DAV 13-OCT-75 17:59 26670

A word in the user-language dialogue

I don't think there is much disagreement that L10 (and CML) programs are difficult for most people to write. There is probably quite a bit of disagreement about what can and should be done about it. But it seems to me that if we are really going to turn several thousand users loose on the system in the next few years, we should make some improvements. 1

Here are a few substantive suggestions for making a more easily understood (and therefore more easily used) "user language". The suggestions are in the form of modifications to L10. The question of whether there should be a completely new language in addition to L10 is not addressed here. 2

Simplifications 3

(1) Get rid of the distinction between L10 "statements" and "expressions". Make everything an expression. In other words, everything returns a value. Statements simply ignore the value. This eliminates about 1/4 of the L10 syntax. 3a

(2) Get rid of the six-letter limitation on names. This is the greatest contribution to obscurity in the language. The funny combinations that result are virtually impossible to remember, let alone pronounce, and they provide little or no semantic help. Also add underbar as a letter. 3b

Additions 4

(1) Add true run-time data types. Reference each instance of a data type with a "descriptor". (Burroughs has been doing this for 15 years.) A descriptor has at least two fields: a TYPE field and an INSTANCE field. The TYPE field contains a small integer representing the type number. The INSTANCE field can contain a machine address, as is done now with "$". Or, if we want relocatable data areas, it can contain an offset from the beginning of some area. (In fact, L10 addresses are simply non-relocatable descriptors that don't contain any type information.) This has several benefits: 4a

REF, $ and & go away. This alone is worth the price of admission. (See Tony Hoare's paper on eliminating references if anyone thinks it can't be done.) 4a1

Much special-purpose L10 syntax goes away (*...*, #...#, :_, etc.) -- probably another 10%. Therefore this is also a simplification. 4a2

For example, instead of 4a2a

s _ "abc", "def", ... 4a2a1

we can write 4a2b

s _ "abc", "def", ... 4a2b1

Generic operations become possible. A generic operation is one whose semantics depend on the types of the arguments passed. The compiler selects a specific action depending on the declared types of the arguments. (Since descriptors carry type information, the disambiguation can even be done at run-time. This "delayed binding" is a VERY powerful concept.) 4a3

For example, 4a3a

x + y 4a3a1

might mean "add" if x and y are numbers, but "concatenate" if they are strings, and "append" if they are lists. The compiler selects the appropriate meaning depending on the types of x and y. Our above example now becomes 4a3b

s _ "abc" + "def" + ... 4a3b1

In addition to reducing the number of funny symbols in programs, data types also REDUCE the number of concepts. Instead of two concepts for "append" -- list append and string concatenation -- there is now one generic operation, perhaps written "x + y" or "x @ y" or "x APPEND y" or simply "append(x, y)". 4a4

As new types are added (see (3) below), the relevant operations can also be extended. If the user adds a type which he wants to be "appendable" (as opposed to "dependable", har har), he can add a new case to the append rules -- in some appropriate formal way. 4a4a

Difficulty: the number of additions that may have to be made to the append rules is 2n+1 in the worst case, where n is the number of existing data types, since, for example, we may want to have different interpretations for 4a4b

<integer> + <string> 4a4b1

and 4a4c

<string> + <integer>. 4a4c1

The language becomes less restrictive in computing arguments/values, Example: 4a5

To return a concatenated string as the value of a procedure, we must now write 4a5a

```
*s* _ "abc", "def", ...;                                    4a5a1

RETURN($s);                                                 4a5a2
```

Where s must be GLOBLAL TO THE PROCEDURE! If every operation computed a descriptor, we could write 4a5b

```
RETURN("abc" + "def" + ...)                                 4a5b1
```

and still return only one actual machine word (or the constant number of words required to represented a descriptor -- 1 on the PDP-10). 4a5c

Fancy things like sub-types become possible. (These may require more fields in descriptors.) One fancy thing to think about is type GENERAL. One uses it to get a cell for holding information, just like "DECLARE x" and "LOCAL x" now. One can go back later after the program is debugged and add specific type declarations for efficiency and/or documentation. We could also do ECL's "union types". 4a6

