not familiar with the application, the requirements analysis and design methods, the tools to be used, the implementation language (if specified), or a Program Design Language (PDL), then time must be allocated for training, and consultants made available to assist as needed. The team might also include a Government representative who, among other things, can assist in the resolution of requirements issues.

Requirements Analysis

This is the first task in the actual dry run of the SEE problem. The input to this task is the draft problem specification. The products of this task typically include: a software architecture that identifies Computer Software Configuration Items (CSCIs), the technically significant sections of the SRSs for each CSCI, the Interface Requirements Specifications, and data and control flow diagrams.

Design

This dry run task follows requirements analysis, and its objective is to raise as many method and design issues as possible to prepare for the offerors' various responses. The problem should require certain difficult areas, (for example, interfaces, timing, control, and concurrency) to be detailed at the Computer Software Component (CSC) level. Some coding, unit testing, and integration could also be required for a specified function or set of functions.

Dry Run Analysis

After completing the dry run, an evaluation is conducted to determine if clarifications or changes should be made to any contractual documents (specification, SOW, schedule and so on) and to develop better evaluation criteria for each factor and subfactor. The problem specification may also be modified to ensure that intended requirements analysis and design trade-offs are addressed by the offerors.

PREPARING THE INPUT TO RFP DOCUMENTS

It is necessary to state in the Request for Proposal (RFP) that a SEE will be conducted as part of the source selection process and describe what it entails. It is also necessary to include the criteria to be used in evaluating an offeror's response. The SEE announcement is inserted in the IFPP section of the RFP and a brief discussion of what the SEE entails is documented in the Preliminary Instructions for the Offerors section. The detailed instructions for the offerors and the final problem specification are normally delivered to the offerors upon submission of their proposals. However, if the SEE is released with the RFP, then it would contain the detailed instructions for the offerors and no preliminary instructions would be required. It is also necessary to state in the RFP that a draft SDP must be submitted with the proposal. The ability of the offerors to follow their SDPs is a major factor in the SEE evaluations.

SEE Announcement

A paragraph similar to the following should be included in the Instructions For Preparation of Proposal section of the RFP. It states that a SEE will be conducted and refers to an appendix or attachment that contains the preliminary instructions for the offerors:

"SOFTWARE ENGINEERING EXERCISE (SEE)

The offeror shall be given a problem specification defined by the Government. The response will be evaluated as part of the source selection process. The attached Preliminary Instructions for the Offerors (*appendix A of this document contains an example*) describes the SEE and the SEE products. The SEE problem specification and detailed instructions will be provided following submission of proposals."

Section M, Evaluation Criteria

A statement that describes the general criteria to be used to evaluate the offerors' SEE products must be included in the Evaluation Criteria section of the RFP (appendix B of this document contains an example). The evaluation criteria are based on risk areas related to the success of the software development. Lessons learned during the dry run can be instrumental in helping to establish these evaluation criteria. Evaluation standards and factors are developed to evaluate both the SEE products and the capabilities of the offeror's staff. These are discussed in section 3.

PREPARING THE SEE PACKAGE

The SEE package includes two documents: 1) the Detailed Instructions for the Offerors, and 2) the final Problem Specification. It is recommended that the package be delivered to the offerors upon submission of proposals (this is done so that the offerors may concentrate on only one effort -- the proposal or the SEE -- at a time). This also allows the Government to concentrate its efforts in a similar manner. There is no interaction between the offerors and Government during the offerors'

implementation of the SEE, allowing the Government to concentrate on the technical evaluation of proposals while the offerors concentrate on the SEE.

Detailed Instructions for the Offerors

Appendix C of this document contains an example of the Detailed Instructions for the Offerors. Typically the detailed instructions are prepared following the dry run, and are more specific and detailed than the preliminary instructions included in the RFP, reflecting changes effected as a result of the dry run. The detailed instructions should only request the offerors to submit products that demonstrate the offeror's competence with the software engineering process, and provide evidence that he can follow his SDP; the list of requested products may also include example products from development activities that follow detailed design. The instructions may require the offeror to deliver all appropriate products in machine-readable form so that they may be compiled and analyzed as part of the evaluation. Also, the instructions should stipulate that all participants must be identified in the proposal as members of the development team (no consultants or ringers are allowed).

