Second Version of the Editorial Processing Center Proposal

As of July 1975 two versions of SRI's proposal to the National Science Foundation for a Editorial Processing center had been prepared. This is the second, submitted in March. The proposal was prepared on the Machine Aided Editing (MAE) system. The translation processes that brings MAE files to NLS do not yet create an orderly hierarchy in the NLS files and has some problems with hyphenation and the like. I (DVN) have delayed journalizing this file for some months intending to get the structure in order by hand, but it is apparent that it is no longer worth the effort so I am journalizing it as is for historical purposses. The first version is avialble as (journal, 25921,). The appedicies which, contain proprietary information, are journalized as (journal,25923,) with restricted access.

1 ************************************************************ 1

1a DOCUMENT CONTROL INFORMATION 1a

2 DISK NAME: (ISG2) LOGIN NUMBER (UIC): 200,12
FILE NAME: DK0:NSF.MAE 2

3 LABOR CHARGE: 710583-8SF MACHINE CHARGE: 710583-8SF 3

4 AUTHOR: P. Whiting-O'Keefe 4

5 TITLE: 5

6 DATE MODIFIED: 23 January 1975, 1000 6

7 SPECIAL INSTRUCTIONS: 7

8 CHARS PER LINE: 72 LINES PER PAGE: 52 8

9 OUTPUT FORMAT: LP:/PF:FINAL/PN:0 9

9a MARK UP HARD-COPY WITH COLORED PEN OR PENCIL !! 9a

10 ************************************************************ 10

10a CONTENTS 10a

18b SRI proposes to develop and operate an experimental computer-aided Editorial Processing Center (EPC) that would be suitable for use in the publication of scientific and technical journals, in response to Category 8 of RFP NSF-74-38. The objectives of the proposed project are (1) to identify and resolve problems inherent in the computer-aided publication of scientific and technical text, and in putting actual production work through a computer-aided EPC; (2) to explore and develop the capabilities inherent in computer-aided publication for access to and dissemination of information derived from the documents produced; (3) to evaluate the economics, the reductions in time-to-publication, and the advantages offered by EPC operations. 18b

18c The approach proposed is to assemble hardware and software, inte-grate them into a system, and use the production of actual documents, with real deadlines, to guide the modifications and refinements. The emphasis of the approach will be on solving the problems inherent in the publication of any scientific and technical text so that the resulting EPC will be applicable to a wide range of journals and to other publishers. 18c

18d SRI proposes to purchase a unit of NLS Workshop Utility Service,* and connect to that service CRT editing and page formatting terminals, input devices (including an optical character reader), and output de-vices (proof printers such as Diablo or Gume). Phototypesetting using third-generation equipment is available as a service, but a CRT type-setter may be added to the system later. 18d

18e Successful operation of a prototype EPC for scientific and tech-nical documents will provide the possibility of a new mode of operation for technical and learned journals, and other publishers, along with new information assembly and dissemination possibilities. 18e

19 ________________________ 19

19a * The NLS System is an advanced computer-based information system providing powerful communication, editing, and other tools. It was developed by SRI's Augmentation Research Center under ARPA sponsorship. 19a

19a1 II NARRATIVE 19a1

20 A. Introduction 20

20a The thrust of this operational experiment is broadly to investigate and evaluate channels for more effectively disseminating scientific and technical information. The functional channel directly addressed by this proposal is the application of computer technology to solve the economic problems that have beset the scientific journal publication industry. The proposed mechanism is the establishment of a prototype Editorial Processing Center and the evaluation of this center for meeting the needs of the industry in an economically justified manner. However, the potential scope of the envisioned experiment transcends the immediate needs and goals of the publishing industry. It really focuses on the need to review and rationalize the justification for traditional channels and methods of communication. 20a

20b A detailed study of existing document preparation and publication processes at SRI has recently been completed (see Appendices A-C). The study considered how these processes might be improved by the adoption of computer aids. It proposed a conceptual design for a computer-aided editorial processing system that could be used for most current SRI publications (e.g., proposals, reports, papers for technical journals), in a variety of scientific and technical disciplines. The study brought together experience gained from over 12 years of work with computer aids for text production, both at SRI and for outside government and commer-cial clients. The conceptual design proposed for the SRI system closely resembled what has been described elsewhere as an Editorial Processing Center (or EPC) (see "Editorial Processing Centers--A Study to Determine Economic and Technical Feasibility," by Westat, Incorporated, for NSF, July 1974, PB-234 959). 20b

20c Much of the software that is needed for an Editorial Processing Center has already been developed or acquired by SRI, particularly in the Augmentation Research Center. What really remains to be developed for a production system for scientific and technical text are procedures that will permit economical use of computer aids in ways that recognize the needs of authors, and that support effective interaction by authors, volunteer journal editors, and reviewers. Experimental operation of an Editorial Processing Center of the kind proposed here will permit the real-world problems posed by computer aids to be addressed, as well as allow study of the potential advantages of having a machine-readable version of each document available for secondary applications. 20c

20d A number of real-world problems can be encountered with such an Editorial Processing Center: 20d

20d1 . In text with complicated formats, extended character sets, display equations, or multiple typefaces and sizes, it is necessary to imbed formatting information within the text itself. In some cases, it is necessary to specify the typo-

; might be used to indicate a level 1 heading. This directive would cause selection of the proper typeface and formatting during computer composition.

graphy directly, for example to specify an extended character set or a display equation. In such cases, a character string such as ".BLD=14"; together with a font specification might be used to indicate 14-point bold-faced type (the system proposed by Westat). In other cases, it is better to describe composition information indirectly in terms of function. For example, the character string ".H1"; might be used to indicate a level 1 heading. This directive would cause selection of the proper typeface and formatting during computer composition. 20d1

20d2 Such indirect specifications allow composition in a variety of formats without having to alter directives imbedded in the text, and are preferable to direct specifications. It may be possible to extend indirect specification to some simple kinds of display equations. Whether direct or indirect, the set of formatting directives must be logically consistent and open ended to support the computer composition software and later enhancements and extensions. Because format specifications must either be captured with the text or inserted later, and then proofread, human factors are particularly important in designing directives and establishing conventions for their use. 20d2

20d3 . The formatting of complex tables is a formidable task, especially when the initial proof copy bears little typographic relation to the final, photocomposed version. 20d3

20d4 . In spite of the assurances of equipment salesmen and engineers that any good typist can learn to operate a word-processing system or text-handling system in a short time, experience with existing systems indicates that this is only partly true. Even a good system makes new demands on production typists. For simple material, essentially "transparent" capture procedures, virtually identical to normal typing procedures, can be used, and learning is rapid. The computer can identify entities such as headings and paragraphs from context, and only limited use of imbedded format directives is needed during text capture. However, as complexity increases, so does the need for additional format directives. For input of complex material and for entering revisions, the typist needs skills beyond those required for normal manual typing. A new kind of typist may be needed (who may command more than the $3 per hour envisioned in the Westat report to NSF).
. It appears that, although the ability to retain correct text in various editing passes cuts down on proofreading needs, the requirement for imbedded formatting commands may introduce new problems for proofreading. For example, some way must be

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provided for a proofer to check, before he sees the final page proof, that 14-point bold has been asked for (or should have been) and has been set. Frequent occurrences of directives imbedded in the text make it difficult for the proofreader, as directives must be proofed character by character. A possible approach is to produce proof copy using a device such as an electrostatic line printer that can represent different typefaces and sizes directly. Several different mechanisms for representing computer-held text are needed: a clean printout of text content only for use by authors, editors, and reviewers; a printout showing all imbedded format directives so they may be verified, modified, or added to; proof copy on which the direc- 20d4

20d5 tives are invisible but the consequences of all directives are clearly indicated; and so forth. The different formats needed to best support the various persons acting on the document add to system complexity, but are an important human factors consideration in system design. 20d5

20d6 . It appears that there will be a strong need to control the number of revision passes (and versions) and to update text following approval. Some positive control system will need to be devised. 20d6

20d7 . Experience suggests that all of the features of conventional publishing cannot be implemented with equal ease in a
computer-aided system. Experimentation appears to be the best way to determine which compromises will provide the best quality of published text, and the best communication of scientific and technical information at costs acceptable to all parties. Refusal not to compromise on some points may raise costs to unacceptable levels, and other unavoidable compromises dictated by hardware and software considerationsmay be found unacceptable. Trade-offs need to be assessed in terms of dollar costs as well as procedures imposed on authors and editors. 20d7

20e These problems and numerous others are pertinent to the production of scientific and technical text, whether it is in the form of a pro-posal, a report, or a journal publication. The assurances of computer professionals and conventional publishers alike cannot substitute for the experience of actual use of such a system. A computer-aided text-handling system can lower the cost and improve the quality of existing communication mechanisms. But it can also permit and encourage funda-mental changes in the way documents are created, structured, manipu-lated, and accessed, and it can support additional graphics communica-tion mechanisms.

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These changes can better serve the essential objective of effective information transfer. The unconventional practices of delivering information to clients (or libraries) on machine-readable media or microfilm, of selectively retrieving and disseminating information from computer files, and of on-line interactive telecon-ferencing in order to present and refine document contents, are examples of additional communication mechanisms made possible by a computer-aided system. 20e

20e1 1. System Objectives 20e1

20e1a Any EPC system must satisfy five essential objectives: 20e1a

20e1a1 (1) Significant and demonstrable cost savings in the production of the majority of publications processed. 20e1a1

20e1a2 (2) Significant and demonstrable time savings for the majority of the documents processed. 20e1a2

20e1a3 (3) Improved document quality encompassing document content, appearance, organization, style, grammar, spelling, and conformity to format and production standards. 20e1a3

20e1a4 (4) Improved management and control, so that the system facilitates, simplifies, and improves the administrative and production control over the publcation and its component parts. 20e1a4

20e1a5 (5) Acceptance -- Any new system, whether computer-aided or not, should be installed with minimal disruption to existing operations and should quickly gain acceptance from users and personnel whose activities it affects. A positive attitude on the part of the affected personnel is the single most important factor in successful system installation. This is achieved only by a thoughtful design that meets real user requirments, and by careful planning and training for installation. 20e1a5

20e2 2. System Scope 20e2

20e2a The diversity of text processing activities at SRI is very great. The study of SRI's text processing considered

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publication production processes and all closely related activities for the bulk of the SRI text processing workload. This study served as the foundation upon which to produce a proposed conceptual design for a computer-aided text handling system to satisfy the requirements of most of the reports and proposals currently produced at SRI, as well as journals, brochures, other types of publications. The wide scope of SRI's effort avoids the risk of designing an EPC for a particular journal or set of journals and finding later that it cannot be easily applied to other journals. 20e2a

20e2b SRI is an ideal development site and proving ground for an EPC because: 20e2b

20e2b1 (1) SRI has many years of experience with the design and
development of a number of text-handling systems.
(2) SRI has facilities, software, and personnel to support and provide building blocks for the EPC system. 20e2b1

20e2b2 (3) SRI's document processing facilities meet all the require- ments of a model or prototype EPC -- diverse document format requirements, heavy and unpredictable document
volume, large centralized editorial staff, and processing procedures that vary as significantly between divisions as they might between journals in different disciplines. The more typical current document production process at SRI is given in the flowchart in Figure 1. 20e2b2

20e3 Most of SRI now uses manual methods of text production, but within the Information Science and Engineering Division, two areas make extensive use of computer aids: the Augmentation Research Center (ARC) and the Information Science Laboratory. The ARC has a large multi-terminal time-sharing system that includes extensive text handling capabilities but goes well beyond text handling per se. The system is intended to support and augment researchers and managers in all of their day-to-day work with textual information--collection, organization, collaboration, conferring, publication, and dissemination. The Information Science Laboratory uses the Machine-Aided Editor (MAE) system, implemented on a minicomputer and dedicated to development of computer aids for document preparation in production applications and environments. Both the ARC and the MAE systems are used extensively for document preparation and publication in their respective organizations, and they have evolved to their p resent form over a period of more than 12

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years. The technology, methodology, and experience of these two organizations are the basis for the proposed EPC. SRI represents an ideal testbed for studying the consequences of introducing a computer-aided EPC into real production environments on a large scale. 20e3

21 B. Study Plan 21

21a 1. General Background 21a

21a1 The proposed development work and experimental EPC operation would address the problems common to all editorial processing of scientific and technical text. Such problems can be well represented by the SRI project reports produced for the several NSF-sponsored projects conducted at SRI. These reports share with technical and scientific journals such common problems as formatting complex tables, solving page make-up problems (e.g., widows, rivers of white), varying publication formats, and composition aids for mathematical and scientific notation. Because many of these reports are in fact submitted to technical and scientific journals, any system that supports their preparation must directly address the problems specific to journal publication. 21a1

21a1a Figure 1 21a1a

21b Flow of Existing Report/Proposal Production Process
SRI has a centralized report production organization that supports the full complement of document production requirements emanating from SRI's eight research divisions. It is in the framework of this existing system that a proposed computer-aided publication process flow is pre-sented in Appendix D. The proposed system results from the study of the current system as it is described in Appendices A through C. The flow-chart shown in Figure 2 is an outline of the proposed production pro-cess. The proposed process flow is intended to address existing problems and to avoid pitfalls associated with a computer-aided approach to an EPC. It establishes requirements for computer aids and the associated data base, but does not presuppose any specific computer system or data base design. 21b

21c This study plan establishes a framework for discussing specific com-puter hardware and software configurations. The features that must be present in a basic initial system are identified, and additional fea-tures and system enhancements are grouped and arranged in order of priority according to anticipated cost, value, and difficulty of imple-mentation or acquisition. A

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time-phased approach to implementation and installation is described that would result in an early return on invest-ment by early introduction of basic system capabilities. Subsequent sys-tem enhancements that can be made in an orderly fashion to satisfy a broader range of document production requirements are also described. The requisite data base support is described, with the steps necessary to developing the data base. Finally a detailed implementation plan is supplied. 21c

21d 2. Priorities for the Study 21d

21d1 The following items and facilities are suggested for development of the EPC, listed in descending order of priority: 21d1

21d2 (1) A basic system intended to eliminate as many manual typing steps as possible and to satisfy functional requirements of (although not necessarily support production capacity for) documents in a wide range of disciplines. Such a basic system must: 21d2

21d3 . Provide for text capture to a computer file 21d3

21d4 . Support editing and modifications of the captured text 21d4

21d4a . Provide for composition and output to a small but adequate set of hard-copy devices, including at least line printers, computer-driven typewriters, and a phototypesetter. 21d4a

21d4b . Be based on a thorough rationalization and systematization of all related document creation and production steps,
management and control procedures, and functions. 21d4b

21d4b1 Figure 2. 21d4b1

21d5 (2) A supporting data base of text information whose subsequent repeated retyping can be eliminated. The initial data should include at least the following (with journal equivalents in parentheses): 21d5

21d5a . Staff biographies (reviewer biographies and experience
for journals) 21d5a

21d5b . Project summary descriptions (abstracts of prior journal articles) 21d5b

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21d5c . Descriptions of the Institute, its various organizational entities, facilities, program areas, and activities (no journal equivalents) 21d5c

21d5d . Other selected "boilerplate" material and commonly used contractual and legal matter (journal subscription, submission, and review policies, staff listings, and the like, published in each issue) 21d5d

21d5e . Frameworks to support the writing of technical publications in the most commonly used formats and organizations (number of columns, type sizes, indents, and other formatting information for each of the journals using the EPC) 21d5e

21d5f . Abstracts and a bibliography of previous SRI reports, proposals, related documents, and staff publications. (for journals, this kind of machine-readable data base would offer benefits that need to be explored). 21d5f

21d6 (3) Facilities for computer entry of all (or at least selected) management and control information, and development of a basic management information system (MIS) that makes use of the collective body of this information (including reviewer experience and selection, journal page charges, control of review time and draft location). 21d6

21d7 (4) Inclusion in, or expansion of, the EPC to support remote preparation, review and production of documents--e.g., in the SRI Washington, D.C. office (or at a remote journal office). 21d7

21d8 (5) Gradual introduction of automated proofreading aids, extended as justified to provide editor and author support. 21d8

21d9 (6) Study and introduction, as justified and feasible, of computer aids to support generation of more complicated scientific and mathematical notations in the body of documents (rather than treating display equations as artwork). 21d9

21d10 (7) Study and introduction, as justified and feasible, of computer aids to illustration rendering.
These priorities reflect an emphasis on actual document

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production, cost-benefit justification, early return on investment, and exploitation of available technology. 21d10

21e 3. EPC Development Plan 21e

21e1 This section is intended to serve two functions. First, it describes the EPC system implementation plan and a hardware configura-tion for basic system development. Second, it explores ways in which implementation of an EPC system can maximize use of available capabilities. 21e1

21e2 The proposed development plan for the basic SRI computer-based EPC system has four phases: 21e2

21e2a (1) Detailed system design covering procedures, forms,
system hardware and software, the data base, and plans for user training and system installation and operation. This activity leads to the placing of orders for selected system hardware components. 21e2a

21e2b (2) Implementation activities while awaiting system
hardware delivery. 21e2b

21e2c (3) System integration and checkout following delivery
and acceptance of hardware. 21e2c

21e2d (4) User training, system installation in user environments, initial system operation in a production mode, and evaluation. 21e2d

21e3 Task statements within each of these plases are delineated in Section C where schedules and manpower requirements are given. 21e3

21e4 We will set the stage for discussion of the proposed EPC by describing our counterpart to the Westat Report's maximum configuration. We will then detail a minimum scale (in terms of hardware) configuration we believe to be suitable for system testing and evaluation. Much of the equipment described in this section is discussed in detail in Appendix E to which the reader is referred. 21e4

21e5 The envisioned full-scale hardware configuration of the EPC is based on the concept of distributed processing. One

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central processor is employed for specialized functions, such as access to the principal data bases; control of phototypesetting and optical character recog-nition equipment; control of high speed line printers, magnetic tape input/output, centralized management and control processing, full-page format CRT editing stations; and so forth. The centralized facilities allow higher-code items to be shared by all system users. 21e5

21e6 Connected to the central processor are a number of editing station controllers. There may, in fact, be a large number of these. Typically, each editing station controller would be a minicomputer which would provide local editing and capture capabilities via a cluster of, say, four to eight CRT terminals. Also, the controller would provide for local storage of active document text, for input/output on a medium such as magnetic tpe cartridges, for hard copy output through a high-speed printer, such as Diablos, and so forth. 21e6

21e7 Individual configurations could differ considerably without markedly different software. For example, a terminal cluster for pro-duction editing might consist of four CRT terminals of moderate complex-ity, perhaps two supporting full page formatting, but no local hard copy output. Hard copy would then be obtained from the central processor when needed. A cluster serving the needs of text capture and perfecting consist of eight simple editing terminals, a number of small on-line capture terminals, and several hard copy output devices. Some clusters might require only two or at most three of the simple terminals. Each such configuration could be tailored to local needs as well as to total system requirements. Individual editing terminals could be located at some distance from the editing cluster controller to which they belong. The clusters of terminals could be replicated to provide increments of system expansion and widespread access to the system. 21e7

21e8 The central processor would have access to sufficient on-line storage to accommodate a full data base as well as all management and control files, data required to support composition and formatting, files to support OCR input, and about one month's total document produc-tion. It is emphasized that the principal function of the central processor is to access the data. The data itself can actually reside elsewhere--e.g., some of it on a computer with a suitable data base management system, some of it off-line in archived form,

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and so forth. It is pointed out that data file backup is in the system. 21e8

21e9 Having described the general outline of the desirable system configuration for a full-scale EPC, we will now describe a systems approach that offers the most flexibility and the least new development work for the EPC as we envision it. 21e9

21e10 The large multi-user text-oriented system developed by the Augmentation Research Center at SRI already contains most facilities needed to support EPC operations, and many that extend well beyond the scope of the proposed experimental EPC operation. This system, called NLS, is described in the Institute Resources Section of this proposal. The system was developed under the auspices of the Advanced Research Projects Agency (ARPA) and other government sponsors, and has until recently been available only to members of the ARPA community through the ARPA Network. 21e10

21e11 ARC now makes NLS available to general users through a commer-cial time-sharing service (Tymshare). The service is provided to users through "slots." One slot gives guaranteed single user access to NLS during a 16-hour operational period six days a week. The contract per-iod for a slot is one year. The slot also provides on-line storage for up to 3,000 pages of data, each page consisting of 512 words of 36-bits or the equivalent of a full typewritten page. There is access to magne-tic tape for archiving, and to text stored on host computers on the ARPA network, to which this utility version of NLS is connected. Finally, a utility slot provides microfilming and photocomposition services. 21e11

21e12 A slot can support more than a single device at the user end. Currently, ARC is developing a minicomputer-based front-end PDP-11 pro-cessor that will support an even broader hardware configuration on a single slot. This development is scheduled for operational use at about the end of the second quarter of 1975. All text data processing will be done by NLS in the central time-shared PDP-10 computer. Later, subsets of text editing commands will be provided locally in the PDP-11 front-end. NLS will then be used for access to central, shared resources such as the large data base and photocomposition services, and for the more computationally demanding functions such as composition. 21e12

21f Implementation Plan 21f

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21g SRI's proposed approach to the implementation of an EPC is based on the use of the NLS utility in conjunction with a PDP-11 front-end pro-cessor which provides support to a group (cluster) of terminals. The configuration that results is remarkably similar in concept to the configuration described in the foregoing subsection and to parts of the intermediate and advanced systems described in the Westat report. 21g

21h SRI would gain access to the NLS utility by purchasing a utility slot. Using the slot would significantly reduce implementation cost as well as speed development of the EPC and permit more experimental opera-tion of it. Initially, most processing services would be obtained from the NLS utility. The utility slot and the EPC development does not re-quire a front-end processor. Subsequently, some of the services would be implemented on the front-end processor. After local service has been established with the PDP-11, the NLS utility can continue to serve data base management and other centralized functions. The hardware required for initial service through an NLS utility is applicable to full-scale systems using front ends, and the software development can proceed as necessary without the front-end processor which is currently being implemented. 21h

21i Perhaps the strongest merit of this approach is that it will accelerate the upgrading of the document editing features available through NLS. NLS currently supports a full complement of text mani-pulating, editing, and formatting functions. However, only recently has NLS begun to address direcly the specific requirements of the publishing industry, and specific NLS capabilities need further development to satisfy these needs. These functions include tab setting and tab con-trol versatility, with provision for editorial intervention, automatic hyphenation, right and left text justification, the ability to shift from two columns to one and back, support of a broader set of fonts, table generation, full-page formatting and CRT display, full in-page footnote capability, and the ability to select from preestablisheddocument formats (with headings and footings) to obviate the need to repeatedly specify format control commands. 21i

21j The system available through NLS to a single user and, through the front end, to multiple users would include most needed text-processing capabilities. In addition, the NLS utility provides access to a powerful data base management system and large amounts of on-line storage. The proposed approach optimizes use of previously developed and available hardware, software, and services. It has the additional advantage that the developers of NLS, namely ARC staff, will actively participate in the proposed

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project. Implementation steps associated with the develop-ment of new software and its refinement can take place independent of the delivery of the system hardware. 21j

21k Thus, we propose the purchase of a slot on the NLS utility to which we attach the following peripheral devices: 21k

21l 2 hard-copy printers (e.g., Qume or Diablo)
2 single-line display terminals
1 CRT editing terminal with four 3M cartridge drives
1 full-page CRT formatting terminal
1 optical character reader (offline)
1 electrostatic printer to support full-format proof copy output. 21l

21m This selection of hardware allows complete checkout and user accep-tance testing of all of the desired peripheral devices for a full-scale EPC serving several large technical journals as well as evaluation of photocompostion services and equipment (see Figure 3 for the described configuration). 21m

21n By reducing the amount of hardware to be integrated and the re-quired software development, greater effort can be devoted to procedural and operational studies, accumulation of user experience, and identifi-cation of the problems associated with introducing computer-aided EPCs into formerly manual environments. Thus, the unique aspect of this project will be not the development of viable hardware or even software, but the application of the EPC realization to actual production work, with the associated deadlines, complications, and proofreading problems that would be entailed in journal productions. 21n

21n1 Figure 3. The Data Base Facility 21n1

21o The Westat report places the data base that we envision for the EPC at a later stage of EPC development. However, a data base that supports EPC operation is considered an integral and necessary part of SRI's total system concept. The degree to which such a data base would support journal publication is not known. However, it is possible that the existence of a computer-accessible data base with detached cataloguing may enable an EPC for a group of related journals to take on a new information-brokerage function not now performed. Whether this is possible or desirable is beyond the scope of the proposed project to establish; however, SRI staff members who work on journals, whether as reviewers or editors, will be asked to comment. The data base will include the following: 21o

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2101 (1) Full text of documents--The full text of all documents
and publications prepared in the EPC will be stored for further use. Text does not need to reside in on-line computer storage; it can be archived on magnetic tape and on micro-film. When the likelihood that the text will be reused in a different form has diminished because of the passage of time, the magnetic tape can be erased and a microfilm (or microfiche) version retained for reprinting as needed. 21o1

21o2 (2) Document indexes--When a group of journals share an EPC, then a union index of all documents prepared at that EPC begins to take on a new and different value, at least if the journals are somewhat related in discipline (e.g., histology, cytology, cyto-chemistry, neurochemistry). One possible use for such a union index might be as resource for the preparation of overview articles assessing a year's work. Another possible use might be in the preparation of special sets of reprints (the custom-tailored journal) to meet requests that cover information in more than one field. 21o2

21o3 (3) Bibliography--A collection of bibliographic citations offers the possibility of setting common references (and proofing
them) very rapidly. There are certain seminal references in a field that will be cited in a wide range of journal articles over a long period of time. In addition, the compilation of a collective bibliography from a group of related journals could provide a valuable resource for researchers. 21o3

21o4 (4) Document abstracts--A computer-accessible collection of
abstracts has utility for a journal in that it permits sending to a reviewer, along with a draft to be reviewed, a selection of abstracts of other journal articles on the same or similar subjects that have been published in the recent past. 21o4

21o5 (5) Project summaries--A collection of project summaries has no obvious manual predecessor in the journal publication industry. Yet for journal publication these could facilitate subject-oriented review compendiums that would include some text describing an overview of technical accomplishments during the year, and links to various articles published on that subject. Project summaries of NSF projects on the system at SRI may well have a value to NSF that is independent of any possible value to scientific and technical journals. On a broader scale, such a computer-based source of summaries is of

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paramount importance to enhanced scientific and technical communication among scientists or researchers in the future. 2105

2106 (6) Indices to illustrations--A collection of indices to illustrations would have possible utility for journal publication to assist in locating and retrieving stored artwork useful in other journal articles. 2106

2107 (7) Standardized document frameworks--A collection of standardized journal frameworks, with column width, type size for headings, and the like would permit an EPC to map drafts rapidly into the format of the journal. A structure skeleton for certain parts of articles (e.g., abstract, bibliography) would permit more rapid composition and typesetting. Standard frameworks could be of special value in an EPC serving several journals, and at SRI serving a multitude of clients, SRI divisions
many of which require different formats. 2107

2108 (8) Supporting data files --A number of other data files might be included in the data base that would be of utility to journal publishing. The most obvious of these is a record of each
reviewer's background and experience, as well as the management and control file that shows when he received and responded to review requests and what manuscripts he has previously processed. (An analogue for SRI is a Capabilities File that contains biographies of SRI researchers, along with a list of projects they have worked on.) Another data file that might be of use in journal publication would be a legal and contractual file that would include releases obtained, standard wording for releases, requests from other journals for releases and the disposition of those releases, and the like. Although initially, as these data bases are amassed and entered, access to them might be awkward for untrained personnel, the aim would be not only to amass the contents of the data bases, but to develop a method by which untrained personnel could, with the aid of tutorial helps built into the system, access the files with a minimum of effort.
Existing data base management will be controlled in different ways: some information will be accessed in several ways (e.g., abstracts will be accessible by date, by subject, by author), and some in only one way (the union index will be accessible by subject).
Statement of Work 2108

2109 SRI proposes the following four tasks: 2109

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21o10 Task 1--Detailed System Design--This task covers the detailed design of the system, including specification of system hardware, soft-ware, data base, procedural requirements, and plans for user training and system installation and operation. Task 1 will also include the placing of orders for selected system hardware components, and the purchase of the NLS slot. 21o10

21o11 Task 2--Implementation of the System Design--This task entails necessary modifications and additions to existing NLS software to make it usable and efficient for production work. 21o11

21o12 Task 3--Installation and Checkout--This task includes both installation and checkout of the system after the hardware has been delivered, and training of production personnel in the use of the system. 21o12

21o13 Task 4--Experimental EPC Operation--This task will include the use of the EPC in actual production of reports on NSF projects (if that is indeed desired by NSF) or other projects. During this task, the system will be refined as problems are revealed. The reports prepared at the EPC will show the progress being made in the development of a usable, economical EPC. 21o13

21p The following section elaborates on these tasks and indicates the estimated time requirements for each task. 21p

22 C. Organization and Management Plan 22

22a Here the phases and tasks required to develop the basic computer-aided editorial processing system are described for the purposes of establishing total levels of effort, personnel requirements, and elapsed times. Project leadership and coordination is broken out separately and requires approximately one professional half-time throughout the project. 22a

22b A detailed personnel breakdown and chronological event chart summarizing the following discussion is given in Table 1. 22b

22c Task 1 -- Detailed System Design 22c

22c1 The detailed design tasks have the objective of producing a complete, integrated detailed design for the proposed system, including all procedures, firm system hardware and software selection, and the data base. Table 1 22c1

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22d ESTIMATED PERSON-MONTHS FOR EPC DEVELOPMENT BY TASK AREAS 22d

22d1 Months
1-2 3-4 5-7 8-9 10-12 Total 22d1

22e Project leadership/coordination 1 1 1 1 1 5 22e

22e1 Detailed design
Procedures design 3 2 5
Software and hardware 4 -- 4
Data base design 2 -- 2 22e1

22e2 Implementation
________--------- Procedures and training --
5 -- -- 5 Software implementation 4 5 1
1 11 Accounting procedures/data base
assembly 2 1 -- -- 3 22e2

22e3 Installation and testing
---------________ Hardware installation and checkout
2 2 Software integration/testing
4 4 Procedures and training
4 4 22e3

22e4 Operation
Test operation/demonstration 7
7 Software maintenance 1
1 Evaluation 3
3 ___ ___ ___ ___ ___ ___ 22e4

22e4a Totals (person-months) 10 9 12 12 13 56 22e4a

22e4b Modifications to the proposed system flow will be made as appro-priate and necessary to further reduce document production time and cost, to further improve product quality, to simplify and smooth system installation and user training, and to reduce required implementation effort and hardware cost. 22e4b

22e4c The refined procedural design will serve as the basis for computer software design, computer hardware configuration and selection, individual document and total system management, accounting and control procedures and mechanisms. 22e4c

22e4d There will be two important products from this detailed design, in addition to the basic system designs

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themselves. The evaluations of these products will constitute important checkpoints in the development: 22e4d

22e4d1 (1) A selection of specific hardware components and vendors, allowing orders to be placed. 22e4d1

22e4d2 (2) A refined plan for the remainder of the development effort, showing detailed implementation and installation schedules
and personnel requirements. 22e4d2

23 The detailed design effort will require an elapsed time of four months. All tasks except completion of detailed procedural designs and job descriptions must be completed by the end of the second month, so that hardware can be ordered as soon as possible and implementation can proceed. 23

23a It is recommended that the detailed EPC design activity be staffed by the equivalent of five full-time professionals. A tentative breakdown of tasks with suggested levels of effort for the first two months of detailed design activities is as follows: 23a

23b Project leadership and coordination -- 1 person-month
Detailed procedural design -- 1 person-month
Design of management and control procedures -- 1 person-month
Design of an accounting policy and procedure -- 1 person-month
Specification of location and organization -- 1 person-month
Detailed software design -- 1 person-month
Detailed data base design -- 2 person-months
Hardware configuration and selection -- 1 person-month 23b

24 Detailed design activities will continue in the procedural area for an additional two months to detail procedures, generate work descriptions, and produce plans for system installation, conversion, and user training. These activities will require 11 person-months. 24

24a It is clear from the above description that a variety of skills and experience drawn from throughout SRI are required. Needed are: computer hardware, computer software, and data base specialists with text processing backgrounds; management science personnel with organizational and procedural analysis skills;

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persons intimately familiar with Report Services functions and organization; and others. 24a

24b Task 2 -- Implementation of the System Design 24b

24c The implementation tasks are dedicated to the implementation of the detailed designs. The elapsed time allocated to this task area is five months. The allocation is based on the time required for hardware delivery after orders have been placed. That is, scheduling is such that basic implementation efforts are staffed for completion by the time the required hardware is first available for integration. It is desired to make the system available for experimental use at the earliest possible date, and the critical path seems to be hardware selection, vendor negotiations, contracting and placing firm orders, and hardware delivery times. Effort is divided into three separate task areas: procedures, software development, and accounting policy and data base preparation. The procedures area is staffed at a level equivalent to two full-time professionals. The first two months are devoted to completion of the detailed procedure design, and to preparation for system installation. This involves readying locations for system hardware and personnel, establishing the required organizations, preparation for user training and initial training of key operational personnel, preparation of user manuals, and so forth. The system can be used on a test bases as soon as the hardware and the utility slot is available. The next three months are a continuation of the previous activities but hopefully with early hardware availability and early system use on a limited basis. 24c

24d The software area is expected to require the equivalent of 2.5 full-time professionals. Individual assignments are planned as follows: 24d

24e Text capture and editing -- 1/2
professional
Text composition and formatting -- 1/2
professional
Tables and other special support packages -- 1/2 professional The
data base system -- 1/2
professional
Management and control and system -- 1/2
professional integration 24e

25 This assignment is perhaps ambitious. Success requires thorough planning in the detailed design stage and use of skilled and productive programmers with appropriate experience. This effort must

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be directed and staffed by individuals who have been responsible for implementations of the ARC utility and MAE text processing systems. 25

25a The data base assembly and capture activity requires the equivalent of one-third of a full-time individual: staff members with editorial backgrounds are required to cull sources, assemble material, ensure conformance to standards, and so forth; and a typist to capture assembled material is also required part-time. 25a

25b At the end of this phase the first NSF review should take place. 25b

25c Task 3 -- System Installation and Testing 25c

25d This is perhaps the most critical stage of development. At its completion, the system should be operational and ready for a short period of pilot operation, after which it will be made available for broader testing and evaluation. 25d

25e This activity is scheduled to take place within two months elapsed time. The activity areas are the same as for the implementation tasks, but the nature of the work changes somewhat. 25e

25f The procedures area shifts markedly into the system installation and conversion tasks. The tasks would be staffed by the full complement of personnel who will become responsible for subsequent system opera-tion. It would consist at least of a supervisor and one person for management and control activities within the system. In addition, atleast one professional would be assigned to training through the installation and conversion period. 25f

25g The 2.5 professional staff members assigned to software development will be required for two months for testing and integration. In the final month, staffing can be reduced to one professional for final system adjustment, software refinement, and completion of remaining software implementation tasks. An additional professional would be assigned to supervise and assist in the integration of the various hardware components as they are delivered, installed, and accepted. 25g

25h Data base acquisition and organization continues during the entire two months at the same staffing level as before. 25h

25i During the final month of this activity, selected test users of the system would make use of the entire system on a pilot basis. This should help identify most remaining problems, smooth

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out procedures, identify inadequacies in training and indoctrination procedures, and so forth. 25i

25j Task 4 -- Experimental EPC Operation 25j

25k At the completion of EPC development, the basic system is opera-tional and documents will be processed on a production basis. The system operational staff will be responsible for refinements to procedures, management and control activities, and system charging mechanisms. The experimental operation of the system as a whole, on production of actual reports, including those resulting from NSF projects and the reports for the EPC project itself, will demonstrate the success of the system, and give guidance to efforts to refine it. 25k

25l It is during this task that a demonstration will be conducted for NSF, interested members of the publishing industry, and other interested groups. 25l

25m Meanwhile, system design personnel continue to observe production work on the EPC, not only to monitor progress and correct defects that a heavy production load uncovers, but also to design new procedures for the production personnel so that they can attain the level of productiv-ity the EPC promises. This effort is not a training effort, but a collaborative refinement and improvement of the system. 25m

25n Present systems designed for production personnel by others are often difficult to use, inconvenient, or require levels of understanding common among the design personel but uncommon among typists, editors, redactors, proofers, and authors from fields that have not made use of computer-aides in text production. Thus, the EPC is not completed when the hardware is installed and working properly; the software is completed when the production personnel have been trained to use the system as it was designed; the EPC is completed when it turns out professionally acceptable documents, when it is sufficiently easy touse that authors and production personnel alike accept it, and when the promised economies and savings of time have been realized. 25n

