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FBIS MODERNIZATION PROGRAM CONCEPTUAL DEFINITION PHASE ESL-Q4472 Volume I, Technical 25 June 1984

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ESL Proposal No. Q4472

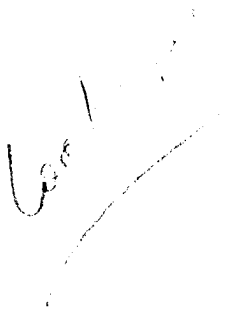
FBIS MODERNIZATION PROGRAM

CONCEPTUAL DEFINITION PHASE

Volume I

Technical Proposal

25 June 1984



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1. Introduction

ESL, a subsidiary of TRW, is pleased to submit this technical proposal for a Conceptual Definition phase (CDP) of the Foreign Broadcast Information Service (FBIS) Modernization Program. The three-phase, 14-week Conceptual Definition Study will require a well coordinated, technically diversified project team to perform the study tasks. ESL is confident that the key personnel and the contributing technical team selected will meet or exceed the SOW requirements and the FMP operational and system objectives.

1.1 Scope of the Conceptual Definition Study

The scope of this study is to develop a concept definition for the FBIS Modernization Program (FMP) system that includes refinement of current requirements for modernization of the FBIS; development of a system design; development of a schedule for acquisition of the commercial products that best meet the needs of the FBIS Modernization Program; identifying and planning development of any special capabilities that cannot be met with commercially available products; and estimating the approach, time and cost of an integrated modernization program.

The deliverables of this study will be a revised version of the modernization requirements document (Document No. SDS-002, Appendix C to the Conceptual Definition Phase Statement of Work); a presentation by ESL describing the company's approach to the modernization; a report on the candidate FMP system design, followed by a briefing to the FBIS Systems Development Staff; a report and briefing on the cost, schedule and Work Breakdown Structure of the modernization program; a concept of operations; and a preliminary system specification.

1.2 Overview of ESL's Technical Approach

ESL's technical approach to the Conceptual Definition Phase (CDP) is to take full advantage of available information systems technology and apply its own experience in system design, integration and development, data base design and development, networking, and advanced processor technology.

ESL will apply top-down system engineering to the FMP concept definition and will coordinate the system design through interactions with the FBIS Systems Development Staff. The ESL staff will take full advantage of their experience with ESL/TRW cost, schedule, and WBS modeling techniques in generating a schedule, cost estimates, and a Work Breakdown Structure for the modernization program.

The technical approach will include the following:

a. Functional requirements review and analysis.
b. Survey of selected information systems technology.
c. Refinement of functional and performance requirements.
d. Development of alternative system configurations.
e. Evaluation of alternative system configurations and the recommendation of one configuration.
f. Preparation of an implementation schedule and cost estimate.
g. Development of the concept of operation and system specifications.

A technical exchange meeting (TEM) between ESL staff and members of the FBIS Systems Development Staff has been scheduled, in addition to the presentations and briefings called for in the SOW. This TEM will focus on the evaluation criteria for selecting the recommended FMP design.

To perform the FMP Conceptual Definition Phase, ESL will use a "total system" method that provides top-down, disciplined system engineering (section 4). This total

system approach ensures an integrated system and makes it possible to trace functions from the lowest to the highest levels. ESL uses the ESL/TRW-developed automated Functional Analysis System (FAS) to support system analysis and to identify hardware/software design trade-offs. The FAS provides a structured method for the definition, maintenance, and display of functional interactions. The system is based on a computer resident master file that interfaces with utility programs.

The selection of candidate commercial products and the planning of special development efforts will be the result of the technology review, the system design, and meetings with the FBIS Systems Development Staff.

1.3 Summary of the Technical Volume Contents

The technical volume consists of the four sections described below.

1.3.1 Section 1 - Introduction

1.3.2 Section 2 - Understanding the Problem

This section presents ESL's perception of the problems to be addressed by the CDP. The problems will be discussed in terms of requirements, system design, and development plans. To identify the similarities and differences of the functions for headquarters and bureau operations, five functional areas have been designated: management, tasking and control; data collection and processing; data base management; storage and retrieval; and production and dissemination.

1.3.3 Section 3 - Design Issues

This section identifies issues relevant to the FMP system design. The presentation is based on an initial analysis of FBIS's preliminary requirements and an ESL strawman system architecture. The issues center on commercially available hardware and software.

1.3.4 Section 4 - Technical Approach

This section contains the ESL system engineering approach proposed for use in the Conceptual Definition Phase. The section describes ESL's system design methods and how those methods promote a complete system design, and the benefits gained by use of system engineering tools. The Functional Analysis System, which incorporates many of those tools in a computerized form, is also described. Each step of ESL's technical approach is expanded. Finally, the experience of ESL's proposed staff is described briefly.

1.4 Applicable Documents

The following documents will be used, as appropriate, in the Conceptual Definition study.

Government Reference Documents

FBIS Information Packet (pre-RFP correspondence).

RFP-0284, Conceptual Definition Phase of FBIS Modernization Program, Statement of Work (SOW) and Appendicies A through G.

Compliance Documents

FBIS Modernization Requirements - SOW Appendix C.

Work Breakdown Structure to second level - SOW Appendix D.

Other Reference Documents

The Fast Data Finder: An Architecture for Very High Speed Data Search and Dissemination, a report on the Associative Mass Storage Device, TRW, Inc., 24 April 1984 (Unclassified) (see Volume II).

Spatial Data Workstation Man Machine Interface, the final report for the Spatial Data Workstation IR&D project, ESL-ER439, 12 December 1983 (Unclassified).

A Survey of Commercially Available Devices for the Production of Video Hardcopy Output, ESL-ER368, 1 December 1982 (Unclassified).

A Survey of Currently Available Image Display Processors, ESL-ER387, 1 February 1984 (Unclassified).

Technology Study: Microprocessors, Operating Systems/Languages, Local Area Networks, ESL-ER434, 5 April 1984 (Unclassified).

2. Understanding the Problem

This section addresses ESL's understanding of the objectives and scope of the FBIS Modernization Program.

Through its network of foreign-based sites, FBIS has provided selected foreign media information to U.S. and other consumers over the past 40 years. The FBIS tasks of monitoring, processing, analyzing and disseminating have undergone a continuing evolution of improvements and enhancements to increase FBIS product quality and productivity. These improvements have been successful and have resulted in a greater demand for FBIS products and reduction in reporting times. The current availability of commercial, largely off-the-shelf automated capabilities provides an opportunity to make significant enhancements to meet this increased FBIS consumer demand. Technology developments in computer and communications capabilities can provide the basis for long-term reductions in FBIS operational costs. This can be achieved by an innovative but practical FBIS system design that can integrate current technology into a phased modernization program and also take advantage of future technology advances. An important ingredient for the FMP success is to utilize a disciplined, top-down system engineering methodology (see Section 4).