Problem Specification (Final)

The problem specification is typically revised as a result of the dry run to reflect lessons learned and to resolve any unintended ambiguities (appendix D contains a skeletal example). Some ambiguities may be left in the problem to measure an offeror's ability to detect and resolve ambiguities during requirements analysis. However, it is particularly important to remove unintended ambiguities since no communications with the offerors are permitted during the offerors' performance of the exercise problem.

STREAMLINING

Streamlining is a desirable goal in most procurements, but something must be given up to accomplish the streamlining -- in this case, some of the risk reduction and quality of results. As one person said, "The best SEE streamlining is no SEE." This is true if the streamlining is so extreme as to jeopardize the integrity of the SEE results. This points out the great care that should be used in eliminating or reducing any SEE tasks and that trade-offs between the effort saved and the quality of the SEE results should be carefully weighed. Having said this, the following paragraphs present some streamlining ideas both for source selection and after contract award applications of the SEE.

Source Selection

Streamlining the preparation of the problem specification and its subsequent dry run can be accomplished by focusing on system requirements studied during the preparation of the system specification. The effort to prepare and dry run a problem can be reduced if it is analogous to one that has already been studied (for example, an issue from the system specification that was the subject of a pre-RFP study, a study that was part of another system but not used in a SEE, or a classic problem for which there are many solutions). Use of such a problem reduces the time to develop the problem specification as well as the time to perform a dry run since solutions would already have been studied. However, care must be taken to ensure that the exercise problem is unique and that one offeror does not have any more advance knowledge of the problem than another.

The dry run of the exercise problem is usually the most time-consuming task of conducting a SEE. A SEE may be implemented with a minimal dry run, but this should be considered only if experts are available to perform the evaluation of the SEE products or if the team is familiar with the exercise problem; for example, the problem was the subject of pre-RFP studies. The SEE has been given to

contractors during a CD phase without a dry run and, used in this way, the results were found useful in the subsequent FSD source selection.

After Contract Award

Some of the SEE tasks may be tailored out or accomplished in a less rigorous and structured manner if the SEE is applied after contract award, since the results do not affect a source selection. For example, if the problem is extracted from the system segment specification and was also the subject of pre-RFP studies, this would greatly reduce the time both to prepare and to dry run the SEE problem. Other streamlining that may be accomplished in an after contract award application includes replacing the IFPP documents with a simplified statement of criteria and with a simplified set of instructions to the contractor. The evaluation standards and factors can be informal since the results are not for source selection use. The on-site audit can be a technical interchange meeting that focuses on needed management or process changes rather than on scoring as for a source selection.

SECTION 3

EVALUATING THE RESULTS

FACTORS AND SUBFACTORS

When the SEE is used for the technical evaluation of an offeror during a source selection, factors and subfactors must be developed together with associated evaluation criteria for scoring purposes. Some of the example evaluation criteria contained in appendix B could be broken down into evaluation factors and subfactors as follows (also included are some example criteria):

Factor A, Methods Used

Subfactor 1, Requirements Analysis Methods

Example Criteria:

- Identification and resolution of ambiguities in the system specification
- Evidence of consistent requirements analysis methods and tools
- Knowledge of method(s) used
- Use of automated tools

Subfactor 2, Design Methods

Example Criteria:

- Evidence of consistent design methods and tools across the system
- Support for control, sequencing, and timing functions, not just data flows
- Knowledge of method(s) used

Subfactor 3, Transition and Traceability Between Requirements Analysis and Design Methods

Example Criteria:

- Integration of methods and tools to allow flow from requirements to design (and back, when appropriate)
- Useful mechanism for traceability between requirements and design

Factor B, Requirements Analysis

Example Criteria:

- Complete set of software requirements and derived requirements, but not design
- User interfaces clearly defined
- All assumptions identified

Factor C, Design

Example Criteria:

- Design that meets requirements without introducing limitations
- Clarity of design and understandable text
- Recognition and treatment of exercise-specific problem areas (these can be planned into the problem, and specific criteria developed for each)

Factor D, Team Expertise

Subfactor 1, Knowledge of Methods

Subfactor 2, Team Composition

STANDARDS

After factors and subfactors have been identified, standards for them based on the evaluation criteria and on other discriminators discovered during the dry run can be developed. These might include such things as the identification of specification ambiguities, consistent design representation, performance analysis, and behavior analysis.