25o Tentative System Hardware Configurations 25o

25p In configuring hardware for the EPC, there have been five basic objectives: 25p

25p1 (1) The hardware configuration must satisfy all performance requirements of the basic system without inordinate

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reserves of capacity. That is, the configuration should be minimum, feasible and realistic. 25p1

25p2 (2) The hardware configuration should be expandable in modest increments. 25p2

25p3 (3) The hardware configuration should be representative, rather than the lowest-cost configuration, because it should establish budgets for hardware without constraining specific hardware selection options during detailed design. Costs should be realistic and conservative estimates of what will be required to do the job. 25p3

25p4 (4) The hardware configuration should support use of existing Institute resources for development where possible. 25p4

25p5 (5) The hardware should be configured to ultimately offer the most flexible and broadest access to the editorial processing system. 25p5

26 In selecting the hardware, the hardware and systems configurations that have been used in the existing SRI text processing systems--MAE and the ARC NLS system--have been considered. The approaches of these systems and the hardware they have chosen represent the best that is available. We propose starting with the powerful software base that has evolved from many years of testing, refining, and expanding the capabilities of these systems. The testing continues to make use of typists, secre-taries, and specially trained control and editing personnel for further improvement of these computer-based systems. Moreover, selection of similar hardware makes possible use of already development software. 26

27 D. Dissemination of Results 27

27a Several ways of disseminating the results of this experiment are envisioned. First, the success of the operational center might best be demonstrated by using the EPC to produce reports for NSF. SRI currently has eleven NSF projects in-house that have completion dates in fiscal 1975. A list of these projects appears in Table 2. If we used the reports of these projects (and others that might become active during the course of the experiment) which require publication during the test and evaluation period of the project as the prime test documents, then
Table 2. NATIONAL SCIENCE FOUNDATION 27a

27a1 TITLE SRI START

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END
NO. DATE DATE 27a1

28 A Study of Interconnec- ISU-3403 5/1/74 10/31/75
tion Structures for a
Large Scale Microprocessor
Array, Grant GJ-42696 28

29 Hazard Priority Ranking ECU 3386 5/1/74
4/30/75
on Manufactured Organic
Chemicals, P41 1151 000 29

30 Survey of Soviet ISU 3226 2/15/74
7/31/75
Programming, GJ 41741 30

31 Radiative and Thermal ERU 3217 2/15/74
7/31/75
Effects of Aerosol
Layers, Grant GA 41787 31

32 Collaboration Research in ERU 3061 12/1/73 5/31/75
Lidar Studies of the Urban
Atmosphere in the Polar
Regions, Grant GV 41040 32

33 Remote Measurement of Air ERU 2687 5/1/72 10/31/75
Pollutants, Grant GI 38986 33

34 Electromagnetic Sounder ERU 2663 5/1/73 10/31/75
for Underground Archeo-
logical Exploration,
Grant GF 38767 34

35 Radar Location of the ERU 8627 5/15/70
3/21/75
Auroral Belt from the
Northern Magnetic Pole,
GA 16269 35

36 Operation and Coordi- ERU 2251 10/15/72
3/31/75
nation of the Chatanika
Incoherent Scatter Radar,
Grant GA 36095 36

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37 Digital System Improve- ERU 3458 6/1/74 11/30/75
ments for the Chatanika
Radar Facility, GA 43190 37

38 Jason Study of Micro- ERU 2517 6/19/74 8/1/75
Electronics Technology,
NSF C 943the format handling generation, quality of product, type of font, hyphenation results, handling of footnotes, features requiring com-promise, time to generate the document, and other factors would be very visible to OSIS and to the other portions of NSF sponsoring projects at SRI. In addition, we propose to report to NSF on our progress at the completion of each of the tasks during the course of the project, and in a final report. These documents will also be generated on the system when it has been implemented and is operating. 38

38a Second, after six months of EPC operation, a day-long demonstration will be conducteed at SRI, primarily focusing on the Report Services test EPC facility and how documents are produced from initial capture, through editing, to preparation of camera-ready copy. Interested parties from OSIS, other NSF groups, journal editors, the publishing industry, and other organizations will be welcome. In addition, during the course of operation interested parties will be welcome to visit and observe the progress of the experiment. 38a

38b Third, expanding the editorial, text manipulating, and copy format-ting and output command repertoire in NLS will enhance the command base immediately available to the community of NLS users. These include members of ARPA, RADC researchers, ARC staff, and a broader set of SRI researchers. 38b

38c A design document will be assembled from this internal development that could be readily transformed into a working description of the system, the priorities of its development, and the design rationales. Problems confronted, pitfalls encountered and suggested improvements will be detailed. A detailed phased expansion plan will also be developed.
SRI PROPRIETARY 38c

39 E. Institutional Resources and Related Programs 39

39a 1. Related Experience 39a

39a1 Commercial Projects 39a1

39a2 SRI has had many years of experience in the design and

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develop-ment of document production systems both in-house and for outside clients. One notable project for an outside client that has particular relevance here is no longer client restricted. This was the design of a complete editorial production system for Encyclopedia Britannica for which the project leader was Thomas Humphrey (who will lead the EPC project). SRI documented the entire editorial process for the Encylo-pedia Brittannica, prepared a preliminary system design for an EDP aided editorial system and performed an economic comparison of the proposed EDP system versus the manual system. SRI delivered a final system design that included software, detailed hardware and software specifica-tions, personnel requirements, schedules, and milestones. SRI also assisted with the initial system implementation phase. 39a2

39a3 NLS 39a3

39a4 For more than a decade the Augmentation Research Center (ARC) at SRI has been developing computer based tools and techniques designed to "augment individuals and groups in the performance of knowledge work." Under government sponsorship, this activity has grown into what is now called the "Augmented Knowledge Workshop". Extensive documenta-tion is available which describes this effort in detail. A principal component of the workshop is an online computer system (NLS). This system provides many services for the ARC and its user community. It includes a comprehensive set of text processing capabilities but is more than just a computer text handling system. For this survey only the text processing capabilities are described. 39a4

39a5 NLS is made up of a number of subsystems, each serving a different function within the total NLS context. The Deferred Execution (DEX) subsystem provides capabilities for preparing text offline for entry into NLS. ARC currently is using Texas Instruments TI 733 ASR terminals for capture of DEX text on cassettes. This keyboard has a different response than an office typewriter, but a trained operator can key text at relatively high rates (requiring from one half to four days training). Text may be captured on any standard teletype terminal and recorded on paper tape, or on a keyboard device interfaced to a digital cassette recorder for recording on a Philips type cassette. Some pre-entry preparation of rough draft text supports DEX capture for subse-quent NLS processing. NLS text can be highly structured in tree or outline form, and representation of structure should be captured with the text. Also, NLS commands may be embedded in text during entry. DEX provided conventions for fully extended editing, operations

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such as deleting characters, deleting words, deleting lines, and capitalizing SRI PROPRIETARY 39a5

40 text. NLS command directives are recorded during capture and performed during subsequent computer processing. 40

40a Text may also be captured online using either display NLS (DNLS) or typewriter NLS (TNLS). Both subsystems provide interactive NLS capabilities. Online capture of text tends to be more costly than offline capture but allows the user to manipulate the material as it is captured. DEX processing, on the other hand, can take place during periods of low system usage, providing for better utilization of the system computer. 40a

40b DNLS and TNLS both offer the user an extensive set of text editing capabilities. DNLS employs a CRT display console and TNLS a typewriter terminal such as the TI-700. Both operate on-line. The command repertoires and facilities are as nearly identical as possible considering the different device characteristics. DNLS provides rather more effective user feedback, and certain operations--such as selecting a character or word in the text--are simpler than with TNLS. The following discussion addresses the DNLS subsystem, but virtually all of the features described are also provided in TNLS. 40b

40b1 With DNLS, a comprehensive set of text manipulating commands are provided: the user can delete, replace or insert. Activities take place on naturally defined units such as characters and words as well as NLS-structured units such as statements and groups. Macro-editing com-mands include move, copy, transpose, and set case. Several techniques exist for format control. The way in which text is represented on the display (margins, character sizes, etc.) may be defined by the user. The way in which statements are numbered provides some formatting con-trol. The structuring of tables, however, has presented problems to NLS users and appears to be a time-consuming activity. Tab setting conven-tions, for instance, are nearly nonexistent. Training time estimates range from two to three days for a user with previous exposure to computer aids, to several weeks for persons who have great difficulty adjusting to a man/machine environment. (Training time would not include training on the more sophisticated NLS facilities.) 40b1

40c One of the strongest features of DNLS is its development of display techniques. Several display devices have been used

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successfully by ARC, both ARC's own designs and commercially available units such as IMLAC or Hazeltine displays. A display station consists of the display, a line-processor control unit, a mouse (a cursor device for positioning and input of some control commands), and a five-finger keyset (for one-handed character input). Both the mouse and the keyset were developed at SRI for interactive processing. The mouse is especially significant. It allows the user to "point" to any character on the display much more naturally than the typical four-directional, character-step cursor control provided with commercial units. The user defines "viewspecs" that control the way material is presented on the display. For example,
SRI PROPRIETARY 40c

41 he may split his viewing screen into as many as eight subscreens, each presenting a different portion of text that can be operated upon independently. The user also has a variety of methods with which to move through the text he is addressing. An author may link his document to several others: a single command will "take" a reader to any of the cited references; another command will return. 41

41a Hard copy of an NLS file may be produced on an upper/lower case line printer or directed to the Output Processor. The Output Processor is an NLS program which formats an NLS file according to instructions (directives) embedded within the text. A total of 186 directives are recognized by the Output Processor including font size, style definition, and page numbering. The Output Processor can direct output to hard copy devices such as the line printer or even to a microfilm phototypesetter, where either Xerox proof copy or high-quality camera-ready masters can be generated. Although complex phototype-setting can be produced in this manner, proofing and editing the embedded Output Processor directives becomes increasingly time-consuming as the output directives become more complex. 41a

41b The Output processor possesses great depth and flexibility within a somewhat limited range of capabilities. It is intended for use with NLS structured files and NLS formats, and for these it is extremely powerful. When some other format is required, use of the Output Proces-sor is less natural. It cannot, for example, accommodate footnotes or tables in a generalized manner. 41b

41c The archiving and retrieval activities of NLS are extensive. Once captured text has been structured into an NLS file, the system main-tains storage control. While the file is active, it is stored online on disk. Inactive files are archived on magnetic tape and may be re-entered into the system upon request. Whenever

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an NLS file is modified by the user, a partial copy file is created by the system. This file will reflect all subsequent changes until the user directs the changes to be finalized. As an NLS file is revised, the system automatically assigns a version number to the new file. Files may be created in such a way as to be accessible to all NLS users, to be accessible on a read-only basis to other users, or to be totally private to a specific user. 41c

41d A utility version of NLS has evolved to support expansion of the NLS user community. This utility has been made available to a limited community for exploratory application as a multi-user, time-shared service administered by ARC. It runs on a Digital Equipment Corporation PDP-10 operating through the TENEX timesharing system, connected via an Interface Message Processor to the ARPANET. A sub-scriber to this service currently pays $40,000 yearly for a utility "slot" guaranteeing single-user access to the system sixteen hours a day, six days a week. In addition a subscriber is provided technical assistance by ARC personnel through training, documentation and
SRI PROPRIETARY 41d

42 consultation. The hardware and operating system is maintained and operated under contract by Tymshare, Inc. 42

42a NLS provides a powerful and comprehensive computer-aided text processing capability, especially in its display-oriented DNLS sub-system. The emphasis on display applications by NLS developers has made this its strongest feature, but uses of hard copy are less highly developed. Page-oriented editing and tabular composition capabilities are rather limited. However, the information exchange features and additional capabilities of the ARC utility make it a powerful tool for the environment for which it is intended. It is an evolving system for a developmental environment of intellectual workers. It must be recog-nized that the ARC system is not just a text processing system. It is far more than that. The impressive repertoire of text editing commands are in fact building blocks that make possible the higher level features supporting the knowledge worker. 42a

42b Machine-Aided Editing (MAE) 42b

42c MAE is a minicomputer-based (PDP 11/20) text editing system developed in the Information Science Laboratory. Its primary function is to provide an environment for the development of production-oriented text handling techniques and to demonstrate the application of these techniques to potential clients. A growing portion of MAE activity has been devoted to report

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preparation by SRI staff. For example, most reports generated by the Information Systems Group are processed through MAE, and other groups such as Chemical Information Services are working with ISG personnel to utilize MAE for production text handling. 42c

42d Draft material is usually captured offline on a special typewriter-recorder. This is a standard IBM Selectric typewriter, fitted with a Tycom baseplate interface and ICP Termicette digital cassette recorder. From 50,000 to 75,000 characters (20 to 30 pages) can be recorded on a standard Philips-type cassette. The design goal has been to provide transparent text capture during conventional secretarial activity. Additional activities necessary to operate the cassette recorder are minimal. The standard keyboard response has not been altered, allowing capture at the typist's normal speed without operator accommodation. This station is intended only for text capture (and ultimately text output); all editing (other than backspace) is deferred until subsequent online activity. There is no special prepara-tion or marking of the rough draft before capture. Only minimal training (one day or less) is required to operate the unit efficiently, and it is portable. 42d

42e Text may be also initially captured online using the inter-active facilities of MAE. Although this allows the user all the editing capabilities of MAE to format or organize the text during input, it is slower and generally more costly than offline capture. In addition to
SRI PROPRIETARY 42e

42f these two capture mechanisms, MAE accepts input through any of its I/O media (see below) if formatting and character coding are compatible. 42f

42f1 Several storage media are available to the user. The most commonly used medium is a removable disk cartridge holding over 2 million characters (about 1000 pages). Other options include cassette, 9-track magnetic tape, DECtape, paper tape, and cards. The current hardware configuration allows access by only one user at a time. However, a multi-user, time-shared environment would be possible through only minor system modifications. 42f1

42f2 The main component of the online environment of MAE is a high performance Vector General CRT display. It is a full graphics display with a frame capacity of 6,000 to 7,000 characters, allowing the user to view an entire page (typically an 8-1/2 by 11 single-spaced typewritten page) of text. The

; might be used to indicate a level 1 heading. This directive would cause selection of the proper typeface and formatting during computer composition.

Keyboard includes a standard ASCII character set as well as a repertoire of control keys. As with most display keyboards, response differs markedly from a standard typewriter keyboard. Also provided are a mouse and a five-finger keyset as described in the NLS discussion. 42f2

42f3 MAE is designed to be highly tutorial in operation. The display always gives a clear indication of what the next user activity should be during any sequence of operations. (The new version of NLS also provides extensive tutorial aids.) A command "menu" or table may be displayed, allowing the user to select any command by pointing to it with the mouse (cursor) or keyboarding the desired command mnemonic. The selected command is then intensified on the menu for the duration of that operation. Additional graphic techniques are used to reflect mouse, keyboard, and cursor activities, all providing explicit feedback to the user. These features aid the novice and casual user. 42f3

42f4 MAE offers a variety of commands to perform micro-editing or text manipulating. One may insert, replace, or delete any user-denoted string of characters, as well as change the case of text. Macro-editing of the text is accomplished through the use of move and copy commands. The user may view any portion of his text by moving through the MAE file with page jump commands (forward and backward page, jump to first or last page, or jump to a specific page). MAE also allows the user to search the body of his text for defined strings or to automatically page through his text at specified rates. 42f4

42f5 Structural editing is possible in MAE through the use of tabs and page size definitions. The user may set the page width (in number of characters) and page size (in number of lines), as well as define tab stops for the entire document. Structuring many tables or resetting margins within a document may require some ingenuity, however. 42f5

42f6 All editing activities during a session take place on a working copy of the user's text. When explicitly directed to do so, MAE SRI PROPRIETARY 42f6

42g creates a permanent copy of this temporary file and transfers the original file to a backup status. The user is expected to name each file and is responsible for his own text archiving. File naming con-ventions and I/O directives are derived from the PDP-11 file handling utility, making them slightly stylized. Text file

; might be used to indicate a level 1 heading. This directive would cause selection of the proper typeface and formatting during computer composition.

sizes as large as one million characters (about 500 single spaced typewritten pages) can be processed effectively by MAE. 42g

42g1 Several output options enable the user to produce hard copy for proofreading. For example, one format is identical to final copy, but the text is double-spaced on double length pages. This provides space on the copy for mark-up but still allows true structure and page editing together with content review. When proofing material on-line at the display, the user may view otherwise transparent control char-acters (spaces, tab stops, form feeds, etc.) by setting a console switch. 42g1

42g2 MAE has the capability of directing text to a variety of hard copy output devices. Text may be transferred to a cassette for playback at the IBM Selectric station using any of a selection of type spheres. Output may be produced on a medium-speed 96-character (upper/lower case) line printer. Output from MAE on magnetic tape can be directed to a commercial photocomposer to produce high-quality, camera ready masters. A MAE text file can be output on a medium acceptable to another external device for hard copy production (e.g., to cassette for transferral to the ARC utility for transmission over the ARPANET). 42g2

42g3 MAE is a fairly powerful page-oriented text editing system. The approach has been to create an easy-to-learn machine-aided environment for processing. The offline text capture activity is designed to enable secretarial personnel to enter text effectively with minimal training and without transitional difficulties. The tutorial approach used in the online portion of MAE allows the novice user to accomplish his editorial goals with relative ease. But MAE is a developmental system for the exploration of a specific set of text pro-duction problems; it is not intended to be either general purpose or used directly in a production environment in its current implementation. It might be best characterized as a prototype of a production system, one that addresses specific application areas for which there are demonstrated needs but no current commercial offerings. 42g3

42g4 CIS Computer Publishing System 42g4

42g5 Chemical Information Services (CIS) began development of their computer publishing system in 1970. The publications currently being produced with computer aids are highly technical--dealing with chemicals and the chemical industry. The content of each is unique stylistically and structurally.

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To date there has been no attempt by CIS to consoli-date their computer-aided text processing into a single, integrated system. SRI PROPRIETARY 42g5

42g6 Most of their text capturing for subsequent computer proces-sing is done on Facit-Ohdner key-to-tape units. They consist of a Facit typewriter interfaced to a seven-track digital magnetic tape recorder. All keystrokes, including shifts, are recorded on the tape. These units have provided CIS with fairly poor mechanical performance, requiring frequent servicing; the six-bit character coding has also proved to have disadvantages. The recording unit seems to be sensitive enough to cause problems when more than one operator is using the same unit. The unit requires two to three weeks use before an operator becomes proficient at text capture. 42g6

42g7 The bulk of CIS computer text processing takes place on the Institute's CDC 6400. Typically, line-oriented editing directives (change, delete or add lines, change a code on line n, etc.) are cap-tured on magnetic tape at the Facit-Ohdner for input to a series of 6400 programs. The directives are programmatically scanned for errors, usually requiring corrections to the directives, and then the directives together with the publication file are processed by a batch updating pro-gram. The result of this activity is either a revised publication or a supplemental publication which reflects the changes caused by the edit-ing directives. Proof copy is normally generated in single case on the CDC 6400's line printer. Some copy (proof and final) has been printed at Optimum Systems, Inc., a commercial computing services firm in Palo Alto, using an extended character set print train originally developed at SRI. A line printer with this train is now available in-house. 42g7

42g8 Two CIS publications are phototypeset by a commercial firm from formatted magnetic tape produced on the 6400. Another uses the line printer with the extended character set print train; output is photo-reduced and printed by SRI Report Services. Because of the good quality of the print train type face and the techniques used, the re-sulting publication is of suitable quality for commercial distribution. 42g8

42g9 Recently the editing activity for the Chemical Economics Handbook Index was transferred to the Information Science Laboratory's MAE system. This is a move to evaluate the use of a generalized, interactive text handling system on the type of

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technical material published by CIS. Thus far the operation has proved to be successful, and reactions from CIS personnel have been very positive. 42g9

42g10 The publications annually produced by CIS using computer aids include: the Directory of Chemical Producers (1350 pages) and its sup-plements; four World Hydrocarbon Reports (9 volumes of 200 pages each)and their quarterly supplements; the Chemical Economics Handbook Index (88 pages) and its monthly supplements; and the Chemical Economics Handbook Companies Index (87 pages, for internal distribution only). CIS is also maintaining its client list for promotional reference and mailing on the CDC 6400 (7400 references). This currently amounts to an SRI PROPRIETARY 42g10

42h annual production of approximately 4200 pages, and represents a sub-stantial committment by CIS to computer-aided text handling techniques. 42h

42h1 The non-generalized ("specific problem/specific solution") approach used in developing the CIS programs to date has enabled them to make a relatively rapid and productive entry into computer-aided pub-lishing. Developmental costs for new programs using this approach will remain substantial; whereas the use of more general techniques in the future could decrease the additional cost increment necessary to expand the number of publications produced. The experience and expertise accumulated by CIS personnel during the development of their programs make them an excellent source of information concerning computerized publishing, especially when considering real-time production problems. 42h1

42h2 Journal Editorial Consultation 42h2

42h3 As described below, SRI staff serves a broad interdisciplinary resource and talent reservoir. In the context of an Editorial Proces-sing Center as an effective channel for the efficient dissemination of scientific and technical information, SRI has a large number of staff members in every division, representing many diverse research disci-plines, who participate in a number of capacities on the editorial staffs of scientific and technical journals. 42h3

42h4 It is anticipated that these staff members would contribute to all phases of the EPC experiemtn in particular representing the special-ized interest, viewpoints and problems

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of the journals for which they provide editorial or review services. In this way we would be assured of avoiding loss of vision and scope pertaining to the journal publica-tion world. 42h4

42h5 2. General Capabilities of SRI 42h5

42h5a Stanford Research Institute (SRI) is an independent, nonprofit corporation performing a broad spectrum of research, consultation and other professional services under contract to business, industry, and government. Most of SRI's work is directed toward problem solving rather than research in the abstract. SRI has developed a capability for working with a client organization, understanding its problems, and structuring a responsive program of professional services that provides realistic solutions to those specific problems. Typically, SRI has 800 to 1,000 active projects at any one time that produce a total annual business volume of approximately $70 million. The staff of Stanford Research Institute numbers over 2,900. There are more than 350 Institute staff members who hold Ph.D. degrees, over 450 with Master's degrees, and approximately 800 with Bachelor's degrees. SRI's profes-sional and technical staff includes engineers, physicists, chemists,
SRI PROPRIETARY 42h5a

42i biologists, and metallurgists, economists, psychologists, market analysts, educators, and many others representing a variety of pro-fessional and technical skills. 42i

42i1 SRI's research facilities include more than 1 million square feet of office and laboratory space and incorporate the most advanced scientific equipment including unique instrumentation developed by the staff. The bulk of these facilities and most of the professional staff are located at the Institute's headquarters at 333 Ravenswood Avenue in Menlo Park, California. 42i1

42i2 Facilities at SRI's main offices include extensive data pro-cessing, library and laboratory support. The comprehensive technical libraries are well supplied with literature in the fields of document generation and handling systems analysis, computers, coding, and manage-ment control systems. The libraries have trained personnel to provide support for research activities through literature searches and the acquisition and distribution of technical documents. In addition, SRI professionals have direct access to the libraries of Stanford University and the University of California.

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Through interlibrary loan arrange-ments, the staff has access to university and technical libraries throughout the United States. In addition to its home offices in Menlo Park, California, SRI maintains a major office in Washington, D.C., as well as in four other major cities of the United States and in five major foreign capitals, including London and Tokyo. SRI also is repre-sented in five other Eu opean countries. 4212

4213 There are 17 in-house computer systems at SRI. These include a CDC 6400, a B6700 dual processor system, and two PDP 10s. Each major system contains random access memory units, and several have on line inter active graphic terminals. Job processing can be accomplished in batch mode or on line in time-sharing mode. Besides its own facilities, SRI has ready access to numerous other nearby computer facilities, including various IBM, DCD, and Univac systems. 4213

4214 Research operations at SRI are organized into eight divisions representing major disciplinary fields, as shown in Figure 4. Overall super vision of research is vested in the Office of Research Operations which reports directly to the Office of the President. Both formal and infor mal arrangements of long standing exist to facilitate interdis-ciplinary research and cooperation between the divisions and their subgroups. 4214

4214a Staff members for this study will come primarily from the Information Science and Engineering Division. SRI PROPRIETARY 4214a

4214b Figure 4 Organization of SRI 4214b

4214b1 SRI PROPRIETARY 4214b1

4215 3. Information Science and Engineering Division 4215

4215a The activities of the Information Science and Engineering Division (Figure 5) are carried out in three laboratories and four research centers. Each of the laboratories is composed of a number of groups with complementary interests and skills. The Information Science Laboratory is predominantly oriented toward research and development of techniques of broad applicability, focusing on the design and development of computers, computer programs, and computer systems. The Augmentation Research Center is the core, a continuing development effort toward a broad based computer support system that improves effective

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utilization of the human intellect in a highly communication oriented society. 4215a

4215b Work on the proposed research project for NSF will be concentrated in the Information Science Laboratory of the Information Science and Engineering Division and the Augmentation Research Center. 4215b

4215c Information Science Laboratory 4215c

4215d The diversified activities of the Information Science Laboratory include both fundamental research and applications of information systems. Research performed by the Computer Science Group is in computer architecture, programming, and other aspects of computer design, primarily for U.S. Government clients. The Information Systems Group undertakes information systems design projects for both government and industrial clients. Applications vary over a wide range of computer-based information systems, including information systems design and evaluation. The Transportation Engineering and Control Group applies advanced engineering techniques to the development of system control and operating policies for both air and ground-based transportation systems. The research and the applications work are complementary; each benefits from the other. In addition, members of the Information Science Labora-tory routinely work with professionals from other parts of SRI on inter-disciplinary res earch teams composed to best meet specific client needs. 4215d

4215d1 Information Systems Group 4215d1

4215d2 The Information Systems Group is engaged in the analysis, design, and evaluation of computer-based information systems. Its research programs have both applied and basic components, being directly concerned with the development of improved analysis, design, and evaluation techniques. The group's work has a strong multidisciplinary character. Detailed knowledge is required of the current and projected state of the art for computer and communications hardware and software. At the same time, considerable skill is required in the application of tools such as computer program specification and generation, system-queuing theory, simulation, evaluation, and optimization methods. 4215d2

4215d2a SRI PROPRIETARY 4215d2a

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42i5e Figure 5 Organization of Information Science and Engineering Division 42i5e

42i5e1 SRI PROPRIETARY 42i5e1

42i5e2 Information Systems Development 42i5e2

42i5e3 The Information Systems Group has pioneered the design of a number of large-scale data processing systems in such diverse areas as banking, transportation, medical services, education, process control, computer-aided design, and military operations. The work has covered a wide spectrum, from the preparation of performance specifications to the actual implementation of systems, including the preparation of all necessary software and procedures. 42i5e3

42i5e4 The design process is composed of three distinct phases. In the first phase, the system goals of the user are translated into a set of realistic economic, technical, and procedural require-ments. Such requirements become the basis for the second phase, overall system design. During the second phase the properties and interconnec-tions of major system components are determined for items such as com-puter programs, input and output devices, data converters, memory de-vices, arithmetic units, communication lines, and display devices. In the third and final phase, the performance of the proposed system is evaluated with respect to such factors as response time, accuracy, reliability, security, cost, and other factors. These three phases--requirements, design, and evaluation--compose a loop that may be traversed many times, each iteration providing an increasingly refined system design. 42i5e4

42i5e5 The group has an extensive capability in the design of software for digital computing systems and the management and use of such systems. Group personnel have performed overall designs for large and advanced software systems including language compilers, computer operating systems, and file-management systems. A major emphasis is placed on adopting a suitable philosophy for the design at the start of a project and applying it systematically throughout the entire design and imple-mentation effort. Techniques that contribute to correctness of code, the mobility (convertibility) of programs, and

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documentability of programs are stressed. Techniques used and directions taken in an implementation are chosen according to a software development plan that is consistent with a previously developed overall design. In recent work, particular emphasis has been placed on language characteristics that contribute to program correctness and the correct execution of programs. 4215e5

4215e5a The group has demonstrated competence in applying advanced analysis techniques to determine a client's current system performance characteristics and to provide the basis for the design, implementation, and operation of future systems for the client. Applica-tion of these analysis techniques to a particular system problem may yield several results that will benefit the client in understanding and dealing with his problem, such as: SRI PROPRIETARY 4215e5a

4215f . A better understanding of the present system behavior, including critical and sensitive system parts and marginal regions of performance 4215f

4215g . A synthesis of an improved system design that will ensure better performance 4215g

4215h . A formula for determining the best sequence of decisions at the various decision or control points in the system. 4215h

4215h1 The Information Systems Group does research on techniques for testing software systems. This work extends from theoretical investigations such as proving correctness of individual algorithms and the development of practical schemes for testing very large systems. The group also develops software performance tests and acceptance tests and analyzes and evaluates the results of such tests. The group frequently serves as an independent monitor, consultant, or advisor on behalf of clients for whom a software development project is being done by another party. The group assists in the management and organization of software development projects. Work in this area includes development of software standards, development of software configurations, management procedures, and recommendations for organization of resources and manpower. 4215h1

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42i5h2 Text Processing 42i5h2

42i5h3 The Information Systems Group is also involved in the design and development of a variety of text-processing and document-production systems. Past efforts have ranged from simple single-terminal systems to complex multiterminal editorial production systems operating within a distributed computer network. These efforts have encompassed a variety of facets of the process, including data capture; processing, editing, and formatting; and document output. 42i5h3

42i5h4 The work of the group ranges from the design and development of such systems (hardware and software) to the implementa-tion of those systems into a client environment, including such consider-ations as staffing levels, training requirements, and scheduling. In conducting text processing developments the group works closely with other groups within the Institute, particularly the Augmentation Research Center within the Information Science and Engineering Division. 42i5h4

42i5h5 Augmentation Research Center 42i5h5

42i5h6 The Augmentation Research Center (ARC) consists of a staff of about 30 researchers dedicated to the concept taht the resources available in man's mind are the most valuable assets to be fully realized in this society. This premise has been the primary motivation for the development and growth of ARC over its 12-year history. Here computer systems and services (collectively called NLS), SRI PROPRIETARY 42i5h6

42j are designed and implemented for assisting researchers, programmers, etc., in performing, organizing, and communicating through text. They are also effective in balancing man's ability to process thoughts and ideas by providing fast visual feedback of information maintained in a hierarchically structured form in any level of detail and from many different points of view. This organization permits more rapid assimila-tion of concepts on various scales of the rapid transmission of this material to the appropriate level of detail to the desired audience. NLS reduces the time and effort of communication because computers perform the necessary manipulations, reconstructions, and transmissions. 42j

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42j1 Internally the NLS software is grouped into subsystems that briefly perform the following asks: 42j1

42j2 . Maintains a hierarchically structured file system 42j2

42j2a . Supports interactive devices (the two-dimensional CRT
display, and the teleprinter) 42j2a

42j3 . Passes commands for various subsystems 42j3

42j4 . Edits and manipulates text and data structures 42j4

42j4a . Formats, processes, and outputs hard copy or microfilm
from a number of text input sources, in particular files. 42j4a

42j4a1 The subsystems all support a powerful complement of commands to perform the necessary functions. Examples of specific capabilities are the ability to divide a display screen into up to eight parts to display portions of up to eight files simultaneously, and automatic index generation for a data set such as author, title word, date of publication, sponsoring organization, etc. 42j4a1

42j4a2 Likewise, NLS contains capabilities to edit, modify, cross reference, and cross copy text or larger blocks of information in continuous or hierarchically leveled blocks. It is in the context of these services that ARC has been performing experiments on several fronts. These focus on: 42j4a2

42j4b . The impact of prolonged, intense human-display terminal and human-typewriter terminal interaction on the ARC community. 42j4b

42j4c . The pursuit of channels for integrating and coordinating
individual efforts into a true work team (and work community) through the NLS interface. 42j4c

42j4d . Man's ability to adapt continuously to an increasingly
effective use of these services and communication mechanisms via a computer intermedia. 42j4d

42j4d1 SRI PROPRIETARY 42j4d1

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42j4e . The refinement and hierarchical expansion of the system to accommodate an increasingly broader set of services and capabilities. 42j4e

42j4f . Expansion of the user base to a distributed nationwide R&D community linked through a computer network. 42j4f

42j4g . Systematic improvement of the process of creating, publishing, and maintaining offline documents through NLS techniques. 42j4g

42j4h . The ultimate realization of a fundamental framework based on a distributed computer network accessed by researchers, scientists, programmers, managers, engineers, professionals, in any discipline, on a nationwide basis, and providing support for planning, designing, writing, communicating, filing, coordinating, and reporting while maximizing effective software and hardware utilization through network-wide resource sharing. 42j4h

42j4h1 A brief description of some of the accomplishments of ARC over the past 12 years will attest to the progress that has been made toward the above goals. 42j4h1

42j4h1a 1) Early explicit recognition of the potential that online computer and communication technologies have in areas outside of straight numeric or accounting computation in enhancing the effectiveness and efficiency of managers, scientists, engineers, programmers, and their supporting staffs in their daily work. 42j4h1a

42j4h1b 2) Development of a set of services collectively into the NLS system and participation in the implementation of the ARPANET, a nationwide network connecting over 1500 remote terminals to 35 different computers. 42j4h1b

42j4h1c 3) Early explicit recognition of the importance to system building of an integrated system of text handling and system building tools. 42j4h1c

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42j4h1d 4) Publication of over 25 reports and papers on NLS
concepts and National Software workshop topics and developments. 42j4h1d

42j4h1e 5) Demonstration to large professional meetings
(FJCC 1968, ASIS 1969, SHARE 1974) to hundreds of visitors, and via film of a working prototype system. The FJCC 1968 conference was the first to show the power of coupled screens, video terminals,
SRI PROPRIETARY 42j4h1e

42j4h1f multiple display windows and multi-media techniques
(computer output, video pictures and a voice link). 42j4h1f

42j4h1g 6) Pioneered the two-dimensional text work to be the
foundation of an intelligent terminal system and developed many highly interactive tools and concepts for working and browsing in an information space, such as view specifications, interfile links, split screens, cross file editing, integration of text and numeric computation. 42j4h1g

42j4h1h 7) Pioneered input device and work station design.
Early work includes development of: video displays, mouse, keyset, desk, and workspace. More recently ARC which makes it economic for intelligent terminals to support two dimensional NLS display. 42j4h1h

42j4h1i 8) Pioneered in high quality formatted publication
quality hardcopy, through line printers, typewriters, and COM. 42j4h1i

42j4h1j 9) Pioneered the concept of an integrated coherent
workshop of many office tools with a uniform user interface. 42j4h1j

42j4h1k 10) Early experience in teleconferencing support between
remote individuals and groups at coupled screens (possibly video projected). 42j4h1k

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42j4h1l 11) Considerable experience with online information
management for an office or project environment, such as memos and correspondence, full text storage and retrieval, indexing, and cross linking. 42j4h1l

42j4h1m 12) First with a comprehensive system for on-line
message control, addressing distribution, delivery, individual and group identification, cross linking, and indexing. 42j4h1m

42j4h1n 13) A History of quality software engineering and a
leader in applying new software engineering tools to aid the system building process. 42j4h1n

42j4h1o 14) Over one hundred thousand hours of hands on console
experience with the use of NLS technology in daily work, both at ARC and at other sites via ARPANET. 42j4h1o

42j4h1p 15) Recognition of the importance of integrating into
the system building process mechanisms for studying and facilitating technology transfer.
a) Early application experience with the Network Information Center. 42j4h1p

42j4h1p1 b) Pioneered the establishment of a solid user
service with the NLS Tymshare operated user system. 42j4h1p1

42j4h1p2 c) Establishment of training and other application
support services. 42j4h1p2

42j4h1q 16) A strong early lead in getting collaboration going
on TELNET, File Transfer Mail, Graphics, and other ARPANET protocols. 42j4h1q

42j4h1r 17) Operation of an ARPANET computer facility for
several years, providing service to the ARC research

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efforts as well as to the Network Information Center (NIC) staff and NIC user groups. 42j4h1r

42j4h1s 18) TENEX development and provision of TENEX service on
a temporary basis to another ARPA contractor to ease the service requirements on another Network TENEX machine. 42j4h1s

42j4h1t 19) Current participation in the National Software
Workshop program to fully realize user transparent resource sharing in the ARPA Network. This involves: 42j4h1t

42j4h1t1 a) Development of a minicomputer based front end
that will support a powerful command meta language that will be uniform through the network 42j4h1t1

42j4h1t2 b) Further enhance the document creation and
document production capabilities of NLS as they pertain to various phases of software development process 42j4h1t2