The additions (2) and (3) below become MUCH easier. 4a7

(2) As Jan Cornish suggested, add NLS primitive structures as data types in L10. For example, 4b

Declarations: 4b1

```
DECLARE WORD w1, w2, w3;                                    4b1a

DECLARE TEXT t1, t2, t3;                                    4b1b

DECLARE STATEMENT s1, s2, s3;                               4b1c

DECLARE GROUP g1, g2, g3;                                   4b1d
```

Expressions: 4b2

```
t1 _ w1 + w2 + w3;                                          4b2a

    % builds a piece of text from three words %             4b2a1

    % if w1 = THE, w2 = BROWN, w3 = COW,                    4b2a2
```

```
        then t1 = THE BROWN COW (i,e,, with spaces) %                    4b2a3

    s1 _ t1 + w1 + t2;                                                   4b2b

        % builds a statement from two pieces of text and a word %        4b2b1

    g1 _ s1 + s2 + g1;                                                   4b2c

        % builds a group from two statements and another group %         4b2c1
```

The point is that specifications such as these are implementation-independent, reducing the number of occurrences of constructions like: 4b3

```
    DECLARE TEXT POINTER tp1, tp2;                                       4b3a

    tp1 _ tp2;              % copy the first word %                       4b3b

    tp1[1] _ tp2[1];        % copy the second word %                      4b3c

        % Note that on 16-bit machines like the PDP-11, text
        pointers take more than two words, so this code won't
        work. %                                                          4b3c1
```

(3) permit the user to add his own data types at compile time via DECLARE DATA TYPE declarations. Data types are often conceptual entities, particularly user-defined types. 4c

They can be used as a "chunking" device, permitting the user to maintain a larger view of the program structure. He can map out the qualities that he wants the type to possess; then, when that is well understood, he can use it as a unit (a "chunk") in his programming. (Cf. Miller's "The Magical Number Seven, Plus or Minus Two" for the glories of chunking.) 4c1

They encourage modular programming, a "structured programming" concept. 4c2

Modifications 5

Make a higher-level debugger so we don't have to go thrashing around in a sea of bits. (The Sorcerer's Apprentice comes to mind.) See LISP's TRACE package, MLISP's TRAP package, Swinehart's thesis, etc. for models. Minimum capabilities: 5a

The ability to breakpoint at source-language statements by bugging the place to be broken. 5a1

The ability to single-step source-language statements and begin execution at any designated statement. 5a2

The ability to interrogate variables by their source-language names, not just their first six letters. Variables should be capable of being: 5a3

- locked on the screen so we may monitor changes to their values as we step through the code; 5a3a

- changed by bugging them and typing in a new value. 5a3b

The ability to display data in a structured way. If a value is a string, it should print as a string. If it is a record class, it should print in some enlightening way, ideally graphically. If it is a number, it should print in decimal, not octal. The user should be able to add display routines for his data types -- easy if the display routine is a generic function. 5a4

DAV 13-OCT-75 17:59 26670

A word in the user-language dialogue

(J26670) 13-OCT-75 17:59;;;; Title: Author(s): David C. Smith/DAV;
Distribution: /SRI-ARC([INFO-ONLY]) ; Sub-Collections: SRI-ARC;
Clerk: DAV;

26670 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, 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, 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

Weekly Report

13-October-75 1

Last Week 1a

nsw management 1a1

-Sent off the report on the Ident System after receiving suggestions from HGL and JAKE (see -- 26669,). 1a1a

-Meeting Report 1a1b

Review meeting previous week with rassmussen, discussed difficulties with AF 66-1, checked on milestones. 1a1b1

nsw protocols 1a2

-no activity 1a2a

arpa protocols 1a3

-Read Network Measurement notes (at last!) 1a3a

Next Week 1b

nsw management 1b1

Work on the "shopping list" of ideas for next proposal round. 1b1a

-Update milestones. 1b1b

-Work on final report for 74-75 contract. 1b1c

-Collect the set of design documents, transmit the table of contents to COMPASS. 1b1d