EVALUATIONS

Evaluations are normally conducted in two parts: an evaluation of the submitted SEE products and an on-site audit. It is important that the same team that evaluates the products performs the on-site audit.

Product Evaluation

The products are evaluated based on the criteria already established, resulting in an initial scoring for each offeror. Questions are also prepared at this time for the on-site audit to verify the product evaluation and to assess the offeror's SEE team capabilities in software engineering, Ada (if appropriate), selected methods and tools, and so forth.

On-Site Audit

The purpose of the audit is to verify the assessment of the offerors' products and to assess the capabilities of their staffs. The offerors brief their SEE products, methods, tools, and other factors. The Government then has an opportunity to question each member of an offeror's team to evaluate each team member's expertise. The offeror's briefing cannot address anything done subsequent to the delivery of the SEE products.

The Government has the opportunity to assess the organization's use of software development and review standards and procedures as well as management's oversight and visibility into the development of the SEE products. Experienced staff can examine areas such as requirements derivation, design traceability, and communications between the system and software engineers. The team can focus on the offerors' identification of software development risks such as the completeness, traceability, and testability of requirements; knowledge of their design/development tools; and adherence to their SDP. The SEE on-site audit should be able to answer such questions as:

- Does the offeror's organization practice good software engineering or are they just a collection of programmers?
- Does the offeror know how to use the proposed tools?
- How did the team communicate information between the requirements analysis, design, and implementation phases?
- Was a mix of system and software engineers used in requirements and top-level design tasks?
- What was the relationship between system and software engineering?

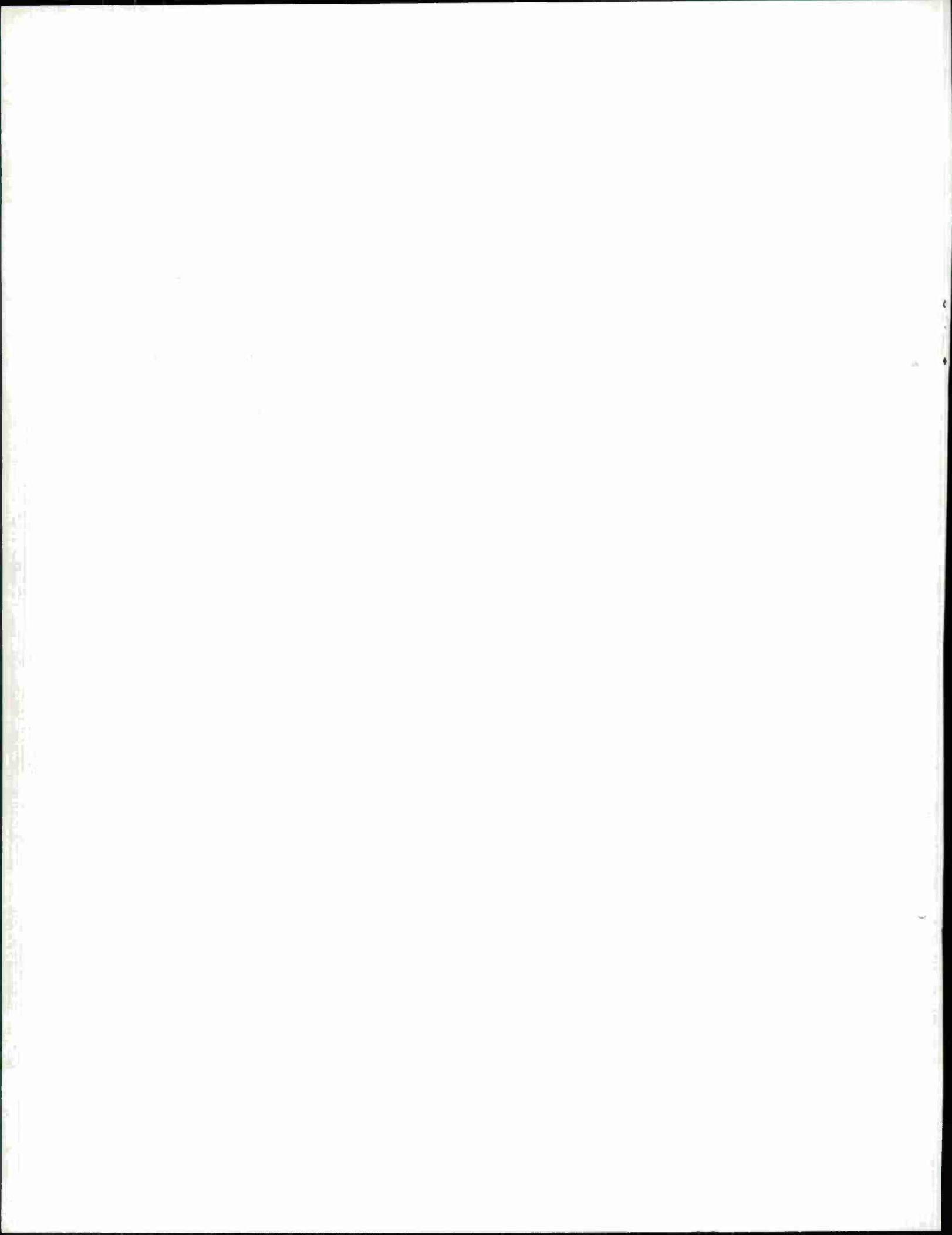
The ability for the Government to question the offerors directly has been very revealing and was found to be a dominant factor in the evaluations. If streamlining of the SEE is a major concern, the on-site audit may result in the most cost-effective utilization of resources.