42j4h1u c) Improvement of services that augment software. 42j4h1u

42j4h1u1 d) Modification for expansion of ARPA protocols to
support these developments.
4. Report Services 42j4h1u1

42j4h2 SRI maintains a centralized Report Services organization of about 160 persons who serve all eight research divisions. Report services offers complete editorial, composition, proofreading, graphics, photographic, and press services. Within Report Services, Editing and Composition offers a wide range of services: 42j4h2

42j4h2a . Technical editing, copy editing, copy marking, editing of tables and graphics. 42j4h2a

42j4h2b . Writing, rewriting, abstracting, indexing, preparation of speeches, structured texts for research

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needs (e.g., questionnaires, experimental texts) 42j4h2b

42j4h2c . Typing and proofreading of text and tabular material to prepare camera ready copy for reports, proposals, proceedings, journal papers, brochures. 42j4h2c

42j4h2d . Consultation on planning and organizing documents, and managing the production of large, multidisciplineary documents in a rigid time frame. 42j4h2d

42j4h2e . Assistance in the setting up and use of machine aided document production systems ranging from simple word processors (e.g., Flexowriter, Redactron) to complex computer based document generation systems e.g., Directory of Chemical Producers). 42j4h2e

42j4h3 Editing and Composition works on more than 2,000 documents per year, or more than 100,000 pages per year. The staff of Editing and Composition consists of 19 editors (plus 9 hourly editors called in for overload or peak load work), 27 typists and 8 proofreaders. Equipment consists solely of electric typewriters and manual editing and proofreading equipment, with the exception of two word processors (Redactrons), and can be expanded to handle almost any load. Personnel from Editing and Composition have worked on computer aided or computer based document production systems in the research areas of SRI. 42j4h3

## 43 F. Personnel 43

43a The project leader will be Thomas Humphrey, of the Information Science and Engineering Division within which final responsibility for the project will reside. Norman R. Nielsen, Manager of the Information Systems Group, will be the Project Supervisor. The key project staff required to support the proposed editorial processing center and its experimental operation will be drawn from several research divisions within SRI and from SRI's Central Support Services. On a project of this scope, such collaboration is crucial to successful implementation and operation. 43a

43b In addition to full time project staff and SRI staff who join the project for short periods as their special expertise is

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needed, it is proposed to establish an advisory committee for the project. In this way, senior SRI scientists -- including those who maintain an active role in the publication of scientific journals -- and senior SRI administrative personnel can add their experience and judgment to the work without the necessity for an extensive (and costly) commitment of time. The proposed project advisory committee consists of: John A. Byrne, Assistant Manager of Editing and Composition, Douglas Englebart (Director of the Augmentation Research Center), Ernest E. Lehman (Director of Project Support Services), Stephen W. Miller, Manager of Program Development in the Information Science and Engineering Division, and Norman R. Nielsen, Project Supervisor. Their biographies are included with those of the SRI staff members who are proposed as full time project staff, even though no formal commitment of time to the project will be made beyond participation on the advisory committee. Biographies follow. 43b

43b1 Table 3 43b1

43b2 EPC DEVELOPMENT STAFF 43b2

43c FUNCTION PERSONNEL 43c

44 Project Supervisor Norman R. Nielson 44

45 Project Leader Thomas L. Humphrey 45

46 NLS Architect Michael Placko 46

46a System Design/Software Hardware Technology Patricia M. Whiting O'Keefe Joseph L. Ehardt Frederick K. Tomlin 46a

47 ARC Software Development Elizabeth K. Michael 47

48 ARC Systems Software Specialist Harvey G. Lehtman Coordination/Technical Support Dirk H. Van Nouhuys 48

48a Technical Editorial Services Management Coordinator Shirley W. Hentzell 48a

49 Communications Specialist Tibor Harsanyi 49

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49a Advisory Committee Douglas C. Engelbart
Ernest E. Lehman
John A. Byrne
Stephen W. Miller
Norman R. Nielsen 49a

49b III CONTRACTUAL PROVISIONS 49b

50 Time and Cost 50

50a The estimated time required to complete this project and report its results is fourteen months. SRI could begin work on receipt of a fully executed contract. 50a

50b The total estimated cost of this project is shown in the cost breakdown at the end of this section. 50b

51 Contract Form 51

51a It is requested that any contract resulting from this proposal be written as a cost-sharing contract. 51a

52 Acceptance Period 52

52a This proposal will remain in effect until March 15, 1975; however, the Institute will be pleased to consider an extension of time if requested. 52a

53 Cost Sharing 53

53a A provision for submission of proposals for Category 8 of the RFP was that the organization proposing to establish a test EPC facility participate on a cost-sharing basis. SRI concurs that, due to the nature of the proposed work, cost sharing is necessary. 53a

53b Therefore, SRI proposes, as SRI's cost-sharing contribution, the provision of the facility on which the experimental operation is to be run and the attendant maintenance, site preparation and installation. Table 4 outlines a breakdown of the items that SRI will provide and lists an estimate for a one year cost equivalent of these items. 53b

53c The attached budget specifies estimates for the NSF contribution to the project which constitutes funding the manpower requirement for the development, implementation, and evaluation of

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the EPC, and providing the NLS utility slot and expendable supplies for the development and evalution period. 53c

53c1 Table 4 53c1

53c2 EPC FACILITY COST ESTIMATE SUMMARY*
(Based on One Year) 53c2

53c3 Cost
Equipment and Interfaces Estimate 53c3

53d 1 OCR Reader (leased)
$ 7,500 53d

53d1 1 CRT test editing station, including cursor and keyboard ($2,500 line processor plus $3,500 display station)
6,000 53d1

53d2 4 Dismountable storage media drives, e.g., 3M Cartridge
10,000 53d2

53e 1 Full-page format CRT editing station
20,000 53e

53f 2 Hard copy printers
7,000 53f

53f1 1 Electrostatic line printer (high-quality proof copy)
12,000 53f1

53g 1 Terminal controller
15,000 53g

53h 2 Electronic capture stations
3,000 53h

53h1 2 Modems to communicate with the NLS Utility (4800 Baud)
10,000 53h1

53h1a Total Equipment
$ 90,500 53h1a

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53h2 Maintenance
15,000 53h2

53h3 Site preparation
7,000 53h3

53h3a Total
$112,500 53h3a

53i ___________________________ 53i

53i1 * Equipment installation costs, if any, are not itemized separately here, but will be assumed by SRI.
Other SRI contributions have not been quantified here but consti-tute a significant base on which this effort need only build, thus eliminating significant initial system development costs. These in part are: the use of a system (NLS) which has a very powerful complement of text-editing, text composition, text formatting, and hard copy or microfilm output capabilities. This software has existed and been widely used for a number of years (work supported by ARPA); the use of developments funded by RADC and ARPA, through the National Software works (NSW) project, providing further capabilities in the NLS system which will be directly usable in this project; other NSW support channelled into the development of a minicomputer front end which will support the text handling subsystem. This provides economic justifi-cation for the proposed approach since with it the system can be scaled up with little software modification to a self-supportive distributed minicomputer system as describ ed in the study plan section. 53i1

53i1a Table 5 53i1a

53i1b ESTIMATED SUPPLIES FOR ONE YEAR 53i1b

53i1c Item
Cost 53i1c

53i1d Magnetic tapes (9-track)
$ 450
Cartridge tapes (3M) 1,400
Line printer paper (electrostatic)
3,500
Line printer ribbons 125
Hard copy paper
4,000

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Cassette tapes
1,700
Typewriter ribbons
300
Toner
450
Miscellaneous
3,075 53i1d

53i1d1 Total
$ 15,000 53i1d1

53i1d1a APPENDIX B 53i1d1a

53i1d1b Proposal Budget 53i1d1b

53i1d1c APPENDIX B (continued)
Proposed Budget 53i1d1c

53j ________________________________________ 53j

53j1 * The payroll burden rate is based upon the Institute's best predic- tion as to financial performance for the calendar year 1975. The overhead rate has been found acceptable by the Department of Defense for billing and bidding purposes for the calendar year of 1974. We request that these rates not be specifically included in the con- tract, but rather that the contract provide for reimbursement at billing rates acceptable to the Contracting Officer, subject to retroactive adjustment to fixed rates negotiated on the basis of historical cost data. Included in payroll burden are such costs as vacation, holiday, and sick leave pay, social security taxes, and contributions to employee benefit plans. 53j1

53j2
____________________________________________________________ 53j2

53j2a The following is proprietary administrative SRI information
which SRI requests not to be released to persons outside the Government, except for evaluation purposes.
______________________________________________________________
-- 53j2a

53j2a1 APPENDIX A 53j2a1

53j2a2 CURRENT SYSTEM PROCESS FLOW 53j2a2

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## 54 A. The Report and Proposal Production Flowchart 54

54a The flowchart shown in Figure 1* is intended to represent the SRI report and proposal production process as it exists today. There is a great deal of variation possible in the way individual reports and proposals are produced at SRI. This variation may consist of short-cutting or omitting processing steps, unusual reordering of steps, performing processing steps in one part of the Institute when they are normally performed in another, and so forth. Reasons for such varia-tions include the press of time, contractual requirements, individual preferences of authors or project leaders, policy differences between divisions, and unusual production requirements. 54a

54b In spite of this, it is possible to discern and describe the main outlines of the report and proposal production process at SRI. The flowchart describes the prototypical process as it is, and should be, when special circumstances or individual eccentricities do not operate to introduce variations. As a prototype, it portrays all report and proposal processing functions that are normally performed, and it portrays them in an order that is commonly used and that is intended to maximize the effectiveness and efficiency of the process. 54b

54c To sum up, the report and proposal production flowchart is intended to describe a complete, correct, and representative prototype of the process at SRI as it exists today. 54c

## 55 B. Commentary on the Flowchart--Document Production 55

55a In the discussion that follows, we proceed step by step through the flowchart along the path normally followed for the production of com-plete documents. Where possible, the steps have been collected into ____________________ 55a

55b * Figure 1 appears in the narrative section of the proposal.groups that constitute separate activities. Within each activity, individual step descriptions are intended to convey the basic action performed, the function accomplished, and variations and special cases that occur. In-depth descriptions are given only where there is considerable variation in the performance of a step or where opportun-ities appear to exist for reducing cost, reducing production time, and/or improving end product quality in a redesigned document production system. Where the step title is considered to be self-explanatory, where performance is relatively uniform, and where little opportunity for improvement in a

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redesigned system can be identified, the step descriptions are brief. 55b

55b1 1. Preproduction Activity 55b1

55b1a Document preparation begins with an initial creation and pre-production activity. A main ingredient of this activity is the creative writing of original text and the generation of new illustration material. In many instances there are existing resources which the authors and organizers can use. These include SRI promotional, descrip-tive, and standard copy material; previous SRI reports and documents; already available SRI illustrations; and various external information resources such as government pamphlets, reports by outside consultants, and so on. The authors of a report or proposal organize and intermix the newly created original text and illustrations with the selections from existing information resources to create an initial draft. 55b1a

55b1b This description is intended to deal only with the document production process; the immediate scope does not extend to the somewhat broader question of computer aids to other activities of the research staff. However, it is not at all clear how to separate the document creation and preproduction steps from other activities of the research staff. Thus, for purposes of this study, the production process is defined to begin when the manually prepared or dictated document draft, or a section thereof, is first submitted to a secretary for rough draft typing. 55b1b

55b1c The creation and preproduction activity is not ignored in the Institute-wide computer-aided document processing system design, however. Computer aids to this activity develop as natural extensions of the basic production system. It is anticipated that computer aids to activities of research personnel, such as those pioneered by the Augmentation Research Center, will gradually be adopted within the Institute. A production-oriented text handling system must easily and naturally interface to and interact with any such system of aids to research activities. 55b1c

55b2 2. Text Capture and Rough Draft Rework Activity 55b2

55b2a The input to the document production process is typically a report (proposal) draft in very rough form consisting of dictated, handwritten, and/or author-typed

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text; hand-drawn figures; and text and figures cut and pasted from pre-existing material. There is often little regard for uniformity of headings, indentation, or other format considerations. This report material is typed in rough draft format and cut and pasted to create a legible and reasonably clean draft that is fairly uniform in format throughout (Step 2). The report authors and others can now see the draft in a complete and legible form, and the need to rework the document can be determined. Reworking (Step 3) consists of markup, creating new material, selecting additional resource material, and reorganizing the typed rough draft. A new version of the draft is created, frequently by extensive cutting and pasting. 55b2a

55b2b Typically, several considerations go into making the decision (Step 4) as to whether cleanup typing is required during, or after, rework: the press of time, the state of the reworked draft, and know-ledge of the preferences of people who will subsequently process the draft. When rework is extensive, one or more interim cleanup typings of the draft may be needed so that the authors have legible copy with which to work. Cleanup typing of the rough draft (Step 5) is usually a selec-tive process; only those parts that have been messed up by reworking are retyped to bring them into line with the remainder of the typed rough draft. In some cases the entire draft may require retyping, however. 55b2b

55b3 3. Preliminary Approvals 55b3

55b3a Certain report-identifying information and production-deadline information is entered on a report (proposal) approval form (Step 6). The form is affixed to the report draft. For solicited proposals, a copy of the RFP is also attached. Before it is finally issued, the document will require the approval of the project leader, one or more group or program managers, one or more lab or department managers, and one or more division directors. In some cases approval by higher management, by Contract Administration Services, by Legal Services, and possibly by Public Relations may also be required. At this point, the decision as to which of these approvals should be sought before editing is a tactical one. Some research divisions have definite rules and requirements for the order of approvals; others have few or none. For some reports, it is possible that no approvals will be obtained before editing. Assuming that the rules and regulations allow latitude, the main issue is whether s eeking some approvals before editing will

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best expedite the total process. The person making this determination may take into account the press of time, the preferences and personalities of people who must approve, his own personal preferences, and so forth. 55b3a

55b3b Usually the entire report (proposal) draft, with the approval form affixed, must be presented to the person(s) whose approval is required (Step 8), but in some cases only the approval form is pre-sented. Approvers very commonly make changes and recommendations for changes on the draft. In some instances, these changes and recommenda-tions are merely suggestions. Other cases, for example a change made by Contract Administration Services, can be binding. Denial of an approval is usually based on some substantial ground that will require a signi-ficant reworking of part or all of the draft. Otherwise, the various approver's changes and recommendations are incorporated (Step 10). The decision as to whether additional cleanup typing is advisable (Step 11) is usually made simply on the basis of the legibility of the draft and whether such cleanup will expedite subsequent processing. Cleanup typing (Step 12) at this point is usually very selective. 55b3b

55b4 4. Management and Control Preliminary to Editing 55b4

55b4a The report coordinator opens the production account, assigns a production number, and opens a production control log (Step 13). The production number is obtained from the Report Services receptionist, who maintains a log of the accounts that have been opened and the production numbers assigned. There are two fundamentally different types of production accounts: the hourly account (production numbers prefixed by an "H"), and the fixed price account (production numbers prefixed by an "F"). If a job is classified, the number will further be prefixed by a "C". Production of a complete report (proposal) is normally done under a fixed price number. Certain unusual jobs, various kinds of art work, isolated bits and pieces of production, and various other tasks may be done under an hourly number. The whole approach to pricing is a delicate and complicated question that clearly needs rationalization in any new system context. The coordinator makes a fixed-price and time estimate using Form 3. 55b4a

55b4b The coordinator now becomes responsible for expediting document processing and is obliged to monitor the production process, maintain a log for control purposes, and answer

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questions about production status. These activities continue until the document is produced and distributed (Steps 17 and 18). 55b4b

55b4c If there are any illustrations associated with the report, and if they should be put into production at this point, the coordinator initiates the parallel process of illustration production (Steps 19, 19a, and 20). Finally, the coordinator logs out the document draft to editing (Step 21). 55b4c

55b4d Upon receiving the document draft, the administrative assistant in Editing Services logs it into editing using the processing control card, Form 6 (Step 22). The administrative assistant makes the preliminary assessment as to whether production through editing is feasible, taking into account the characteristics of the draft, the indicated time constraints, and the workload and staffing situation in editing (Step 23). If normal production is not feasible, various remedial actions may be taken (Step 24). These include sending the editing job outside the Institute, temporarily augmenting the editing staff, splitting the draft into fragments and processing the fragments in parallel, as well as other possibilities. The administrative assistant alerts the head of Editing and Composition Services, who determines whether or not the available remedial steps are adequate and normal production can resume (Step 25). 55b4d

55b4e The way in which editors are assigned (Step 26) is determined very much by the management philosophy and the personal style of the head of Editing and Composition Services. In some cases, specific editors are requested by the author. The draft is logged out to the assigned editor or editors (Step 27). The processing control card made out in Step 22 may be used. 55b4e

55b5 5. Editing 55b5

55b5a The editor may first make a preliminary scan of the document draft to take inventory of the materials included in the draft and to get an overview of the editing problem facing him (Step 28). The editor next considers any constraints that may bind him in his approach (Step 29). These may be time constraints, funding constraints, or constraints imposed, for example by the author, on the scope and type of editing to be done. At this point, the editor is

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in a position to determine whether the material in hand is complete and suitable (Step 30). If it is not, the editor may initiate one or more activities to correct the situation (Step 31), or it may be determined that a major rewrite of at least part of the material is needed. The most satis-factory way to locate missing material is to work through the report coordinator. If any requirements for new material or new time schedules result from such corrective actions, the coordinator should be informed. 55b5a

55b5b After these preliminary steps the editor may edit the report draft and all associated material (Step 34). An important part of this process is to edit the illustrations and associated captions and labels. Sometimes the captions already exist in the draft. In other cases, the editor must actually develop and supply the captions. Also at this point, the parallel process of cover production (bound reports only) begins (Step 33). 55b5b

55b5c When editing is completed, the editor may decide whether a conference between himself and the author(s) is necessary and feasible (Step 38). This decision may be influenced by the press of time, the editor's own style and preferences, the availability of the author and so on. The editor may wish to accomplish any number of things at a conference with an author (Step 39). He may wish to explain the ration-ale for some of his editing; he may wish to get explanations from the author of parts of the draft that the editor did not understand; he may wish to try to convince the author to deal with certain major problems in the draft. It is ordinarily the author's responsibility to incorporate or otherwise dispose of editor's changes and recommendations (Steps 40 and 41). In many respects, the editor's recommendations can be considered merely advisory by an author, but there are some respects in which an author would be contravening SRI conventions and policies if he were to ignore th e editor's suggestions. The editor may need to review the author's disposition of editorial changes, especially when additional new material has been introduced (Steps 42 and 43). 55b5c

55b5d After the editor's changes and recommendations have been worked into a draft, it may require cleanup typing before proceeding (Steps 44 and 45). The person making the decision about cleanup will balance the need and benefits of cleanup against the possible hazards of introducing new

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mistakes into the draft. Cleanup typing is usually very selective at this point. 55b5d

55b6 6. Approvals 55b6

55b6a In the normal case, all approvals must be obtained before final typing is begun. Therefore, all approvals not previously obtained at Step 8 should now be solicited (Steps 46 and 47). Some changes and recommendations are almost always made by the various approvers. These can usually be worked into the draft without major problems (Step 48). The denial of an approval at this point is rare and almost always forces the draft back to some earlier stage of writing or production where the objection is dealt with. 55b6a

55b7 7. Final Typing 55b7

55b7a At this point, the parallel production of illustrations associated with the document draft must be coordinated with the pro-duction of the draft (Step 49). Final typing cannot begin until all illustration sizing information is available. The figure sizing sheet developed during production of the illustrations is merged with the edited draft (Step 50) so that report typists can allow proper spaces in the final typed masters for the figures to be inserted. 55b7a

55b7b Final typing of report (proposal) masters may be done in the research unit, but it is commonly done in the typing pool of Composition Services (Step 52). Most frequently, the draft is split up into parts that are typed in parallel. The head of the typing pool will log out the various pieces of the draft (Step 51). The resulting masters are carefully proofread and errors are corrected (Steps 53, 54, and 54a). Each typing step is an opportunity to introduce new errors. In Composition Services, the typing of front matter and the pagination of the manuscript (Step 55) are ordinarily done separately from the typing of the main body of text. The typist who paginates the manuscript may fill out a pagination sheet (Step 56), or it may be left for a latter stage of production. 55b7b

55b8 8. Final Checks 55b8

55b8a At this point, the intention is that the author read and proof the typed masters just to determine if the typing operation has been accomplished correctly (Step 57). Authors

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commonly find some instances where the typist or the editor has misconstrued or altered material from what the author intended in his original draft, so that minor correc-tions are needed. In a surprising number of cases this reading prompts the author to revise or change the report (proposal) so significantly that production must revert to some earlier stage and even make emergency production measures necessary. This results in greatly increased production time and cost. 55b8a

55b8b Minor changes can often be made simply by the typist (Steps 58, 58a, and 58b). After minor changes are made the author almost invariably gets an opportunity to reread the final version (Step 59). If a pagination sheet has already been created by a typist, the report coordinator will verify it. Otherwise, the coordinator will make one (Step 61). For proposals, the approval signatures must be put on the cover (Step 62). The report coordinator collects and orders all illustrations prior to submitting the report to be printed. 55b8b

55b8c At this point, all parallel production processes must be synchronized. The document masters, completed illustrations, and covers(for bound reports) are all brought together before production can proceed (Step 60). 55b8c

55b8d In some cases, most commonly with government clients, the contract specifies that the client must approve the report before it can be published. This can also occur with proposals, especially for commer-cial clients. One or more approval copies of the document masters are made for the client (Step 65). These are often reproduced by a process different from the process to be used in final publishing. The required number of approval copies are transmitted to the client (Step 66) and processing suspends until the client returns his comments. This may take several months, and even as much as a year. When the approval copy is returned, minor or major changes may be indicated and required (Step 67). Major changes may cause production to revert to some earlier stage. Minor changes can usually be accommodated by minor reworking of the typed masters (Steps 68 through 71b). The author or person responsible for the content of the report reworks the material to incorporate the client's changes and suggestions. In some cases, the format required for the client's approval copy is different from that required for the final published version, and a retyping will be needed (Step 69). 55b8d

55b8e At this point, all information about costs to be

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billed for document production are known. These include page count, number of figures, extraordinary charges for late revisions, and so on. The report coordinator ordinarily records these for entry into the accounting system to initiate billing (Step 72). The report coordinator fills out orders for press, for photo, and for bindery (Step 75). These orders accompany the masters through the subsequent stages of printing and binding. 55b8e

55b9 9. Final Production 55b9

55b9a Itek plates (or metal halftone plates) are made for all new pages (Step 74). Negatives may already exist for illustrations that have been used previously. Plates are not required if Copy Center Xerox reproduction is used. The document is then reproduced and collated (Steps 75 and 76). 55b9a

55b9b A final check of the reproduced and collated documents before binding (Step 77) often turns up problems such as inverted pages, missing pages, improper collation, and so on. This check is normally made by the litho quality checker; however, it may be made by an author, report coordinator, or sometimes by an editor. It is not always done. However, the problems, though usually minor, occur sufficiently often that this check should always be done. The document is then bound (Step 78). 55b9b

55b9c Distribution of documents, both external and internal (Steps 79 and 80), is handled in a variety of ways depending upon diverse procedures in the various research divisions. Some internal recipients such as the Library must often discover the existence of a document and request copies, rather than automatically receiving copies as a routine matter. At this point, the report coordinator's interest in and monitoring of the report production process terminates. 55b9c

55b10 10. Errata and Amendments 55b10

55b10a After reports (proposals) are issued, various errors and new information tend to become known, and after some period of time the need for an errata sheet or amendments can be decided. The various errata are accumulated by some person--e.g., the author--concerned with the document (Step 83). The presence of errors does not always justify the issuance of an errata sheet. Someone must make the decision as to whether the accumulated known errors justify an errata sheet or an amendment (Step 84). This decision will depend

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upon the number and seriousness of the various errors, the volume and significance of new information, the nature of the document, the nature of the client, and so on. The preparation and issuance of an errata sheet or amendment is usually quite informal. The sheet is typed, proofed, corrected, copied, and distributed to holders of the report with a cover letter (Steps 84a through 90). 55b10a

56 C. Commentary on the Flowchart--Illustration Production 56

56a Detailed description of the production and handling of illustration material is outside the scope of this proposal, but the report on a study of this procedure is available through SRI (Ref. 1). There are several key steps at which illlustration production must interface to report production. 56a

56b If a related report or proposal draft is currently in production, it is essential that the format and content of the illustrations be coordinated with the format and content of the draft. If processing of the associated draft has not progressed into Editing, illustration production is normally held up until the editor can communicate knowledgeably with respect to the format and content requirements of the illustrations. 56b

56c The specification of the typography for illustrations (Step 111) pertains to all label and caption text. Figure sizings (Step 112) are generally not relevant for figures that are not associated with any document or document text. For almost all proposals, figures are sizedto be printed one per page; therefore explicit sizing information is not required, and a sizing sheet is not created. 56c

56d If possible, figure sizing information is specified early in the illustration production process (at Step 112). But in some cases figure sizings cannot be specified until the end of illustration production (Steps 134 and 135). At this point, production for illustrations associated with a document must be coordinated with production of the document itself. 56d

57 D. Diversity in the Report Production Process 57

57a The most striking characteristic of the report production process at SRI is its diversity. This diversity takes many forms. Processing steps are performed in different orders and at different stages in the process. In some cases, processing steps are ignored or omitted entirely. In some cases, key elements of the report production system, such as report coordinators, are

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utilized and relied upon while in others they are ignored or circumvented. In some research units, well-defined rules and requirements governing report processing exist and are followed whereas in other units such procedures do not exist or are flouted. Finally, the same type of processing may be done differently in different parts of the Institute. 57a

57b It is worthwhile to consider the sources, or reasons for, the diversity currently found in the SRI report production process. Six fundamental sources of diversity in report processing are: 57b

57c . Variety of end product 57c

57d . Variety of market and clientele 57d

57e . Policies and styles of research division managements 57e

57e1 . Personal styles and eccentricities of report production personnel 57e1

57f . Individual preferences and eccentricities of authors 57f

57g . Variety of time and cost constraints. 57g

57h The variety of end product is real. The same system produces 400-page bound reports and 5-page stapled reports. Some reports are quite informal, others are very formal and glossy. A report may be a technical report or an administrative report; it may be a quarterly report or a final report. Many of the items produced by the report production process are not, strictly speaking, reports at all. Such things as test booklets, questionnaire forms, and operations manuals are common products of the system. Other examples are illustrations or artwork separate from any actual report, such as flip charts, Vu-Graph transparencies, and slides for presentations. The variety of market and clientele cannot be ignored and is not fully under the Institute's control. Some clients contractually specify requirements for published matter submitted to them. For others, a particular line of business or a customary working style dictate a special type of report product. Others impose requirements that may affect the very nature and organization of the SRI report production process itself. For example, a client may require that a report be submitted on a magnetic tape to be printed at his own facility. 57h

57i The impact of the several SRI division managements on the document production process is significant. The policies, styles, and attitudes of a division director pervade his whole research

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operation, and strongly influence the way in which his research personnel use and interact with the report production process. His approach to scheduling and budgeting research work so that adequate time and funds are allocated to report production can act to minimize instances in which the report production process is confronted with difficult schedules and inadequate funding. His policy toward approval requirements will determine how consistently his researchers are casual or take liberties with approvals. The way a division director resolves conflicts that may arise between a researcher and persons or components of the report production system can have long term consequences. Differences between divisions become especially obvious when reports and proposals involve personnel from two or mor e divisions. 57i

57j Personal styles and eccentricities of report production personnel can be highly influential on the report production process. Sometimes these are relatively inconsequential, sometimes they are beneficial. But sometimes they act to subvert the report production process by producing a negative attitude among the researchers with whom they work. The report production process is a service function, and many of the people involved think of it that way. There tends to be an implicit attitude that the author is always right, in the same sense that in a retail business the customer is always right. Therefore the people involved in the report production process commonly exert themselves to give an author what he wants even when the product suffers as a result. 57j

57k Individual preferences and eccentricities of authors are an important source of the diversity found in the report production process. Especially significant are the author's appraisal of his own writing skills, his attitude about editors, and his understanding of the total report production process, its limitations, and its requirements. 57k

57l Finally, and perhaps most important, time and cost considerations often strongly influence the manner in which the document production takes place. There are both desirable and undesirable ways in which time and cost constraints can be accommodated. Certain groups and individuals that are frequently faced with such constraints have developed methods of approach that work satisfactorily. These vary considerably with circumstances, but generally are based on a shortened form of the procedures shown in the flowchart. Time and cost constraints are dealt with most effectively when one or a very small number of authors are involved in the effort so that coordination of activities is simplified. Although serial creation, editing, and production may not be feasible, an editor may work with the

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author(s) from the beginning to accomplish many of the same functions in parallel. An editor may serve quite effectively as a surrogate author of nontech-nical parts of the document. When time a nd cost are constrained, adequate planning and control become even more important. The editor can be especially helpful in this planning and coordination, if there is good rapport with the authors. Adherence to a proven method of approach, perhaps even a formula or prototype document, is in effect another way of exploiting good planning and previous experience. Effective use of the services of the report coordinator is especially important when time and cost are constrained. 57l

57m Most difficulties occur when, in an attempt to save time or cost, established procedures are ignored or subverted. At best, the quality of the document suffers. At worst, it often becomes necessary to repeat work. That is, there is not time to do it right but there is time to do it twice. Cost and time are increased rather than reduced. In most cases, better planning and full use, rather than circumvention, of editorial and report coordinator resources better serve the overall objectives of working within tight time and cost constraints. 57m

57n In some instances, too generous a schedule creates similar problems. Time pressures force an author into action. Without such pressures, time is squandered until there is too little of it. Then the situation is essentially the same as if there had been too little time in the first place. The solution is proper planning with adequate but not excessive time and resource allocations, and constant monitoring of progress against schedule.
---------------------------------------------------------------- 57n

57n1 The following is proprietary administrative SRI information
which SRI requests not to be released to persons outside the Government, except for evaluation purposes.
---------------------------------------------------------------- 57n1

57n1a APPENDIX B 57n1a

57n1b WORKLOAD AND PRODUCTION STATISTICS FOR THE CURRENT SYSTEM 57n1b

57n2 The statistics presented here represent roughly one year's workload and production volume at SRI. These statistics were derived from data collected through examination of production logs and interviews with key personnel in Report Services and were gathered in order to provide some of the foundation for

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the design of the proposed computer-aided document production system. 57n2

58 A. Editing and Composition Workload 58

58a Work load statistics for SRI Editing and Composition Services are based on data collected from their production logs of mid-December 1973 through March 1974. These data are a combination of actual counts and page estimates recorded by report coordinators. 58a

58a1 Reports Proposals Other Total 58a1

59 Total pages, annual 66,175 37,303 4,655 108,133
Total pages, peak month 9,175 5,193 648 15,016
Total pages, peak week 2,450 1,381 173
4,004 59

60 Total documents, annual 986 925 220
2,131 Total documents, peak month 156 149 46
351 Total documents, peak week 41 40 13
94 60

60a Normal range of pages
per document 3-230 4-152 1-56 Normal
average pages
per document 59 35 14 Extreme
pages per document 600 201 160 Pages above
normal high,
percent of total 13.9 15.4 38.1 Documents
above normal high,
percent of total 2.7 3.2 6.8 60a

60a1 pages/day pages/week pages/month 60a1

61 Average work load summary 433 2,163
9,011B. Editing and Composition Productivity 61

61a The following table is based on Editing and Composition Services' time-charged records. These hourly figures represent hours charged to production activities (exclusive of sick-leave, vacation, administrative duties, etc.). The page rates are also based on page counts in the preceding table.
Average Rate Peak Peak hours/week
pages/hour hours/week hours/month 61a

62 Editing 730 3.0 835 3,081

; might be used to indicate a level 1 heading. This directive would cause selection of the proper typeface and formatting during computer composition.

| | | | | | |
|---|---|---|---|---|---|
| Proofreading | 281 | 7.7 | 320 | 1,286 | |
| Typing | 994 | 2.2 | 1,140 | 4,319 | 62 |

62a More detailed data on weekly fluctuation is available from SRI internal documents. 62a

63 C. Press 63

63a Production statistics for SRI press operations were obtained from 1973 production logs and include all press work (reports, proposals, promotional material, etc.). Page and document counts reflect originals, not total copies. (In 1973, 23 million pages were printed from the 133,844 originals.) The data for ranges and extremes of pages per document are estimates. 63a

| | | |
|---|---|---|
| 64 Total pages, annual | 133,844 | |
| Total pages, peak month | 12,331 | |
| Total pages, peak week | 3,394 | 64 |
| 65 Total documents, annual | 14,425 | |
| Total documents, peak month | 1,329 | |
| Total documents, peak week | 366 | 65 |
| 66 Normal range of pages per document | 1-350 | |
| Extreme pages per document | 1,000 | |
| Classified documents, percent of total | 2.8% | 66 |

67 D. Copy Center Statistics 67

67a Production statistics for the SRI copy centers were obtained from their 1973 production logs and cover all copy requests for reports and proposals during that year. Page and document counts reflect originals, not total copies. 67a

67a1 Reports Proposals 67a1

| | Reports | Proposals | |
|---|---|---|---|
| 68 Total pages, annual | 34,306 | 22,813 | |
| Total pages, peak month | 5,898 | 3,094 | |
| Total pages, peak week | 1,488 | 903 | |
| Total documents, annual | 1,170 | 1,035 | |
| Total documents, peak month | 173 | 117 | |
| Total documents, peak week | 46 | 45 | 68 |

69 F. Table Statistics 69

69a These figures were obtained by examining a random set of 65 bound reports produced at SRI during 1973. Table complexity was

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determined as follows: difficult tables were those which included more than fifteen columns (requiring reduction), medium tables were those requiring approximately one page (four - fifteen columns) and easy tables were those less than one page. It is estimated that approximately eighty percent of the reports produced at SRI include tables. 69a

| | | | |
|---|---|---|---|
| 69b Reports with difficult tables, percent of total | | 61.5% | |
| Average tables | 6 | | |
| Range | 1-38 | | 69b |

| | | | |
|---|---|---|---|
| 69c Reports with medium tables, percent of total | | 80.0% | |
| Average tables | 5 | | |
| Range | 1-27 | | |
| Extreme | 83 | | 69c |

| | | | |
|---|---|---|---|
| 69d Reports with easy tables, percent of total | | 78.5% | |
| Average tables | 6 | | |
| Range | 1-19 | | |
| Extreme | 70 | | 69d |

70 G. Illustration Statistics 70

70a These figures are estimated derived from conversations with SRI Illustrations Department personnel. 70a

70a1 Reports Proposals Total 70a1

| | | | | |
|---|---|---|---|---|
| 70b Documents with illustrations, percent of total | 70% | 10% | 42% | |
| Average illustrations per document | 10-15 | 5-10 | 10 | |
| Normal range of illustrations per document | 1-40 | 1-25 | 1-40 | |
| Extreme illustrations per document | 125 | -- | 125 | 70b |

71 H. Divisional Summaries 71

71a Subtotals of statistics are available for each SRI division; these were compiled during examination of the Editing and Composition production log of mid-December 1973 through March 1974. The following generalizations are the results of discussions with the Supervisor of Report Coordinators. 71a

71b Economics -- utilizes Editing and Composition but beginning to do more typing in division. 71b

71c Electronics and Radio Sciences -- utilizes Editing and

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Composition but most typing done in divisions; 1 full-time editor assigned. 71c

72 Engineering Systems - utilizes Editing and Composition. 72

72a Information Science and Engineering -- utilizes Editing and Composition, some specific groups within division do most of their own typing and some editing. 72a

72b Life Sciences -- most of their work done within the division; 2 full-time editor-coordinators assigned. 72b

73 Management Systems -- utilizes Editing and Composition. 73

73a Physical Sciences -- about eighty percent of their work done within the division; 1 full-time editor assigned. 73a

73b Urban and Social Systems -- utilizes Editing and Composition; rely heavily on their own copycenter. 73b

74 I. Summary 74

74a In summary it should be noted that the recording of production data occurs in only a few areas of report processing at the Institute, and the data collected is meant to describe labor utilization rather than to monitor document flow. Currently there is no mechanism at the Institute which provides periodic assessment of comprehensive workload and production statistics similar to those presented here. 74a

74b ---------------------------------------------------------- 74b

74b1 The following is proprietary administrative SRI information
which SRI requests not to be released to persons outside the Government, except for evaluation purposes.
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74b1a APPENDIX C 74b1a

74b1b CURRENT PROBLEMS AND A NEW SYSTEM 74b1b

74b2 A computer does not by itself solve any problems--indeed, it can create new ones. A computer does allow solutions and approaches to rationalization that would not be possible or feasible in a wholly manual context. This discussion of problems with the existing SRI report and proposal production