-Reallocate the funds among the project account numbers. 1b1e

-Prepare a note relating project account numbers to contract work statement tasks. 1b1f

arpa protocols 1b2

-Consult at DCA 15-17 Oct. 1b2a

-Read INWG notes 1b2b

-Write a chapter on protocols for the "arpa book" 1b2c

Weekly Report

(J26671) 14-OCT-75 01:41;;;; Title: Author(s): Jonathan B. Postel/JBP; Distribution: /ARC-DEV([INFO-ONLY]) ; Sub-Collections: SRI-ARC ARC-DEV; Clerk: JBP;

26671 Distribution

Jan H. Kremers, Susan K. Ocken, Raphael Rom, David C. Smith, Andy Poggio, David L. Retz, Jan A. Cornish, Larry L. Garlick, Delorse M. Brooks, Beverly Boli, James E. (Jim) White, Ann Weinberg, Kenneth E. (Ken) Victor, Dirk H. Van Nouhuys, Jonathan B. Postel, Elizabeth K. Michael, David S. Maynard, Karolyn J. Martin, Harvey G. Lehtman, Kirk E. Kelley, Charles H. Irby, Robert Louis Belleville, Don I. Andrews, Richard W. Watson, Douglas C. Engelbart,

CHI 14-OCT-75 12:14 26672

Comment on 26670

Dave, your memo contains many good ideas. I would like to point out, however, that MPS (now called MESA) was derived from L10 to address many of these needs. ARC has the legal right to use MESA and I strongly suggest investigating this possibility before launching off on a big change to L10. -- Charles. 1

CHI 14-OCT-75 12:14 26672

Comment on 26670

(J26672) 14-OCT-75 12:14;;;; Title: Author(s): Charles H. Irby/CHI; Distribution: /DAV([ACTION]) NPG([INFO-ONLY]) ; Sub-Collections: SRI-ARC NPG; Clerk: CHI;

26672 Distribution

David C. Smith, Susan K. Ocken, Raphael Rom, Jan H. Kremers, David C. Smith, Andy Poggio, David L. Retz, Jan A. Cornish, Larry L. Garlick, Robert Louis Belleville, Elizabeth J. Feinler, Joseph L. Ehardt, Jonathan B. Postel, Kirk E. Kelley, Karolyn J. Martin, David S. Maynard, Kenneth E. (Ken) Victor, James E. (Jim) White, Elizabeth K. Michael, Don I. Andrews, J. D. Hopper, Charles H. Irby, Harvey G. Lehtman,

SRI-ARC Proposal No. ISC 75-218 A Text Processing System for G E Nuclear Engineering Division DRAFT

Introduction

About 75 pages. At this stage we redirected the proposal toward a system based on a single PDP-10 because we learned that single 10's adequate for this purpose would soon be selling at a price competitive with the group of mini's described. This draft is preserved for historical interest. It responds to an Inquiry from the General Electric Nuclear Engineering Division, XDOC 33089.

1 INTRODUCTION

1.1 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 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. NLS editing and formatting capabilities presently 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.

1.2 NLS presently runs on a DEC PDP-10 computer and is available to clients through a facility operated for SRI by Tymshare Inc. SRI is also operating NLS on client leased or owned PDP-10's. Because the PDP-10 can support more terminals than desired by GE, at a corresponding increase in cost, we are proposing to move NLS to run on a mini-computer architecture tailored to GE's present and future needs.

1.3 This architecture offers low-cost per workstation (terminal), rapid user response, and considerable flexibility in scaling, expansion, and adaptation to the rapidly changing technology of mini-computers, terminals, and peripherals.

1.4 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 COM and hardcopy versions.

> 1.5 Last Minute Insert: On Monday morning, October 13 we learned from the Digital Equipment Corporation (DEC) PDP-10 Product Line Manager that shortly after Janaury 1, 1976 DEC is going to announce a new PDP-10 Product, the KL 10/20 System. The 10/20 System will be slightly slower than the fastest current PDP-10 system, the KI-10, but faster than the KA-10 system that ARC now uses. A configuration of the forthcomming KL10/20 system

that would meet G E's speicifcations for file handling and number of users, will cost around $300,000 dollars. (DEC will not release price fingures firmer than that at this time.). Out experience indicates this 10/20 system would provide the rapid command response G E requires.