SCORING

The SEE scoring approach does not allow the clarification request and deficiency report cycle associated with the proposal; the offeror is allowed only one submission of the exercise products with no changes or revisions. However, the on-site visit provides the contractor the opportunity to clarify issues for the Government. The scoring of the SEE may be pass/fail, with a pass if the offeror's products are at least satisfactory for a prescribed majority (for example, 65 or 75 percent) of the evaluation factors. A better and more precise scoring approach can be taken by assessing each evaluation factor for strengths and weaknesses, and then prioritizing them by risk to give weight to the more important risk factors for the procurement.

CONTRACT ADJUSTMENTS

Various problems with the proposed contractor's SEE products may be uncovered during the evaluation; there may be deficiencies in his software development process that pose a threat to the success of the acquisition. Typically, there may be disparities between the contractor's SDP and his demonstrated ability to implement it. These deficiencies may be addressed by negotiating modifications to the SOW that require the contractor to perform certain tasks to improve his software development process.



GLOSSARY

Acronyms

ADL	Ada-based Design Language
CD	Concept Definition
CSC	Computer Software Component
CSCI	Computer Software Configuration Item
FSD	Full-Scale Development
IFPP	Instructions for Proposal Preparation
PDL	Program Design Language
RFP	Request for Proposal
SDD	Software Design Document
SDP	Software Development Plan
SEE	Software Engineering Exercise
SG	Scenario Generator
SOW	Statement of Work
SRS	Software Requirements Specification

APPENDIX A

PRELIMINARY INSTRUCTIONS FOR THE OFFERORS (Example)

(This is only an example! This document should be completely tailored for each SEE as the instructions, products, and scope may differ significantly from this example.)

1.0 PURPOSE

The purpose of the Software Engineering Exercise (SEE) is to permit the Government to evaluate an actual application of each offeror's proposed software development process as documented in the SDP. The SEE concentrates on the offeror's approach to requirements analysis and design, and on their interrelationship. However, the offeror's approach to implementation, integration, test, quality assurance/configuration management, and other development activities explicitly mentioned in the following paragraphs is also evaluated by the Government as part of the SEE. *(NOTE: The products of the SEE can be expanded to include limited examples of products from these activities.)*

2.0 INSTRUCTIONS

The offerors will provide a prototypical example of their proposed software development approach as applied to the exercise problem. The Government will define the problem and provide the problem specification to the offerors following receipt of their proposals. In performing the exercise, the offerors shall comply with all provisions of their proposed Software Development Plan; deviations shall be noted by the offerors.