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system is thus a summary of the problems that have been identified in preceding sections and the course of this study, with elaboration and additional details. This discussion serves as the starting point and the challenge to a thorough rationalization of the system and the design of an integrated computer-aided document production system for the Institute. 74b2

75 A. Problems That Can be Resolved by a Computer-Aided System 75

75a Numerous problems are the direct outgrowth of any complex manual document production system. This section describes the most glaring ones which will, to different degrees, be mitigated by a computer-aided system. The obvious and most appreciated ones are well known: 75a

75b . The need for multiple manual retyping steps 75b

75b1 . The specialized formatting and layout problems associated with the generation of tables 75b1

75b2 . The abundance of diverse forms which tie together the document production efforts 75b2

75b3 . The split responsibility for content control (remaining with the author) as different from physical control (maintained by Report SERVICES) 75b3

75c These elements are obvious and have been treated elsewhere. The remaining topics will be treated in more detail. Multiplicity of Formats 75c

75d One of the problems faced by both editors and typists at SRI is the plethora of formats. For example, divisions and even some departments tend to format their reports as though they were to be published in the learned journals of their field. Some divisions follow the suspense method of writing (leave the conclusions to the last) and others follow the busy executive method (findings and conclusions first). Headings vary in format from division to division, and references must be done in a division-specific style. For example, one group never puts in titles of journal articles; whereas another does. One of the time-consuming exercises an editor must go through is finding out for an inter-divisional report whose format is to rule. If one has to mix references from a department that does not list journal article titles with references from a department that does, the final list is at least odd. A system with computer aids will offer a splendid opportunity for standardizing forma ts. 75d

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75e The multiplicity of report formats among the SRI research divisions is expensive. Steps can be taken now to define basic standard formats for the whole Institute and for almost all reports and proposals. Although a computer-aided system can make it easier to accommodate a variety of formats, each format to be introduced may require additional programming, or manual intervention. There will always be reports for which a client specifically directs a particular format, and these must be accommodated. However, special formats based solely on history or whim are expensive items. 75e

75f Proofreading 75f

75g A formal proofreader/copy editor step at the time the rough draft is prepared (when usually there still is time) would allow the desirable situation that from then on, everything is a refinement of the basic document, and only the changes need to be proofed. With this approach, there would be less of a jam at the end of the production process, and the closer one gets to the end, the less would be the investment in time for each editing, typing, and proofing cycle. 75g

75h Report Services Personnel Scheduling 75h

75i The problem of downtime, which results from erratic production flow through Editing and Composition, is a significant one. Over one period of 25 weeks, Editing had 1,028 hours of downtime and 821 hours of overtime. For that period, Editing essentially carried one full editor doing nothing while an extra editor was working for 20.5 weeks. No overtime would have been needed if the idle time could have been filled. 75i

75j In typing, the problem is exacerbated. Over the same period of 25 weeks, Composition had 1,688 hours of downtime and 2,325 hours of overtime. That is, over that period we were carrying 1.7 idle typists, and employing 2 extra typists at premium wages (since overtime is paid for at time-and-a-half). Had the system made it possible for the idle time to be productive time, only 16 weeks of overtime would have been needed instead of 58. 75j

75k Queueing and Waiting Points 75k

75l A computer-aided system can, by eliminating some of the discrete, non-intersecting steps, eliminate some of the queueing and waiting points. Furthermore, beginning the editing process and the typing process earlier, thus distributing these functions over time instead of laterally over a number of people working in

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parallel, will remove some of the reverberations of any single wait in queue. However, it might be well to consider the possibility of establishing an ad hoc group, formed of those people whose time is not committed on any given day, that would function as a quick-response group to handle proposals. To some extent this is done at present, but it would be easier to do with a computer-aided system, a full utilization of stored information in form suitable for rapid playout and tailoring, and stored formats. 75l

75m Charging for Report Production Services 75m

75m1 The present system of charging the project for work done in Report Services is to assign every piece of work an average cost-per-page if it comes within the limits of usual work. A new system that allowseditorial and proofing effort to be recorded by means of log-on and log-off times would allow actual costs to be assessed for the project. 75m1

76 B. Problems Likely to be Created by a Computer System 76

76a Unfortunately, installation of a computer-based document production system cannot be expected to solve all existing problems and to realize all possible improvements without introducing new ones. This section identifies several problems that can occur with a computer-based system and that must be addressed by the design specifications and implementation plans for any Institute-wide computer document production system. 76a

76b Handling Peak Loads 76b

76c The processing system in Report Services is now expandable to handle peak loads (although it is true that each increment of expansion is less effective as it is added). A machine-aided system must either be designed to handle peak loads that may increase beyond experience (and thus have considerable waste capacity during most of the work year) or it must be designed to handle the generally increasing average level. Although_the computer hardware itself can be easily configured with sufficient excess capacity, some problems must be anticipated. A document that exists entirely within a machine cannot easily be corrected by a typist who has no access to that machine. A temporarily hired outside editor who has never worked on printout with special formatting codes is not likely to understand what he is seeing. Four sections of a report that go through the phototypesetter are difficult to marry up with a fifth section that had to be typewritten. 76c

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76d Security 76d

76e The obvious problem of controlling access to report material that should be kept private will be exacerbated by the use of machines in which access depends upon a piece of knowledge (the number that will make the machine give you the information) rather than upon physical presence. One may still be able to hide a private report on his messy desk, but how can he be sure that an unauthorized individual isn't going to sit down at some other terminal and dial up the report? How can he tell if this has happened? 76e

76f Document control 76f

76g In the existing system, problems of document control occur when multiple copies of a document are processed in parallel or when a document is revised many times so that there exist several different versions. 76g

76h This problem has resulted from the widespread use of office copiers. The office copier has become an important part of the total document production system without having been fully rationalized and systematically integrated with a full set of control procedures. 76h

76i Introduction of computer text processing can exacerbate this problem. To exploit many of the potential advantages of computer text processing, it can be expected that new, cleaned-up versions of a document will be produced more often than can be justified today when expensive manual retyping is required. 76i

76j Of course, the computer text file should always have the most recent version of the document text. Each printout of the document should show, on each page, the version number. It should be a simple matter to determine which version is the most current by inquiry to the computer system. Such a control procedure is not formally available in the existing manual system. There remains, however, the problem of selecting a procedure for cancelling previous versions as new ones are released and making all concerned parties aware of the cancellation. 76j

76k Mathematical and Scientific Notation 76k

76l Mathematical and scientific notation is especially difficult to accommodate in a computer-aided document production system. The more complex the notation, the more difficult. There is little or no problem with the increased character set required. Line

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printers with extended character sets and phototypesetters can in fact deal with large char-acter sets more effectively than a typist at a standard typewriter, who must use Typits or change typespheres or apply dry transfers. Problems occur in specifying to the computer during capture which characters are to be used and how they are to be positioned. The computer does not know that a Typit or different typesphere has been used without explicit specifications. It is also unaware of manual carriage movements used to produce sub- and super-scripts. As the character set becomes larger and the carriage positioning becomes more complex or the special characters occur more frequently throughout the text, the task of specifying appropr iate control information to the computer during text capture becomes increasingly tedious and time-consuming. 76l

76m There is no simple solution that can be implemented at low cost and that reduces necessary operator training and skill. There are better and worse designs and implementions, but even the best requires operator training and results in either tedious and specialized capture proce-dures or requirements for specialized capture facilities or both. There is a point of diminishing returns, beyond which it is not cost effective to provide for larger character sets or notations of increased complex-ity. This point has yet to be determined for an Institute-wide system. Only modest capabilities will probably exist in an initial system. It will therefore be necessary at first to treat most mathematical and scientific notation as artwork, and to produce many documents with heavy scientific and mathematical notation by largely manual methods. No matter how sophisticated the computer system becomes, there may always be cases where manual methods are more effective. 76m

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76n1a APPENDIX D 76n1a

76n1b A PROPOSED SYSTEM PROCESS FLOW 76n1b

77 A. Introduction 77

77a A process flow diagram for a computer-aided text handling system intended to meet the current objectives is shown in Figure

; might be used to indicate a level 1 heading. This directive would cause selection of the proper typeface and formatting during computer composition.

2*. It is anticipated that the changes proposed in the new process will have a dramatic effect on product cost, production time, and product quality. 77a

77b Figure 2 is a system design in that it specifies system functions and their interrelationships. However, it does not directly specify the design of the associated computer aids. Rather, it establishes requirements. The system design is feasible to the extent that the required computer aids can be implemented and installed within existing constraints of cost, time, technology, and user acceptance. 77b

77c Where a step is functionally unchanged from Figure 1, the step number and description has been retained without change. In some cases these steps occur in a different order in Figure 2, so the step numbers of Figure 2 are not always in strictly ascending order. A step whose function is similar to that of a step in Figure 1 but whose performance is different is indicated by marking the step number with an asterisk (*). Where several new steps replace one step from Figure 1, interpolative step numbers have been assigned. Descriptive information about each step is included in Table 2, which is similar to Table 1 in format and content. 77c

78 B. Step-by-Step Description 78

78a In the step-by-step description that follows, the steps are grouped together as was done for Figure 1. Where individual steps, or groups of steps, are essentially unchanged in function or performance from the existing system, no comment is made. 78a

79 ---------------------------- 79

79a * Figure 2 and the associated Table 2 appear at the back of this section. 1. Preliminary Steps 79a

79a1 An important new feature of the proposed system is a group of steps to be performed at the very inception of document production, shown in Figure 2 as "Preliminary Steps." The objective is to formally acknowledge, as early in the production process as possible, that a document is being produced, and to plan for the most efficient possible production of that document. 79a1

79a2 Assignment of a report or proposal coordinator initiates the document preparation process. Opening the production account and coordinator's log (Step 13) are functionally

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similar to the same-numbered step in the existing system but occur at the very start of the process flow. It is intended that a more effective and more uniformly maintained coordinator's log will be used. These steps result in opening the computer files--both for text and for management and control data--that will be used for the document while it is in production. 79a2

79a2a An editorial consultant is assigned to help in planning the document creation and production (Step 0.1). In the past there have been attempts to make early use of editors, but success has been neither uniform nor remarkable. 79a2a

79a3 It is anticipated that an editorial consultant will be a person with the special skills needed at document inception and those who are able to work effectively with research personnel at this stage in the process. 79a3

79a4 There are numerous obvious benefits to early planning. Especially important is the opportunity to schedule editors, illustrators, typists, production editors, production facilities, and so forth, in advance. This allows production problems to be anticipated and corrective measures taken. Early identification of resource material such as standard descriptive text for proposals can expedite total document production. This step includes participation of research personnel, the editorial consultant, and the coordinator. 79a4

79a5 The assignment of document sections to authors (Step 0.3) occurs only for multiauthor documents. 79a5

79a6 Throughout document production, the document plan is refined and updated (Step 0.5), and improved planning information is supplied to Report Services as specifications for the document and its associated illustrative material become more definite (Step 0.6). 79a6

79a7 These preliminary steps must, of course, be tailored to document requirements. For letter proposals and short reports, only simplified versions of Step 13 need be done--the other steps can be skipped. For reports and proposals of modest size, only modest use of an editorial consultant and modest planning are required. What is to be avoided is the effort and time that are wasted when there is inadequateearly planning, inadequate use of editorial resources, and inadequate followup. 79a7

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79a8 2. Existing Resources 79a8

79a8a An important feature of the proposed system is a central data base including captured versions of SRI promotional, descriptive, and standard copy material. This will be especially significant for proposal preparation. In addition, there will accumulate over time a data base of previous SRI reports and documents. It should be possible to select from this data base, using the thesaurus approach, such items as: standard descriptions of the Institute, its divisions and subordinate groups, and its specific programs; descriptions of past projects; bibliographies of previous reports and staff publications; and collections of biographies. The selected material can then be edited to tailor it to the needs of the particular proposal or report. This data base will allow simple production or modifications to standard contracts without excessive typing. 79a8a

79a8b For certain classes of documents (e.g., letter proposals), it is common that the text is relatively standard except for two or three paragraphs and a few words of text. Standard "frameworks" or "templates" for such documents that can be filled out for each case will reside in the data base. 79a8b

79a8c Often a final report makes heavy use of intermediate report text. When the intermediate reports are already in a computer data base, the organization of suitable extractions into the body of the final report will be greatly simplified. 79a8c

79a8d It is anticipated that there will be many applications throughout the Institute for on-line computer files of past projects, staff biographies, and so forth. Applications of this information for purposes such as promotion, prepration of capability statements, dissemi-nation of local information to a broader audience (including other organizations), contract administration, management of research opera-tions, and the like are above and beyond the immediate justification of report and proposal production, but their benefits to the Institute are potentially great. 79a8d

79a8e The two categories of existing resources that are intended to be available as on-line computer data bases are marked with asterisks (*)in Figure 2. 79a8e

79a9 3. Initial Creation and Preproduction 79a9

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79a9a Except as augmented by the ready availability of a centralized and simply accessed collection of SRI promotional, descriptive, and standard copy material, and previous reports and documents, no direct computer aids to the initial creation and organization steps are currently proposed. Such aids are in many respects beyond the scope of simple text handling, as explained in preceding discussions. Note, however, that how much the author is aided and augmented depends most on how the author chooses to make use of the system. He can work as though the system were not there at all, or he can use the system for all it is worth, capturing bits and pieces and continually reorganizing the collected material beginning from the start of the project work. 79a9a

79a10 4. Text Capture and Rough Draft Rework 79a10

79a10a It is in the text capture and rough draft rework activities that the most dramatic change is made, both to individual steps and step sequencing. As with the existing system, this activity begins as soon as the first rough draft material is ready to be typed. 79a10a

79a10b The intent of this activity in the computer-aided system is to capture the document--at least its textual material--in computer-readable form as early as possible in the production process. There are two important consequences. First, subsequent manual retranscription steps are minimized. It will minimize, if not eliminate, the intro-duction of errors through retyping of unchanged portions of text. It will not, however, eliminate all subsequent retyping. It can be ensured that in virtually all cases, at least one full transcription (the final typing step) can be eliminated. In the case of proposals and documents that make heavy use of already captured material, even the initial capture transcription effort will be significantly reduced, since it will be limited to new material. 79a10b

79a10c Because the document text will reside in a computer file, a preliminary step is to supply some control information about the document (Step 2.1). This information will become part of the document text file and will be used to manage and control the text file and the document production process. Information will include: production number (from Step 13); project or work order number; persons responsible (e.g., author, report coordinator, or editorial

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consultant), document category (e.g., report, proposal), and so forth. 79a10c

79a10d The capture procedure must be chosen to suit the requirements of the document (Step 2.2). The most common capture procedure, the one illustrated in the flow diagram, will be "transparent" to the typist. That is, the typist will use a device virtually identical to the normal office typewriter and will follow essentially the same procedures that would be followed for normal rough draft transcription in the existing document production process. The feasibility of such an approach has been demonstrated by the capture procedure adopted for the PDP-11 MAE system described in at SRI. 79a10d

79a10e As an alternative, typists with additional training can perform more complicated capture procedures in which before capture, the text must be marked-up with special codes that will control subsequent document formatting and computer processing. This approach is currently used with the Report Services Redactron word processor devices. Special-ized capture procedures will be required for demanding material such as complicated tables. For all but the most complicated capture procedures requiring specialists and handling difficult material, the same steps will be performed but the order will be different. 79a10e

79a10f The actual keyboard transcription activity (Step 2.3) will vary with the capture procedure. For the simplest procedures, the activity will be essentially identical to normal rough draft typing at a standard office typewriter. An on-line terminal with extended keyboard and CRT display terminal may be required for capture of demanding material, such as tables or illustration captions and labels. 79a10f

79a10g A production account and the coordinator's log are opened (Step 13) only if not already done as preliminary steps or for some other component of the document. For capture procedures involving specialists at centralized typing pools, this step must precede Step 2.3. 79a10g

79a10h The captured text is then read into the computer and made into a file (Step 2.4). Information from the document control form must accompany the text when the computer file is created. Information included in the computer-readable text will specify which elements, if any, are to be extracted from already existing computer text files (such as

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past project descriptions) and merged with the newly captured text. Alternatively, the captured text may be only one part of a larger document with which it is to be merged. 79a10h

79a10i Each full document will be represented by a unique, independent text file. If a document is to be revised and reissued, the old version will be retained as one file, and a copy will be made into a separate file from which the revised version will be produced. Each such file will include not only text, but all associated management, control, and identification information. 79a10i

79a10j After the computer file has been successfully produced and all resource material merged, the capture must be verified. A listing of the captured text will be produced in a suitable format (Step 2.5). The listing of the captured text is scanned to identify transcription errors (Step 2.6). This is not intended to be a full proofreading activity. At this point in the production process, no more effort need be expended than would be expended for typist correction of a rough draft in the present system. 79a10j

79a10k The persons responsible for this task are here called "production editors." This job description is to be distinguished from that of the editor. The production editor is concerned with proofreading and for the format of the document, whereas the editor is responsible for document content. The new title becomes important because the responsibility of the production editor extends beyond simple proofreading. 79a10k

79a10l To allow subsequent computer composition of the document, it is necessary to supply formatting information by means of directives or special codes imbedded in the document text. Entities to be marked include various headings, footnotes, indented material, tabular material, and so forth. These codes must be supplied now by the production editor for the simple transparent capture procedure, or verified if already entered by a more sophisticated capture procedure. 79a10l

79a10m After the production editor's listing of the captured text has been marked up to correct transcription errors and include necessary formatting codes, the computer text file is updated to incorporate these corrections and additions (Step 2.8). This is done at an on-line CRT display terminal. 79a10m

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79a10n If it is anticipated that the document or section of a document is to be so heavily reworked that recapture or significant updating will subsequently be required, Steps 2.5 through 2.8 can be postponed. The initial capture is then only to produce clean copy with which to work and to allow utilization of various computer aids during the early rework process. The initial production editing steps must, however, be completed before the document is released for initial approvals and editing. They are thus performed following Step 5.3 in one of the rework cycles. Alternative step numbers for such cases are shown in parentheses in Figure 2. 79a10n

79a10o At this point the document text is ready for author rework, and a listing of the text is produced in an appropriate format (Step 2.9). Different formats can serve different objectives, and the author is given the choice of the format he prefers. 79a10o

79a10p The document rough draft is reworked (Steps 3 and 4) and, whenever sufficient changes have been made, it is cleaned up and a new listing produced. Heavily marked-up copy clearly has a negative subjective influence on the rework process. Often, the real consequence of a change cannot be evaluated in marked-up form. This is especially true if the rework entails considerable reorganization and moving of text within the document. 79a10p

79a10q This feature can be abused, however, if used to excess. Both time and cost can actually be significantly increased if repeated unnecessary cleanups of the document are performed simply because it is easy to do so. Abuse of a computer-aided text-handling system in this manner is a potentially serious problem. The solution lies partly in correct training and indoctrination of authors and project leaders, and partly in the guidance that can be supplied by editorial consultants and document coordinators. 79a10q

79a10r The changes produced by rework are incorporated into the computer text file (Steps 5.1, 5.2, and 5.3). Where changes are light, they may be incorporated at an on-line CRT terminal. Where changes are heavy or there is much new material, it is often more effective to recapture entire sections of the text. New or recaptured text is merged with the old or updated text to create a new version of the document file. The old document version should be retained in archive form at least until the revised version can be

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reviewed and accepted by the author. Specialized production editor format listings of the text can aid in proofreading only the changed text but in such a manner that errors of both commission (making the change wrongly) and omission (failing to make an indicated change) can be readily detected. The process ends by producing a new printout of the revised document text in author's format (Step 2.8 repeated). 79a10r

79a11 5. Preliminary Approvals 79a11

79a11a The preliminary steps--from 6 through 12--are little changed from the existing system. A complete and clean copy of the document text is available for approval, not simply a cleaned-up rough draft. 79a11a

79a12 6. Management and Control Preliminary to Editing 79a12

79a12a Steps 14 through 27 are functionally unchanged. Certain of the management, control, and logging information currently maintained manually will be entered into the computer as well. 79a12a

79a13 7. Editing 79a13

79a13a The editing steps--Steps 28 through 43--are essentially unchanged from those for the existing system. It is anticipated that better early planning, a more finished rough draft product from the author, and clean copy in a uniform and consistent format will increase editorial effectiveness. 79a13a

79a13b Changes resulting from the editing activity are incorporated as in the rework cycle, the method depending upon extent of changes. Following incorporation of editorial changes, a new, clean listing of document text is produced. 79a13b

79a13c Because changes suggested by an editor are seldom made without consent of the author, the editor would probably not work directly at a CRT terminal unless a means can be found to represent suggested editorial changes side-by-side with the original text until the author approves or rejects. 79a13c

79a14 8. Approvals 79a14

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79a14a As with the preliminary approvals, these steps are essentially unchanged. 79a14a

79a15 9. Final Formatting--Proof Stage 79a15

79a15a This is a major departure from the existing system. There is no final manual typing. Instead, the document text is composed in final page format with page numbers, space for illustrations, and all front matter added by computer. The computer can produce tables of contents, lists of illustrations and figures, and indices from informationincluded in the computer text file. No new errors are introduced in the final composition process. A printout of the composed text is produced for final author review and production editing. 79a15a

79a15b All factors considered, it is estimated that fewer major changes will occur at this point and that minor changes will be reduced in scope and workload. The flow diagram has been modified to account for differences in computer text file updating requirements for minor and moderate author changes. Moreover, even if major changes are made, there is no final manual retyping to be repeated. 79a15b

79a15c A new step at this point is the final production editing
(Step 58.5). The computer can do a good job of final composition and page makeup, but not a perfect one. Beyond a certain point, small improvements in computer composition quality are achieved only at great cost in software development time and program complexity. The production editor must check all illustration placements, check final formatting of tabular material, eliminate "widows," and perform other page make-up refinements. If computer hyphenation is employed, the production editor must verify all hyphenations. Although the production editing step requires a comprehensive check of document format, and perhaps hyphenation, it is not to be confused with proofreading. No new content errors will be introduced by the computer in the final composition process; hence, proofreading should not be required. 79a15c

79a16 10. Steps Preceding Printing 79a16

79a16a Steps 60 through 64 and Steps 72 and 73 are essentially unchanged in function and substance. In the event that the prepublication copy must be in a different

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format than the final copy--e.g., double-spaced for approval, single-spaced for final--a significant simplification results from the fact that no additional manual retyping in final form is required. Instead, only a second pass through computer composition and perhaps production editing checks is needed. 79a16a

79a17 11. Final Production Steps 79a17

79a17a These steps are also essentially unchanged. New equipment--especially phototypesetters--will have impact on reproduction methods selected and the number of pages required for a given volume of text. This is especially important considering the rapidly increasing cost of paper. (One Navy facility reports press costs decreased 30 percent by phototypesetting, which gets more words per page with improved legibility). 79a17a

79a17b Step 80 has been broken into three separate steps, which are considered important. First, because the computer is used for document management and control, distribution of document copies to internal SRI recipients will be more uniformly accomplished (Step 80). (At present, entities that ought to receive copies of many documents as a matter of course, such as the Library, must in many cases learn of the existence of a document through various channels and request necessary copies.) Second, entries will be made as a matter of course in computer-held files of past projects, report abstracts, bibliographies, and so forth. This will support a growing library of information that will progressively enhance the value of the computer text-handling system (Step 72.1). Finally, the final version of the document will be archived on some medium such as magnetic tape or microfilm. This will simplify subsequent errata production, revision, republication, and further use of the document (Ste p 72.2). 79a17b

79a18 12. Errata and Amendment Processing 79a18

79a18a These steps are functionally unchanged. The availability of a computer text-handling system can simplify the accumulation, verification, and production of errata sheets and amendments when required. 79a18a

79a19 13. Illustration Production 79a19

79a19a This entire process, including Steps 91 through 135, is essentially unchanged by the presence of the computer

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text-handling system. The automated management and control, together with improved preliminary planning and consultation, should improve the scheduling of illustration production, which is currently rather difficult. 79a19a

79a19b There is one important departure from current practice regarding captions and illustration sizing information. It is important that this information be captured in computer-readable form and merged with the document text. Labels need not be captured, although the availability of computer text editing and composition aids and phototypesetting can certainly be used to good effect. The caption and sizing information for an illustration is considered to characterize the illustration for purposes of editing, automatic generation of front matter, and full format document composition and page makeup. From the point of view of the illustration groups, it is only necessary that a list of illustration captions and associated sizing information be prepared. It is the function of the editor, the author, and the production editor to determine where in the text the illustration descriptor information should be placed. 79a19b

80 C. Summary 80

80a It is recognized that the proposed system does not meet all the Institute or general document generation requirements. Most obviously, it does not address the special requirements of classified documents or documents that make extensive use of mathematical or scientific notation. The system as proposed can develop and evolve to accommodate an increasing number of documents produced at the Institute, failing in only special cases. However, a manual system will prove to be either necessary or the most cost-effective mechanism for certain categories of documents produced at the Institute for some time to come. 80a

80b ------------------------------------------------------------ 80b

80b1 The following is proprietary administrative SRI information
which SRI requests not to be released to persons outside the Government, except for evaluation purposes.
------------------------------------------------------------ 80b1

80b1a APPENDIX E 80b1a

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80b1b ANALYSIS OF THE APPROACHES TO IMPLEMENTING TEXT CAPTURE, TEXT FORMATTING, AND CONTROL AND SECURITY 80b1b

81 A. Background 81

81a Virtually all text material prepared at SRI is typed or otherwise transcribed at a typewriter-like keyboard at least once. Proposals, reports, and similar documents generally require both rough draft and final typing steps. In many cases, additional retypings of parts or all of a document are necessary. Each such typing or keyboarding represents an opportunity to capture the text in computer-readable form and thus minimize or eliminate subsequent manual retypings. 81a

81b At SRI there are at least three different kinds of text capture opportunities involving different categories of personnel: 81b

81b1 (1) Transcription by secretarial personnel engaged in full time production typing--e.g., the Report Services typing pool. 81b1

81b2 (2) Transcription by secretarial personnel for whom such typing is only one of a variety of secretarial tasks--e.g., departmental secretaries. 81b2

81b3 (3) Transcription by an author generating rough draft text using a typewriter. 81b3

81c The primary task of secretaries is efficient and error-free transcription, and formatting. Concern with content is secondary. It is a production activity. In contrast, authors, and editors, are primarily concerned with content and organization. Choice of transcription mechanism--longhand, typewriter, or dictation--is secondary and usually a matter of personnel preference and convenience. A basic system should concentrate on the effective use of secretarial personnel for text capture. Some authors will work naturally within the resulting system of procedures and constraints, but full exploitation of the author as an opportunity for text capture properly belongs only as a part of later system enhancements leading to use of augmentation techniques. Two classes of secretarial personnel have been described: the first transcribes text on a full-time production basis; the second transcribes text only part of the time, having numerous other duties. Approaches to use of these two groups of secretarial personnel for text capture are different: 81c

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81c1 . More extensive and specialized training can be cost-justified for full-time specialists than for part-time typists. Procedures for text capture must have a simplified subset easily learned by non-specialists. This subset should not depart significantly from normal typing procedures. 81c1

81c2 . Specialized text capture hardware can be considered for full-time specialists because it can be fully utilized. 81c2

82 Apparently, the two categories of secretarial personnel require two capture procedures. Ideally, one procedure should be a subset of the other. In fact, there should be several levels of sophistication, so that a secretary could, with minimal training, act to capture document text, and gradually, through additional training, become more proficient and deal with more and more complicated textual material. 82

82a It is thus concluded that a hierarchy of text capture capabilities are needed. At the lowest level would be procedures that could be used by departmental secretaries using existing office hardware, or at least normal office typewriters, with minimal training. At the highest level would be procedures used by full-time specialists with appropriate special purpose capture terminal hardware. There would be intermediate levels with appropriately scaled training requirements, hardware, and procedures. 82a

82b 1. Constraints 82b

82b1 The experience with the MAE system in the Information Science Laboratory has demonstrated that a fully satisfactory transparent capture procedure using standard IBM Selectric typewriters can be implemented. 82b1

82b2 Similarly, there is considerable experience within the Institute with capture procedures requiring that directives be imbedded in the text to control subsequent formatting. Such procedures are necessary to accommodate tables, scientific notation, indented matter, footnotes, and so forth. The Deferred Execution System used by ARC is an example of a successful approach implementation of this feature. 82b2

82b3 The difficulty exists not in designing a suitable procedure or training existing personnel, but in selecting the appropriate capture hardware. Ideally, the capture terminal should be connected on-line to a computer or to some off-line

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medium such as a magnetic tape cassette that can be read directly into the computer. Especially for secretaries engaged in part-time capture, the device should have the same feel, performance characteristics, and keyboard layout as a normal office typewriter. At this time, devices having these characteristics are rather expensive, typically $7,000 to $8,500, and often not fully satisfactory. 82b3

82b4 An IBM typewriter (the I/O Writer) with an electrical connection is available for about $1600. Several of these can be interfaced to a small computer with pooled storage to capture text. The computer logic and storage costs are shared, but the per-terminal cost is still typically $4,000 to $5,000 (or more). If any part of the centralized computer or pooled storage fails, all terminals become useless for text capture. This occurs infrequently because few components are involved, but it does occur. Specialized problems of interfacing the I/O Writers may be encountered. 82b4

82b5 Alternative devices, such as the TI (Texas Instruments) Silent 700 series of teleprinter devices, are less expensive and in some cases have more favorable characteristics than the office typewriter--e.g., reduced noise level. However, keyboard layouts and feel are typically different and result in accommodation problems for a typist who must switch from such a terminal to a normal office typewriter with any frequency. 82b5

82b6 Another possibility is to use CRT terminals instead of typewriters. Interfacing is no problem. These devices are becoming progressively less expensive. The biggest difficulty with presently available CRT terminals is that virtually all of them are designed as teletype replacements. Keyboard layout and feel is significantly different than an office typewriter. Many keyboards cannot support typical sustained secretarial typing rates. 82b6

82b7 For capture, only the keyboard itself and the computer-readable medium are required. There is no real need for hard copy. A good typist seldom looks at hard copy during transcription and detects most errors within one or two keystrokes after they have been made, by feel. A display of the last few characters keyboarded would suffice to satisfy the needs of most typists. The printing mechanism in a typewriter is the principal source of noise and requires actions such as returns of the carriage and changes of paper that break the capture rhythm and reduce speed. 82b7

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82b8 There are a small number of recently announced devices that seem suitable for text capture as portrayed here. The keyboards are modeled after the standard office typewriter keyboard, not the teletype. Operator feedback of captured text is by CRT displays, or plasma display panels showing only the most recently keyed characters--perhaps up to 32. The devices are small, quiet, and attractive. Some have optional hard copy capability. Costs in quantity are typically less than $1,000 and may be as low as $600. Interfacing to a small computer with shared storage for captured text is standardized. Those with modest CRTdisplays can serve for both editing and capture. To date, none of these devices has been available for test or evaluation. 82b8

82b9 The industry today may be characterized as not yet ready systematically to address the problem of text capture and related text processing with a broad line of inexpensive components that may be assembled into a computer based system for in-house document production. Available devices are either too expensive or not quite suited to needs or both. This situation is beginning to change, but it will be several years before any broad range of fully suitable devices is available at low cost. In the meantime, equipment selection remains a problem. We wish to avoid large investment in devices that are less than ideal and that will become obsolete in the near future or constrain procedure designs in ways that make future transitions to more suitable devices difficult or impossible. 82b9

82c 2. Recommended Approaches 82c

82c1 It is recommended that provisions for text capture in a basic system pursue several different alternatives to satisfy different capture requirements and to keep future options open. 82c1

82c2 First, to support capture by department secretaries and similar personnel on a part-time basis, the use of Optical Character Recognition (OCR) techniques is recommended. Text is typed at an IBM Selectric typewriter using an appropriate typesphere. Typing is done with double or triple spacing, and procedures are othewise virtually unchanged from normal rough draft typing procedures. The finished typed material is then delivered to some centralized location where an OCR device reads the text and produces a computer readable version. Common-ly available devices allow text to be deleted by means of a heavy black line or inserted by appropriate interlineation, so that some corrections can be made to typed material before scanning. The three most common OCR typefaces

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are OCR-A, OCR-B, and the Courier 12. The OCR-A font is rather stylized, but the Courier 12 font closely resembles normal typewriter fonts (Figure 3 shows examples of some OCR fonts). Both transparent capture procedur es and procedures involving use of imbedded formatting directives can be implemented with OCR. 82c2

82c3 An OCR device for the somewhat stylized OCR-A font typically costs less then $15,000 and can support the output of up to 30 typists working full-time at 50 words/minute. Additional cost must be allocated for interfacing such a device to a computer or to some means of recording output on a medium other than paper tape. Devices in this category generally lack "bells and whistles" and are intended for economical, reliable, and efficient capture of textual data using standard office typewriters. 82c3

82c3a Figure 3. 82c3a

82c4 More sophisticated devices accommodating other fonts and having features for processing and editing scanned material cost more--from $25,000 to $30,000 for the next step in complexity and somewhat more for the most powerful devices. This is a dynamic field, similar in some respects to the minicomputer industry, and expectations are that devices with more features and better performance will continue to arrive on the market at steadily reduced costs for the next several years. 82c4

82d OCR seems to offer a great deal of power and flexibility at low cost. It is not a new technology, but has been in the field for a number of years. (In fact, SRI was instrumental many years ago in helping to establish this industry.) OCR supports basic transparent capture procedures by departmental secretaries using essentially standard rough draft transcription methods at normal office typewriters. Investment per capture station is low--the cost of an office typewriter and special typesphere plus some fraction of the OCR device cost. There is no large investment in hardware that is likely to become obsolete in a short period of time. The OCR device may be leased if appropriate. The stylized OCR-A font may be used for capture to allow use of the most efficient scanners (the author sees a computer-produced printout in a normal typeface, not the material submitted for OCR scanning). The typesphere can be changed to a traditional typeface so that the Selectric typewriters can be used for normal secretarial work when not occupied for capture. For all these reasons, the use of OCR approaches to text capture is recommended

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as the initial vehicle for a wide-based computer document production system. The volume of data capture required to assemble the initial system data base can probably justify acquisition of one OCR scanner by itself. 82d

82d1 In addition to an OCR approach, use of dedicated capture terminals for specialists and for department secretaries producing large volumes of report and proposal text is also recommended. It is suggested that these consist of CRT terminals of modest capability with an office typewriter compatible keyboard. Several different configurations are suitable: 82d1

82d1a . A stand-alone terminal capable of recording data on a
computer-readable medium such as magnetic tape cartridge or floppy disc. 82d1a

82d1b . A cluster of terminals supported by a small processor with pooled storage of captured data. Terminals can be col-
located or remote from the processor. 82d1b

82d1c . A cluster of terminals supported by a small processor with pooled storage and one or more shared hard copy output
devices. This allows use of each capture station for both straight text capture and for local word processing applications such as correspondence and memoranda.
. Specialized capture terminal configurations supporting capture of tables, scientific notation, and other difficult or specialized material. 82d1c

83 The following kinds of terminals should be considered: 83

83a . Keyboards with minimal visual feedback for straight text capture. 83a

83b . Keyboards with displays of at least 12 lines of 80 characters each to serve both text capture and limited text editing. 83b

83c . Keyboards with displays having more complete graphics capabilities to support capture (and editing) of tables scientific notation, full formatted pages, and so forth. 83c

84 Processors to support these displays are similar in all cases and

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software development is common. Different versions of the software support different numbers of terminals and different levels of capture procedures and word processing and/or editing applications. For the simpler cases, the computer is very small and acts only to control and interface the keyboard and display to the storage medium (and hard copy printout if included). For the complex capture procedures such as for tables, and for editing, interactive techniques are needed. 84

84a A word about the clustered set of keyboard/displays with shared storage and shared hard copy output (the keyboard/displays have been described above). There are currently available hard copy printout devices, similar to typewriter print mechanisms, that are somewhat quieter than a standard office typewriter, three to five times as fast, with print quality equal or superior to that produced by an IBM Executive, and with some of the flexibilities of the Selectric with its changeable typespheres. An example is the Qume printer. We strongly believe that in the very near future standard office hardware configurations will not be based on individual typewriters or stand-alone typewriter-based word processor equipment, but on keyboard/ displays suitable for transcription and text perfecting (i.e., word processing or editing) and separate shared devices such as the Qume printer for all intermediate and especially final hard copy output. The analysis and arguments leading to this conclu sion are beyond the scope of this discussion, because they go well beyond document production. Such configurations support all office text-handling. Within as little as two years, such configurations can become fully competitive with, and thereafter will be preferable to, normal office typewriters for many applications. These configurations have therefore been made an integral part of the proposed computer document production system concept: because they are justified by requirements for general text capture in the basic system; because they support specialized text capture requirements; because they are also suitable for the text editing requirements discussed below; because they do not rely on any exotic technologies; and because they will not only serve the immediate needs of document production but have long range use throughout the Institute for all other text applications as well. 84a