1.6 The cost of the forthecomming 10/20 system thus is about the same as the minicomputer-based system proposed here. If G E were interested in a system based on the PDP-10 KL 10/20 processor, we could deliver a system to to G E 's requirements with considerably less development cost. We discuss this possiblity in the section headed Supplement. The remainder of the poposal is oriented toward the minicomputter-based system, but for the most part is valide with respect to the system based on the PDP-10 except as noted.

1.7 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.

1.8 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 software. We consider it a thinkpiece because the short time to respond did not allow for detailed design. 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.

1.9 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 design of system, and user interface capabilities for those features not presently fully supported to GE requirements.

1.10 We have tentatively chosen the DEC PDP-11 family for use in the proposed design because of the hardware support capability of DEC, the flexibility of the PDP-11 architecture, and our experience with the PDP-11. The high level system programming

environment used in the construction of NLS and the NLS command language interpreter presently run on a PDP-11. SRI has also built two operating systems for PDP-11's.

1.11 As described below under Background, (Paragraph ???) SRI is actively involved in text processing applications with several other clients. The approach outlined in this proposal, we believe, would also be attractive to other clients. If the proposal approach is attractive to GE, it is a significant possibility that SRI could approach these other clients to share development costs with GE.

1.12

2 LIST OF ILLUSTRATIONS

1 Figure 1 System Configuration Following Paragraph XXXXXX

2 Figure 1 Modular Software Approach Following Paragraph XXXXXX

3 Figure 3 Command Syntax Following Paragraph 5.1.3.2

4

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I The Augmented Knowledge Workshop, Douglas C. Engelbart, Richard W. Watson, and James C Norton, The Augmentation Research Center, SRI, Menlo Park, Calif. March 1973.

II Coordinated Information Services for a Discipline or Mission-Oriented Community, Douglas C. Engelbart, The Augmentation Research Center, SRI, Menlo Park, Calif. March 1973.

III RWW NLS Usr Interface Paper

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 DLA Line Processor: A Device for Amplification of Display Terminal Capabilities for Text Manipulation, Donald I Andrews,..... paper

X Display Techniques for Interactive text Manipulation, ChArles H. Irby,.....

XI Charles CLI Paper

XII 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.

4.16

SYSTEM HARDWARE

5.1 INPUT/OUTPUT DEVICES

1 Required

5.1.1.1 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, Appendix xx.) The input devices are connected to the terminal computer through an interface designed by ARC to produce RS-232 asynchronious serial output. Much of the speed and flexability 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 users. These input devices are independent of the output display. For G E there are several possible displays available at this time.

At the lowest cost and capability level, 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. Although few interactive display users (least of all ARC) like the 80x24 format of these lowest cost displays, NLS uses dynamic formating and split screen capabilities to capitalize on the reliability and low cost of these devices.

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 Vydec 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 (or risk) involved in these hardware configurations restricts their inclusion in a production system at this time. G E may elect to include one or more of these high performance units in a mix with a number of low cost displays; however, because of operator adaptation and training problems this approach is not particularly recommended. 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 can provide 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 x 52 for about $10,000. Although special characters are included they are not the ones specified by the Inquiry. In general, ARC will be willing to work with G E to specify and interface any of these displays if the cost is satisfactory to G E.

The great white hope of the display market has been the Owens-Illinois plasma panel which was developed by Bitzer 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 minicomputers. 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 dissapointing 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. (Magnivox 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 panel. As a result the unit is difficult to use for linework with a moving cursor (the cursor effectively erases the screen) and the cursor must be constrained to the interline space in text displays which reduces the total line capacity by 6 (1 dot x 50 lines / 9 dots per character = 6 less lines)lines to 44.

It is recommended that G E initially adopt the Hewlett-Packard display because it represents a good compromise between performance and cost. As we have pointed out, any breakthroughs in display technology can be easily brought into the NLS environment at some future time with minimal impact on the system as a whole. We recommend that G E lease the displays so as to be able to take advantage of improved models in the rapidly changing display market. If G E is willing to consider units in the $10,000 to $20,000 range so as to achieve a closer approximation to full page portrayal, we will examine these units in greater depth.