Participation in the exercise shall be limited to those individuals identified in the offeror's proposal as part of the full-scale development team. Subcontractors who will be responsible for software development shall be active participants; consultants shall be precluded from participating.

The offerors are allocated a period of four (4) calendar weeks from receipt of the exercise materials until delivery to the Government of all requested materials in the formats described below. The Government then evaluates this material. Following this evaluation, the Government conducts on-site visits at the offerors' facilities, at which time the offerors will brief the Government on the methods used and have their teams available to answer questions from the Government. The Government will coordinate the schedule for the on-site visits with the offerors upon receipt of their exercise results. Note that there will be no interaction between the offerors and the Government during the four-week exercise period. Should the offerors have any questions on the exercise, they are instructed to identify appropriate assumptions, to note these assumptions, and to proceed with the exercise based on those assumptions.

3.0 PRODUCTS OF THE EXERCISE

3.1 Delivery to the Government

At the conclusion of the exercise, the offeror shall deliver the following items to the Government:

- a. A complete software architecture for the sample problem
- b. For one or more Government-selected components of the system, all requirements analysis conclusions and the documentation

- c. For one or more Government-selected components of the system, all preliminary design documentation, including requirements traceability, Ada-based design language (ADL) listings, and graphics products
- d. For one or more Government-selected components of the system, all detailed design documentation, including requirements traceability, ADL listings, and graphics products.

All textual products of the exercise, including requirements analysis conclusions and documentation, ADL listings, and other design documentation shall be delivered to the Government both in hard copy form and in machine-readable, 9-track, 1600/6250 bpi tape format in accordance with ANSI X3.27-1978 (exceptions are made for materials which the offeror does not propose to create or maintain on-line during the contract). In particular, graphical representations shall be submitted in hardcopy form; the offeror shall provide six (6) copies of all hardcopy products. The products delivered shall be clear, coherent, legible, and prepared in sufficient detail for effective evaluation; elaborate documentation, expensive binding, detailed art work, or other embellishments are unnecessary.

3.2 Briefing to the Government

In addition to the products described above, the offerors shall provide a briefing to the Government that summarizes their experiences in the carrying out of the exercise and describes the products produced. The briefings shall not exceed three (3) hours in duration. The topics presented shall include the following:

- a. Management approach
- b. An overview of the requirements analysis approach
- c. An overview of the approach to preliminary and detailed design
- d. Other topics to be determined by the Offeror

The briefing to the Government shall be presented after delivery to the Government of the exercise products described in points a through d in 3.1. The briefing shall not include any discussion of further work which the offeror may have completed following submission of the exercise products. All participants in the exercise shall be present at the briefing to respond to government questions; all offeror responses to these government questions, together with the briefing presentation material and the exercise products, are considered part of the offeror's proposal and subject to evaluation by the Government.

4.0 SCOPE OF THE SEE

The Government will not evaluate the following items:

- a. Additional work accomplished on the SEE after the initial four-week period
- b. Level of staffing
- c. Measures of productivity

APPENDIX B

RFP SECTION M, EVALUATION CRITERIA (Example)

(This is only an example! This section must be tailored for each source selection and included in RFP Section M, Evaluation Criteria. This material identifies the basis on which an offeror's SEE products will be judged by the Government.)

Item: Software Engineering Exercise

Offerors are evaluated on their familiarity with the selected software development methods and on their capability to utilize Ada. Offerors are also evaluated on their corporate Ada and software engineering expertise; their requirements analysis and design approaches and interrelationships; the robustness and cohesion of their requirements analysis and design methods; their familiarity and expertise with the methods; their familiarity with the tool set and the development environment; the robustness, cohesion, and completeness of their exercise design; their ability to address and analyze real-time requirements and issues; the clarity and communication of their design, including the use of ADL to express design; and their compliance with the exercise specification requirements and their SDP. A visit to each offeror will be scheduled after receipt of their SEE products; there will be no opportunity to revise the exercise products. The visiting government team will be assisted by personnel from the MITRE Corporation.