84b All of the configurations described above can operate either as stand-alone stations or clusters, or on-line by telecommunications to a full support text processing computer system. 84b

85 C. Text Editing 85

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85a In this category are included all modifications to computer-held text. Modification activities are variously called text perfecting, editing, word processing, and so forth. Thus text editing involves both minor changes to the text that are essentially local in context and text modifications of broader scope. Minor changes generally involve correcting capture and spelling errors, inserting or deleting words or sentences, and so forth. Editing must also allow moving portions of text to reorganize a document, assembly of independently created parts of a document, merging new sections and boilerplate into a document framework, and so forth. 85a

85b The editing generally takes place in one of two contexts. Early in the document production process the text can be considered as a galley or continuous scroll. Page formatting is relatively unimportant. Editing can be accomplished effectively at a display showing from 10 to 20 lines of the text at a time. It becomes necessary to be able to locate points in the text by line number, paragraph name or number, section number or title, and so forth because there are no page numbers. In this galley context it is helpful to have a split screen capability allowing two (or more) separate parts of the text to be viewed and acted upon simultaneously as is currently available in the ARC system. Towards the end of document production, it becomes more useful to consider the document as a sequence of formatted pages to allow illustration and table placement, to correct "widows" and other formatting problems, to generate and edit the table of contents and lists of illustrations and tables, and so forth. 85b

85b1 It is suggested that the document production system include: 85b1

85b1a . A small number of CRT editing stations able to display at least a full, single spaced, typewritten page 85b1a

85b1b . A larger number of CRT stations able to display about
20 full lines of text, each line 80 or even 96 characters long 85b1b

85b1c . A still larger number of more modest CRT editing stations able to display about 10 to 12 lines of at least 80 characters each (the same as recommended for the more complex capture stations). 85b1c

85b2 There is no problem foreseen in selecting and implementing a suitable set of text editing commands for any of the CRT

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stations. Numerous CRT text editing systems have been implemented at the Institute over a period of more than 12 years. The sets of commands for editing that are required, most useful, or convenient have been well established through literally hundreds of man-years of user experience and feedback. In addition, the ARC system has considerable experience with the power-ful split-screen techniques, and the MAE system has explored capabilities needed for full page format editing. 85b2

85b3 Perhaps more critical than the command repertoire are the editing system features that support a high quality of man-machine interaction and feedback to the operator, for both casual and full-time users. This has historically been the strongest feature of the ARC systems, and has been brought to a high level of perfection in current NLS and the MAE implementations. 85b3

85b4 All but the simplest capture stations can serve also as editing stations with the approaches to editing described here. There is thus a natural progression from OCR capture, to an electronic capture keyboard with limited display, to a CRT terminal that can serve both for capture and editing, to two additional types of more powerful CRT editing stations. The software and hardware needed to support this hierarchy of terminal types is also hierarchical and upward compatible. Much of the development is shared and the full range of needed capabilities is provided. 85b4

85b5 The recommended approach to editing thus supports, and is integrated with, the recommended approach to text capture, as it should. All necessary design and implementation experience is present for both technical and human factors considerations. 85b5

86 D. Text Formatting and Composition 86

86a The text editing systems at SRI have for several years included capabilities for text formatting. These have in some cases been relatively complex. Generally, however, they have only addressed a limited range of formatting requirements. 86a

86b According to current SRI manuals of style, the following formatting capabilities must be implemented to support the needs of document production: 86b

86b1 . Hierarchically ranked headings to at least five levels, including document title at the highest level, section

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headings at the next, and at least three levels of sub-section headings. Explicit identification and hierarchical ranking is needed to allow appropriate formatting and to support automatic generation of tables of contents. 86b1

86b2 . Additional categories of headings to be used with appendices, abstracts, bibliographies, and so forth. 86b2

86c . Paragraphs of main body text.
. Underlined text not occurring in headings or other explicitly delimited structural components. 86c

86c1 . Provisions for italics, bold face, and other alternative
typographic representations not occurring in headings or other explicitly delimited structural components. 86c1

86d . At least limited provisions for expanded character sets. 86d

86d1 . Illustration captions with sizing information and illustration identification codes. Explicitly delimited illustration descriptor information supports caption composition, document formatting with spaces left for illustrations, correct merging of illustrations with text masters, and automatic makeup of lists of illustrations. 86d1

86d2 . Table captions, with sizing information and identification for separately prepared tables. Explicit delimitation
supports automatic makeup of lists of tables, etc. 86d2

86d3 . Footnotes with automatic formatting on a page and automatic assignment of footnote reference symbols. 86d3

86e . Bibliographic citations occurring in text. 86e

86f . Blocked and indented material such as quotations. 86f

86f1 . Listed material in both numbered and unnumbered form with at least two hierarchical levels each. 86f1

86f2 . Tabulations. These are simple unruled tables generally having no more than two columns and/or no more than six rows. 86f2

86g . Tables. 86g

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87 This is a basic list. It can be expanded and enhanced to accommodate special cases and/or give additional power and flexibility in formatting. 87

87a None of the formatting and composition programs used with existing SRI computer text processing systems can satisfy all of these requirements. Composition programs supplied with phototypesetters have been found to require text structures that are not desirable in the SRI context. The best approach appears to be to begin from scratch with a comprehensive design for a computer composition program. A design that satisfies most requirements has already been prepared as a part of SRI Project ESC 8196 for a commercial client, and can serve as the basis for this design. 87a

87b Hyphenation represents a special case. For some documents a ragged right format without hyphenation is satisfactory. This report is an example. There will still exist, however, requirements for hyphenated text in both ragged right and fully right and left justified formats. A complete specification for a hyphenation algorithm has been obtained from Bell Laboratories that appears to be ideally suited to SRI appli-cations. It produces an acceptable level of hyphenation and hyphenation accuracy--although it does not find all possible hyphenation points, it makes few errors. It is simple to encode as a computer program, oper-ates with very small computers, and can be readily tailored to meet the needs of specialized vocabularies such as for chemistry. 87b

87c Implementation of suitable composition and formatting software is thus not considered a problem, but original development work will be required. 87c

87d Hard copy output devices to be supported by any such composition and formatting software should include: automatic typewriter; line printers, such as the IBM 1403 now available with the Institute's CDC 6400 computer, as well as dedicated line printers with more modest capabilities; a phototypesetter; and perhaps such devices as the newly available Xerox 1200 copier that can produce hard copy directly from magnetic tape or even on-line to a computer. 87d

87e Selection of an appropriate phototypesetter device represents no difficulty. As currently understood by Report Services there appear to be a number of these devices suitable to Institute requirements and costing about $20,000 or less. Two are needed to handle peak workloads, and are recommended for redundant backup.

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One alternative is to obtain two identical machines. Another, with about the same total cost, involves one simple machine adequate for normal production and one more powerful machine to satisfy specialized requirements. There are good arguments for both alternatives and no choice should be made without further, more detailed, investigations. 87e

87f The Xerox 1200 copier possesses a number of very attractive features. Driven by magnetic tape, it can produce multiple copies of multipage documents. The documents are produced one at a time in page sequence, so there is no separate collation step. This appears to be expecially well suited for small production runs, and for cases where a small number of additional copies are needed after the main press run. The full set of features needed for SRI document production are not found on currently available devices, but have been announced. This device has sufficient important applications within the Institute that its progress should be carefully monitored and budget tentatively allocated for this or a similar machine at some future date--late 1975 or early 1976 when the needed features will become available and can be evaluated. 87f

88 E. Control and Security 88

88a This is a most critical area. Any design advanced must be sufficiently comprehensive to address all foreseen problems, and wouldbe beyond the scope of this already long discussion. Several key items are identified. 88a

88b Problems of control of multiple copies of multiple versions of a document have already been described. A computer system does not create this problem, but because it becomes easier to produce more versions of a given document during production, the computer system makes the problem even more important to address. The computer can simplify the problem by rigidly enforcing automated assignment of version numbers and allowing immediate access to the latest version or version number. The problem of multiple copies of a version remains. One solution is to print all hard copy (except, of course, the final master) on paper having a colored designation of "Master." Any Xerox copies will not reproduce the master designation in color, so the master copy can always be easily identified. There are, of course, a number of special cases that can arise and that must be addressed in the text system design. For example, multiple computer-produced copies of the same version, not all of which c an carry the master designation, or output to a phototypesetter which cannot have the colored designation on the photographic paper or film. There are thus ways in which the computer text system can contribute to the solution

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of this problem, but there is no way the computer can act to fully solve the problem as long as there are office copiers and people who fail to take note of latest version numbers. In the long run, strict adherance to a well designed set of manual control procedures is necessary. 88b

88c A second critical problem is security of computer-held text against innocent as well as malicious unauthorized access and modification or destruction. The most sophisticated computer implementations can go only part way towards solution of such problems. An accompanying set of rigidly enforced manual procedures are also necessary. This problem impacts many other parts of the system design, and results in some cases in additional effort on the part of users to achieve security. 88c

88d For example, each editing terminal and terminal cluster is configured with archiving media devices such as magnetic tape cartridges or removable floppy disks. This allows a user to bring his text to the terminal for editing, act upon it, and take a copy of the text with him when he leaves. At the very least, this gives a backup copy of the computer held text. It also allows the user to delete all copies of the text from the computer so that no one else can gain unauthorized access. Likewise, the recommended initial system configuration calls for the OCR scanner(s) to be attended by a trained operator at a central location to protect against innocent misuse. 88d

88e There are a large number of additional control and security problems. Some deal with physical access protection, some with logical access and ownership, and some simply with mechanisms for insuring backup of text--both in terms of redundant copies on secure media and in terms of archived historical versions of a document that can be reverted to during production. The examples given have been key and representative. It will be absolutely necessary to rely heavily on the experience of users within SRI, particularly in ARC, who have had to deal with these problems in multi-user systems in the past. 88e

88f It is expected that original development efforts required will be largely concerned with designing suitable manual controls and procedures to support and supplement computer controls. 88f

Second Version of the Editorial Processing Center Proposal

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1a Norman R. Nielsen, Thomas L. Humphrey, Robert Louis Belleville, Elizabeth K. Michael, Richard W. Watson, James C. Norton, Robert N. Lieberman, Pat Whiting O'Keefe, Douglas C. Engelbart, Dirk H. Van Nouhuys, Delorse M. Brooks, Kathey L. Mabrey,

1b Martin E. Hardy, J. D. Hopper, Charles H. Irby, Harvey G. Lehtman, James C. Norton, Jeffrey C. Peters, Dirk H. Van Nouhuys, Kenneth E. (Ken) Victor, Richard W. Watson, Don I. Andrews, Delorse M. Brooks, Elizabeth F. Finney, Beverly Boli, Joseph L. Ehardt, James H. Bair, Robert N. Lieberman, Pat Whiting O'Keefe, James H. Bair, Robert Louis Belleville, Ann Weinberg, Thomas L. Humphrey, Jeanne M. Leavitt, Kirk E. Kelley, Duane L. Stone, Elizabeth J. Feinler, N. Dean Meyer, Dirk H. Van Nouhuys, Douglas C. Engelbart, James C. Norton, Richard W. Watson, Charles H. Irby, James H. Bair, David R. Brown, Glenn A. Sherwood, N. Dean Meyer, Kathey L. Mabrey

1c Buddie J. Pine, Andy Poggio, David L. Retz, Laura J. Metzger, Karolyn J. Martin, Jan A. Cornish, Larry L. Garlick, Priscilla A. Wold, Pamela K. Allen, Delorse M. Brooks, Beverly Boli, Rita Hysmith, Log Augmentation, Joseph L. Ehardt, Raymond R. Panko, Susan Gail Roetter, Robert Louis Belleville, Rene C. Ochoa, Ann Weinberg, Joan Hamilton, Adrian C. McGinnis, Robert S. Ratner, David S. Maynard, Robert N. Lieberman, Sandy L. Johnson, James H. Bair, Jeanne M. Leavitt, Rodney A. Bondurant, Jeanne M. Beck, Marcia L. Keeney, Elizabeth K. Michael, Jonathan B. Postel, Elizabeth J. Feinler, Kirk E. Kelley, N. Dean Meyer, James E. (Jim) White, Douglas C. Engelbart access



# Format Sample Session

Augmentation Research Center

18 JUL 75

Stanford Research Institute
333 Ravenswood Avenue
Menlo Park, California 94025

&SRI-ARC 18-JUL-75 13:10 25924
ARC 25924 Rev. 18 JUL 75

## INTRODUCTION

This "Format Sample Session" shows you how to use an online subsystem called Format to impose a standard layout on an NLS file when it is printed. Since the Format subsystem is not available automatically, this sample session also shows you how call it through the Programs subsystem.

You will find it useful to be at a typewriter terminal, typing in the commands and text as the sample session describes them.

This document describes specific functions and notes at each step generalize the operation. It includes the actual printout of an formatted document. Using this scenario as a model, the inexperienced user should be able to perform any of the operations described here and refer to Help and other documentation for related information about formatting.

The Format session here shows how you can put a file in one of several specific layouts available. Beyond the standard formats, the NLS Output Processor use hundreds of directives to controll exactly the appearance of printed files. The Format Subsystem inserts the right directives for each format. Hand modification of the format requries special training.

This scenario will format the file created in the "Editing Sample Session II". It includes actually printing out the file. However, you may format any file you choose.

Throughout this sample session, we spell out the sequence of keys you strike to make something happen and separately show what will appear at your terminal in response. Keys that do not print are named inside angle brackets. <SP> represents a space. The control key <CTRL> is used like the shift key.

When you see <CR>, use the return or carriage return on your keyboard.

If you get stuck or confused, typing "?" will show you the next possible alternatives.

> You then type in one of the alternatives and continue your command.

Typing <CTRL-Q> will provide you with information and explanations about the Format Subsystem.

> Typing <CTRL-X> will put you where you were before you typed <CTRL-Q>.

&SRI-ARC 18-JUL-75 13:10 25924
ARC 25924 Rev. 18 JUL 75

For more about getting information via <CTRL-Q> see the "Preface to NLS Tools" and "Help Services Sample Session."Text[Section]="Instruction";

&SRI-ARC 18-JUL-75 13:10 25924
ARC 25924 Rev. 18 JUL 75

INSTRUCTION

1. Access to the Format subsystem is through the Programs subsystem.

.................................................................
You type: ep<CR>lpformat<CR>gf<CR>

You see:

BASE C: Execute (subsystem) C: programs OK:

PROG C: Load C: Program T/[A]: format

Loading User Program

Don't Execute via RUN PROGRAM Command

Use GOTO SUBSYSTEM Command

Loading User Program

Subsystem FORMAT Now Available (Attached)

BASE C: Goto (subsystem) C: Format OK:

FORM C:
.................................................................

2. The Jump Commands are avaialbe in all subsystems so you can now go to your file that contjans a report on editing. The file should be updated.

.................................................................
You type: jl<CR>Editing,<CR>
You see:

FORM C: Jump (to) C: Link T/[A]: Editing,
<DIRECTORYNAME, EDITING.NLS;1,>
.................................................................

3. Format's Insert Format command does the job of adding directives that control printing. After the command words, you type <CR> to show you want to format the file you have loaded. Typing "y" next will show you a list of formats available. You choose a format by typing in its number. The system wil then question you for certain information to put on the title page.

```
......................................................................

   You type: if<CR>y1<CR>Editing Report<CR>JCU<CR><CR>
   You see:

   FORM C: Insert C: Format (in file at) A: (Using Format #)

      List formats?

      0:  title page only
      1:  simple printer format
      2:  journal format
      3:  8 pt News Gothic, level one titles
      4:  9 pt Times Roman, level one titles
      5:  10 pt News Gothic, level one titles
      6:  8 pt News Gothic, lev 1 titles, lev 2 subtitles, right
      stmnt nums
      7:  9 pt Times Roman, lev 1 titles, lev 2 subtitles, right
      stmnt nums
      8:  8 pt News Gothic, level 1 titles, 2 columns; you will
      have to hand
         format to balance columns at end of each branch
      9:  9 pt Times Roman, level 1 titles, 2 columns; you will
      have to hand
         format to balance columns at end of each branch
      10: 9 pt Times Roman, indented paragraphs, no statement
      numbers
      11: ARC userguides format

      .........Format # T/[A]: 1

      (Title:) T/[A]: Editing Report

      (Author Ident(s):) T/[A]: JCU

      (Journal Number:) T/[A]: <CR>

      (Formatting File)
      ..................................................................
```

How to respond to the prompts:

A: You can format a file you have not loaded; if you had typed in the name of another file at the first prompt A:, it would have formatted that other file.

List: You need not see the list of formats every time you use the command. If you type "n" for "no" instead of "y" for yes at that step, it will go on to ask you for the format number you want. For more information about the formats, use the Help command or read the Augmentation Research Centert's document entitled "The Format Library".

Author: If the author has an IDENT (we used the hypothetical IDENT JCU) the system will gather her name and address and add them properly to the title page. If the author is unknown to the Ident system, you may type in his name and address. To use carriage returns to end lines in the name and address, you must preceded them with <CTRL-V> which prevents them from interrupting your command.

Number: The Augmentation Research Center maintains a numbered and automatically cataloged online collection of documents called the Journal. The simple format chosen in this sample session does not require a journal number. For the process of getting a journal use number, ask for "preassigned number" with the Help command. If you do not have such a number, you may hit <CR> and go on in any format. The place usually occupied by the number in the layout will then be blank.

4. you must leave the Format Subsystem to see what you have done:

..............................................................
You type: qtb<CR>
You see:

FORM C: Quit OK/C: To C: Base OK:
BASE C:

5. You may see many of the directives which Format inserted by printing statement 0.

.................................................................
You type: ps0<CR><CR>

You see:

```
BASE C: Print C: Statement (at) 0 V:
<DIRECTORYNAME,EDITING,NLS;1> DATE TIME IDENT
;;;;LM=-3;.SN=0;.RM=72; .BRM=68; .SNF=72; .SNFShow=<=3;
.YBS=1,6p; .YBL=0,2p; .F="page .GPN;";.H1="Editing Report";
.PN=0; .PES; .FP=FR;. .PxPShow=1; .PxFShow=1,2; .PxFYD=1;
.PxFYS=2; .PxFYU=2;
```

.................................................................

The expressions bounded by . on one side and ; on the other are directives.RM=72, for example, sets the right margin to 72 characters. To learn more about them, see the Output Processor Users' Guide or type "directives" in the Help command. If you use a different format, the directives that appear in statement 0 will be a little different, of course.

6. Printing arrangements vary according to what printer or terminal you are using and may effect details of page width and length. You can see a close approximation of what your printed page will look like by using the Output Terminal Command. Output Terminal uses dashes (-----------) to indicate page breaks.

.................................................................
You type: ot<CR>yny
You will see the following which includes the actual formatted pages:

BASE C: Output (to) C: Terminal OK/C: OK:

(Send Form Feeds?) Y/N:

(Wait at page break?) Y/N:

(Go?) Y/N:

Processing Output

--------- . 3

Insert: This command allows you to add, duplicate, or create information in a file. The command Insert Statement was presented in the "Editing Sample Session I." This sample scenario adds Insert Word and Character. 3a

Replace: This command allows you to erase a string or structure at a specified destination and put in some other content. 3b

Delete: Delete erases something which you specify, such as a character or statement, from the destination you specify. This command was introduced in the "Editing Sample Session I." 3c

Copy: The Copy command is used to reproduce a source (such as string or structure) at a specified place. 3d

Substitute: The command Substitute allows you to put a new string in the place of an old string everywhere it appears in the structure you specify. Substitute is the most common editing command used on the typewriter terminal. 3e

Move: This command is being introduced in this sample scenario. Move transfers a specified source (such as string or structure) to a destination you specify. 3f

Transpose: Transpose allows you to make strings or structures change places. 3g

--------- 3g1

# Editing Report

Jonathan C. User

18 JUL 75

Gull Flight Research Center

Aerodynamic Research Institute
333 Sandy Avenue
Seaside, California 94025

---------

.................................................................................... 5

Note that the title page is always last in a formatted file.

7. NLS files cannot be sent directly to printing media. You may creat a formatted text file with the Output Printer File Command. You can save this text file and later send it to a printer that understands ASCII code.

.................................................................
You type: opfediting.print;<CR>
You see:

BASE C: Output (to) C: Printer OK/C: File T/[A]:
editing.print;
Processing Output

BASE: C
.................................................................

Now you have a file named Editing.print;1 for future printing purposes.

8. All the changes you made in the file since the last time you used the Update command can be removed with the Delete Modifications command. If you updated just before inserting format, you can remove the directives and the Title Page now by deleting modifications.

.................................................................
You type:dm<CR><CR>
you see:

BASE C: Delete C: Modifications OK: (really?) OK:
BASE C:
.................................................................

## SAMPLE SESSION SUMMARY

6

To enter the Format subsystem:

Goto Programs, Load Format, Goto Format

Commands in Format:

Insert Format adds directives and a title page so that a file can be printed in one of a list of formats. The list changes as ARC adds new formats.

Another command, Delete Directives, will remove all the directives from a file. You could have use it instead of Delete Modifications above to create a file without directives for easey online reading or you can use it to remove old directives from a file and start fresh with a new format. Note that Delete Directives will not remove the content of the new title page branch created by Insert Format.

After you have formatted the file:

To see a formatted printout ...within the capbailities of your terminal...use the Output Terminal command. With the Output Printer File command you may file away your formatted document in a format ready to go to most printers.

To remove the format:

As an alternative to the Delete Directives command you may use the Base command Delete Modifications which removes all changes made since the last time you used the Base Update command.

For assistance when using Format:

Use <CTRL-G> or the Help command. (See the "Help Services Sample Session".)

(J25924) 18-JUL-75 13:10;;;; Title: Author(s): Stanford Research Institute /&SRI-ARC; Distribution: /DMB( [ ACTION ] dirt and dpcs notebooks please) BEV( [ ACTION ] I think this guy is ready to printbut let's not wait for that, OK?) SRI-ARC( [ INFO-ONLY ] ) DPCS( [ INFO-ONLY ] ) DIRT( [ INFO-ONLY ] ) ; Sub-Collections: NIC SRI-ARC DPCS DIRT; Clerk: DVN; Origin: < VANNOUHUYS, FORMATSS.;5, >, 18-JUL-75 13:02 DVN ;;;; ####;

1 25924 Distribution

1a Rita Hysmith, Pamela K. Allen, Delorse M. Brooks, Elizabeth F. Finney, Beverly Boli, Lawrence A. Crain, Kirk Sattley, Susan Gail Roetter, Robert N. Lieberman, Ann Weinberg, Kenneth E. (Ken) Victor, Douglas C. Engelbart, James H. Bair, Elizabeth K. Michael, Richard W. Watson, Elizabeth J. Feinler, Harvey G. Lehtman, Kirk E. Kelley, Laura E. Gould, Jeanne M. Beck, Dirk H. Van Nouhuys, James C. Norton,

1b James E. (Jim) White, Douglas C. Engelbart, Martin E. Hardy, J. D. Hopper, Charles H. Irby, Harvey G. Lehtman, James C. Norton, Jeffrey C. Peters, Dirk H. Van Nouhuys, Kenneth E. (Ken) Victor, Richard W. Watson, Don I. Andrews, Delorse M. Brooks, Elizabeth F. Finney, Beverly Boli, Joseph L. Ehardt, James H. Bair, Robert N. Lieberman, Pat Whiting O'Keefe, James H. Bair, Robert Louis Belleville, Ann Weinberg, Thomas L. Humphrey, Jeanne M. Leavitt, Kirk E. Kelley, Duane L. Stone, Elizabeth J. Feinler, N. Dean Meyer, Dirk H. Van Nouhuys, Douglas C. Engelbart, James C. Norton, Richard W. Watson, Charles H. Irby, Jonathan B. Postel, Priscilla A. Wold

1c Delorse M. Brooks, Beverly Boli, Buddie J. Pine, Andy Poggio, David L. Retz, Laura J. Metzger, Karolyn J. Martin, Jan A. Cornish, Larry L. Garlick, Priscilla A. Wold, Pamela K. Allen, Delorse M. Brooks, Beverly Boli, Rita Hysmith, Log Augmentation, Joseph L. Ehardt, Raymond R. Panko, Susan Gail Roetter, Robert Louis Belleville, Rene C. Ochoa, Ann Weinberg, Joan Hamilton, Adrian C. McGinnis, Robert S. Ratner, David S. Maynard, Robert N. Lieberman, Sandy L. Johnson, James H. Bair, Jeanne M. Leavitt, Rodney A. Bondurant, Jeanne M. Beck, Marcia L. Keeney, Elizabeth K. Michael, Jonathan B. Postel, Elizabeth J. Feinler, Kirk E. Kelley, N. Dean Meyer

ARC 25925

# Format Sample Session

SRI-ARC

9 SEP 75

Augmentation Research Center

STANFORD RESEARCH INSTITUTE
MENLO PARK, CALIFORNIA 94025

INTRODUCTION

This "Format Sample Session" shows you how to use an online subsystem called Format to impose a standard layout on an NLS file when it is printed. Since the Format subsystem is not available automatically, this sample session also shows you how call it through the Programs subsystem.

This document describes specific functions and notes at each step generalize the operation. Its pages include the actual formatted file as it would appear on a terminal. Using this scenario as a model, the inexperienced user should be able to perform any of the operations described here and refer to Help and other documentation for related information about formatting.

The Format session here shows how you can put a file in one of several specific layouts available. Beyond the standard formats, the NLS Output Processor uses hundreds of directives to control exactly the appearance of printed files. The Format subsystem inserts the right directives for each format. Hand modification of the format requires special training.

This scenario will format the file created in the "Editing Sample Session II". It includes actually printing out the file. However, you may format any file you choose.

Throughout this sample session, we spell out the sequence of keys you strike to make something happen and separately show what will appear at your terminal in response. Keys that do not print are named inside angle brackets. <SP> represents a space. The control key <CTRL> is used like the shift key.

When you see <CR>, use the return or carriage return on your keyboard.

If you get stuck or confused, typing "?" will show you the next possible alternatives.

You then type in one of the alternatives and continue your command.

Typing <CTRL-Q> will provide you with information and explanations about the Format Subsystem.

Typing <CTRL-X> will put you where you were before you typed <CTRL-Q>.

For more about getting information via <CTRL-Q> see the "Preface to NLS Tools" and "Help Services Sample Session."

INSTRUCTION

1. The format shown in this sample session centers all text at the highest level for the purpose, for example, of centering the headings of chapters. The file (editing,) you created in Editing Sample Session II is all at the highest level. Let us begin by inserting a heading and moving the remaining statements below it. After you have loaded the file:

..........................................................................

```
You type:  is<CR><CR>EDITING REPORT<CR>
           mg2<CR>9<CR>1<CR>d<CR>

You see:

   BASE C: Insert C: Statement (to follow) A: L:
   T/[A]: EDITING REPORT

   BASE C: Move C: Group (from) A: 2
   (through) A:9
   (to follow) A: 1
   L: d
```

..........................................................................

Before working with the format subsystem, it is useful to Update your file if you plan to remove the formatting directives after you make your printout. Update your file now.

2. Access to the Format subsystem is through the Programs subsystem.

```
..................................................................
You type:  eplpformat<CR>gf<CR>

You see:

   BASE C: Execute (command in) C: Programs

   PROG C: Load C: Program T/[A]: format

   Loading User Program

   Don't Execute via RUN PROGRAM Command

   Use GOTO SUBSYSTEM Command

   Loading User Program

   Subsystem FORMAT Now Available (Attached)

   BASE C: Goto (subsystem) C: Format OK:

   FORM C:
..................................................................
```

3, Format's Insert Format command does the job of adding directives that control printing. After the command words, you type <CR> to show you want to format the file you have loaded. Typing "y" next will show you a list of formats available. You choose a format by typing in its number. The system will then question you for certain information to put on the title page.

...................................................................

You type: if<CR>y1<CR>Editing Report<CR>HQU<CR><CR>

You see:

FORM C: Insert C: Format (in file at) A: (using Format #)

List formats?

0: title page only
1: simple printer format
2: journal format
3: 8 pt News Gothic, level one titles
4: 9 pt Times Roman, level one titles
5: 10 pt News Gothic, level one titles
6: 8 pt News Gothic, lev 1 titles, lev 2 subtitles, right stmnt nums
7: 9 pt Times Roman, lev 1 titles, lev 2 subtitles, right stmnt nums
8: 8 pt News Gothic, level 1 titles, 2 columns; you will have to hand format to balance columns at end of each branch
9: 9 pt Times Roman, level 1 titles, 2 columns; you will have to hand format to balance columns at end of each branch
10: 9 pt Times Roman, indented paragraphs, no statement numbers
11: ARC userguides format

.........Format # T/[A]: 1

(Title:) T/[A]: Editing Report

(Author Ident(s):) T/[A]: HQU

(Journal Number:) T/[A]: <CR>

(Formatting File)

...................................................................

How to respond to the prompts:

A: You can format a file you have not loaded; if you had typed in the name of another file at the first prompt A:, it would have formatted that other file.

List: You need not see the list of formats every time you use the command. If you type "n" for "no" instead of "y" for yes at that step, it will go on to ask you for the format number you want. For more information about the formats, use the Help command or read the Augmentation Research Center's document entitled "The Format Library".

Author: If the author has an IDENT (we used the hypothetical IDENT HQU) the system will gather her name and address and add them properly to the title page. If the author is unknown to the Ident system, you may type in his name and address. To use carriage returns to end lines in the name and address, you must precede them with <CTRL-V> which prevents them from interrupting your command.

Number: The Augmentation Research Center maintains a numbered and automatically cataloged online collection of documents called the Journal. The simple format chosen in this sample session does not require a journal number. For the process of getting a journal use number, ask for "preassigned number" with the Help command. If you do not have such a number, you may hit <CR> and go on in any format. The place usually occupied by the journal number in the layout will then be blank.

4. You must leave the Format subsystem to see what you have done:

..............................................................

You type: qtb<CR>

You see:

FORM C: Quit OK/C: To C: Base OK:
BASE C:

..............................................................

5. You may see many of the directives which Format inserted by printing statement 0.

...............................................................
You type: ps0<CR><CR>

You see:

```
BASE C: Print C: Statement (at) 0 V:
<DIRECTORYNAME,EDITING,NLS;#> DATE TIME IDENT
;;;;LM=-3;.SN=0;.RM=72; .BRM=68; .SNF=72; .SNFShow=<=3;
.YBS=1,6p; .YBL=0,2p; .F="page .GPN;";.H1="Editing Report";
.PN=0; .PES; .FP=FR;. .PxPShow=1; .PxFShow=1,2; .PxFYD=1;
.PxFYS=2; .PxFYU=2;
```

...............................................................

The expressions bounded by . on one side and ; on the other are directives. RM=72, for example, sets the right margin to 72 characters. To learn more about them, see the Output Processor Users' Guide or type "directives" in the Help command. If you use a different format, the directives that appear in statement 0 will be a little different, of course.

6. Printing arrangements vary according to what printer or terminal you are using and may effect details of page width and length. On certain, high-resolution display terminals a page may be displayed as it would be printed. On a teletype-like terminal you can see a close approximation of what your printed page will look like by using the Output Terminal Command. Output Terminal uses dashes (----------) to indicate page breaks.

...............................................................
You type: ot<CR>yny

You will see the following which includes the actual formatted pages:

```
BASE C: Output (to) C: Terminal OK/C: OK:

(Send Form Feeds?) Y/N:

(Wait at page break?) Y/N:

(Go?) Y/N:

Processing Output
```

Editing Report

---------

< DIRECTORYNAME,EDITING,NLS;# > DATE TIME IDENT ;;;;

# EDITING REPORT

1

This report defines some of the editing commandwords presented in the Editing Sample Sessions I and II."

1a

Insert: This command allows you to add, duplicate, or create information in a file. The command Insert Statement was presented in the "Editing Sample Session I." This sample scenario adds Insert Word and Character."

1b

Replace: This command allows you to erase a string or structure at a specified destination and put in some other content.;"

1c

Delete: Delete erases something which you specify, such as a character or statement, from the destination you specify. This command was introduced in the "Editing Sample Session I."

1d

Copy: The Copy command is used to reproduce a source (such as string or structure) at a specified place.

1e

Substitute: The command Substitute allows you to put a new string in the place of an old string everywhere it appears in the structure you specify. Substitute is the most common editing command used on the typewriter terminal.

1f

Move: This command is being introduced in this sample scenario. Move transfers a specified source (such as string or structure) to a destination you specify.

1g

Transpose: Transpose allows you to make strings or structures change places. 1h

---------

Editing Report

Hypothetical Q. User

9 SEP 75

Augmentation Research Center

Stanford Research Institute
333 Ravenswood Avenue
Menlo Park, California 94025.

---------

5

Note that the title page is always last in a formatted file.

7. NLS files cannot be sent directly to printing media. You may create a formatted text file with the Output Printer File Command. You can save this text file and later send it to a printer that understands ASCII code.

..............................................................
You type: opfediting.print;<CR>

You see:

BASE C: Output (to) C: Printer OK/C: File T/[A]:
editing.print;
Processing Output

BASE: C:

..............................................................

Now you have a file named Editing.print;1 for future printing purposes.

8. All the changes you made in the file since the last time you used the Update command can be removed with the Delete Modifications command. If you updated just before inserting format, you can remove the directives and the Title Page now by deleting modifications.

..............................................................
You type: dm<CR><CR>

You see:

BASE C: Delete C: Modifications (to file) OK: (really?) OK:
BASE C:

..............................................................

## SAMPLE SESSION SUMMARY



To enter the Format subsystem:

Goto Programs, Load Format, Goto Format

Commands in Format:

Insert Format adds directives and a title page so that a file can be printed in one of a list of formats. The list changes as ARC adds new formats.

Another command, Delete Directives, will remove all the directives from a file. You could have used it instead of Delete Modifications, above, to create a file without directives for easy online reading; or you can use it to remove old directives from a file and start fresh with a new format. Note that Delete Directives will not remove the content of the new title page branch created by Insert Format.

After you have formatted the file:

To see a formatted printout ...within the capabilities of your terminal...use the Output Terminal command. With the Output Printer File command you may file away your formatted document in a format ready to go to most printers.

To remove the format:

As an alternative to the Delete Directives command you may use the Base command Delete Modifications which removes all changes made since the last time you used the Base Update command.

For assistance when using Format:

Use <CTRL-G> or the Help command. (See the "Help Services Sample Session".)

Format Sample Session
Introduction

(J25925) 9-SEP-75 20:26;;;; Title: Author(s): Dirk H. Van Nouhuys, Beverly Boli/DVN BEV; Distribution: /SRI-ARC( [ INFO-ONLY ] ) DIRT( [ INFO-ONLY ] ) ; Sub-Collections: SRI-ARC DIRT; Clerk: BEV; Origin: < ARCDOCUMENTATION, FORMATSS.NLS;3, >, 9-SEP-75 13:27 BEV ;;;; ####;

25925 Distribution

Douglas C. Engelbart, Martin E. Hardy, J. D. Hopper, Charles H. Irby, Harvey G. Lehtman, James C. Norton, Jeffrey C. Peters, Dirk H. Van Nouhuys, Kenneth E. (Ken) Victor, Richard W. Watson, Don I. Andrews, Jonathan B. Postel, Priscilla A. Wold, Rita Hysmith, Pamela K. Allen, Delorse M. Brooks, Elizabeth F. Finney, Beverly Boli, Lawrence A. Crain, Kirk Sattley, Susan Gail Roetter, Robert N. Lieberman, Ann Weinberg, Kenneth E. (Ken) Victor, Douglas C. Engelbart, James H. Bair, Elizabeth K. Michael, Richard W. Watson, Elizabeth J. Feinler, Harvey G. Lehtman, Kirk E. Kelley, Laura E. Gould, Jeanne M. Beck, Dirk H. Van Nouhuys, James C. Norton,

David C. Smith, Mary Ann Kellan, Buddie J. Pine, Andy Poggio, David L. Retz, Laura J. Metzger, Karolyn J. Martin, Jan A. Cornish, Larry L. Garlick, Priscilla A. Wold, Pamela K. Allen, Delorse M. Brooks, Beverly Boli, Rita Hysmith, Log Augmentation, Joseph L. Ehardt, Raymond R. Panko, Susan Gail Roetter, Robert Louis Belleville, Rene C. Ochoa, Ann Weinberg, Adrian C. McGinnis, Robert S. Ratner, David S. Maynard, Robert N. Lieberman, Sandy L. Johnson, James H. Bair, Jeanne M. Leavitt, Rodney A. Bondurant, Jeanne M. Beck, Marcia L. Keeney, Elizabeth K. Michael, Jonathan B. Postel, Elizabeth J. Feinler, Kirk E. Kelley, N. Dean Meyer, James E. (Jim) White

About 75 pages. This is the text that actually went to GE on Friday the 17th. For its status as a draft, see (journal,25930,1m). For hardcopy see Dee Brooks or Dirk van Nouhuys.