2.1 Need for FMP Requirements Baseline

To ensure a fully integrated and responsive FMP system design, it is necessary to develop a comprehensive baseline of FMP requirements. The FMP requirements (SOW Appendix C) will be reviewed and refined based on analysis of the FBIS operations and site visits to Washington, D.C., and Nicosia, Cyprus. The resulting requirements document will form the basis for the FMP system design, concept of operation, and system specifications. The FMP requirements must provide for system flexibility and modularity to accommodate FBIS mission and task changes and future technological developments. To maintain control of the requirements document throughout the FMP system development, ESL will provide requirements traceability matrices to support configuration management control.

A key objective in the development of FMP requirements will be to retain the framework of current FBIS operations and infuse current technologies to increase productivity and reduce the stress caused by the rapid expansion of open-source media material, and at the same time to be sensitive to the "people role" in the system in terms of system acceptance and training needs. The program is required to improve the efficiency and functionality of the present system and procedures rather than to reorganize its structure. The new equipment and operational concept will overlay and streamline, not replace time-proven methods.

2.2 System Design

The FMP system design must provide a reliable, continuous operation in widely separate geographic locations with varying environments. Key elements are minimum technical risk, ease of growth, minimum special development, and ease of use. For those areas that do not require a major technology change, assessment and application of readily available commercial components as well as broadly accepted interface standards will be system design objectives.

ESL anticipates that some requirements will not be satisfied by existing hardware and software. These requirements will be identified in the system design by a development plan that includes risk assessment and cites published research to back-up the design options recommended. These requirements will be subject to trade-off studies.

The system requirements have been initially allocated to five functional areas. Table 2-1 shows the distribution of existing tasks to these functional areas.

2.2.1 Management, Tasking, and Control

The effective operation of a unified system for FBIS activities using the power and data manipulation capabilities of current computers and storage devices demands a comparably unified concept for management. The full utilization of the FMP resources to be installed will only result if management and control functions are linked to the data handling in an effective manner.

The two areas of concern are collection of management information and allocation and control of resources. The FMP system must provide meaningful data to the managers and supervisors of the FBIS process so they can control the product. The system must yield traffic descriptors, financial data, and administrative support data from each significant monitoring point from bureau to headquarters, and must do so at a level of detail consistent with the control function requesting the data.

Resources (people, machines) must be easily directed by the appropriate authority. This means the system design must include disciplined communications capabilities with ready access for all users. A tailored electronic mail subsystem will be the basis for communication and will be integrated with global message handling features. Computer implementation of the process log and job queueing aids for editors will streamline the flow of copy through several layers of editing.

Tools such as schedulers, job trackers, performance analyzers, and other management software utilities will be required. These control aids must be compatible with the data they are designed to analyze and thus will be treated as integral to the system design.

It may be necessary to provide a degree of flexibility to the bureau or section chief so that the new system is not regarded as an infringement of his/her right to apply management and editing methods in a manner best suited to the individual. It should be an overriding concern to integrate the people with the machinery and not force them to adapt in a rigid manner.

Training of personnel for the new system as it is phased in is required. Since the new system replaces existing procedures, it may be initially viewed as an

Table 2-1. FBIS Functional Areas

FBIS

- MANAGEMENT, TASKING AND CONTROL
  - Administration
    - management: financial, staffing, payroll
    - reports: ambassador, headquarters, time and attendance, purchasing, shipping, receiving
    - control: visitors, documents
    - communication
    - equipment maintenance
  - Planning and Scheduling
  - Quality Control: Critique monitor's/editor's work
  - Training
  - Independent Contractor Control
    - estimate words
    - assign work
    - evaluate contractors
    - track/status jobs
- DATA COLLECTION AND PROCESSING
  - Collection: receive, record, log, and store
    - radio
    - television
    - press agency transmissions (text, fax, photo)
    - publications
  - Cruising: Search and verify transmitters, file reports
  - Processing
    - Monitor, review, consult, and log
    - Make internal dissemination
    - Select for translation, assign, review, and log
    - Edit, consult with monitors, and review support information
- DATA BASE MANAGEMENT
  - File creation and sorting
  - Storage
  - Maintenance: Create, delete, modify, backup, verify
    - files, records, fields
    - directories, attributes
  - Archiving
- SEARCH AND RETRIEVAL
  - Retrieve
    - Search: text, keyword, attributes, context
    - Display
    - Browse
  - Review
  - Analyze
  - Research

Table 2-1. -- Continued

PRODUCTION AND DISSEMINATION
- Message Traffic Support
  - Communications
    - AUTODIN
    - Diplomatic Telecommunications Service
    - Defense Communications Service
    - Telex
    - Department of State COMSAT
    - Other future facilities
    - Independent contractors
      - input translations
        - telephone/modem
        - floppy disks or cassettes
        - OCR or rekeying
      - outgoing material
        - hard copy
        - floppy disks
        - facsimile
  - Assignment
  - Message preparation and proofing
  - Message routing and distribution
  - Interrupt/Retransmission
  - Message storage
- Sort, select, and collate
- Edit, proof, and review
- Depth determination
- Report generation
- Document generation: Composing, indexing, and paginating

alternate method, e.g., electronic editing instead of paper/pencil editing. On-line training facilities will include a self-paced tutorial, choice of terse and verbose prompting, and extensive help screens. Off-line training will consist of classroom and videotape briefings. Learn-by-doing is recognized as the most efficient technique for computer technology. Users with differing frequency of usage will require differing levels of help and prompting complexity.

2.2.2 Data Collection and Processing

This functional area centers primarily on the bureau but has some parallel elements at headquarters level as well. The collection function has the complex task of locating, tuning, and receiving multiple transmission types (radio, TV, TTY, publications), but is also the most mechanical task in the process and therefore quite susceptible to automation and control. The independent data collection support function of cruising shares these attributes.

A system component dedicated to control of the acquisition of scheduled transmissions will be required for radio and TV collection automation. This controller component should provide for antenna selection, receiver tuning, recording device queueing, and linking to the appropriate monitor function and/or retransmission facilities. The radio/TV controller will be interactive to the extent of allowing manual intervention for fine tuning and alternate antenna/receiver combinations. The controller should provide a status display in real time of its current and scheduled activities.