APPENDIX C

DETAILED INSTRUCTIONS FOR THE OFFERORS (Example)

(This is only an example! This document should be completely tailored for each SEE since the instructions, products, and scope would differ significantly from this example.)

1.0 PURPOSE

The purpose of the Software Engineering Exercise (SEE) is to permit the Government to evaluate an actual application of each offeror's software development method as proposed. The SEE concentrates on the offeror's approach to requirements analysis and design and their interrelationship. The offeror's approach to implementation, integration, test, quality assurance, configuration management, staffing level, productivity measures, software metrics collection, and other development activities, explicitly mentioned in the following paragraphs, is also evaluated by the Government as part of the SEE. (See note in Appendix A.)

2.0 INSTRUCTIONS

The offerors will provide a prototypical example of their proposed software development approach as applied to the exercise problem. Attachment 1 [*appendix D of this document*], Problem Specification, presents the requirements for the problem. In performing the exercise problem, the offerors shall comply with all provisions of their proposed Software Development Plans (SDPs). The offerors shall make use of proposed development tools and procedures; deviations shall be noted by each offeror.

Participation in the exercise shall be limited to those individuals identified in the offeror's proposal as part of the development team, subcontractors who will be responsible for software development shall be active participants, consultants are precluded from participating. Each offeror shall deliver to the Government all requested materials in the formats described no later than.... The Government will review this material for a period of time not to exceed two (2) calendar weeks. Following completion of the Government review, a Government team will conduct an on-site visit at the offeror's facility, at which time the offeror shall brief the team on their approach and provide responses to Government questions (the Government will coordinate the schedule for the on-site visit with the offeror upon receipt of the offeror's exercise results). Preliminary plans are for the Government to conduct the on-site visit during the week of.... Note that there will be no interaction between the offeror and the Government during the offeror's implementation of the exercise. Should the offeror have any questions on the exercise, the offeror is instructed to identify appropriate assumptions, to document the assumptions, and proceed with the exercise based on these assumptions.

The Government will conduct its evaluation of the offeror's delivered materials and assess the offeror's proposed methods using as a primary reference the SDP submitted with the proposal, particularly the software standards and procedures contained in the SDP. The offeror may submit with the SEE products an augmentation to the SDP, not to exceed fifteen (15) pages, which provides further concise, technical, and explicit details regarding the offeror's proposed software development approach and methods. The Government will consider any such augmentation as part of the offeror's proposal (but not included in page limitations), and subject to Government evaluation.

The Government will employ automated tools to conduct its evaluation of the offeror's delivered materials; therefore, the offeror is required to deliver some of the exercise products in machine-readable format. In order to assess the compatibility of the Government's tools and the offeror's machine-

readable products, the offeror is requested to deliver to the Government no later than a demonstration tape containing sample files of the offeror's products (for example, Ada-based design language (ADL) listings) in the same format that will be submitted at the conclusion of the exercise period. The Government will not evaluate the contents of this demonstration tape, but will merely use it to study and resolve any compatibility issues that may develop between the Government's tools and the offeror's tape output. The sample files on the demonstration tape do not need to represent actual products of the exercise; they need only represent general products of the offeror's proposed methods which the offeror will submit for evaluation at the end of the exercise period.

3.0 PRODUCTS OF THE EXERCISE

3.1 Delivery to the Government

At the conclusion of the exercise period, the offeror shall deliver the following items to the Government for evaluation:

- a. A complete software architecture for the sample problem. This architecture shall contain an identification of CSCIs and CSCs, an allocation of functions to these levels, a preliminary specification of interfaces, and internal interface diagrams depicting control and data flow.
- b. [*For one or more Government-specified components of the system,*] all requirements analysis conclusions and documentation. With respect to the selected components, the requirements analysis shall represent a complete utilization of the tools and procedures proposed by the offeror. Offerors shall identify any deviations from these tools and procedures and associated rationale for these deviations in their briefings to the Government.
- c. [*For one or more Government-specified components of the system,*] all preliminary design documentation, including requirements traceability, ADL listings, and graphics products. With respect to the selected components, the preliminary design documentation shall represent a complete utilization of the tools and procedures proposed by the offeror. Offerors shall identify any deviations from these tools and procedures and the associated rationale for these deviations in their briefings to the Government.
- d. [*For one or more Government-specified component of the system,*] all detailed design documentation, including requirements traceability, ADL listings, and graphics products. With respect to the selected component(s), the detailed design documentation shall represent a complete utilization of the the tools and procedures proposed by the offeror. Offerors shall identify any deviations from these tools and procedures and the associated rationale for these deviations in their briefings to the Government.

All textual products of the exercise, including requirements analysis conclusions and documentation, ADL listings, and other design documentation shall be delivered to the Government both in hard copy form and in machine-readable, 9-track tape (exception will be made for materials which the offeror does not propose to create or maintain on line during the contract.) In particular, graphical representations shall be submitted in hard copy form. The tape shall be in 9-track, 1600 bpi format in accordance with ANSI X3.27-1978, ASCII labelled, and with an identified record size and block size; the block size shall be 512 bytes. For readability, all tabs should be expanded to spaces. The offeror shall provide ten (10) copies of all hard copy products; the products delivered shall be clear, coherent, legible, and prepared in sufficient detail for effective evaluation (elaborate documentation, expensive binding, detailed art work, or other embellishments are unnecessary). The offeror shall include with these products indices delineating the subject and contents of the hard copy material

package and the 9-track tape, the operating system command(s) used to create the tape, a list of ADL compilation units, and a list of the compilation order of these units.

3.2 Briefing to the Government

In addition to the delivered products described above, offerors shall provide a briefing to the Government during the on-site visit that summarizes their experience in carrying out the exercise and describes the products generated. The briefings shall not exceed three (3) hours in duration. The topics presented shall include the following:

- a. Management approach, to include:
 - 1. Introduction of team members
 - 2. A description of individual roles and experience
- b. An overview of the requirements analysis approach, to include:
 - 1. A rationale for the selection of the software components
 - 2. A description of the tools and procedures employed
 - 3. Significant requirements issues encountered and their resolution
 - 4. A discussion of deviations from the proposed approach, and associated rationale
 - 5. Other topics to be determined by the offeror
- c. An overview of the approach to preliminary and detailed design, to include:
 - 1. A rationale for the selection of the software components
 - 2. A description of the tools and procedures employed
 - 3. Significant design issues encountered, alternatives considered, and a rationale for the decisions made
 - 4. A discussion of deviations from the proposed approach, and associated rationale
 - 5. Other topics to be determined by the offeror
- d. Other topics to be determined by the offeror

The briefing shall not include any discussion of further work which the offeror may have completed following the submission of the SEE products on, since the Government will not evaluate this additional work. All participants in the exercise shall be present at the briefing to respond to government questions. The offeror shall provide ten (10) paper copies of the briefing slides and accompanying text at the time of presentation; a transcript of the questions and answers will be kept. All offeror responses to these government questions (the transcript) together with the briefing presentation material and the exercise products identified in a through d in 3.1 shall be considered part of the offeror's proposal and subject to evaluation by the Government.

APPENDIX D

PROBLEM SPECIFICATION (Example)

(This is only an example of the manner in which a problem should be specified. A unique problem should be developed for each SEE that incorporates those features and objectives discussed in sections 1 and 2.)

1.0 SCOPE

The exercise system will create scenarios under user direction and will simulate the capability in real time.

2.0 APPLICABLE DOCUMENT

System Specification, section ..., dated

3.0 REQUIREMENTS

3.1 General Description

The exercise system shall maintain and display information in tabular form in real time. Specifically, the exercise system shall create scenarios under user direction and store each created scenario in a separate scenario file. It shall use a generated scenario to run the simulation in real time. The system shall provide the capability for the user to The design for the exercise system shall be modular to facilitate changes in software components which are needed to accommodate future changes in operational requirements.