DRAFT Proposal For Research
SRI Number ISC 75-218

A Text Processing System For General Electric's Nuclear Engineering Division

Part One--Technical Proposal

Prepared For:

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General Electric Company
117 Curtner Avenue
San Jose, California 95125

Prepared By:

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Dirk H. van Nouhuys
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Richard W. Watson
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Approved:

Douglas C. Engelbart,
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David R. Brown,
Director Information Sciences Laboratory

Bonnar Cox, Executive Director
Information Science And Engineering Division

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## LIST OF ILLUSTRATIONS

# INTRODUCTION

The Augmentation Research Center (ARC) of Stanford Research Institute (SRI) is pleased to submit this proposal in response to GE Inquiry J2M93 for a text processing system to be used by the Nuclear Energy Division (NED). The Augmentation Research Center has been developing for the past twelve years a system to aid management, professional, and clerical staff in their daily work. We call this system oNLine System (NLS). One important application domain has been in the development, production, and control of documentation, formal and informal. Several organizations are presently using NLS for that purpose.

Our own experience and that of our clients has demonstrated that use of NLS at a display workstation with a responsive system increases document production productivity significantly over non-automated techniques. We have measured the productivity of skilled NLS operators versus skilled operators of typewriter oriented editors on various types of editing tasks and found that the use of NLS can increase productivity by as much as a factor of two over that obtained when using other systems. While use of high speed displays is a factor, it is the ability in NLS to use the displays in a two dimensional manner by "pointing" at text to be operated on rather than by addressing it by line number or content that is the major factor, along with the powerful set of NLS editing and viewing operations. The increased productivity clearly results in lower over all costs. Substantial benefits also derive from the ability to produce a document quickly.

NLS editing and formatting capabilities meet most of the GE requirements. The powerful and flexible NLS file system, command language interpreter, and general system structure make it easy to add the additional capabilities desired by GE.

NLS runs on a DEC PDP-10 computer and is available to clients through two facilities operated for SRI by Tymshare Inc. in Cupertino California, and Bolt Beranek and Newman Inc. in Cambridge Mass.. SRI is also operating NLS on client leased or owned PDP-10's.

The prime GE requirement is for a text processing system for internal and external nuclear system documentation. There are needs for support of engineering specifications, proposals, and other reports as well. The large documents to be worked with will in general have been input by OCR or other method. The prime use of the system will be to update, revise, and tailor the existing documents to changes in design, customer needs, and legal requirements, and to produce publication quality Computer Output Microfilm (COM), photocomposer, and hardcopy versions.

The users of the system will be clerical and other specialists in document editing and production. There is a strong requirement for a very responsive powerful system to significantly increase the productivity and effectiveness of these specialists.

Our proposal based on the requirements in the Inquiry and conversation with GE representatives should be considered a "thinkpiece" that indicates our view on how these needs can best be met using SRI developed software. We consider it a thinkpiece because the short time to respond did not allow for detailed design or costing. Many design issues, and choices of hardware require our having further discussions with GE on its needs. In order to provide GE guidance on the estimated cost of our approach we have chosen representative hardware, and utilized our past experience to estimate manpower required.

If the proposed approach and estimated associated cost are attractive to GE, we would like to refine our understanding of GE requirements relative to NLS capabilities further and work jointly with GE in the detailed design of the user interface capabilities for those features not presently fully supportive to GE requirements and make the final hardware selections.

The Inquiry requests a minicomputer based system. Our experience with NLS, the only existing system of the class necessary to meet GE requirements, running on the PDP-10 and our contact with researchers who are building less powerful editors that run on minicomputers show us that GE's functional requirements, desire to support up to 16 high speed display terminals, and requirement for rapid response cannot be met on available minicomputer architecture.

The only minicomputer approach that we believe can adequately meet the above requirements is one based on a distributed multiprocessor architecture. We performed a preliminary design and hardware and manpower development cost estimate for such an approach.

Comparing this approach and costs with very recent information from DEC on their PDP-10 product line plans, we feel that a PDP-10 based system is the most appropriate direction to recommend to GE at this time. This recommendation is discussed in some detail below.

This proposal is organized as follows: The first two sections, System Hardware and Software, are organized to parallel with the structure of the Inquiry. The Business and Development plan to implement changes necessary to make NLS conform to the Inquiry's requirements in all respects follows, The next two sections respond to the Inquiry with respect to Training and System support, Section 6 summarizes the advantages for GE in working with ARC, Section 7 describes the architecture of NLS, Following this section are a description of the Background capabilites of SRI and its Staff and a list of the attachments we have provided to give detailed explanations to various matters discussed briefly in the proposal,

This draft copy does not contain a Business Plan, That part of the proposal is presently undergoing SRI management approval, A final copy containing the business plan, cost estimate, and contractual provisions will follow shortly, The technical proposal in the final copy will differ only in editorial details,

# SYSTEM HARDWARE

## 2.1 INPUT/OUTPUT DEVICES

### 2.1.1 Required

#### 2.1.1.1 Terminals.

NLS is not tied to a specific terminal display device. The current system supports several alphanumeric displays, the Imlac display computer, and most typewriter-like devices. ARC maintains a watchful eye on the rapidly changing display market and has a history of capturing display technology as soon as stability and price performance criteria are reached.

The NLS workstation consists of a pointing device called a mouse, a five fingered keyboard called a keyset, and a keyboard. (See Design Considerations for Knowledge Workshop Terminals, Attachment XIII.) The input devices are connected to the terminal computer through an interface designed by ARC to produce RS-232 asynchronous serial output. Much of the speed and flexibility of the NLS command system depends upon the use of these devices. Moreover, our experience has shown that the units are very easy to learn to use and contribute greatly to the effectiveness of operators.

These input devices are independent of the output display. It is important to point out here that in contrast to most text processing systems, NLS allows use of display terminals in a true two dimensional manner, rather than as simulated typewriters. This allows the operators to point at text to be edited as well as address it in other ways. The screen can also be split into multiple windows for cross file editing. Significant productivity increases result.

Terminal keyboards can be ordered to GE requirements for character set, feel, and layout.

GE requested a full page display and display of a number of non ASCII characters. Displays do exist that can display full pages of text or close approximations thereof and that can have tailored output character sets. However, they are presently quite expensive. There is also the problem of keyboard design and internal character encoding when nonstandard character sets are used. Character set is discussed under Photocomposer. ARC in our own work has been using the more generally available low cost displays that handle 1/3 to 1/2 a page. We have mixed feelings about use of these devices. For many types of editing operations and applications, these devices are completely adequate and in fact offer the advantage of faster screen change than would exist for full page units, because fewer characters need to be retransmitted.

For page layout and certain other operations the small screen size is disadvantageous. Many of these disadvantages are corrected for by use of our page proofing console.

Below we describe briefly the current state of the commercially available display market. Because the capability and cost curve of the market has significant discontinuities, we feel that without further analysis of GE's needs and a chance for GE to experience use of the smaller screen low cost units, it is premature to recommend a specific unit or configuration. We would work with GE to analyze its needs, provide an opportunity for GE to experience working with the lower cost units and then jointly make the most cost effective display configuration selection. Whichever units are ultimately selected, GE should consider the possibility of leasing terminals in this fast changing market. Capabilities available on the market are described below.

At the lowest cost and capability level there are a number of terminals available. We have used four, the Hazeltine 2000, the Delta Data 5000, the Data Media, and the LSI ADM-2. Of these we prefer the Data Media for reliability, cost, and keyboard. The Data Media display (about $2000) provides a relatively clear white on black display of 80x24 ASCII characters with no capacity for the display of special symbols.

The Hewlett-Packard 2640 display provides very clear video display of 80x24 characters. This display can be configured to display special symbols and to contain a full page of text within its local memory that can be scrolled by the terminal itself. The price for the display is about $3700. The most important limitation of the display is the fact that it can only be operated at 2400 baud; however, ARC understands from conversation with Hewlett-Packard that this limitation will be overcome in the very near future.

The Owens-Illinois plasma tube is available from Magnavox for about $10,000. The display has the capacity of 64x32 characters. Programmable character memory provides for the creation of arbitrary sets of special symbols.

The Vadic and Linolex displays (as well as the Imlac display computer) do not have the image quality required for daylong terminal sessions. The Daconics display (Owens-Illinois) is not available as a separate unit.

At costs above $10,000 there are several accessible display technologies; however, the cost involved in these hardware configurations may limit their inclusion in a production system at this time. GE may elect to include one or more of these high performance units in a mix with a number of low cost displays. Display technology is improving with time and the NLS system is flexible enough to include new units without major system impact.

Vector General and Sanders, for example, can provide high quality displays of the full page class, in fact one of SRI's experimental text systems utilizes the Vector General display. The cost of these displays is between $20,000 and $40,000 per unit.

Ramtek has pioneered the use of semiconductor memory in video (raster) displays. While relatively high character density is theoretically possible the overall reliability and image quality of these systems is rather low in comparison to the system cost which ranges well above $10,000 per display. (depending on total number of characters to be displayed.)

Information Displays produces a refreshed display with a character capacity of 74 characters x 52 lines for about $10,000. Although special characters are included they are not the ones specified by the Inquiry.

The great white hope of the display market has been the Owens-Illinois plasma panel which was developed at University of Illinois. The technology provides for the creation of large size, medium resolution, low cost displays; however, Owens-Illinois has not demonstrated a willingness to aggressively market, promote and develop the unit. As a result the Digivue display panel (Used by Daconics) is limited to a 512 by 512 raster and a rather bulky package with no standard interfaces to commercially available computers. With a character set based on a 7x9 dot matrix (the minimum acceptable size for both upper and lower case characters) the unit is limited to a 64 character by 50 line format which leaves only one dot between lines and characters.

In addition to the disappointing character density, the unit is relatively slow, requiring about 20 microseconds to plot a single point. In the case of the 7 by 9 character format 1.26 milliseconds are required to plot the character matrix. This speed limitation imposes a maximum baud rate of 4800. (Magnavox and the Plato system use 2400 baud - that is a 3200 character screen update will require 12.8 seconds) If all that is not discouraging enough, special electronics (that are not readily available) are required to read the state (on or off) of the bits in the panel. As a result the unit is difficult to use for linework with a moving cursor (the cursor effectively erases the screen). The cursor must be constrained to the interline space in text displays which reduces the total line capacity by 6 lines to 44 (1 dot x 50 lines / 9 dots per character = 6 less lines).

2.1.1.2 Medium-speed line printer.

The medium speed line printer required by the Inquiry can be provided by an electrostatic printer/plotter driven by a small PDP-11(about $7000) attached to the PDP-10. There is a possibility that the printer can be attached directly to the terminal line scanner of the PDP-10, which is a PDP-11. Thus eliminating the need for a special printer control PDP-11. The raster printer can produce working draft and proof material as well as essentially finished copy with both tables and special symbols.

Both Versatec and Varian have introduced 200 dot per inch printer/plotters that provide the capacity to print all the special symbols required of the photocomposer. Units up to 22 inches wide can be obtained with print rates from 200 to 800 lines per minute. Impact printers in this performance class do not provide the range of symbols provided by the electrostatic models. Whichever printer is selected, a backup printer (Diablo or Qume) is recommended. The price range for the electrostatic printers is $10,000 to $25,000 depending on size, speed and computer interface. The Varian model 4211a will provide 400 lines per minute on 11 inch wide paper for $10,800 with all special symbols generated by software. The Anderson Jacobson AJ830 containing a Qume print unit can be used for backup. The AJ830 costs $4,000.

2.1.1.3 Read/write tape drive.

DEC can provide the TU 10 tape drive for the PDP-10. It is a 9-track, 800 bpi format that will operate at or above 45 in/sec.

2.1.1.4 Photocomposer

ARC will work with GE to seek out and interface a photocomposer that best suits their needs. In the short time available we have not been able to adequately survey the market carefully enough to recommend a specific unit at this time.

Coding of special characters for output to the photocomposer will be accomplished by the use of a printing escape character whach conditions the use of normal ASCII as special characters until an escape back to the ASCII character set is inserted. Display of special characters will not in general be available on the workstation displays but will be portrayed as ASCII characters bracketed by the escape characters. The proof system, the printer, and the photocomposer (or COM) will portray the special characters directly.

2.1.1.5 Computer output microfilm.

COM output is directly available from the present system. Output from the Output Processor (the formatting program) is written on magnetic tape in a virtual COM format which is processed by the COM. At present, output can be directed in this way to an III Comp80 or a Singer 6000. Arrangements for GE to purchase the software for these two machines can be made if necessary. COM interfaces to other COM machines can be written by ARC for an additional fee which would be negotiated based on the COM machine configuration selected.

2.1.1.6 Bulk input from OCR or other means.

The NLS command, Input Sequential File provides an interface to data obtained from most conventional media including OCR or key-to-tape facilities. By use of consistent conventions for paragraph spacing and indentation during input, the material can be easily placed in the appropriate NLS file hierarchical positions. The Output Sequential File command provides compatability between NLS files and conventional sequential file structures.

2.1.1.7 page layout console.

Online page proof capacity is provided by a Tektronix 4014 display which is capable of 132 characters by 64 lines. The character capacity of the 4014 allows the proofing of documents of greater than 9 point body type, and proofing of layout of smaller type sizes. The page proof system has been in use for several months now and the Tektronix unit has been very satisfactory. The Tektronics 4014 costs $12,000 and the associated hardcopy unit $6,000.

2.2 CENTRAL PROCESSOR

2.2.1 Computer Mainframe

2.2.1.1 The Inquiry specifically requests an in-house minicomputer based configuration. In its present form, NLS is based on the TENEX operating system and a PDP 10.

2.2.1.2 We considered two approaches to meeting GE's requirements, one using a minicomputer based architecture outlined below, and the other using an about to be announced low cost PDP-10 approach. We are recommending the PDP-10 approach for reasons outlined below. First we provide background on the minicomputer approach considered and then provide background on the PDP-10.

2.2.2 Minicomputer Approach

2.2.2.1 A terminal configuration based on a single minicomputer cannot provide acceptable response for 16 interactive high speed display users of a system meeting GE's functional requirements. GE's requirement for system responsiveness and large high speed displays cannot be met by conventional systems that are designed for low speed typewriter terminals, in fact, no manufacturer is offering high speed, multiterminal, display interaction, anything like a minicomputer. Our experience is that, a PDP-10 class machine, on which the current NLS is based, is required to provide the level of responsiveness required by GE for up to 16 users if a single processor is used, and there is also to be a significant background formatting, global substitution, and printing or photocomposing load.

2.2.2.2 In order to meet the need for a responsive, low-cost minicomputer based system, a hierarchical minicomputer configuration was selected that would provide, timely system response coupled with large on-line storage. The system would consist of a central file and background computer and computers within each workstation. The architecture is described in more detail below.

2.2.2.3 Workstation

Each operator would have access to a private display, CPU and disk file system with a local capacity of about 2.5M characters. The terminal computer would provide all the features of the text editor for purposes of file creation and manipulations.

2.2.2.4 Background Processor

A background machine would complete the facility by providing two services to the terminal processors.

File system maintenance and control - Both the magnetic tape and 176M character disk store are connected to the background machine. Files to be manipulated at the terminal processor are copied from and returned to the central file system This organization provides both file security and control by insuring that there are two copies of any file being modified and that the proper access clearance has been obtained before a file is released from the central system for modification.

Background document manipulation and formatting - The execution of document wide text substitutions and the formatting of documents for photocomposer or COM output is also performed in the background machine. This approach frees the interactive terminal processors from the rather time consuming file global activity required for final formatting and subsequent printing. The background processor would also be used to actually drive the printer and the photocomposer.

A simple operator interface console would be provided for the background machine so that the system can communicate with GE operational personnel to:

1) Request and confirm the mounting of physical files. (tapes and disk packs).

2) Control the operation of the printer and photocomposer.

3) Set priority for the execution of global file substitutions and requests for Output Processor service.

2.2.2.5 A configuration such as described above to support 16 terminals and meeting other GE requirements would cost about $450,000, not including display and photocomposer costs. A ten terminal system would cost about $350,000.

2.2.2.6 The development cost to map NLS to this system would be in excess of $500,000, not including the development cost of additional features required by GE, but not presently supported by NLS.

2.2.2.7 As described below it appears that a PDP-10 configuration to meet the same needs will be obtainable for about the same cost and would require no additional development costs if the TENEX operating system was used or only minimal development costs to move NLS to run with the TENEX like operating system to be available from DEC.

2.2.3 PDP-10 Approach

2.2.3.1 NLS presently runs on a PDP-10 using the TENEX operating system(see attachement XIV). NLS is presently running on PDP-10's at four sites and has been running on the PDP-10 for four years. NLS is now a well shaken down system in the PDP-10 environment.

2.2.3.2 The PDP-10 is a 36-bit machine and has full paging and memory protection hardware. The TENEX operating system takes full advantage of this hardware to provide demand paging. The operating system is very solid and provides for a highly reliable file system. The PDP-10 meets or exceeds all GE mainframe requirements. The current situation with regard to the PDP-10 product line is the following.

DEC's current PDP-10 line is built around two CPU's the KI-10 and the KL-10. The KI-10 systems are about twice as fast as the now discontinued KA-10 system. The current KL-10 is 3-5 times faster than the KA-10.

A KI-10 based configuration to meet GE's requirements containing 256K of 36 bit memory, 300 million bytes of storage, tape drive, line printer, and terminal controller lists for about $600,000. Previous experience in negotiating with DEC indicated that this price could probably be reduced.

2.2.3.3 We have just learned that DEC is going to announce a new system to be called the KL 10/20 that with a comparable configuration to that listed above would sell for around $400,000 and operate between the KA-10 and KI-10 in speed. We have learned that the product will not be officially announced until shortly after January 1, 1976. Initial delivery dates are vague although indicators are that initial deliveries will begin after July 1976. The system will be delivered with an operating system derived from the TENEX operating system. The system will also run the TENEX operating system.

2.2.3.4 We would recommend the following strategy for GE.

Wait until shortly after the first of the year until the official KL 10/20 announcement to confirm price and delivery schedule. If price is confirmed, but delivery is later than desired by GE, or some other reason precludes its use, seriously consider using a KI-10 based system for the initial installation,

Another alternative available to GE is to buy initial NLS service from SRI through its Tymshare operated facility until it can take delivery of its own system, This service could be used for either training and exploratory use or for operational, use

2,2,3,5 The considerable advantages to GE of going with a PDP-10 NLS system, besides the powerful capabilities of NLS are:

1) Minimal extra development costs,

2) A thoroughly tested and reliable system,

3) A system, in the form of the KL-10/20 appears to be cost competitive but considerably more powerful than a minicomputer based system, Even a KI-10 based configuration would save expensive development costs,

4) A KI-10 based system could be delivered in a 90-120 day time frame from order date,

5) GE could not only take delivery of NLS, but also the full rich programming support system, If the minicomputer approach were taken, development would have taken place in our powerful PDP-10 NLS Programming workshop and object code would have been produced for the minicomputer, Extra development cost would have been required to move this environment to run stand-alone in the minicomputer,

6) Cost of PDP-10 class machines will continue to decrease,

7) The existence of larger faster PDP-10 family members coupled with the PDP-11 Frontend system described below offer considerable scaling potential,

2,2,3,6 If after having said all the above, GE would still like to consider a minicomputer based architecture for use with NLS, we would be glad to consider it further,

2,2,4 Mass Working Storage

2,2,4,1 Disk storage will be available for any machine configuration selected, For the PDP-10 system three RP 04 drives would provide 300 megabytes of file storage and swapping capacity,

## SOFTWARE

### 3.1 INTRODUCTION

3.1.1 The following paragraphs list and define the text processing functions of NLS following the order of specification in Section 2 of the Inquiry. At the end we list selected features of NLS not directly specified in the Inquiry, but that we believe would bring added value to the NED's documentation work. In most cases NLS instructions are given in the form of the command words with appropriate description of its effect on text. We have not provided examples of all commands as requested in the Inquiry partly because we had a very brief time to prepare this proposal, and partly because of the difficulty of describing in ordinary text the actions of commands that take place dynamically on the two-dimensional NLS display screen. Attachment VII, the NLS-8 Command Summary contains the formal syntax of all NLS-8 commands, organized by subsystem. All the commands discussed in this Section of the proposal are in the Base or Universal Subsystem. Attachment VIII, the NLS-8 Glossary, which is organized alphabetically like a dictionary, contains more detailed descriptions of all NLS concepts and commands and comments on their effect on text.

3.1.2 SRI will provide copies of NLS software and associated compilers to the GE Nuclear Division in the form of source tapes and object tapes. NLS was developed largely under U.S. government sponsorship. SRI desires to maintain usage rights to the software as augmented for GE needs.

3.1.3 Definitions of Terms
Certain terms common in speaking about NLS are used so frequently in this proposal that we define them separately here:

3.1.3.1 Statement:
The basic unit of NLS file structure is a statement. It may include 1-2000 characters and several hundred pages of graphic information. The statement may be thought of as a variable-length record. NLS is not a line-oriented system; commands that act on lines in other systems frequently have analogs in NLS that act on statements. This approach allows greater flexibility and selectivity in operation and addressing, and corresponds more naturally to units of thought. In text processing, statements usually correspond to paragraphs, but they may be used for other entities, e.g., headings, rows in a table, or equations. This paragraph is a statement and the heading above it "Introduction" is another statement.

3.1.3.2 Level:

When they enter the system, either by typing or through some automated input medium, each NLS statement is allocated a level in the NLS file hierarchy, either above, equal to, or below the preceding statement. All NLS files have this hierarchic structure and the structure serves as the basis for commands that aid in viewing, searching, and output formatting. This statement (a paragraph) is on the same level as the one preceding and following, it is a substatement of the Heading, "Definition of Terms"

3.1.3.3 Command Format:
In general NLS commands consist of a verb saying "do this", a following noun that names the object of the action, followed by an address that gives the location of the object, followed by one or more command completion characters. (See Figure 1.) Addresses in NLS can be specified by using the cursor to point at a character, word, text or other entity, or by other means. See Attachment VIII for more detail on addressing. Although other command recognition modes are available, in general an operator types the first character of each noun and verb, the system responds by typing out the rest of the word, the operator then types in the address and command implementation characters. NLS is a full duplex system.

3.1.3.4 "Part of a File":
The Inquiry in several places requires that a formatting function or a command be able to span "part of a file". The meaning of "part of a file" will naturally differ from system to system according to file organization and addressing capabilities. NLS users deal with parts of files in the following ways:

By pointing on the screen or addressing the character at each end of the part:
Most editing commands in NLS (Delete, Copy, etc.) may address in this way any string of consecutive characters in a file without regard to statement boundaries. The Replace command and a few others that would leave statement boundaries ambiguous can only address strings within statements.

By pointing to a hierarchical structure:
In dealing with large parts of files or in using the Replace command it is usually easier to point or address one of several units of hierarchical structure recognized by NLS as addressable entities. (See "structure" in Attachment VIII.) One of these is, for example, a branch which comprises a statement and all its substatements. Another is a group of contiguous statements (paragraphs).

With "Directives":

Directives in the NLS formatting system generally take effect over any consecutive string of characters in the file if that is appropriate to their function.

3.1.3.5 Idents:
A unique string of characters is associated with every operator to identify source of drafts, and the like. It is called an "ident" and is usually the operator's initials. It is attached with the time of change to every statement edited by the operator, and files that are private contain a list of operator-idents that are allowed access to the file. In the version of NLS proposed for the GE Nuclear Engineering Division, an operator logging in to the system will in addition supply a secret string of characters called a password.

3.1.3.6 Directives:
Formatting commands to control the layout of printed documents are embedded in NLS text. They are called directives. Attachment IV lists them alphabetically.

3.2 FUNCTIONAL CATEGORIES

3.2.1 Our response attempts to follow the division of software functions presented in the Inquiry at paragraph 2.2.1

3.3 SYSTEM AND FILE CONTROL

3.3.1 Required

3.3.1.1 System and Subsystem entry and exit. An operator signs on through the timesharing systems Login command, that requires a password, selects subsystems by the NLS Goto Subsystem Command, gains access to files by the Load File, Jump to Link, or other Jump command. One file is returned to storage automatically when another is displayed. Operators may perform any NLS function at any number of terminals simultaneously, excepting output or display functions limited by the requirement for special terminals. Certain system's functions are limited to key personnel.

3.3.1.2 Protect Features. Access to NLS is protected by the login procedure which requires the operator to supply his or her name, non-printing password, and optionally may require account number. File access may be further limited to established groups of named individuals, or to a list of people possessing certain passwords. See the TENEX Userguide (Attachement XI) for details of the user's view of and control over the TENEX file system.

3.3.1.3 Input Control. When typing from an online keyboard, it is possible to backspace-delete a single character by typing a single control character, and to backspace-delete to the previous space by typing another control character. One can also "backspace" screen selections and command words and arguments.

3.3.1.4 Output Control. It is possible to print NLS files on a variety of typewriter like terminals, on a variety of medium speed printers, and to format and print them via a COM device. The software to output to COM may readily be adapted to output to a photocomposer. It is possible to output NLS to normal computer tape devices.

3.3.1.5 File Manipulation. The NLS copy command can copy files or parts of files, and merge one file with another. Create and Delete commands can add and delete entire files. Normally it is possible to view but not alter an NLS file from more than one station. It is possible however for the operator to restrict access of any type. File operations are also possible through the TENEX Executive.

3.3.1.6 File Size. Present NLS files are limited to about 750,000 characters. In the system proposed for GE a higher-level unit called a Document (see paragraph 8.7.10) will encompass and control many NLS files to provide the file size and global functions GE requires.

3.3.1.7 Disk Storage Control. Changing disk packs has been unusual in recent NLS development history so there is no present provision for specifying the number of the disk on which a file is located. Such record keeping can be provided. The TENEX operating system supports removable disk pack hardware, but the operating system does not presently allow the packs to be removed and remounted.

3.3.1.8 Record Keeping. The NLS Show File Status Command displays information about file size, date, time, and the like. The time of the last change to any NLS statement and the ident of the operator that made it are recorded with each NLS statement and may be displayed at the operator's discretion. The present NLS system runs without removable disks, and the disk location of files is not reported. It is straight forward to add a command to display such information. Content is established by the file's name, or by various aids to rapid scanning.

3.4 EDITING PROGRAM

3.4.1 Find. The NLS Jump command operates over any part of a file, the whole contents of a file, and between files. It allows the user to locate a unique string of more than 100 characters, or to locate a specific statement in a file by its place in the hierarchic structure or by an unique acquisition number. It also allows the user to automatically return to a previous location; automatically repeat his previous search; and specify the view to be displayed for the selected location.

3.4.2 Print. The NLS Jump command displays the statement in which a specified string of characters appears. The NLS Content Analyzer function allows display of all statements in a file that contain a given string.

3.4.3 Insert, Delete, Change. Insert, Delete, and Change (called Replace) commands exist in NLS. They may operate over any part of a file or the whole contents of a file. Any amount of material may be changed. The commands also allow for changing by copying already existing material rather than typing in new characters. In some instances when statement boundaries are crossed, modifying text from a given character to some other character requires, more than one command.

3.4.4 Move. The NLS Move command can move a block of text from one point in a file to another or from one file to any point in another file.

3.4.5 Copy. The NLS Copy command copies a whole file or any part of a file. It is possible to use the copied material in more than one place in the new file or in several different files.

3.4.6 It is possible to use the copy command with a culling function to, e.g., copy all the statements that contain a certain string to a new file.

3.4.7 Response/No Response. NLS displays the entire command before the user must decide whether or not it is to be executed. It can then be executed, edited, or aborted. In our demonstration/ discussion with GE representatives they indicated this syntax to be satisfactory, except in the case of global commands, discussed below.

3.4.8 Merge, Imbed. The NLS Move command can append one file to another, or imbed a file or a part of a file in another file.

3.4.9 Global Commands. The NLS Substitute command provides partially for the requirement of a global command to replace one string with another in a file. It currently allows the operator to replace one string of up to about 200 characters with another string of up to about 200 characters in all or part of a file without regard to linebreaks. We anticipate no difficulty in modifying the substitute command to conform to GE's requirements by increasing the buffer that accepts the input string, adding the "respond/no respond" command function, limiting the command to the next "n" occasions of the string, and setting up a method whereby the command could operate over the Document entities discussed in (8.7.10).

3.4.10 Commands for Photocomposition. Commands that control the operation of the lineprinter or COM format are embedded in the NLS file as text. (See Attachment IV, "The Output Processor's User's Guide" for more information on using formatting directives.) They control type size, font, line spacing, columnation layout, etc. The file may be displayed or printed on a line printer with formatting commands executed, ignoring and suppressing photocomposition commands, or with photocomposition commands printed out. Where proportional spacing is invoked output is directed to a virtual printing mechanism; a simple translation program will make the output appropriate for a photocomposer.

3.4.11 Special provisions for tables. The NLS Xtable subsystem partially fulfills NED's requirement for handling tabular material. It allows the operator to insert tabular material free form, to specify the number of columns, the width of columns, and the end of each item entered. It allows insertion or deletion of new items without affecting the rest of the table, transposition of columns and rows, and right and left justification of columns and centering on the decimal. It does not allow half spacing in items or items of more than one line.

3.4.11.1 Note, however, that all these provisions operate only in monospacing environments; when tabular material appears in proportional spacing, the operation of tabs is much more complex. Tabs may be set in proportionally spaced material through NLS Output Processor directives (see "Tabto" in Attachment IV), but there is no automatic carryover from the tables created by the Xtable system. In connection with functional development we would anticipate working closely with GE to specify a fully satisfactory method of handling tabular material.

3.4.12 Interrupt. Long string searches, long printing operations and the like may be interrupted by typing a control character, Control-O. Prior to giving the final okay for a command, input may be changed or the command may be aborted.

3.4.13 Order. The NLS Sort command sorts lists of statements alphabetically. A simple (two-command) program replacement converts the sort to numerical order or any one of a growing number of other sorting criteria.

3.4.14 Table of Contents, list of illustrations, list of tables. Current features of NLS provide for GE's requirements in this area only to a limited degree. For the operator, the file structure and viewing capacities of NLS provide clipped views of files corresponding to a Table of Contents. (For example, views of a file organized into sections, chapters, and paragraph headings, may show all sections, sections with their chapters following, or sections, chapters, and their respective paragraph headings.) The subsystem command Generate (table of contents) creates tables of contents automatically, but it has serious format constraints. If GE is willing to accept the convention that text naming tables and illustrations follow a strict format, it is a small programming task to develop the features as spelled out in the Inquiry. Free-form identification of tables, illustrations, etc. is available at slightly higher development cost.

3.4.15 Rollback for table entry. It is possible to enter tabular items a column at a time through the Xtable subsystem if the items are limited to one line. See 4.4.1.10 above.

3.4.16 Cull. The cull function is performed by the NLS Set Content (pattern) command, which allows the user to print out all sentences containing a specified string of characters. It is also possible to specify ellipsis in the string, all Boolean combinations of two or more strings, and the like. The user may also cause the Move, Copy, Delete, and a variety of other commands to act only on statements containing the selected string(s).

3.4.17 Index. NLS now includes only very limited indexing capabilities. The subsystem command Index creates indices automatically, but the material is indexed by statement number rather than page number and the command will only work on small files. We would look forward to co-operating with GE in specifying a satisfactory method of indexing as part of the function development and anticipate no programing difficulties.

3.5 FORMATTING PROGRAM FOR LINE PRINTING AND KEYBOARD/PRINTER

3.5.1 Required

3.5.1.1 Page length and paper length. In using the NLS Output Processor, the operator may specify the number of lines on a page and the length of the paper page by means of directives embedded in the text. (See Attachment IV: ) The most used directives for this purpose are: "BM"-Bottom margin setting; "YMax"-Maximum vertical distance on a page; "YBL"-Distance between lines in a statement.

3.5.1.2 Margins. Right-hand and left-hand margins may be specified for textual output with the NLS Output Processor directives (Attachment IV: "LM Base"-Left margin base; "LM"-Left margin setting; "RM"-Right margin setting; "BRM"-Body right margin; "BLM"-Body left margin). With the options in the Useroptions subsystem, the operator may set the right-hand or left-hand margin for display or printout at a terminal. In output to COM the operator may set the margins of columns in multi-column formats with the directives "XBC" (Attachment IV: ). With the Insert Edge command the operator may create columns on the screen which will be reproduced one column to a page (like galley proofs) when printing the screen image through a line printer.

3.5.1.3 Fill and justify. NLS text output to COM presently may be justified by inter-word spacing under the control of the directive that sets body position ("BP=J" in Attachment IV) Development work now going on for another project will shortly provide hyphenation.

3.5.1.4 Heads and feet. The NLS Output Processor provides up to four headings with any number of lines and one footer. The location and content of each heading and footer may be specified by the operator. The footer may be any number of lines and may be changed at any point so the function of several footers exists. Additional footers could be provided formally with little development work. (See Attachment IV: header directives beginning on page 27, with "H1"-Text of page Header 1; footer directives beginning on page 21, with "F"-Text of footer.)

3.5.1.5 Page numbering. The NLS Output Processor provides page numbering as described in the Inquiry under the control of embedded directives (Attachment IV: "GPN"-Generate text for page number; "PNType"-Page number type).

3.5.1.6 New Line and new page. The NLS Output Processor provides commands to start new lines and new pages under the control of embedded directives as described in the Inquiry (Attachment IV: "PBL"-Paginate before this line; "PBS"-Paginate before this statement; "PEL"-Paginate at end of this line; "PES"-Paginate at end of this statement).

3.5.1.7 Single and multiple spaces. Commands in NLS control spacing as described in the Inquiry either at a terminal or under the control of directives through the Output Processor (Attachment IV: "YBL"-Distance between lines in a statement; "YBS"-Distance between statements).

3.5.1.8 Space and picture. Directives exist in the NLS Output

Processor to set aside white space for illustrations as described in the Inquiry (Attachment IV: "GYBL"-Generate vertical distance before line; "GYEL"-Generate distance after line; "Photo"-Insert Photo). When these directives are used in conjunction with one other directive (Attachment IV: "Grab"-paginate if can't fit n lines on page), the pagination requirements for handling white space are also met.

3.5.1.9 Indent and undent. Directives exist in the NLS Output Processor to control indentations as described in the Inquiry. (See directives listed under "Margins", above. The margin widths specified in these directives may be altered at any time in the text of a document. In addition, there are directives that control indenting according to the hierarchic level of text units.). Viewspces A and B (Attachment VIII) control indenting on the display.

3.5.1.10 Begin paragraph. Directives exist in the NLS Output Processor to control indenting and line interval between paragraphs as described in the Inquiry (Attachment IV: "IFirst"-Indentation for first level of statement; "Ybs"-Distance between statements [equivalent to paragraphs]). More refined directives may control indenting according to the level of the paragraph in the hierarchic structure.

3.5.1.11 Center. A directive exists in the NLS Output processor to center any number of lines as described in the Inquiry (Attachment IV: "Center"-Center the next n lines).

3.5.1.12 Tabulation. A directive exists in the NLS Output Processor to Tabulate as described in the Inquiry, depending on type size and length of text being entered (Attachment IV: "Tabto"-Tab to given character position). Note, however, the problems of handling proportionally spaced tabs discussed under "Special provisions for tables", above.

3.5.1.13 Backspace for second character. No general provision exists in NLS for backspacing to write a second character in a given character position. The effort required for development depends on the generality of the implementation. Underscore exists in NLS as a character, but not overscore. The real usefulness of underscore depends on the output medium.