Terminal keyboards can be ordered to G E requirements for character set and layout.

5.1.1.2 Medium-speed line printer.

The medium speed line printer required by the Inquiry can be provided by an electrostatic printer/plotter. This device 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 with a PDP 11 interface will provide 400 lines per minute on 11 inch wide paper for $10,800 with all special symbols generated by software. This unit has been used in the estimated system shown below.

5.1.1.3 Read/write tape drive.

In the example PDP 11 configuration, the tape requirements are met by the DEC TM11 9-track magnetic tape transport and control unit. The unit is expandable to a total of 8 TU10 transports, operates at 45 in/sec, 800 bpi and is industry compatible.

5.1.1.4 Photocomposer

ARC will work with G E to seek out and interface a photocomposer which 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 which 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.

5.1.1.5 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 G E 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.

5.1.1.6 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 consistant conventions for paragraph spacing and indentation during input, the material can be easily placed in the appropiate NLS file hierarchical positions. The Output Sequential File command provides compatability between NLS files and conventional sequential file structures.

5.1.1.7 Page layout console.

On-line 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.

5.2 CENTRAL PROCESSOR

1 Computer Mainframe

5.2.1.1 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. As a result, the present system must be mapped onto a minicomputer architecture which possesses both the computational power required, and the capacity to expand to meet the overall file size and terminal load requirements.

5.2.1.2 In order to meet the need for a responsive, low-cost system, a hierarchical minicomputer configuration has been selected which will provide not only, timely system response coupled with large on-line storage, but also a measure of redundancy which will insure maximum system availability. The system will consist of a central file and background computer and computers within each workstation. The architecture is described in more detail below.

5.2.1.3 A terminal configuration based on a single minicomputer cannot provide acceptable response for 16 interactive users, nor can it guarantee the level of reliability provided by an independent terminal computer approach. G E's requirement for

system responsiveness and large high speed displays cannot be met by conventional systems such as DEC's RSTS which is designed for low speed typewriter terminals, in fact, no manufacturer is offering high speed, multiterminal, display interaction and text formatting on anything like a minicomputer. Our experience is that, the PDP 10 on which the current NLS is based, cannot provide the level of responsiveness required by GE to more than twenty users. (The PDP 10 on which these judgments are based costs about $1,000,000.)

5.2.1.4 Workstation

Each operator will have access to a private display, cpu and disk file system with a local capacity of about 2.5M characters. The terminal computer will provide all the features of the text editor for purposes of file creation and manipulations. By providing 10 of these relatively low cost stations, each with removable disk storage, G E is assured that failure of the central system will not idle the entire department.

5.2.1.5 Background processor

A background machine completes 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 formating - The execution of document wide text substitutions and the formating 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 formating and subsequent printing. The background processor would also be used to actually drive the printer and the photocomposer.

A simple operator interface console will be provided for the background machine so that the system can communicate with G E 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,

5,2,1,6 While detailed specification of the target processor system must be deferred until the system design is completed, an example implementation is described below in the section titled System Architecture, The minicomputer market is at least as volatile as the terminal market and premature selection of hardware technology will not lead to the most favorable cost/performance ratio,

2 Mass Working Storage

5,2,2,1 In the PDP 11 example configuration, a dual drive RJP04 provides 176MB of storage on two removable disk packs with an average access time of 28 milliseconds and a 500,000 byte per second transfer rate,

3 System Architecture

5,2,3,1 Introduction

The architecture of the G E NLS system consists of a collection of software modules which implement the basic editor and document formatter (Output Processor), These modules are stored on both the terminal and background processor's disk and executed by an event driven multi-tasking operating system, Below we discuss each of the major modules in some detail,

5,2,3,2 File system

The file system module implements the well proven hierarchical file organization pioneered by SRI over the last several years,

Figure xx shows the internal organization of an NLS file, The hierachical structure of the data is a powerful organization which 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 which emanates directly from the file origin, any property may contain an inferior tree which may contain a tree of properties related to the parent property. This approach provides the flexability to handle mixed text and graphics and to provide for future features and capabilities.

Historically, NLS files have been 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 flexability requires that users exploit the structure by organizing their material into meaningful hierachies. 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.