3.2 Hardware

The system will generate only tabular displays. No special graphics hardware or capabilities shall be used. The user interface shall be designed to operate on a single dumb terminal with a keyboard entry device.

3.3 Simulation data

3.3.1 Configuration

The configuration to be simulated shall be as follows:

- a. There shall be one command center.
- b. There shall be seven sensors.
- c. There shall be five missile launch origin locations and five predicted impact (nuclear detonation) locations.
- d. Sensor connectivity shall be from each sensor to the command center.
- e. The system shall simulate the transmission and processing delay incurred from the time a sensor transmits a message until the message has been processed by the system and made ready for display. The processing delay parameter shall be user selectable from 0-99 seconds and shall be constant during a given simulation.

3.3.2 Data

Data shall consist of..... and

3.4 Display Formats

Display formats shall consist of menus for the user interface and tabular displays.

3.4.1 User Interface

The user interface shall be menu driven and user friendly. All user input shall be validated for proper format and range of values. The user shall be notified of any entries that are erroneous or that cannot be processed for any other reason. Error messages shall be self-explanatory and shall specify, to the extent practical, the cause and location of the error.

General user capabilities to be provided shall include the capability to start and stop a session, the capability to terminate and exit to the main menu upon user request, the capability to display the directory, the capability to select the processing delay parameter, and the capability to interface with and

All user input shall be acknowledged within one second of the input. For data entered by the user, the time from completion of entry until the data base is modified to reflect the update shall not exceed two seconds. An advisory shall be provided withinseconds if the system cannot complete such an update. At a minimum, these performance requirements shall be met on dedicated processing equipment and with at least 20 stored scenario files, consisting on the average ofevents.

3.4.3 Tabular Displays

The system shall be able to generate three displays for data: a Summary Display, a Predicted Summary Display, and a Message Display. The summary displays shall present the information as generated by a selected scenario, summarized from the start of the scenario, in real time, and in accordance with the specified processing delay. The formats for the Summary Display and the Predicted Summary Display shall be as specified in The Message Display shall sequentially list the messages received by the command center as received in real time. The capability to display the contents of at least the five most recently received messages in the scenario shall be provided. Display updates shall be processed and reflect a scenario event within one-half second of the activation time of the event.

3.5 Scenario Generator

The Scenario Generator (SG) shall be activated and deactivated only as a result of user action. The SG shall be able to create, delete, edit, and save files containing scenario data. Edit capabilities for a selected scenario file shall include changing the contents of events in the scenario file. The capability shall be provided to save a scenario and any changes to it as a new file or as the current file. Each event in a scenario shall have a unique activation time to the nearest tenth of a second, where the activation time represents the time the reporting sensor transmits the missile warning message. The user shall be precluded from entering multiple events into a scenario with the same activation time. The user shall be able to query an individual scenario file to search for events based on reporting sensor and/or time of event activation. The design for the system shall be flexible to allow the capability to perform this query across all scenario files. The SG shall accept input from the keyboard to perform the above functions. There shall be a default scenario file consisting of a total of individual events and their associated

times of activation covering a minute scenario period. The SG shall support a total of at least events contained in one or more scenarios.

3.6 Simulation

The simulation shall provide the user with the capability to select and run a scenario contained in a scenario file. It shall run this scenario in real time, generating the Summary Display, the Predicted Summary Display, or the Message Display as specified by the user. The simulation shall be activated or deactivated only upon user request. Capabilities shall be provided for the user to select the processing delay parameter, to suspend the simulation, to resume the simulation, to fast forward the simulation (where fast forward means the run time between event activations is reduced by two), and to stop the fast forward capability and return to the normal run time between event activations. The user shall also have the capability to select among the three displays, and to move to other displays while the simulation is running.

3.7 Simultaneous Generation and Simulation

The system shall provide the capability for the user to run the simulator and SG simultaneously, either on the same or different scenario files, while still meeting the performance requirements specified herein. Formats for the displays when both are running simultaneously will be defined by the contractor as part of the design effort.

When both the SG and simulator are processing the same scenario, the simulator displays shall reflect a modification to an event in the scenario only if the event has not yet been processed by the simulator; otherwise, the simulator displays shall not reflect the changes.