3.5.1.14 Literal and ignore. Provisions exists in the NLS Output Processor to print formatting commands ("directives") as described in the Inquiry (Attachment IV: "D"-Print directives switch). The NLS Output processor also allows text segments to be ignored (Attachment

IV: "IGB"-Ignore branch [a statement and all of its substatements]; "IgLS"-Ignore line segment; "IgRest"-Ignore rest of statement; "IgS"-Ignore statement; "IgText"-Ignore text),

3,5,1,15 Stop, A command exists in the TENEX operating system to stop a line printer, A special command in NLS (Control-O) stops the processing of a file, NLS presently has no output to a photocomposer, but the same commands should operate in the same way in that case,

3,5,1,16 Special files for formatting instructions, It is possible to retain printing instructions in special files in NLS as described in the Inquiry, In addition, subsystems exist that can impose a standard set of printing instructions that involve changes in format in the course of printing the file (Attachment V, "The Format Library"), These also allow for the insertion of further formatting by hand,

3,5,1,17 Single and continuous form, Provision exists in the NLS Output to Terminal Command to stop the output at the end of each page or not, This function could easily be added to the instructions for the lineprinter,

3,5,1,18 Revision bar, No revision bar as such now exists in NLS, It could easily be developed, A user program exists that accepts date and time as input and then marks each statement (paragraph) with the word "CHANGED" if it has been changed since that time, In addition, a record of the date of the last change and the user making the change is automatically kept in the file for all statements and may be printed or displayed under the control of Viewspec K (Attachment VIII), The capacity to mark statements with revision bars could easily be added,

3,5,1,19 Automatic paragraph numbering, As discussed under "levels" above, all paragraphs in NLS files occupy numbered positions at all times, Renumbering is automatic and the numbers may be displayed or not at the operator's discretion, The numbering format for display is not according to GE specification, but it could easily be changed, When the document is processed for printing, it is possible to control numbering and numbering format according to level down to twelve levels, Provision exists in the NLS Output Processor for automatic paragraph (statement) numbering as described in the Inquiry and also in several other formats (Attachment IV: "PxNShow"-Plex number level switch; "PxN"-Plex numeral style/level), These directives were used to number the paragraphs of this proposal.

3,5,1,20 Automatic figure and table renumbering, NLS has no provision for automatic renumbering of figures and tables. The feature could be developed without great difficulty. We would want to consider with GE whether the function should be based on marking figures with special invisible characters or by establishing a strict naming convention in the text.

3.5.1.21 Automatic renumbering of references to text in paragraphs. NLS does not automatically renumber references. The feature could be developed without great difficulty.

3.5.2 Optional

3.5.2.1 Running heads. NLS does not provide for automatic creation of running heads. Running footers could easily be added; running heads would require an important change in the Output Processor.

3.5.2.2 Security classification in heads and feet. NLS does not provide for security classification indicators in headers and footers. As above, this could be developed with minimum effort, in the case of footers, with more effort in the case of heads.

3.5.2.3 Tabulation on decimal. An NLS subsystem command allows for the vertical alignment of numbers on the decimal point or on the last digit at the operator's option or on any designated character.

3.5.2.4 Equations. NLS does not have a package for the formatting of mathematical equations, though this capability could be developed, by extending our graphic facility.

3.6 INSTRUCTIONS FOR PHOTOCOMPOSITION

NLS does not presently support output to a photocomposer. However, the Output Processor (Attachment IV) has been designed to output to a virtual device, which allows new output devices to be attached with a simple conversion program. For example when we recently added the Singer 6000 as a COM output device, the only change necessary in the Output Processor programs was the addition of tables listing the size of the Singer's characters. We anticipate no difficulty in adapting the Output Processor commands ("directives") that control lineprinter and COM output to control of a photocomposer. All the remarks below apply to output from NLS to this virtual device with proportional spacing.

3.6.1 Commands to photocomposer. The commands are described in (IV).

3.6.2 Provision for special characters. Provision for special characters for the photocomposer is discussed in connection with the NLS character set (2.1.1.4.2).

3.6.3 Increased line spacing to allow for Overscoring, Superscripts, and Subscripts. Provision for special line spacing may be developed as described in (2.1.1.4.2).

3.6.4 Standard formatting instructions. The NLS Output processor includes all the instructions noted here in the Inquiry in its provision for output to a virtual Output device and no difficulty is anticipated in writing a conversion program for a photocomposer.

3.6.4.1 Commands to fill and Justify are discussed in 3.5.1.3.

3.6.4.2 Commands to Ignore and execute instructions ("directives") are discussed in paragraph 3.5.1.14.

3.6.4.3 The "stop" provision is discussed in paragraph 3.5.1.15.

3.6.4.4 The "ignore" provision is discussed in paragraph 3.5.1.17.

3.6.5 Special instructions. All special instructions described under this heading in the Inquiry exist as directives discussed in 4.5 and explained further in Attachment (IV). No difficulty is anticipated in development to transfer them to a photocomposer.

3.6.5.1 The directives to change type size begin with the word "Size" (see Attachment IV).

3.6.5.2 The directives to change type size begin with the word "Face" (see Attachment IV).

3.6.5.3 Provision for special characters is discussed under 2.1.1.4.2.

3.6.5.4 The directives "Ybl" and "Ybs" (see Attachment IV) control line spacing to within the thousandth of an inch.

3.6.5.5 several directives control page layout, see Attachment IV page 12. They include two- and three-column layout.

3.6.5.6 The directive "WidowL" described in Attachment IV controls widow lines.

Note also that control of widows is restricted to controling the minimum number of lines from a given paragraph that will appear at the top of a succeeding page or column.

3.6.6 Page layout console. NLS provides a page layout console as described in 3.7.1.5. For photocomposer output it would operate exactly as it does for COM.

3.7 SUMMARY OF AREAS POSSIBLY REQUIRING DEVELOPMENT

3.7.1 Required

3.7.1.1 Special Characters: NLS displays now handle only the ASCII character set. This does not include certain special characters, subscripts, superscripts, or overline. NLS Output to COM offers Greek letters and some other special characters requested by GE, but not all and not sub- or super- scripts (see 2.1.1.4.2).

3.7.1.2 File Size: NLS files are now limited to about 750,000 characters. We offer to develop Document entities that combine these files in a manner that will provide the functions GE requires (see 8.7.10).

3.7.1.3 Disk Storage Control: The disk packs used in the TENEX PDP-10 system are physically demountable; however, the system does not support the use of removable disk packs. The tape drive will be used to archive files. The new TENEX based DEC operating system may support removable disk packs, but it has not yet been officially announced. Some operating system changes may be required to support removable disk packs.

3.7.1.4 Global Commands: The present NLS Global change command must be modified to increase the length of the string that can be inserted, to add the respond/no respond command feature, and to operate over the Document entities described above.

3.7.1.5 Full Page Display: NLS provides full-page display on the special-purpose terminal that supports the Page Proof and Graphics system, but not at other workstations. NLS was designed to use a variety of display terminals and we look forward to cooperating with GE in providing the best selection the hardware market allows. Some changes to NLS may be required depending on the display configuration chosen.

3.7.1.6 Photocomposer: A translation program must be written to convert NLS output for COM to output to a photocomposer.

3.7.1.7 Tables: Support to GE specifications for two dimensional tables can be added to NLS. The existing table subsystem can provide the basis for this development.

3.7.1.8 Tables of Contents, Lists of Illustrations, Lists of Tables: Automatic production of these items needs to be developed in NLS.

3.7.1.9 Automatic renumbering of References to paragraphs: A facility for this purpose needs to be built in NLS.

3.7.1.10 Automatic Figure and Table Renumbering: A system for this purpose needs to be built in NLS.

3.7.1.11 Multiple footers: NLS presently allows only one footer. However it may be of any number of lines.

3.7.1.12 Revision bars: Changes need to be made in the NLS CHANGED program to provide revision bars.

3.7.1.13 Printer With Special Symbols: A facility must be added to NLS to format text and special symbols for the recommended electrostatic printer.

3.7.1.14 Editing Facilities for the Page Proof Terminal: No direct editing is possible at the page proof terminal. Because the page proofer is physically associated with the editing workstation, the editor can use the workstation to correct the document page displayed on the page proofer. The Output Processor must then be invoked to recreate the proof display.

3.7.2 Optional

3.7.2.1 Running Head: A provision for running heads would have to be developed.

3.7.2.2 Equations: A way to portray equations in NLS must be developed.

3.7.2.3 Index: An index creation system needs to be built in NLS.

3.7.3 Depending on exactly how GE would like the them to appear to the user, we estimate that 1-2 man years of development would be required to implement the items designated as required.

3.8 OTHER NLS FEATURES WE BELIEVE WOULD BE USEFUL TO NED DOCUMENT PRODUCTION.

3.8.1 View control and easy accessing. NLS incorporates several important features that serve to quickly locate and manipulate large volumes of online information.

3.8.1.1 Split screen. It is possible to divide the display area of an NLS screen into several windows and display contents of the same or separate files in each window. This greatly facilitates cross file editing, and incidentally allows the user to print on the line printer drafts of column width, the width of the display window.

3.8.1.2 Clipping. NLS allows the operator to view only certain levels or lines of a file hierarchy, providing a dynamic table of contents-like view as she searches quickly into the structure of large files.

3.8.1.3 Automatic return to previous location. NLS allows the user to automatically return to her former location in a file, or her location in previous files with the Jump Return and Jump File Return commands.

3.8.1.4 Addressing. NLS addressing is more flexible than that of any other computer-based system used for text processing. It is possible for an operator to address any file to which she is allowed access and that is on a disk available to her. The address may be based on statements numbered by hierarchic position or acquisition number (SID), by relative hierarchic position, by content, by statement names, or by any combination thereof (see Attachment VIII, "NLS-8 Glossary": "position", "Jump", and "contentaddress"). For example, it is possible to go to the second occurrence of the word "data" in the second chapter of the file name "chapter" by the address (chapter, 2 2"data"). This address may be used in a command (e.g. to replace that word). It may also be put in a file as executable text and used in commands for the operator's future convenience (see "links" in Attachement VIII).

3.8.1.5 Command Repetition. By ending a command with a special termination character an operator can cause a command to repeat up to the point where it expects a new address. The command will continue to repeat until the operator leaves the repeat mode. This command greatly facilitates repetitive editing operations where the object text varies and hence is not amenable to global substitutions. Typing a single character at the herald puts the system into a mode whereby it repeats the insert command to facilitate typing in masses of text.

3.8.1.6 Commands branches. It is possible to write down a series of NLS commands and cause the system to execute them, enabling an editor to easily automate many of her functions or perform the same functions over many files.

3.8.1.7 Illustration. The NLS Graphics subsystem allows you to draw and edit simple illustrations, e.g. organization or flow charts, that are part of NLS files. Text and graphics are fully integrated. Users with screens of sufficient resolution may view and edit such drawings and print them through appropriate printers. In the case of half tones and complex line drawings, the user must set aside white space with format directives and strip in the illustrations during printing in the manner normal to photo offset publication.

3.8.1.8 Format. A special subsystem called Format aids the operator in preparing documents for formatted output. It allows the user to delete all directives (formatting commands) from a file, show only those statements containing directives, or automatically format a file in one of several possible formats. (See Attachment V, "Format Library"; a complete description may be read in Format 10.) Formats are added to the library from time to time, requiring a few person-days of programming (depending on complexity).

3.8.1.9 Journal/Sendmail. The NLS Journal is a data base of all items sent through the NLS message system, Sendmail. All Sendmail items--brief messages up to long files--are recorded and may be catalogued and indexed by author, accession number, date/time sent, title, key words, update status, and various other items of bibliographical or document control interest. The Journal has been used to control distribution and updating of NLS user manuals.

3.8.1.10 Help. NLS provides online information about the system and how to use it. Typing a question mark makes the system print out the alternative commands or next steps in commands possible at that point. After typing the command Help, the user may type in any term (e.g., commands, subsystems, concepts) and a description of the term followed by a list of related terms will show on the display screen. The Help command and the data bases it accesses are designed to logically guide the user to relevant information. Another method of accessing this information is through Control-Q. At any point while typing in a command the user may type Control-Q, and a description of that command will be provided. The Glossary, Attachment VIII, was derived by a semi-automatic process from the Help data base, a procedure which was itself an innovative step in computer-based documentation.

3.8.1.11 Automated Editing Commands. NLS includes commands such as the Substitute command in the Modify subsystem which automate various common editing functions. This command corrects the spacing between sentences, and after semi-colons, colons, and commas. Other commands are discussed in connection with the Modify subsystem (Attachment VIII). These commands are added from time to time in the course of NLS development.

3.8.1.12 Userprogramming: The functions provided by NLS for handling text and output can often be easily built into userprograms for special application without extensive training. The Xtable subsystem discussed above (3.4.11) is an example. It was created in about a weeks working time by a non-programmer who had programing experience.

3.8.1.13 DEX (Delayed Execution). A system exists which allows operators to type in files offline at a terminal attached to one of several cassette recording devices for later input in to the computer. The operator has limited editing capabilities when typing in the text. This is an economic method of typing in large volumns of text.

BUSINESS AND DEVELOPMENT PLAN

4.1 This draft of the proposal does not contain the business plan description as that is presently undergoing management discussion and approval. Below we discuss development issues.

4.2 ITEMS NEEDING RESOLUTION

There are two factors that need final resolution before a cost estimate more accurate than that to be given in the upcoming Part II Cost Estimate of the proposal can be made.

Further analysis and discussion of GE's needs so that hardware, operating system, and designs for added features to NLS can be made firm.

The mainframe hardware cannot be selected nor can the operating system be selected until shortly after 1 January 1976, if GE would like to seriously consider the PDP KL 10/20 system.

4.3 PLANNED STEPS

1) Further analysis and discussion with GE of its needs. From this analysis and discussion would come the following results:

a) Selection of a display configuration. If the displays selected would require modification to NLS software, then two displays would be initially delivered to SRI to be used for development and checkout purposes before final delivery to GE. As part of the display selection process, SRI would provide GE with online experience using NLS with the smaller screen displays. If other candidate displays meet certain criteria, then we could also interface them to NLS for trial use as well.

b) Detailed user feature specification to be used as the basis for implementation design, acceptance testing, and other contracting purposes.

The assumption here is that GE would desire to add to NLS the capabilities described earlier necessary to make NLS conform even more closely to the Inquiry requirements on character set, file size, etc.

c) Selection of mainframe configuration and operating system. We recommend waiting until the DEC KL 10/20 announcement before making a final selection here. The choices available for the operating system are either TENEX or the DEC TENEX based system available at extra cost for delivery with the machine. TENEX was developed under U.S. Government funding and is in the public domain.

d) Selection of photocomposer and printers.
The photocomposer and raster printer software can only be checked out at the GE facility when all hardware has been delivered and accepted.

The manpower required for this analysis and specification phrase will depend on whether or not GE would like to add additional features to NLS. We estimate 4-7 man months of effort, over at least 2-3 calendar months for this step.

2) Choice of hardware and operating system and detailed specification of new features to be added to NLS will then allow us to more accurately estimate the development effort required on a per task basis. From the information in the Inquiry and conversations with GE representatives, it appears that the effort required to interface the selected displays, possibly move NLS to a new DEC TENEX-like operating system and upgrade NLS in ways described in previous sections will require between 12 and 24 man months of development depending on the functional details desired. GE could select all or some of the features.

3) SRI would install NLS on GE's configuration.

Discussion of maintenance, new releases and related issues will be developed as part of the total business plan.

4) We estimate that the new NLS features developed for GE could be implemented and checked out during a nine month period following detailed specification.

5) SRI will provide user and system documentation.

User documentation will be in the form of an Online Help database and command summary of all NLS commands including the new features developed for GE. Additional scenario and primer types of documents will also be provided as part of operator training.

System maintenance documentation will take the form of programming system documentation, commented source code, and a brief system overview.

It is difficult to estimate the total effort required here until the extent of new user features is specified, but we, estimate that 6-9 man months of documentation effort is required.

6) SRI will provide a basic training package as specified for managers, editing operators, computer system operators, and programmers. Additional training can be obtained. The basic training package requires 3 man months.

4.4 MILESTONES

Milestones will be developed as part of the overall development and business plan.

4.5 FUTURE AGREEMENTS

Future agreements could be worked out for any other developments, training, or documentation desired by GE after usage experience.

# TRAINING

## 5.1 MANAGEMENT

5.1.1 A three-day version of the seminar currently given to potential clients will be given to orient managers to the capabilities of the system. Each day ARC representatives will speak about subjects such as: the components of the system (both hardware and software), the kinds of activities that can be accomplished, with special attention to those planned by NED, the experiences of other groups using NLS primarily for document production. Attendees will be given online experience to get a flavor for using the system. This session will be held at ARC.

## 5.2 SYSTEM SUPERVISOR

5.2.1 Two weeks of intensive training for supervisors will include topics covered in the manager's seminar dealing with an overview of the system, all topics covered in the operator's courses (described below), plus other information as necessary. The two week-long sessions could be consecutive or with a one-week break between. The training would take place at ARC. After the system supervisor has observed the training of the operators, two days will be spent with an ARC trainer to discuss training methods in preparation for the system supervisor to train new operators. An additional week of trainer's time will be provided for questions and problems that may arise later.

## 5.3 OPERATORS

5.3.1 Training will be conducted at GE in San Jose using materials similar to those used for other clients primarily interested in document production and will be for a total of twelve days per operator. Half-day sessions over a period of two weeks should be sufficient to thoroughly ground operators in the use of NLS. The group of 10-15 operators would be split into two groups and each group run through an identical session. The half-day when not in class would be spent practicing material covered in that day's class. The first week would cover topics under System and File Control and Editing; the second week would concentrate on Formatting and Photocomposition. There would be a one-week break between the two weeks of training, with a day-long session at the end of the break week and again the week after the second week of training to discuss problems and questions encountered with the entire group of operators.

## 5.4 PROGRAMMERS

5.4.1 The programmer(s) should first be grounded in the use of NLS as it will be used by NED. This will be accomplished by their attending the same session as the system supervisor(s). Training in the programming languages would be conducted at ARC in five three-day segments by an ARC programmer. The number of sessions will depend somewhat on the background of the person and on what GE expects the programmer to do. The proposed training is designed to allow a programmer to write user-subsystems and deal with most problems that may come up. The programmer(s) will be required to read a set of documentation on the programming languages which should enable them to write a simple program before attending. Programming experience in a high-level language is desirable. One week of an ARC programmer's time will be provided to cover questions and problems that may come up after these training sessions.

5.4.2 If GE is interested in developing an NLS programming capability beyond modest user programming and a general understanding of system operation, more extensive training will have to be negotiated on the basis of GE's needs and the background of the programmers involved.

5.4.3 The Operating system will either be TENEX or a standard DEC product. If it is a standard DEC product, then training in its operation and maintenance would be arranged from DEC. If it is TENEX, then SRI can provide training to whatever level is desired by GE.

5.4.4 TENEX is now very stable so that the minimal level required would be at the level of a sophisticated operator. If GE desired to modify the code for schedules or other functions, then more training would clearly be required. This training can be negotiated after operating system selection.

# SYSTEM SUPPORT

## 6.1 HARDWARE UPDATING AND MAINTENANCE

6.1.1 The equipment selected will be maintained through a separate agreement between GE and the manufacturers. A large part of the selection process involves a determination of the quality of the maintenance provided by each of the equipment manufacturers involved in the system. Manufacturer's updates will be installed in cooperation with both GE and ARC to insure that the system software is not impacted by these additions.

## 6.2 SOFTWARE UPDATING AND IMPROVEMENTS

6.2.1 Arrangements for updates and improvements will be covered in the business plan.

## 6.3 TRAINING IN THE USE OF NEW HARDWARE AND SOFTWARE FEATURES

6.3.1 Trainer's time can be provided for training in new features or changes in old ones after the initial year.

## UNIQUE ADVANTAGES OFFERED BY SRI FOR THE GE SYSTEM

NLS is the only existing text processing system with several hundred person years of user experience that can come close to meeting GE's requirements.

The NLS system contains many features, in addition to the requested requirements, useful to GE's application needs.

NLS on a PDP-10 has had over four years of use and shakedown.

SRI has over 125 man years of text processing system analysis and development experience. The NLS system being proposed has more than 100 man years of development behind it.

The power and flexibility of NLS system architecture, to meet present and future GE application needs and the capability to meet much wider needs within GE is unique.

The modular NLS system structure provides for ease of maintenance and evolution.

The User Interface System provides ease of tailoring and the addition of new features.

The NLS Hierarchical file system allows for mixed text and graphics, future evolution of features such as reviewer comments on documents, and allows for very powerful features for formatting, viewing, editing.

NLS is a display system independent and provides for easy display upgrading as GE's needs change and the display market matures.

NLS contains a rich modular set of system primitives for easy addition of new features.

GE will have association with a growing community of clients using NLS for large document production and the implications this has for continuing development and evolution at no or low cost to GE.

The broad applicability of the system that makes it suitable for much wider application with in GE once successfully introduced in NED.

The power of the development environment in which the system will be implemented will be available to GE for its ongoing maintenance and evolution should GE so chose.

# NLS SYSTEM ARCHITECTURE

## 8.1 INTRODUCTION

8.1.1 In the final analysis, it is the software that forms the system and not the hardware. NLS is a carefully designed modular system implemented in the best software engineering conventions. NLS is written in a high level system programming language called L-10. It is is coded with reentrant code so that users share the code pages. Although it is a large system, only code pages in use are brought into main memory by the operating system.

8.1.2 The modular software approach of NLS represents the only viable long term solution to the software problems of today. Software systems that are required to operate over long periods of time in a reliable way, in the face of changing requirements and changing hardware capabilities require the highest level of design consideration and attention to implementation detail.

8.1.3 NLS has over the last several years undergone major changes to improve its modularity. The file system, the command system, display control, the editor, the programming language, the portrayal generation system, the user program systems, and the Output Processor represent modules that work together to effect a viable, living system.

## 8.2 MAJOR NLS MODULES

8.2.1 The organization of NLS is shown in Figure 2. A brief description of each of the modules follows.

## 8.3 FRONTEND-BACKEND SPLIT

8.3.1 NLS is organized into two main modules the Frontend and the Backend. The Frontend provides all user interface and terminal control functions. The Backend contains the portrayal (formatting) modules, the file system and editing and other subsystem (tool) modules. The Frontend and Backend can reside on different machines. Presently the Frontend can run on PDP-10. A PDP-11 version is under development for the National Software Works project mentioned later. It will be operational January 1976; the Backend presently runs on a PDP-10. Given GE's plans to have the mainframe hardware in the same plant location as the users and desire to only support 16 users, the Frontend would reside on the same PDP-10 as the Backend with a standard procedure call communication interface. ARC also operates NLS in a computer network environment with the host remote from the users, where for responsiveness and communication cost reasons, it is appropriate to run the Frontend on a PDP-11 local to the users.

8.4 FRONTEND MODULES

8.4.1 Terminal Control

NLS isolates all terminal- specific drivers and data in either a microcoded processor or a separate software module. The NLS approach to 2-dimensional user interface and display use and control are described in detail in Attachments III and X.

NLS uses the concept of a virtual display system to insure that new displays can be added to the system and to insure that the display code is contained at a level within the system that allows the higher parts of the system to process text and format displays without any knowledge of the particular device attached.

8.4.2 Command System

The user interface is implemented through the use of the Command Meta System that consists of the Command Meta Language (CML), the CML compiler, the Command Language Interpreter (CLI) and a communication interface between the CLI and the editor and other modules. (See Attachment XI.) The user interface, commands, command feedback, and control conventions are described in the special high-level CML language. This description is compiled into a data base for a tool, called the grammar for the tool.

The CLI interprets the grammar to parse a user command and interact with the user. The object of the parse is a data structure that is passed to the appropriate Backend execution module.

For example, the Replace Character command prompts the user to provide the location of the character to be replaced, either by pointing with the mouse or by typing an address, then the CML directs the CLI to prompt the user for the replacement. These two data structures (the pointer to the character and the one to its replacement) are communicated to the Replace Character module that modifies the file and evokes the module that updates the display.

The interpreter uses another data base known as the

Useroptions data base to determine the form and verbosity of the prompting, the type of command input the system will recognize, and to establish keyboard key meanings. The data in the Useroptions data base is manipulated by a subsystem that allows the users to tailor the system to their requirements.

Because of the high level description of the user command set (CML), the interpretation of the language definition by the CLI, and subsequent invocation of a solution module; the system provides a flexibility and conciseness which is not matched by preprogrammed command system found in other systems. This is important in tuning the user interface to different applications and installations and in providing flexibility in system evolution. See Attachment III.

8.4.3 Communication Module

Communication between the Frontend and Backend is through a standard interface. The implementation of this interface varies depending on where the Frontend and Backend are located relative to each other. For the GE system the normal, single-process, very high bandwidth procedure call and return mechanism will be used.

8.5 BACKEND MODULES

8.5.1 File System

The heart of the NLS Backend is the file system.

The file system module implements the well proven hierarchical file organization pioneered by SRI over the last several years.

Figure 3 shows the internal organization of an NLS file. The hierarchical structure of the data is a powerful organization that is unique to NLS.

The files are constructed of a simple tree of data nodes. These nodes consist of a ring element which contains pointers to the superior, next, and subordinate nodes of the file, as well as, a pointer to a list of data cells called properties. In addition to the main branches of the tree that emanate directly from the file origin, any property may contain an inferior tree that may contain a tree of properties related to the parent property. This approach provides the flexibility to handle mixed text and graphics and to provide for future features and capabilities.

NLS files are based on the file system provided by the TENEX operating system and the PDP 10. Because the PDP 10 uses an 18 bit address NLS files have been limited to 256,000 words of 36 bits. (This results in a file size of about 750,000 characters when the structure, and statement overhead is taken into account.)

Compared to users of systems with conventional sequential files, NLS users may operate on larger files with a smaller penalty in file positioning time. That is, one can move around in an NLS file with significantly more facility than with conventional systems. This flexibility requires that users exploit the structure by organizing their material into meaningful hierarchies. Our experience shows that the facility offered for moving within the file, the power of the system editing and other features that can be built to utilize the file structure, and the natural relationship of the file structure to the way documents are normally organized more than justifies the cost in file storage overhead.

NLS users have never found the 750,000 character NLS file size to be a problem in itself. Virtually any material can be broken down into logical units which are well within this bound; however, the control of these units can be a problem.

The system proposed for GE will contain the construct of a Document. The system facilities to support this construct can be used to:

Group several files into a single unit. (The Document control file can be as large as any NLS file so that the potential total number of characters in a Document could be on the order of 75 billion.)

Control the archival and cataloging of very large documents.

Specify and control the scope of document global operations such a formatting, text substitution, and such operations as indexing and interdocument citations for tables of illustrations and contents.

Specify and control file protection and access to specific sections of a total document. This capacity is useful for both security classification and to control the scope of modifications during document updates.

Schedule and control modifications at the editor workstations.

Figure 4 shows the organization of the Document entity.

8.5.2 Portrayal Generation - Formatters

Display formatters

The display formatting system is composed of:

1) a fast formatter and data structures that allow NLS to modify portions of the display image in response to user modification of the files being displayed, and

2) user controls, such as the display NLS (DNLS) jump commands, that control what is portrayed and how much is shown.

This formatter can maintain images in several "display areas" at one time, updating them as necessary. Each area may display information from several files.

A special formatter is invoked when a statement containing a graphic entity is encountered.

Typewriter terminal print control

This is a formatter that is oriented toward printing parts of a file onto a typewriter terminal.

Hardcopy formatters

These include a relatively simple system, Quickprint, and a more complicated formatting program, the Output Processor.

Quickprint formats the text for printing as it appear through the display or typewriter terminal formatters.

The Output Processor can feed to a variety of different devices, including printers and microfilm, and controls the formatting of the document according to directives embedded within the text. For details, refer to the "Output Processor User Guide"Attachement IV.

Sequence generator

The sequence generator is the module that passes through a file and tests each statement against system or user filters.

An example of the system filters it observes in deciding whether the identifier of a statement should be part of a sequence is the level truncation viewspec that permits the display of only those statements above particular levels in the NLS hierarchical file structure.

Those sequences of statements satisfying the filter conditions are used by formatters for terminal or hard-copy portrayal, by compilers, or by processors that manipulate files, such as the sorter.

User filters and reformatters

The user may specify and invoke additional filters that the sequence generator will use as a final acceptance test.

User sequence generators

The user can write his own sequence generators that can make use of any NLS routines.

User Written L10 Programs and Subsystems

A user written program may be given control by the sequence generator in exactly the same fashion that a content analysis program is initiated. However, in addition to pattern matching, it may change the format of a statement being displayed and may modify the statement itself (as well as other statements in the file).

Users may also write their own subsystems using NLS system primitives and CML to provide a user interface. User subsystems and user programs are placed in private or system libraries for future use. This capability is extensively used to extend the facilities of the system for special applications.

8.5.3 Editing Modules

File manipulation algorithms

These algorithms carry out the file manipulation commands of NLS. They decide what is to be done by the textual and structural editing routines and in what order. Utility routines actually manipulate the NLS files.

Some commands make use of textual editing routines exclusively (e.g., "Insert Text"); some use only structural editing routines (e.g., "Move statement"); others use a combination of the two (e.g., "Insert statement").

These algorithms can move and copy text from one file to another through cross-file editing.

Structure editing

These routines involve the manipulation of ring structure alone and do not alter the contents of the statement data blocks which contain the text.

Text editing

These routines edit the text of NLS statements. Content analysis features of L10 are used to determine where changes should take place; the string manipulation and SDB manipulation machinery then change the contents of the file.

8.5.4 Other Modules

NLS contains a number of other tools, calculator, message system, graphics system, additional document production modules and so forth. These are all integrated in a consistent manner to utilize the NLS file system and provide a coherent workshop.

# BACKGROUND

## 9.1 GENERAL CAPABILITIES OF SRI

Stanford Research Institute (SRI) is an independent, nonprofit corporation performing a broad spectrum of research, development and other professional services under contract to business, industry, and government. Most of SRI's work is directed toward problem solving rather than research in the abstract. SRI has developed a capability for working with a client organization, understanding its problems, and structuring a responsive program of professional services that provides realistic solutions to those specific problems. Typically, SRI has 800 to 1,000 active projects at any one time that produce a total annual business volume of approximately $70 million.

The staff of Stanford Research Institute numbers over 2,900. There are more than 350 Institute staff members who hold Ph.D. degrees, over 450 with Master's degrees, and approximately 800 with Bachelor's degrees. SRI's professional and technical staff includes engineers, physicists, chemists, biologists, and metallurgists, economists computer scientists, psychologists, market analysts, educators, and many others representing a variety of professional and technical skills.

SRI's facilities include more than 1 million square feet of office and laboratory space and incorporate the most advanced scientific equipment including unique instrumentation developed by the staff. The bulk of these facilities and most of the professional staff are located at the Institute's headquarters at 333 Ravenswood Avenue in Menlo Park, California.

Facilities at SRI's main offices include extensive data processing, library, and laboratory support. The comprehensive technical libraries are well supplied with literature in the fields of document generation and handling systems analysis, computers, coding, and management control systems. The libraries have trained personnel to provide support for research activities through literature searches and the acquisition and distribution of technical documents. In addition to its home offices in Menlo Park, California, SRI maintains a major office in Washington, D.C., as well as in four other major cities of the United States and in five major foreign capitals, including London and Tokyo.

There are 17 in-house computer systems at SRI. These include a CDC 6400, a B6700 dual processor system, and two PDP 10s. Each major system contains random access memory units, and several have on line inter active graphic terminals. Job processing can be accomplished in batch mode or on line in time-sharing mode. Besides its own facilities, SRI has ready access to numerous other nearby computer facilities, including various IBM, CDC, and Univac systems.

Research operations at SRI are organized into eight divisions representing major disciplinary fields. Overall supervision of research is vested in the Office of Research Operations which reports directly to the Office of the President. Both formal and informal arrangements of long standing exist to facilitate interdisciplinary research and development among the divisions and their subgroups.

Staff members for this study will come primarily from the Information Science and Engineering Division with limited possible cooperation from the Management Systems Division which has experience in design of data retrieval and Indexing systems for Nuclear Power Plant Documentation.

9.2 INFORMATION SCIENCE AND ENGINEERING DIVISION

The activities of the Information Science and Engineering Division are carried out in three laboratories and four research centers, the Augmentation Research Center, The Information Sciences Laboratory, The Engineering Sciences Laboratory, The Sensory Sciences Research Center, The Artificial Intelligence Center, the Electronics and Bioengineering Laboratory, and the Telecommunications Sciences Center. Each of the laboratories is composed of a number of groups with complementary interests and skills. The Information Science Laboratory is predominantly oriented toward research, development, and implementation of techniques of broad applicability, focusing on the design and development of computers, computer programs, and computer systems. The Augmentation Research Center is the core, a continuing development effort toward a broad based computer support system that improves effective utilization of the human intellect in a highly communication oriented society.

Staff members for this project will come primarily from the Augmentation Research Center with support from the Information Sciences Group within the Information Sciences Laboratory.

9.3 AUGMENTATION RESEARCH CENTER

9.3.1 We present here a wide span of information about the Augmentation Research Center. Not all is directly relevant to this project. However we wish to show that the applicability of ARC technology to other areas of information handling and the momentum and experience of its development community is an important advantage GE would gain by engaging ARC to provide this service.

9.3.2 Summary

9.3.2.1 The Augmentation Research Center (ARC) consists of a staff of about 30 people dedicated to developing computer-based processes to augment people's abilities to handle textual and pictorial information. These aids are based on providing fast visual feedback of information maintained in a hierarchically structured form. The information can be displayed to any level of detail and from many different points of view. This organization permits more rapid assimilation of concepts and rapid transmission of this material to the appropriate level of detail for the desired audience. NLS reduces the time and effort of communication because computers perform the necessary manipulations, reconstructions, and transmissions.

9.3.2.2 Internally the NLS software is grouped into subsystems that briefly perform the following tasks:

Maintains a hierarchically structured file system

Supports interactive devices (the two-dimensional CRT display, and the teleprinter)

Passes commands for various subsystems

Edits and manipulates text and data structures

Formats, processes, and outputs hard copy or microfilm from a number of text input sources, in particular files.

9.3.2.3 The subsystems all support a powerful complement of commands to perform the necessary functions. Specific examples are the power to edit, modify, cross reference, and cross copy text or larger blocks of information in continuous or hierarchically leveled blocks. It is in the context of these services that ARC has been developing experience on several fronts. These focus on:

The impact of prolonged, intense human-display terminal and human-typewriter terminal interaction on the user community

The pursuit of channels for integrating and coordinating individual efforts into a true work team (and work community) through the NLS interface

Users' ability to adapt continuously to an increasingly effective use of these services and communication mechanisms via a computer intermedia

The refinement and hierarchical expansion of the system to accommodate an increasingly broader set of services and capabilities

Expansion of the user base to a distributed nationwide community

Systematic improvement of the process of creating, publishing, and maintaining offline documents through NLS techniques.

### 9.3.3 Documentation Production Activity

#### 9.3.3.1 General

NLS provides the basis for flexible systems of creating, modifying, disseminating, and controlling documentation. NLS has particular advantages in easy modification of master copies, large-scale modification and reorganization of documents either as initial drafts or later for revision after publication, facile detailed editing, and flexibility of printed output, including line drawings. NLS is used as a medium to make printed or microfilm versions of files that are primarily intended for reading online an to publish material that would not otherwise be online.

Input:
Input into NLS is through typing directly online at a display terminal or typewriter-like terminals, or offline onto a magnetic medium that is later read into the computer, or through copying online files from other computer systems.

To put text directly online, NLS users employ groups of commands beginning with "Insert" in the NLS Editor Subsystem. The basic insert commands are illustrated in the accompanying Glossary (Attachment VIII).

Input to magnetic media, on the other hand, is normally through the NLS DEX (Deferred Execution) system. The present DEX system can operate through several terminals and digital cassette recorders. It is possible to record limited editing during input. A userguide for DEX is available.

Input from other systems may require special-purpose translation programs to format the text into ASCII TENEX files. Insert Sequential Commands in the Editor subsystem convert such files to NLS files with options to preserve their format and/or translate it into appropriate positions in the NLS file hierarchy.

Draft Development:
All NLS files are organized in outline form. A group of commands in the Editor subsystem can rearrange and reorder these outlines at a global level more rapidly and flexibly than is the case with paper copy or online systems that address text line by line. This facility is particularlly useful in the initial stages of creating a document. Similar commands can transfer or copy files or parts of files according to their outline position or content.

Editing:
Copying, transfer, and replacement commands that operate on small units of text can greatly increase the productivity of editors. Automatic editing facilities are found in the NLS Publish, Modify and Format Subsystem. The publish Subsystem contains, for example, a command to generate a table of contents. The Modify subsystem contains a command to correct the number of spaces between sentences, and the Format subsystem a command to set up an online file for printing in one of several standard formats.

Illustration:
The NLS Graphics subsystem allows you to draw and edit simple illustrations, e.g. organization or flow charts, that are part of NLS files. Text and graphics are fully integrated. Users with screens of sufficient resolution may view and edit such drawings and print them through appropriate printers. In the case of half tones and complex line drawings, the user must set aside white space with format directives and strip in the the illustrations during printing in the manner normal to photo offset publication. The black and white figures in this proposal are prepared with the NLS graphics subsystem and are part of the online file. Pressures of time in proposal preparation required use of the Tektronics hardcopy output.