A separate system component will be required for the automation of press agency teletype and fax-type transmission acquisitions. These transmissions are unscheduled but are in relatively uniform flow and therefore require a straightforward logging and recording function. Electronic storage and simultaneous hard copy generation should be balanced for optimum retrieval capability.

Acquisition of publications requires a library function for good management of the data, including logging and subscription tracking.

An essential feature of all types of data collection is the logging and filing function. Regardless of transmission type, an effective front-end design for this feature will make subsequent retrieval and processing efficient. The situation may be likened to any product in raw material form starting down the production line. Factories have discovered that a properly handled traveller attached to each product or product batch serves to enhance control and downstream operations. The data must have this traveller in the form of search and selection keys as well as file status.

The system design for bureau data processing will require features common to most computer operating systems in terms of file management and access. The design is also required to support edit traceability in what will probably be a nontraditional manner, at least for electronic editing systems. Editing will be an area for human factors concern, especially during transition to the new system. The analogy of newspaper copy flow to bureau data processing will provide a useful background for this aspect of the design.

2.2.3 Database Management

Database handling is required at both the bureau and headquarters level. The bureau database management problem is one of a modest size data bank with fairly short-term on-line storage and modestly complex search requirements. The headquarters database management problem encompasses a much larger database that grows geometrically with time and must be organized to permit efficient searches. The headquarters database will be characterized by large size (33 Gbytes in ten years), multiple datatypes, with the eventual inclusion of graphic information. The system design for data base management at the headquarters level must protect the integrity of archived text and graphics by access safeguards, logical rejection of illogical or unlikely edits (such as modifying a verbatim quotation), and solid backup operating procedures. Since the database contains relational data, the file manager must preserve the integrity of the relation links through proper handling of directories and file attributes. All database management features incorporated in the FMP must support improved productivity as well as the functional requirements of the FBIS processes. Users will require ready access to reference files as well as publishable text. See Section 3 for a complete discussion of database management design issues.

2.2.4 Storage and Retrieval

The central feature of the FMP storage and retrieval capabilities will be retention of the virtual appearance of the present file structure. Users will be familiar with their current file naming and functional characteristics. These files will reappear in the new structure with an enhanced search and retrieval environment.

Storage methods must present data efficiently to search algorithms, whether software or hardware implemented, and must permit allocation of data to off-line, little used files vs. on-line, frequently consulted files. The storage methods chosen must occupy minimum physical space and have nonvolatile data retention through the storage life anticipated.

Storage and retrieval methods will vary between bureau and headquarters. The bureau archive and access pattern will support the selection and editing functions, while the headquarters archive will be exercised to implement the higher level analysis and selection for daily and joint publications.

Retrieval for radio and TV will depend heavily on good design and operation in the logging and filing function. Recordings will require queueing machinery in both hardware and software.

Retrieval methods in the FMP include searches against file attributes, file contents, file relations, and contextual arguments. Personalization of queries will yield efficient, minimum keystroke operations for experienced users. Selective display and printing techniques will make the retrieval process a finely tuned tool for each user's requirements. The correct implementation of retrieval will make the analyst significantly more efficient and will concentrate his/her time on analysis instead of search tasks.

A number of design issues arise from the preliminary storage and retrieval requirements. These are discussed in Section 3.

2.2.5 Production and Dissemination

The production and dissemination tasks are common to both headquarters and bureau operations. Production capabilities must support the existing hard copy output as well as soft copy links to specific customers. The creative, user-interactive features of sophisticated retrieval and editing facilities must be followed by the generation of a readable, high quality output that communicates effectively.

Message handling is a key element in both bureau and headquarters communications. The system must provide an integrated facility for message formatting, header and footer inserts, and dispatch and routing automation. Machine-assisted proofing of message headers will minimize retransmissions. The design must remain compatible with present FBIS message coding and classification but also incorporate desk-to-desk electronic mail and generate required traffic management reports.

A multilingual editing facility with flexible copy flow between workstations is a design objective for bureau operations. In addition, the headquarters operation will require typesetting with fully integrated graphics insertion.

Facilities for editing and typesetting should be balanced between functional raw text work and typeset soft copy proofing stations to optimize yield of invested money and CPU facilities. Not every editor will require typeset copy to perform his/her function, but adequate supervision of quality will demand typeset displays prior to print, a capability well within today's technology. Typeset displays will also be capable of graphics display to enhance final product proofing.

Although the system design should be an integrated, internally efficient whole, it should degrade gracefully in the event of inevitable mechanical breakdowns. Modularity in system components and carefully defined interfaces will allow incorporation of alternate automatic or manual methods in case of primary function failure. This will be achieved through distributed computing and both electronic and paper back-up plans. Support of an ongoing 24-hour operation will be required. Section 3 addresses the issue of workstation performance.

2.3 Need for Development Plan

An essential ingredient in the success of the FMP will be the smooth introduction of new facilities while maintaining a high standard of service. The development plan will be required to show the schedule and costs for acquisition and installation of all system elements up to full on-line operation with phase-in strategies. This plan will give FBIS visibility for monitoring the acquisition contractor.

2.4 Need for Concept of Operation and System Specification

ESL will develop a concept of operation to describe the operational interactions of the hardware, software, and people in an organizational environment. A

concept of operation is required to verify that each system design feature is fully exploited and is indeed required. The system design specification will provide detailed performance levels and equipment requirements. It will serve as a checklist and basis for acceptance of hardware and software procured during the acquisition phase.

3. Design Issues

3.1 Process Flows

The analysis to determine relevant design issues synthesizes the Baseline Description (Appendix B of the SOW) with the Modernization Requirements (Appendix C).

This analysis has resulted in a set of process flows, presented in Figures 3-1 through 3-3. These flows present a first cut at a preliminary design for the automated portions of the modernized system. Figure 3-1 shows the process flow for the operation of each bureau. Figure 3-2 expands upon this process flow for each type of source data and each result at each processing step. Figure 3-3 shows the process flow for the operation at headquarters.

These process flows suggest some useful conclusions. For example, the proofing function at each bureau may not be required in the modernized system. In the current system, this function verifies paper tape keypunching accuracy. With all text on-line at a much earlier stage of the processing, this keypunching and subsequent verification is unnecessary.

3.2 System Architecture

The system process flow diagrams in Figures 3-1 through 3-3 suggest a top-level, strawman system architecture.

At headquarters, the system will include host processors, a set of sophisticated workstations, and other hardware.

The database processing, text search, and data storage requirements for headquarters suggest that a cluster of host processors is needed to supply the required processing power.

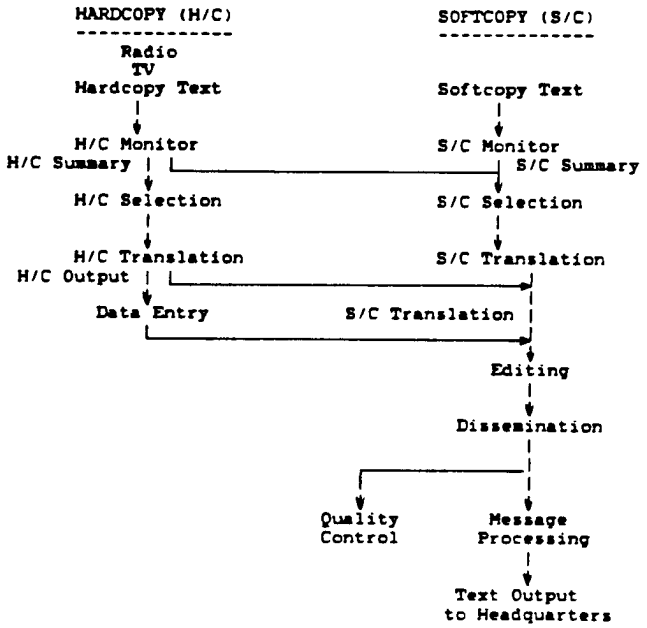

Figure 3-1. Field Bureau Process Flow

Process Step	SOURCE				RESULT			
						Softcopy (S/C)		
						Add	Make Entry Into	
	Radio	TV	Publi-cation	TTY, Photo, Fax	Hardcopy	Info	Edit Trace File	Process Log
Monitor							X	
Edit			X	X				
Add S/C Summary	X	X	X	X		Summary		X
Attach H/C Summary	X	X	X		H/C of S/C Summary			
Selection	X	X	X	X	Annota-tion	Annota-tion		X
Translation								
H/C	X	X	X		Transla.			X
S/C				X		Transla.		X
Edit								
Data Entry (to S/C)	X	X	X					X
Review	Review and edit S/C translation						X	X
Final Edit	Final edit of S/C translation					Revised Item	X	X
Dissemination	Add dissemination information					Header		X
Message Processing	Translate to AUTODIN format							X
Quality Control	Review translations							X

Figure 3-2. Field Bureau Processing Summary (Starting with Monitoring)

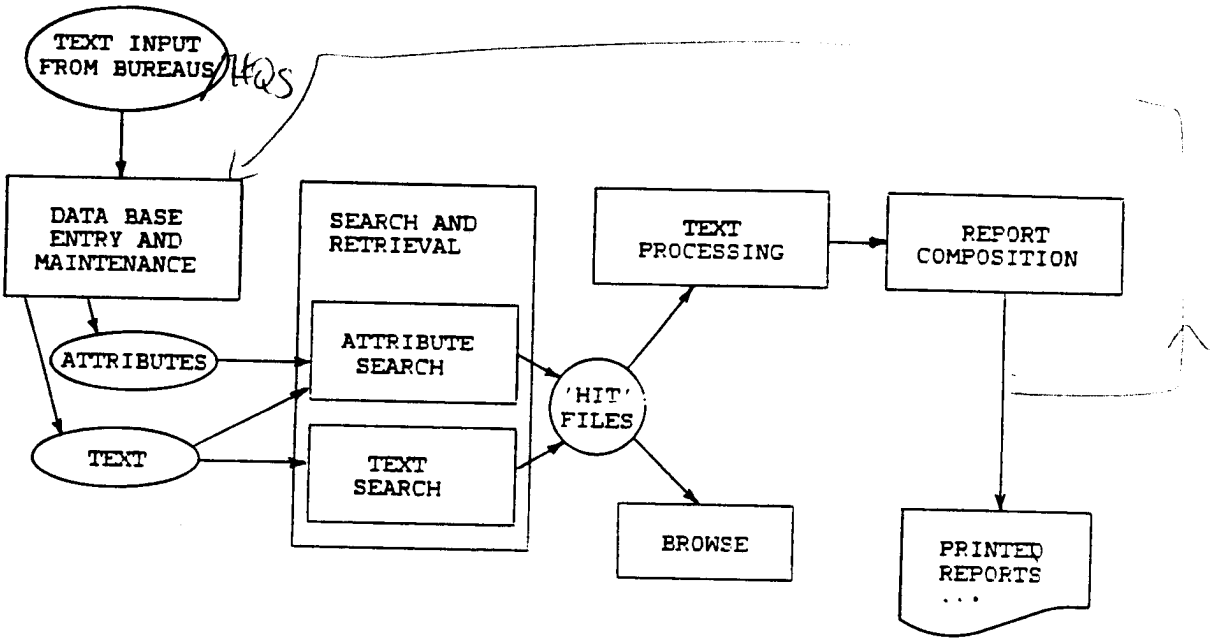

Figure 3-3. Headquarter's Process Flow

The text processing and report composition requirements suggest that sophisticated workstations may be required for at least some of the editors. These workstations will perform text processing and page makeup functions similar to magazine and newspaper production.

Other hardware may include a scanner to input half-tone and line graphics for report production; electronic text transfer links to replace existing paper interfaces (e.g., dissemination of message traffic at headquarters); and interfaces to the scanner, to a typesetter, and to other existing hardware.

At the bureaus, the system may include a host processor and will include workstations and other hardware.

The data base processing requirements for each bureau are much less than for headquarters, and the text processing and report composition requirements are virtually nonexistent. More detailed analysis is required to determine if each bureau requires a host processor, or if a set of workstations would be sufficient.

The workstations at the bureau can be less sophisticated than at headquarters. At the bureau, high-quality text editing must be available, but little else.

Other hardware at the bureaus may include optical character recognition equipment and interfaces to existing communications equipment.

3.3 Discussion of Design Issues

Tables 3-1, 3-2, and 3-3 describe the major, Secondary, and long-term design issues, respectively. The FMP system architecture will draw from technologies in the following areas:

Table 3-1. Major Design Issues

Issue	Requirement (RFP Appx. C)	Why Important	Candidate Design Choices
Text Search	1.5	FBIS has a large volume of text data (3 gigabytes after one year) and complex search patterns. (By comparison, current technology in the form of a 7.5 MIPS IBM 3081 may take over one hour to search 300 Mbytes of text for only one pattern of average complexity.)	Text Search Systems: o h/w based; examples: - TRW Fast Data Finder - GE GESCAN II o s/w based; example: - TRW SAFE
Continuous Operations at Headquarters/Bureaus	1.1	Reliability requirement is beyond a single processor architecture.	System architectures: o Fault tolerant o Redundant o Distributed
Workstation Characteristics	1.1 1.7 1.8 2.3	To support: 1. Application-specific, friendly user interface 2. Multilingual editing 3. Graphics input and display 4. Satisfactory user response, by balancing the processing between the workstations and the host processor.	1. Symbol Library Bit map versus text display Command versus menu Pointing devices. 2. Bit mapped display Font library Text rendering. 3. Screen resolution Graphics sizing and positioning. 4. Intelligent versus passive workstation.