Production Control:
By Default all NLS printouts give the date and time and ident of the person who printed them out. The date and ident of the last editing change made on each statement is recorded and may be displayed or printed.

Output:
Commands in the Editor subsystem allow printing text in a simple draft form (Output Quickprint), or a format with headers, footers, control of top and side margins, etc., in a monospace font on a local printer or terminal (Output Printer), or via output to microfilm and offset plates with a variety of type sizes, fonts, and columnation (Output COM). Coded directives, visible online but not printed, control format via Output Printer or Output COM. Such directives are most often inserted automatically by use of the Format subsystem or the Sendmail subsystem, but may also be inserted by users with special training. The operation of the Format subsystem appears in the accompanying Format Sample Session.

Post-Publication Control:
The Automatic numbering and indexing services of the NLS Sendmail subsystem provide a medium for freezing, cataloging, and identifying documents, and recording their standing with respect to updates.

Procedures:
NLS offers new freedom to the publications process. Procedures that have in the past been forced on us by the medium, for example limited distribution of drafts, become matters of option. As a result introduction of NLS into a publications operation on more than an occasional basis requires careful planning.

9.3.3.2 Current Usage

Gunther/Pentagon

The United States Air Force at Gunter Air Force Base in Montgomery, Alabama and the Systems Division of the Logistics Directorate in the Pentagon have begun using NLS as a tool to jointly maintain large manuals that are in constant revision. Production of these manuals amounts to several thousands of pages a year. At the Pentagon text is typed onto MTST magnetic cards which are translated at an IBM-based service bureau to a tape readable on the NLS host machine. At Gunter the text, without any special format is typed into the computer using a standard outline form to indicate paragraphs and subparagraphs. Each chapter, which ranges from a few pages to several hundred, exists as a separate entity. Printed copies of the text are edited by writers at various airforce bases and the changes are incorporated by trained secretaries. Often, writers wish to replace one special term for another throughout an entire document. This is accomplished in seconds using a simple substitute command. Writers often choose to quickly view only those paragraphs on which some editing has been done, so their revisions can be easily checked. This is accomplished by culling paragraphs changed since a given time with the NLS content analyzer feature.

Once the editing is completed, specially written programs are run on the chapters to format them according to elaborate and highly specific military standards. This process is repetitive when run on many chapters and special, semi-automatic procedures have been developed to decrease a user's computer interaction and to increase efficiency. These allow fairly naive users to execute complicated series of commands. At any point, however, a user may modify the format to accommodate an exception particular to a single chapter.

The formatted text is then converted into high quality camera ready proofs for printing. Finally, the special format instructions are deleted and the text remains ready online and available for any future revisions.

The Pentagon and Gunther groups have installed Proof-Graphics terminals as suggested for GE and are beginning to use them for production.

Rome Air Development Center

An 800-page JOVIAL Manual is being published at the Rome Air Development Center through NLS. Difficult page-layout to show flow charts and functional relationships within the computer language distinguish this document. The layout is being handled by a combination of NLS's flexible capacity to locate characters on a page and leaving white space for drawing. The text was typed online with liberal use of single special characters to represent special effects in the final format. A local vendor of computer-based typesetting services bid $40,000 for the job and the cost via NLS appears to be between $10,000 and $15,000, although the figures are not strictly comparable because of overhead differences and the use of inhouse typists.

Rome is intending to and publish submanuals by means of the NLS capacity to cull on the basis of structure and content. These special purpose submanuals would not otherwise have been economically feasible. Rome also publishes internal reports and has developed a special subsystem to handle certain types of internal forms.

ARC

For over 12 years ARC has published its reports, proposals, user manuals and the like through NLS. Current production is a couple of thousand pages a year of documents that are distributed in 20-500 copies. Typically input is by a typist using the version of NLS based on typewriter like terminals(TNLS), or input to cassette tapes later read online (DEX), or by authors usually at display stations, and occasionally by translation from sources on another computer systems. Document control during production is though established procedures normally involving submission of small files by authors to a master file closely held by a coordinator. Reviewing and editing is entirely nline. Control after production is through the Sendmails system automatic numbering and index features. Printing is via offset from lineprinter copy or plates made from COM film.

Most of the documents attached to this proposal were prepared at ARC in this manner.

Other

A number of other NLS subscribers publish reports, articles, and the like amounting to several hundred pages a year, partly via various line printers and partly via COM.

The Information Sciences Group at SRI in co-operation with ARC has proposed to the National Science Foundation to develop and evaluate an Editorial Processing Center for Academic journals. A number of features specified by GE that require development in NLS were also proposed to the National Science Foundation, or resemble them so closely that development cost and time might be reduced by combining efforts. The proposal has not been accepted at this writing but after a period of lengthy negotiations we are expecting notification of acceptance at any time.

9.3.4 Recent Development Work Of Particular Relevance

9.3.4.1 In cooperation with several DoD agencies the Defense Advanced Research Project Agency is managing and development project called the National Software Works, ARC is a principal contractor in this work, Current participation is related to provision of a text processing system to NED involves:

Development of a minicomputer-based Front End that will support a powerful command meta language system to provide a consistent user environment to a distributed, multi-host set of software services, The approach substantially lowers the cost of tuning the user interface for a particular installation, This approach will be incorporated in the NED system,

Further enhancement of the document creation and document production capabilities of NLS, Several of the features of NLS that make it correspond to the specifications of the Inquiry, for example the Proof Subsystem, the Graphics Subsystem, and the Publish Subsystem (see Attachment VIII), were developed under sponsorship of the National Software Works which continues to sponsor development in this area at about $250,000s per year,

9.3.5 Development Community and Utility

9.3.5.1 The ARC Community Plan

In our experience, complex man-machine systems can evolve only in a pragmatic mode, within real-work environments where there is an appropriate commitment to conscious, controlled, and exploratory evolution, For over ten years the evolution of our "augmented knowledge Workshop" system has developed within such an environment,

The next stage application is now underway, We are continuing to involve a wider group of people so that we can transfer the fruits of our work to and among others, and so that we can obtain feedback needed for further evolution from a wider spectrum of applications than is possible in our Center alone, NLS is now in use by more than 300 people in the organizations listed below,

9.3.5.2 Elements Of The Workshop Utility Service Relevant to GE

SRI currently provides Workshop Utility service(NLS) to client through computer facilities operated for SRI by Tymeshare Inc in

Cupertino Californai, and by Bolt Beraneck and Newman Inc. of Cambridge Mass.

The service includes:

Providing training as appropriate in the use of the ARC online system (NLS): Display NLS (DNLS), Typewriter NLS (TNLS), and Deferred Execution (DEX) software subsystems.

Ending in 1974 ARC experimented widely in training techniques, including, for example, video taping and training through computer-based linking of terminals. We currently have settled on a training technique based primarily on structured face to face sessions as described in 5 above. The present ARC training staff of eight people, which has been offering courses in NLS in general and its use for document preparation in particular to utility clients for two years now, will be available for training GE staff. Several of the trainers have doubled as consultants or workers in document production and so are particularly and concretely knowledgeable in this area.

This technical assistance includes help in the development of NLS use strategies suitable to each organization's environment, procedures within each organization for implementing these strategies, and possible special-application NLS extensions (or simplifications) to handle the mechanics of particular user needs and methodologies.

Technology Transfer

The process of technology transfer is not simple, judged by our and others' experiences. We base our "Community Plan" strategy upon our understanding that there are at least two main requirements for a successful transfer process that proceeds at a reasonable speed and cost:

1) The group originating the technology and having the experience, enthusiasm, and initial commitment to its value must follow through with training and application support of the end user groups until a critical mass of equivalently experienced and enthusiastic end users has developed.

2) The end user groups must each have at least one properly placed, active supporter of the transfer

process. We have been using the term "local Workshop Architect" for this role.

We give particular emphasis to this second requirement--that each coherent group planning to integrate the proposed services into its working life should have at least one member serving as a "Workshop Architect." The function of this person is to be familiar in detail with both the needs of his or her organization and the capabilities we are proposing. The Architect knowing his group's needs and our capabilities, will help introduce a Workshop system into his organization (in appropriate evolutionary stages), meeting these needs. ARC personnel work closely with the Workshop Architect--in training him, in initially giving him significant help in his role, and in a continuing exchange of technical information.

## 9.3.5.3 SUBSCRIBING ORGANIZATIONS

Present Subscribers

[ A "slot" is a guaranteed percent of the system available to the client 22 hours a day, 7 days a week. ]

RADC slots: 5 Rome Air Development Center (Air Force)

Over 30 users at RADC concentrating on management system use, software engineering, and document production with the goal of matching the capabilities of NLS and its related methodologies to Air Force "knowledge-worker" needs.

Bell Canada 1 Business Planning Group

About 10 users at Bell concentrating on online communications and document production with the goal of gaining first-hand experience with these new techniques and assessing the possibilities for and impacts on communications services that may be provided in the future.

ARPA 5 General ARPA use and National Software Works

Many ARPA users use USC-ISI and BBN-TENEX computer systems for online message service (SNDMSG, READMAIL, TECO, and RD). Over 50 directories have been established at OFFICE-1 for purposes of backup for those needs and as a step toward the gradual introduction of NLS into ARPA offices. Over 35 ARPA people have started using NLS in their work during the past few months. We expect an increasing use in program management activities by ARPA people, using techniques based on the capabilities in NLS and on specially developed methodology. In addition, the ARPA/Air Force National Software Works (NSW) program is just beginning and will grow into a significant effort with NLS Utility use as a core for many developmental and communication functions.

ETS 1 ARPA: Educational Testing Service

ETS is using NLS for document production, correspondence management, and structured data base design construction for publishing filtered subsets.

NIC 1 ARPA: Network Information Center Users

This is the set of ARPA Network Information Center (NIC) users who were previously been served through the SRI-ARC computer. Their specialized online NIC service is now being provided from OFFICE-1 (over 40 user sites). The data base is being produced and accessed through NLS.

Seismic 2 ARPA: Seismic Data Mgt System Development

The Seismic Data Management System Development (SDMS) effort, part of the ARPA VELA program, is beginning to use NLS as the basis of dialogue among participants in the VELA program and as the basis for a set of files that will aid users of the Seismic Data system to find information about resources that will enable them to use the data being collected by the system.

BRL 1 Ballistic Research Laboratories (Army)

BRL is starting to explore application of Workshop technology to their operations. Document production, team dialogue, and personal information management are most likely initial areas of use.

Hudson 1 Hudson Institute (ARPA subcontract)

Hudson is starting to explore application of Workshop technology to the online and hardcopy production of foreign country profile documents under an ARPA contract. NLS will also provide a communications link with their ARPA project monitors.

NSRDC 2 Naval Ship Research and Development Center

NSRDC is exploring the application of Workshop technology to their operations. Document production, team dialogue, and personal information management are the initial areas of use.

SRI 1 Stanford Research Institute

SRI management is starting to explore application of Workshop technology to their own operations, Document production, distributed project team dialogue, and personal information management are most likely initial areas of use.

NSA 1 National Security Agency

NSA is starting to explore application of Workshop technology to their operations related to the design and building of the NSAnet. Document production, distributed project team dialogue, information center services and personal information management are most likely initial areas of use.

They are expected to have an entire in-house machine dedicated for users of NLS.

AMC 3 Army Material Command HQ

AMC is initially exploring the use of our AKW system for inter-office mail and personal information management.

NSW 3 AF Data Systems Design Center and AF Data Services Center

These Air Force organizations (AFDSC at the pentagon and AFDSDC at Gunter AFB) are heavily using our service for documentation production and control. Eventually these sites will be the prototypes for the National Software Works (ARPA and Air Force sponsored project).

Several other Business and government organizations are currently planning to subscribe to the NLS Utility.

9.3.6 History

9.3.6.1 A brief description of some of the accomplishments of ARC over the past 12 years will attest to its leading position in the development of effective services for people working with textual information.

Early explicit recognition of the potential that online computer and communication technologies have in areas outside of straight numeric or accounting computation in enhancing the effectiveness and efficiency of managers, scientists technical writers, engineers, programmers, and their supporting staffs in their daily work.

Participation in the implementation of the ARPANET, a nationwide network connecting over 1500 remote terminals to 35 different computers.

Early explicit recognition of the importance to system building of an integrated system of text handling and system building tools.

Publication of over 25 reports and papers on NLS concepts and allied workshop topics and developments.

Demonstration to large professional meetings (FJCC 1968, ASIS 1969, SHARE 1974) to hundreds of visitors, and via film of a working system. The FJCC 1968 conference was the first to show the power of coupled screens, video terminals, multiple display windows and multi-media techniques (computer output, video pictures and a voice link).

Pioneered the two-dimensional text work to be the foundation of an intelligent terminal system and developed many highly interactive tools and concepts for working and browsing in an information space, such as view specifications, interfile links, split screens, cross file editing, integration of text, graphic information , and numeric computation.

Pioneered input device and work station design. Early work includes development of: video displays, mouse, keyset, desk, and workspace. More recently ARC developed the Lineprocessor which makes it economic for intelligent terminals to support two dimensional NLS display.

Pioneered in high quality formatted publication quality hardcopy, through line printers, typewriters, and COM.

Pioneered the concept of an integrated coherent workshop of many office tools with a uniform user interface.

Considerable experience with online information management for an office or project environment, such as memos, user documentation, and correspondence, full text storage and retrieval, indexing, and cross linking.

First with a comprehensive system for online message control, addressing distribution, delivery, individual and group identification, cross linking, and indexing.

A History of quality software engineering and a leader in applying new software engineering tools to aid the system building process.

Over one hundred thousand hours of hands-on console experience with the use of NLS technology in daily work, both at ARC and at other sites.

Recognition of the importance of integrating into the system building process mechanisms for studying and facilitating technology transfer including establishment of training and other application support services.

Development work on the TENEX timesharing system used on the PDP-10 and the Elf timesharing system used on the the PDP-11.

## 9.4 INFORMATION SCIENCE LABORATORY

The diversified activities of the Information Science Laboratory include both fundamental research and applications of information systems. Research performed by the Computer Science Group is in computer architecture, programming, and other aspects of computer design, primarily for U.S. Government clients. Applications vary over a wide range of computer-based information systems, including information systems design and evaluation. The Transportation Engineering and Control Group applies advanced engineering techniques to the development of system control and operating policies for both air and ground-based transportation systems. The research and the applications work are complementary; each benefits from the other.

In addition, members of the Information Science Laboratory routinely work with professionals from other parts of SRI on interdisciplinary research teams composed to best meet specific client needs. The Information Systems Group undertakes information systems design projects for both government and industrial clients.

Within the Information Sciences Laboratory it is the

Information Sciences group that will Support the Augmentation Research Center in providing a text processing system to the NED.

9.5 THE INFORMATION SYSTEMS GROUP

The Information Systems Group has pioneered the design of a number of large-scale data processing systems in such diverse areas as banking, transportation, medical services, education, process control, computer-aided design, and military operations. The work has covered a wide spectrum, from the preparation of performance specifications to the actual implementation of systems, including the preparation of all necessary software and procedures.

The group has an extensive capability in the design of software for digital computing systems and the management and use of such systems. Group personnel have performed overall designs for large and advanced software systems including language compilers, computer operating systems, and file-management systems. A major emphasis is placed on adopting a suitable philosophy for the design at the start of a project and applying it systematically throughout the entire design and imple-mentation effort. Techniques that contribute to correctness of code, the mobility (convertability) of programs, and documentability of programs are stressed. Techniques used and directions taken in an
implementation are chosen according to a software development plan that is consistent with a previously developed overall design. In recent work, particular emphasis has been placed on language characteristics that contribute to program correctness and the correct execution of programs.

The Information Systems Group is also involved in the analysis, design, and development of a variety of text-processing and document production systems. Past efforts have ranged from simple single terminal systems to complex multiterminal editorial production systems operating within a distributed computer network. These efforts have encompassed a variety of facets of the process, including data capture; processing, editing, and formatting; and document output.

The work of the group ranges from the design and development of such systems (hardware and software) to the implementation of those systems into a client environment, including such considerations as staffing levels, training requirements, and scheduling. In conducting text processing developments the group works closely with other groups within the Institute, particularly the Augmentation Research Center within the Information Science and Engineering Division.

9.6 MANAGEMENT SYSTEMS DIVISION

For the Hanford Engineering Development Labs the Industrial Management Department of the Management Information Systems Division designed a Documentation Control and Retrieval System.

Systems to control and retrieve documentation associated with the design, fabrication, construction, and startup of the Fast Flux Text Facility or other nuclear plants are required by various regulatory and contracting agencies. As a part of this project, the Industrial Management Department developed a document and location identification system to control nearly all of the documentation associated with the Fast Flux Test facility. The document and location identification system is to be used by personnel of the Hanford Engineering Development Laboratories to locate and retrieve any document among an estimated total of 2,750,000 drawings and documents associated with the facility.

The document and location identification system developed is computerized and uses data base management techniques in order to permit a user to locate the specific document he needs based upon a partial and possibly incomplete description of the document he is looking for.

# STAFF

Dr. Douglas C. Engelbart heads SRI's Augmentation Research Center; the Center has two Assistant Directors, Dr. Richard W. Watson and James C. Norton, in charge of Development and Applications respectively. The bulk of the work in this proposal is in the Development area and will be under the project supervision of Dr. Watson. We include the resumes of other programmers from ARC and supporting groups who are knowledgeable in this area and might be expected to work on the project along with the resumes of specialists in training and application of computer-based systems to text processing and information retrieval.

DOUGLAS C. ENGELBART, DIRECTOR AUGMENTATION RESEARCH CENTER
INFORMATION SCIENCE AND ENGINEERING DIVISION

Specialized professional competence

. Man-computer systems; circuits, special components, logical design, and programming of digital computers; vacuum- and gas- discharge techniques; large intercommunication systems; wind tunnel drive and control systems; electromechanical control systems; and information systems

Representative research assignments at SRI

. Expanded and developed for the Institute the basic concepts for the Augmented Human Intellect program which he had developed independently since 1950; program is aimed at improving human intellectual effectiveness through real-time computer aid. Formulated a comprehensive conceptual framework for man-machine studies with both broad and specific research goals; many of its specific goals have been translated into the establishment of a computer-based information utility and a number of on-going projects within a coordinated and growing program. Basic development work on magnetic components for computers and with other fundamental research into the physical techniques of computers

Other professional experience

. Formed and directed Digital Techniques, Inc.; corporation did development work on his inventions. Consultant to Marchant Research, Inc. (Oakland); development work has been carried out on patents bought from him. Assistant professor, University of California; associate in electrical engineering. Electrical engineer, Electrical Section, Ames Laboratory (Moffett Field, California)

Academic background

. B.S. in electrical engineering (1948), Oregon State College; E.E. (1953), University of California; Ph.D. in electrical engineering (1955), University of California

Professional associations

. Association for Computing Machinery; IRE PGEC (chairman of the San Francisco Chapter, 1959-60); ISE (member of the Solid State Circuits Subcommittee 4.10); Institute of Electrical and Electronics Engineers--Group on Computers (Electronic) and member of the Cybernetics Committee; National Academy of Sciences (member of the Information Systems Panel under the Computer Science and Engineering Board)

RICHARD W. WATSON ASSISTANT DIRECTOR AUGMENTATION RESEARCH CENTER INFORMATION SCIENCE AND ENGINEERING DIVISION

Specialized professional competence

. Research and design; interactive computer information systems (hardware, software, communications, user interface, and use methodologies); computer systems; computer architecture; analysis of information system needs and requirements; data management; technology transfer; research and system development management

Representative research assignments at SRI

. Assistant director, Augmentation Research Center . Manager, ARPA Network Information Center

Other professional experience

. Various positions in computer science research, Shell Development Co. (Emeryville, California); final position supervisor, Computer Science Research; research in man-machine system design; management information systems . Lecturer in electrical engineering and computer science, University of California (Berkeley) and Stanford University . Assistant professor, computer science, Stanford University; areas of research were artificial intelligence and man-machine systems

Academic background

. B.S. E.E. (1959), Princeton University; M.S. (1962) and Ph.D. (1965), University of California (Berkeley); all degrees in electrical engineering with specialization in computer science

Publications

. "Knowledge Workshop Terminal Systems," Symposium Digest, Society for Information Display International Symposium (May 1974). "The Augmented Knowledge Workshop," Proc. National Computer Conference (1973); Timesharing System Design Concepts, McGraw Hill Book Co. (1971); "A Display Processor Design," Proc. Fall Joint Computer Conference (1969); "Self-Checked Computation Using Residue Arithmetic," Proc. IEEE (December 1966); numerous technical reports

JAMES C. NORTON, ASSISTANT DIRECTOR AUGMENTATION RESEARCH CENTER
INFORMATION SCIENCE AND ENGINEERING DIVISION

Specialized professional competence

. Research management; man-computer system development and operation; information system development operation

Representative research assignments at SRI

. Augmentation Research Center, Assistant director: operational management of computer services (hardware and software) and administration; user interface activity; people services; project management of integration of Augmented Knowledge Workshop technology into working environments, such as Rome Air Development Center and Advanced Research Projects Agency. Senior research analyst: operations administration; system development, including Dialog Support System (journal), catalog development (production aids), baseline management system, and basic feature development for Augmented Knowledge Workshop. Information Science and Engineering: administrative manager; financial performance analysis and reporting; project administration (government and commercial); proposal cost estimating; budget preparation; computer facility planning and accounting; supervision of clerical staff; liaison with SRI central service activities

Other professional experience

. Pacific Telephone and Telegraph Co. Traffic engineer; planning studies for long and short range equipment additions and rearrangements; studies for the California Public Utilities Commission on cost analysis of proposed extended service and new exchanges; forecasting future call volumes and resulting toll circuit and other facility requirements. Traffic assistant; central office management; supervision of operators, force and load planning, employment, training, and performance analysis

Academic background

. B.A. in economics (1953), Stanford University

Publications

. Coauthor of paper, "The Augmented Knowledge Workshop"

(June 1973). Coauthor of SRI reports: "Online Team Environment - Network Information Center and Computer-Augmented Team Interaction" (May 1972); "Network Information Center and Computer-Augmented Team Interaction" (July 1971); "Advanced Intellect-Augmentation Techniques" (July 1970); "Computer-Augmented Management System Research and Development of Augmentation Facility" (April 1970)

ROBERT L. BELLEVILLE, RESEARCH ENGINEER AUGMENTATION RESEARCH CENTER INFORMATION SCIENCE AND ENGINEERING DIVISION

Specialized professional competence

. Design and implementation of computer based information systems, including: man-machine communication, interface and system design, computer graphics, minicomputer-based systems, and graphics terminal design

Representative research assignments at SRI

. Design and implementation of a computer graphics extension to NLS, adaptation of NLS to minicomputer-based systems.

Other professional experience

. U.S. Army Aberdeen Proving Ground (Maryland): directed production testing of the Gama Goat all terrain truck; designed and implemented a computer based maintainability data collecting system. Monsanto Company (East St. Louis): designed and implemented manpower scheduling systems for both the maintenance department and labor relations; worked with IBM 1800 based data collection system to improve quality control in a motor oil blending operation. Private consulting with: Monsanto Company--documentation; Inland Container Corporation--material property and economic modeling; U.S. Military Academy (West Point)--graphics and computer systems

Academic background

. B.S.M.E. (1968), M.S. in computer graphics (1969), and Ph.D. in man-machine communication (1974), Purdue University

Publications

. Coauthor of "Two Approaches to Online Graphics Systems" (in preparation). "Man-Machine Communication: An Examination of the Machines," Ph.D. thesis, Purdue University (August 1974). "Special Study of Automation of Maintainability Data Collecting and Reporting Procedures," Aberdeen Proving Ground report (June 1971). "The Design and Development of an Interactive Computer Graphics System," M.S. thesis, Purdue University (June 1969)

Honors

. Crozier Award for outstanding achievement in the development of the Automotive Data System at Aberdeen Proving Ground

DIRK H. van NOUHUYS, RESEARCH ANALYST INFORMATION SCIENCES LABORATORY, INFORMATION SCIENCE AND ENGINEERING DIVISION

Specialized professional competence

. Technical writing; all types of writing; technical publications management; application of computer based techniques to technical publications; teaching writing

Representative research assignments at SRI

. Technical writer; development of an advanced, computer-based interactive text handling and information retrieval system; organization of and participation in online composition and printing of reports and proposals, participation in design and debugging of the command language, teaching and development of tutorial materials for the online language, and development and operation of interactive retrieval and cataloguing systems, coordinating and promoting development of computer-based text processing systems.

Other professional experience

. Management of the Resource Data Center, TRW Systems of Redondo Beach . Proposal writer for TRW. Technical writer and editor, Western Regional Research Laboratory of the USDA (Albany, California)

Academic background

. B.A. in writing (1956), Stanford University; M.A. in contemporary literature (1957), Columbia University; additional study in physics, psychology, French, and English

Publications

. Coauthor of SRI technical reports on computer system development, Text Processing Systems, Training in Use of Online Computer Systems, Interactive question answering systems; coauthor of four technical movies or video tapes

ELIZABETH K. MICHAEL, PROGRAMMER AUGMENTATION RESEARCH CENTER
INFORMATION SCIENCE AND ENGINEERING DIVISION

Specialized professional competence

. Design, implementation, and development of computer systems in the following areas: interactive time sharing systems, system measurement and performance evaluation, user accounting and billing, terminal control programs, and text editing; interactive and batch management information systems; payroll and general ledger; information retrieval

Representative research assignments at SRI

. Design, programming, and implementation, under ARC NLS, of a calculation subsystem to permit the user to perform simple and complex arithmetic calculations based on values entered from a keyboard or retrieved from files and to specify format of results

Other professional experience

. Stanford Computation Center, Stanford University; design, implementation, and administration of system measurement and user accounting system for an IBM 360/70 computer supporting 100 interactive terminals while processing 3000 plus batch jobs a day. Administrative data processor, Stanford University; supervision and training of programmer analysts; design and implementation of all University Administrative Computerized Tasks, including student registration and records, alumni information, business, and accounting . Research statisticians, Office of the Dean of Students, Stan ford University

Academic background

. B.S. in physical science/organic chemistry (1947) and M.A. in economic statistics (1948), Stanford University

Publications

. Various articles and manuals for the Stanford Computation Center; articles on computer measurement and accounting for the SHARE Computer Measurement and Evaluation Project

Professional association

. Association of Computing Machinery (former member)

HARVEY G. LEHTMAN, SYSTEMS PROGRAMMER AUGMENTATION RESEARCH CENTER INFORMATION SCIENCE AND ENGINEERING DIVISION

Specialized professional competence

. Design and development of large software systems; applications programming; experimental high energy physics; technical writing

Representative research assignments at SRI

. Development of information retrieval and tutorial help systems. Development of the computer system and associated organizational techniques at the Augmentation Research Center. Report writing; languages and project reports

Other professional experience

. Teaching assistant in computer science and programming, University of California (San Diego). Research in experimental high energy physics, University of California (Berkeley) and University of Chicago

Academic background

. B.A. in physics (with honors, 1966), University of California (Berkeley); M.S. in physics (1967), University of Chicago; work toward Ph.D. in physics (through 1969), University of Chicago; additional graduate work in computer science, University of California (San Diego)

Publications

. L10 Manual; Tree Meta Report; 1972 Rome Report; 1972 ICCC Video Tape

THOMAS P. BUN, SENIOR SYSTEMS ANALYST

Specialized professional competence

. Design and installation of computer applications, in the areas of management science, industrial operations research, planning, and financial management; extensive and diversified European and Latin American experience

Professional and business experience

. Leader of development of the Documentation Control and Retrieval system for Nuclear Plants

. Completed development of new microprocessor applications for Unicom Systems, a division of Rockwell International, including a programmable desk-top calculator that executes complex financial routines with single key depressions

. Feasibility study and framework for new management systems of the Light & Power Co. of Rio de Janeiro & S. Paulo, Brazil, a subsidiary of of Brascan Ltd., Toronto: covering the areas of power system planning, energy management, power distribution control, and new construction scheduling

. Developed new products analysis procedure and an innovative "short form" management information system, for the recently consolidated Business Equipments Division of Smith-Corona Merchant Corporation

Academic background

. Degree of Engineer in planning (1944), Budapest University; M.S.E.E. in digital systems (1968), Stanford University

Languages

. German, French, Spanish, Portuguese, Hungarian, and some Russian

KENNETH E. VICTOR, SYSTEMS PROGRAMMER AUGMENTATION RESEARCH CENTER INFORMATION SCIENCE AND ENGINEERING DIVISION

Specialized professional competence

. Operating systems; interactive editing systems

Representative research assignments at SRI

. Maintenance and development of TENEX and Exec, Maintenance and development of NLS

Other professional experience

. IBM; worked on FORMAC (a symbol manipulation extension capability to PL/1), CPS (a conversional PL/1 system), and an interactive file manipulation and text editing system, Hewlett Packard; designed and implemented a dedicated, real-time system; designed an operating system for a new medium sized computer

Academic background

. B.A. in physics (1968), Brandeis University

Publications

. Coauthor of IBM Manual on FORMAC; IBM Manual on CPS; SRI-ARC Reports, Coauthor of various Augmentation Research Center documents

DONALD ANDREWS, SYSTEMS PROGRAMMER AUGMENTATION RESEARCH CENTER INFORMATION SCIENCE AND ENGINEERING DIVISION

Specialized professional competence

. Systems programming; compiler writing and compiler writing systems; time sharing systems; interactive systems; analysis of system efficiency; micro computer devices

Representative research assignments at SRI

. Development of special purpose language for implementing NLS control language; development of TREE META compiler writ ing system; basic development and programming of NLS system; analysis of, efficiency of, and modifications to TENEX time sharing system; development of subsystem for monitoring TENEX performance; development of lineprocessor micro computer device

Other professional experience

. Suppe's Computer Based Laboratory, Stanford University; developed compiler writing system on PDP-1, University of Washington; implemented small machine interpreter on B5500

Academic background

. B.S. in physics (1965), University of Washington; M.S. in computer science (1967), Stanford University

Publications

. Coauthor of "Tree Meta, a Meta Compiler System for the SDS 940," SRI internal report (1967)

Professional association

. Association of Computing Machinery (past member)

BEVERLY R. BOLI, RESEARCH ANALYST AUGMENTATION RESEARCH CENTER INFORMATION SCIENCE AND ENGINEERING DIVISION

Specialized professional competence

. Technical writing and editing, particularly instructional writing; documentation of computer systems, software, hardware, and electronic components; teaching writing

Representative research assignments at SRI

. Technical writer: development of advanced, computer-based interactive text handling and information retrieval system; participation in online composition and printing; development of tutorial materials for the online language

Other professional experience

. Technical editor and Manager of Editing and Publications, Quantum Science Corporation ((Palo Alto, California): supervised in-house publications division and performed technical editing in fields of computer equipment and services, communications equipment and services, and electronic components

. Instructor in writing and literature, Burlington County College (New Jersey)

Academic background

. B.A. in English (1967), United States International University; M.A. in English (1968), University of California (Berkeley); additional courses in writing, linguistics, and teaching

ANN C. WEINBERG, RESEARCH ASSOCIATE AUGMENTATION RESEARCH CENTER SYSTEMS INFORMATION SCIENCE AND ENGINEERING DIVISION

Specialized professional competence

Technical writing; computer-based publications procedures; educational writing; educational publications; educational consulting; psychological counseling; elementary teaching

Representative research assignments at SRI

Technical writer; development of an advanced computer based interactive text handling information retrieval system; participation in online composistion of reports and proposals; participation in design and writing of the online help database; teaching and development of on and offline tutorial materials for the online language; consultation in and training of new users in application of computer-based text processing systems to technical documentation.

Other professional experience

Westinghouse Learning Corporation, Sunnyvale, California; designing, writing, and editing of learning units, tapes and filmstrips for an individualized computer managed learning system; instructing and consulting in the implementation of an individualized computer managed learning system.

Academic Background

B.A. in psychology (1969), Connecticut College, New London, Connecticut and M.A. in Counseling Psychology (1971), Stanford University

Publications

Various Learning Units and Teacher Materials for Project PLAN*, Westinghouse Learning Corporation; Various Tapes and filmstrips for Project PLAN*, Westinghouse Learning Corporation

Honors

Cum Laude Graduate from Connecticut College

SUSAN G. ROETTER, RESEARCH ANALYST AUGMENTATION RESEARCH CENTER INFORMATION SCIENCE AND ENGINEERING DIVISION

Specialized professional competence

, Scheduling and supervising other trainers. Training people in the use of NLS (a computerized information handling system). Systems analysis; problem solving; writing

Representative research assignments at SRI

, Direct NLS assistance at ARPA (Advanced Research Projects Agency) - 5 months. Analysis of the Network Information Center (NIC) with special emphasis on the future possibilities of SDI. Various studies of system efficiency and usage

Academic background

, B.S. in mathematics and psychology (magna cum laude, 1972) Milligan College, Tennessee; Graduate work, San Jose State University

LIST OF ATTACHMENTS:

I D. C. Engelbart, R. W. Watson, J. C. Norton, The Augmented Knowledge Workshop, In AFIPS Proceedings, Vol. 42, 1973 National Computer Conference, pp. 9-21, 1973. (14724)

II D. C. Engelbart. Coordinated Information Services for a Discipline- or Mission-Oriented Community, Augmentation Research Center, SRI, Menlo Park, Calif.. Paper given at Second Annual Computer Communications Conference, San Jose, Calif., 24 January 1973. (A12445)

III Richard W. Watson, Issues in the Design on the NLS Users' Interface, Chapter in Knowledge Workshop Development, The Augmentation Research Center, SRI, Menlo Park, Calif. October 75..

IV The Output Processor Users' Guide. The Augmentation Research Center, SRI, Menlo Park, Calif. July 1975.

V Format Library. The Augmentation Research Center, SRI, Menlo Park, Calif. March 1975.

VI TNLS-8 Quick Reference. The Augmentation Research Center, SRI, Menlo Park, Calif. May 1975.

VII NLS-8 Command Summary. The Augmentation Research Center, SRI, Menlo Park, Calif. May 1975.

VIII NLS-8 Glossary. The Augmentation Research Center, SRI, Menlo Park, Calif. September 1975.

IX Donald I. Andrews, Line Processor -- A Device for Amplification of Display Terminal Capabilities for Text Manipulation, in Proceedings of the National Computer Conference, 1974, p.257-265. (20184)

X Charles H. Irby, Display Techniques for Interactive Text Manipulation, in Proceedings of the National Computer Conference, 1974, p.247-255. (20183)

XI A Command Meta Language for NLS. Charles F. Dornbush, Kenneth E. (Ken) Victor, and Charles H. Irby. The Augmentation Research Center SRI, Menlo Park, Calif. January 1975.

XII TENEX Guide for Users of NLS. The Augmentation Research Center, SRI, Menlo Park, Calif. August 1975.

XIII D. C. Engelbart, Design Considerations for Knowledge Workshop Terminals, In AFIPS Proceedings, Vol. 42, 1973 National Computer Conference, pp. 221-227, 1973. (14851)

XIV Daniel G. Bobrow et al., TENEX, a Paged Time Sharing System for the PDP-10, in Communications of the ACM, March 1972, Vol. 15, No. 3, pp. 135-143. (7736)

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Jeanne M, Beck, Marcia L, Keeney, Elizabeth K, Michael, Jonathan B, Postel, Elizabeth J, Feinler, Kirk E, Kelley, N, Dean Meyer, James E, (Jim) White, Douglas C, Engelbart, Martin E, Hardy, J, D, Hopper, Charles H, Irby, Harvey G, Lehtman, James C, Norton, Jeffrey C, Peters, Dirk H, Van Nouhuys, Kenneth E, (Ken) Victor, Richard W, Watson, Don I, Andrews,

Elizabeth J, Feinler, N, Dean Meyer, Dirk H, Van Nouhuys, Douglas C, Engelbart, James C, Norton, Richard W, Watson, Charles H, Irby, Israel A, Torres, Jan H, Kremers, Susan K, Ocken, Raphael Rom, David C, Smith, Buddie J, Pine, Andy Poggio, David L, Retz, Laura J, Metzger, Karolyn J, Martin, Jan A, Cornish, Larry L, Garlick, Priscilla A, Wold, Pamela K, Allen, Delorse M, Brooks, Beverly Boli, Rita Hysmith, Log Augmentation, Raymond R, Panko, Susan Gail Roetter, Robert Louis Belleville, Ann Weinberg, Adrian C, McGinnis, Robert S, Ratner, David S, Maynard, Robert N, Lieberman, Sandy L, Johnson, James H, Bair, Jeanne M, Leavitt, Rodney A, Bondurant

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