Table 3-2. Secondary Design Issues

Issue	Requirement (RFP Appx. C)	Why Important	Design Choices
Data Format	1.4	Convenience for storage, browsing, text processing, product generation, etc., impacts system performance.	Inclusion or exclusion of page/paragraph delimiting characters (e.g., end-of-file, end-of-line)
Data Organization	1.4	Organization of text data into fields, records, groups, and files must accommodate periodic updates and modifications and allow flexible attribute assignments.	Data modeling approaches: o Hierarchical o Network o Relational o Semantic (aggregation, generalization, cover)
Data Integrity	1.4	Maintenance of logical relationships between data elements assures database correctness.	Minimize redundancy through normalization.
Stored Queries	1.5	The capability to easily invoke repetitive tasks enhances user productivity.	Text editor integrated with the data base management system, with either user-managed text editor command files or a system-managed query catalog.
Text Volume	1.5	The volume of text impacts browsing performance.	Browsing and search and retrieval capabilities are separate, or browsing is a part of the search and retrieval process.
Edit Trace	1.2 2.3	The capability to trace the form and purpose of editing changes enhances the overall quality of FBIS products.	On-line editing markup and typesetting techniques.

Table 3-3. Long-Term Design Issues

Issue	Requirement	Why Important	Design Choices
Retro-spective Search	RFP App. G	Growth in volume of text and attributes impacts storage requirements and search efficiency	Storage options include: o standard disk and tape o optical disk o associative mass storage devices Very large attribute database search and retrieval
Growth in Data Collection Volume		Translation and dissemination bottlenecks	Machine translation Associative mass storage devices Knowledge-based systems

a. Data base management
b. World-wide communications
c. Text collection and processing
d. Office automation and management.

Existing commercial technologies are sufficient for virtually all FBIS modernization objectives, with the exception of some long-range requirements. Therefore, the design issues consider FBIS requirements for which significant alternatives exist in the selection and application of existing commercial technologies.

Tables 3-1 through 3-3 address three classes of design issues. Major issues involve those that are expected to have considerable impact on the overall system architectural design. Secondary issues involve those that impact system performance and ease-of-use characteristics. Long-range issues deal with the flexibility and extensibility of those portions of the FBIS system that must accommodate growth in data volume and system usage. This set of design issues is expected to be expanded and revised during CDP and to serve as the basis for cost-versus-capability trade analyses.

4. Technical Approach

4.1 Systems Engineering at ESL

To accomplish the FMP Conceptual Design Study, ESL will combine its experience in system design, development, and integration with the most recent techniques in hardware, software, and system engineering.

4.1.1 Total System Development

ESL uses the top-down system engineering process to ensure a "total system" development. As applied to FMP, total system development includes examining the FBIS mission and tasks, and the physical and operational environment in which the organization operates. Figure 4-1 illustrates the total system approach used by ESL.

4.1.2 Top-Down Engineering

The top-down (hierarchical decomposition) method is applied by ESL not only to system functions, but to interfaces and personnel relationships. Emphasis is placed on developing a complete system structure at each level of detail before proceeding to the next lower level.

Once a level is completed, each component of the level may be divided into "elements" that collectively accomplish the desired result of the original component. The purpose of the partitioning is to promote simplicity in system development by separating the system into pieces that can be understood, implemented, eliminated, or changed with minimal consideration of or effect on the other pieces of the system.

As used by ESL, the hierarchical decomposition technique illustrated in Figure 4-2 ensures that every component is hierarchically related to its "parent," the higher-level component of which it is a part. All aspects of the FMP system will be described first at the highest level of abstraction, and then at levels of increasing detail. All detailed definitional charts, figures, and tables are subsets of a higher-level set of definitions. This method will provide a structured system design and requirements traceability.

4.1.3 System Engineering Tools

To define the FMP concept, ESL will use system engineering tools whose interrelationship is depicted in Figure 4-3. These tools define the "what," "where," "when,"

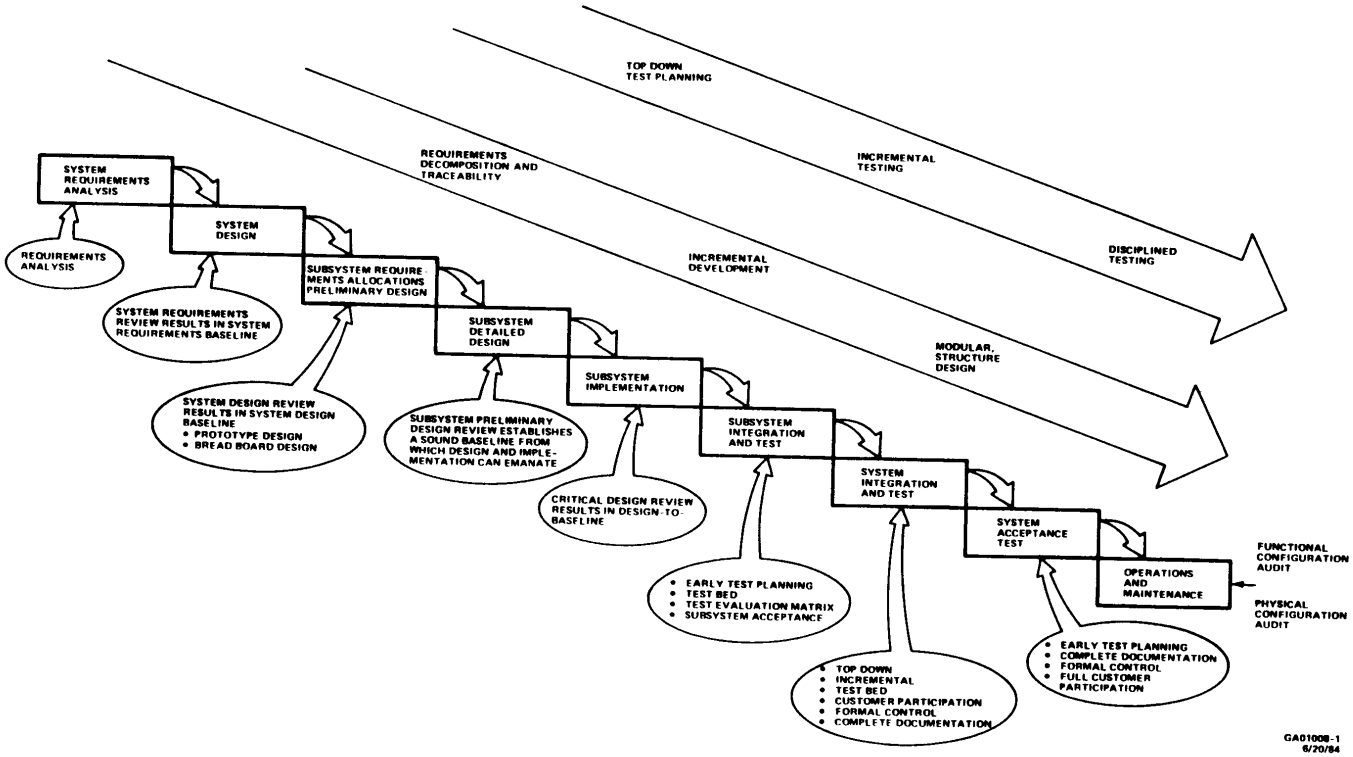

Figure 4-1. ESL's Disciplined Top-Down System Development Methodology

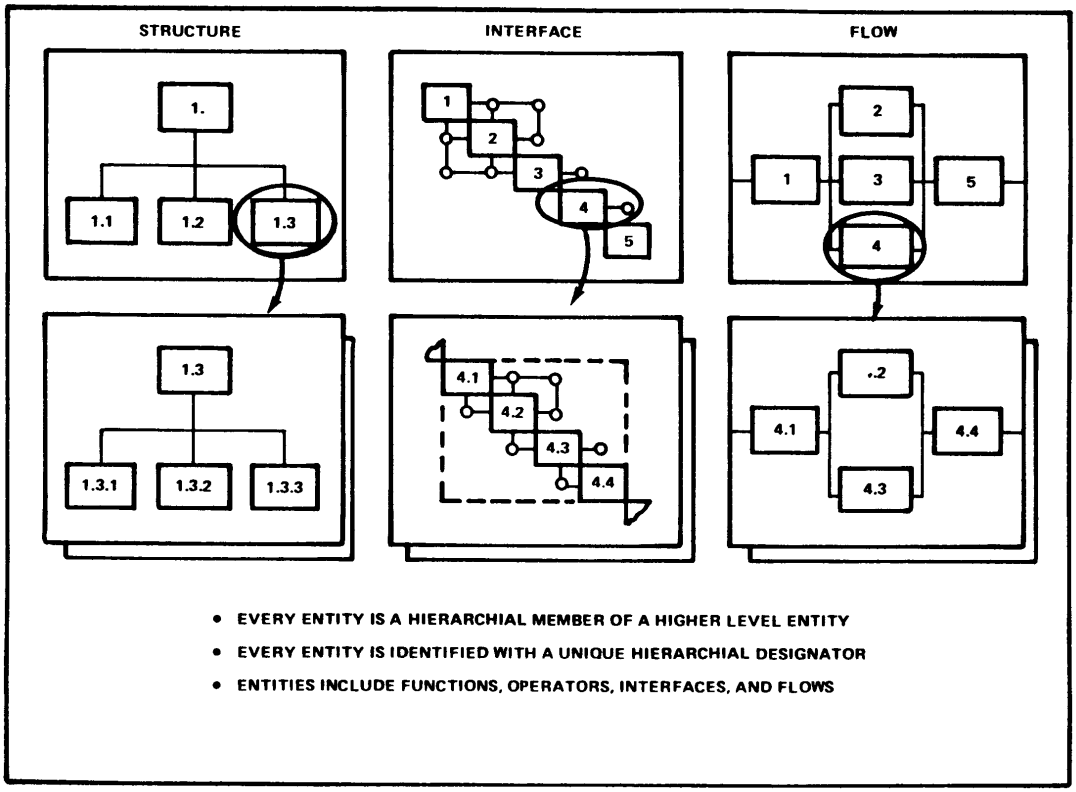

Figure 4-2. The Hierarchical Decomposition Concept

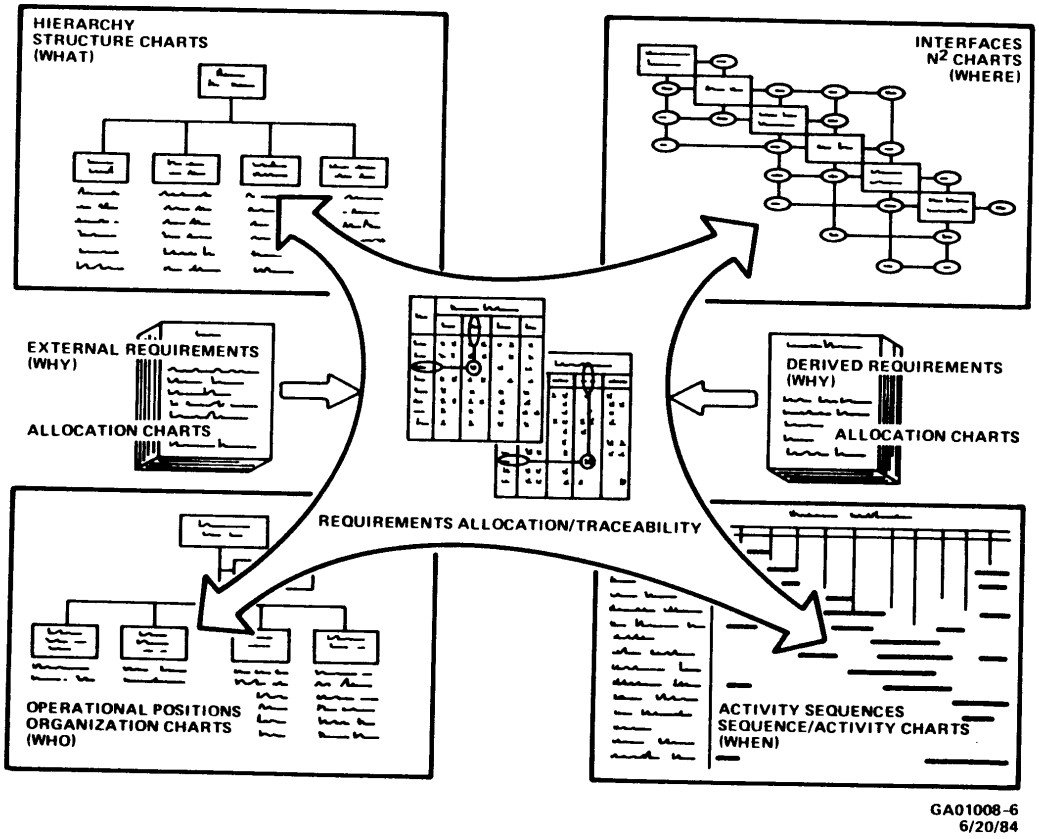

Figure 4-3. System Engineering Tools Relationships

and "who" of the FMP system. The resultant work will be reflected in the briefings and other documents.

4.1.3.1 Hierarchy Structure Charts

Structure charts are used for hierarchical decomposition of the FMP system into manageable modules or components. Each box (component) of one level of a chart may be the top-level box of lower structure charts.

4.1.3.2 Functional Flow Block Diagrams

The functional flow block diagrams will define the event sequences required to accomplish various FBIS system activities. The diagram graphically presents the functions of the system and their data flow relationships and is used to develop software and data flowcharts.

4.1.3.3 Requirements Allocation Matrix

The requirements allocation matrix will ensure that each functional requirement is assigned to specific hardware, software, or staff. Each matrix is a table whose rows (or columns) contain system functions and whose columns (or rows) contain system requirements. The matrix provides the basis for system design and the development of the concept of operation and the requirements traceability matrix.

4.1.3.4 N-Squared Interface Diagrams

The N-squared interface diagram, or N-squared chart, is used to define, tabulate, analyze, and design all major internal and external system interfaces and relationships. The chart is a graphical presentation of system functions in which data flows between the functions are represented by a matrix-like format.

4.1.3.5 Activity Sequence Charts

The activity sequence chart is used to define the more detailed timing relationships of FBIS system operations. It is a graphical presentation of the system activities and their relationships to a standard time axis, and is used to develop timeline charts to support productivity analysis and improvements.

4.1.3.6 Requirements Traceability Matrix

The requirements traceability matrix is a dynamic engineering tool that is used throughout system development. It provides a history of the requirements that is derived from allocation matrices and supports configuration management.

4.2 ESL's Automated System Analysis Model

To support its technical approach, ESL will use its computer-based Functional Analysis System to permit accurate documentation of FMP requirements and to promote rapid, orderly, and traceable changes.

4.2.1 ESL's Balanced Approach

An increasingly significant problem facing system designers and planners is the complete and accurate definition of system element interfaces, and task or activity interrelationships. To alleviate this problem, a structured technique or discipline

is used that gives equal weight to all definitions and parameters in system development. Interfaces and activity relationships are dealt with in a top-down, hierarchical way that is as structured as the function definition process. Implementation of an effective interface definition method is essential because the interfaces within systems under development have increased in complexity.

4.2.2 The Automated Functional Analysis System

The FAS provides a structured method to define, maintain and display functional interactions. The system includes a computer-based master file that interfaces with six utility programs in addition to a text editor. The major Functional Analysis computer programs in the FAS system are N-Squared, WBS (Work Breakdown Strucutre), THREAD and HIPO (Hierarchy plus Input-Process-Output).

The N-Squared program generates N-Squared charts. The WBS program generates a graphical layout showing the hierarchical structure of the master file containing the system function definitions. The THREAD program allows generation of function sequences based on definitions contained in the master file. HIPO produces a list of activity inputs, functions, and outputs based on commands used by the N-Squared program. Each FAS computer program contains quality assurance checks to ensure and verify the integrity of the database and user commands.

4.3 FBIS Concept Definition Technical Approach

ESL's technical approach in the FMP Conceptual Definition Phase (Figure 4-4) will consist of the following tasks, using the system engineering tools described above. The schedule for accomplishing the SOW tasks are shown in Figure 2-2 of Volume II, Management and Cost Section.

4.3.1 Review and Analysis of Functional Requirements (SOW 3.1).

An important activity of this subtask (Phase 1) is the review of requirements, which will include interviews and site visits. During the site visits, the ESL staff will correlate the FBIS baseline description and FMP Phase 1 requirements with the FBIS mission areas, capabilities, and operational environment. These visits with headquarters and site staff and management will provide a basis for the development of the concept of operations, N-Squared interface diagrams, functional flow block diagrams, requirements allocation matrices, and activity sequence charts (Figure 4-4).

4.3.2 Refinement of FMP Requirements (SOW 3.1)

Phase 1, functional requirements review and analysis, will enable ESL, working with the FBIS, to refine the FMP requirements. The revised version of the modernization requirements will be delivered to and presented in a briefing to the FBIS Systems Development Staff.

The requirements refinement process will involve at least the following considerations:

- The FMP system should be as effective as possible: It should be easy to use, easy to learn and easy to manage and maintain, should increase productivity.
- Commercially available technology should be exploited to meet FMP requirements and to maximize system reliability, even if it means foregoing the highest possible performance (subject to the trades-off studies).

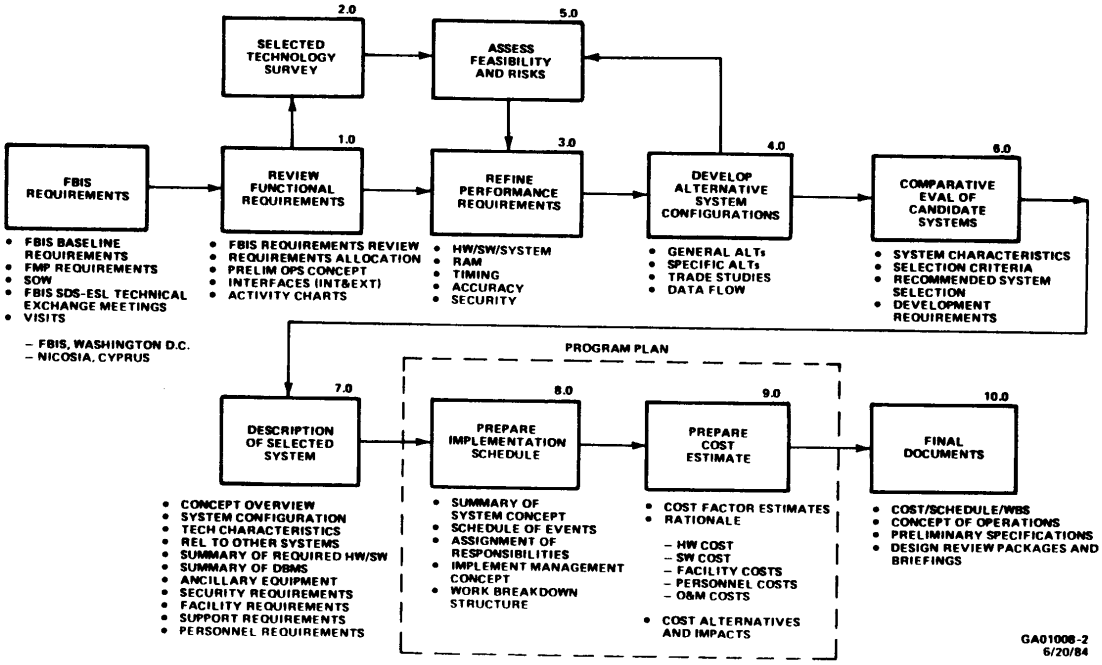

Figure 4-4. FBIS Concept Definition Technical Approach

- Where possible, special software development should be minimal because it increases the risks and costs of system design, development, and integration.
- The system should be easily expandable to accommodate new technology.
- Installation and training costs for each copy of the system should be as low as possible.
- The differences between hardware, software, and organizations at separate installations should be minimized to reduce training, maintenance, inventory, and staff costs.
- Responsiveness to local- and global-crisis situations should be anticipated and accommodated in the FMP design.
- Management of bureau and other subsystems should be eased by computer support (office automation).

4.3.3 Survey of Information Systems Technology (SOW 3.2)

A survey of information systems technology will be conducted to augment ESL/TRW's product knowledge in the critical areas discussed in Section 3. The survey will include gathering information on commercial products and compiling relevant working papers, such as trade-off studies and design analysis reports. This survey is expected to continue at least until candidate products are selected and special development efforts are identified. The survey will enable ESL to assess the feasibility and risks of the different kinds of commercially available technology relevant to the FBIS system.

4.3.4 Development of Alternative System Configurations (SOW 3.2)

Candidate system designs will be developed (Phase 2) based on the revised FMP requirements and on the availability of commercial products. The most important criteria in developing the system architectures will be high reliability and continuity of service in FBIS installations; minimal technical risk; a system that does not preclude system growth; and ease of learning and use of the system.

The development of the system design will be an iterative process in which candidate commercial products and design alternatives (alternative system configurations) are integrated by ESL and then assessed in cooperation with the FBIS Systems Development Staff. Trade-offs will be used to support design rationale and decisions. A report on the proposed design will be delivered to the FBIS Systems Development Staff and presented in a briefing.

4.3.5 Recommended FMP System Configuration (SOW 3.2 and 3.4)

A comparative analysis will be conducted on the candidate system configurations to determine which configuration of commercially integrated products best meets the FMP requirements. Special developments will be recommended for functional requirements not adequately provided by commercial products.

The recommended system will be described and justified in the system design report delivered to and presented in a briefing to the FBIS Systems Development Staff. The report and the briefing will detail system design, functional allocation, the decision process used, and the risks and anticipated deficiencies in the recommended approach. A concept of operation will be developed as outlined in the SOW, Section 3.4 and Appendix E. A preliminary system specification will be prepared as outlined in Section 3.4 and Appendix F of the SOW. The concept of operation and the system specification will be used to synthesize a system design.

4.3.6 Implementation Schedule and Cost (SOW 3.3)

ESL will detail the schedule and cost estimate (Phase 2, continued) for the development, procurement, delivery, installation, training, operation, and maintenance of the recommended FMP system. The schedule will recommend milestones for incremental increases in functional capabilities during the FMP acquisition and development. The schedule will be developed in conjunction with cost data and the Work Breakdown Structure (WBS) as defined in Appendix D of the SOW. The schedule and WBS will be delivered in a report and presented in a briefing to the FBIS Systems Development Staff.

The modernization program's cost will be derived from the schedule, the Work Breakdown Structure, ESL's experience in system development, and the use of current tools for cost estimation of system engineering projects, including cost simulators. The cost estimates will be delivered in a report and presented in a briefing to the FBIS Systems Development Staff. The estimates will be categorized as hardware, software, facility, personnel, and O&M (operation and maintenance), and a rationale will be provided for the costs in each category.

4.3.7 Description of Recommended FMP System (SOW 3.4)

Phase 3 will consist of the refinements of the FMP system design, functional allocation, cost and schedule, and the WBS. Also included will be the final version of the concept of operations and the preliminary system specifications. Figure 4-4 illustrates the technical, cost, and schedule work flow descriptions that will be provided. A design review package and briefing will be provided that include the refinements described above and the concept of operation and specifications documents.

4.4 Experience of Proposed Staff

ESL will bring to the Conceptual Definition Phase a staff with experience in system integration and development, database design and development, networking, and advanced processor technology.

4.4.1 Project Manager

Roger Dahlberg has been named Project Manager. Mr. Dahlberg has responsibility for leadership and direction of project personnel and for coordinating their efforts to meet FMP requirements efficiently. He has extensive experience in project management, system engineering, and system development and applications.

4.4.2 System Engineer

The System Engineer provides the technical focus for the system engineering activities in the Concept Definition Phase and reports to the Project Manager. The System Engineer will help ensure the proper mix of commercially available hardware and software and ESL-developed hardware and software for an effective, easy-to-use system that is reliable and expandable. Mr. Myron Sabes has been selected as the system engineer. Mr. Sabes has more than 17 years of experience in large-scale system engineering. He was involved in the engineering of telephonic communications networks for seven years and has been involved in software engineering and hardware/software integration for more than 10 years.

4.4.3 Database Management Systems Specialist

Recognizing the central importance of database management to this program, ESL has specified that the Database Management System Specialist will report directly

to the Project Manager. Mike Forster will fill this role. Mr. Forster has extensive experience in the development of database management systems, and in the integration of man-machine interfaces with database management systems. Mr. Forster will be consulting with Dr. Kwang-I Yu of TRW, who is the designer of the Fast Data Finder chip, and Professor Michael Stonebraker of the University of California at Berkeley, expert on database technology and a developer of the relational database management system INGRES.

4.4.4 Hardware and Software Integration Specialist

The Hardware and Software Integration Specialist will work closely with both the Database Management Systems Specialist and the Systems Engineer to ensure that the FMP concept definition meets performance and MMI requirements. He will also be best able to judge the costs of the integration tasks required for the FMP. ESL has chosen Alan Nitteberg for this task. Mr. Nitteberg has more than five years hardware and software experience in system development. He has designed and implemented hardware interfaces and software drivers for peripherals, and has been involved in the development of advanced image processing systems.