Raw file size is a relatively unimportant measure of system capability. Sequential files can be constructed from multiple tape volumes; however, access time for an arbitrary character in the file may be on the order of several minutes as tapes are requested and mounted. The entire 88M character disk drive, recommended for this system, could contain a single file; however, even the access time for that file would be considerable.

NLS users have never found the 750,000 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 G E will contain the construct of a Document. The system facilities to support this construct can be used to:

1) 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.)

2) Control the archival and cataloging of very large documents.

3) 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.

4) 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.

5) Schedule and control modifications at the editor workstations.

Figure xx shows the organization of the Document entity.

The total file system consists of two main parts the central system and the terminal system. The central system is the larger of the two and possesses the ability to control about 160 million characters of on line storage. Each terminal has a smaller private file system which cooperates with the central system to provide the needed files at the workstation. This division of labor provides redundancy in the system and insures that the terminal processors have high speed access to the needed data.

File access control at the terminal workstation will take two forms:

1) Read only. Read only files will be partially mapped onto the private file system at the workstation as they are needed. This insures that files can be constructed from a number of large files without overflowing the capacity of the terminal file system. (Or the central system for that matter.)

2) Read/Write. Read/write files will be completely copied into the terminal system. While the number of large read/write files that can be stored at the workstation is limited, the central file system can insure that when a file is accessed for read/write:

a) A copy of the file is maintained to backup the terminal copy,

b) The file can be locked so that if another request is made for access it can be blocked and the second user notified,

c) A time/location stamp is placed on the file so that the publication supervisor can determine how long the file has been out and its current location.

For additional security, file modules (file modules represent parts of files, that is a module is not a whole file) that have been modified by the terminal workstations will be copied back to the central system to backup the terminal system. This facility insures that if either the central or terminal file system is damaged, then the modifications to files will not be lost.

When the modification of a file is completed at the terminal workstation, the file is returned to the central system, unlocked, and marked for rearchival.

5.2.3.3 User Interface

The user interface is implemented through the use of the Command Meta System which consists of 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. (ref CHI (CML) paper)

The CLI interprets the CML to parse a user command. The object of the parse is a data structure which is passed to the appropiate 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 which modifies the file and evokes the module which updates the display.

The interpreter uses a data base known a Useroptions to determine the form and verbosity of the prompting and the type of command response the system will reconize. The data in the

useroptions is manipulated by a subsystem which alows the users to tailor the system to their requirments.

The interpreter does not process the CML directly. CML definitions are compiler in to an efficient data structure callded the grammer.

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 flexability and conciseness which is not matched by preprogrammed command system found in commercial systems. This is importand in tuning the user interface to different applicaions and installations and in providing flexability in system evolution. See Appendix xx (rww NLS user interface paper)

5.2.3.4 Virtual Display System

NLS uses the concept of a virtual display system to insure that new displays can be added to thesystem and to insure that the device dependent display code is contained a a level within the system which allows the higher parts of the system to process text and format displays with out any knowledge of the particular devide attached.

5.2.3.5 Minicomputer Central Processors.

Minicomputer processors

The selection of a processor for the implementation of the NLS document publication system must be approached with a good deal of caution. Over the years since its introduction in the form of the PDP 8, the minicomputer has evolved into a sophisticated and powerful computer concept. Modern processors such as the PDP 11, Data General Eclipse, Hewlett-Packard 2100 and 3000, Interdata 8/32, Modcomp IV, Prime 300, Sel 32, and the Varian 700 series machines are considerably more effective processors that any of the so called second generation large mainframes (and many of the third generations as well). Because of cost and technology limitations, these machines do have limitations in both calculation ability, and in architecture.

With a very few exceptions these processors are based on 16 bit words (2 to the 16th power is about 65,000) and have a limited direct address space. The PDP 11 for example was developed with a total memory capacity of only 28,000 words. As memory

costs have fallen, steps have been taken to increase the total physical memory available. The 11/70 has a box which allows the machine to handle 2 million bytes of physical memory; however, the machine architecture is essentially the original 11/20 with its 28,000 word bound. In short, minicomputer manufacturers use a good deal of adhoc design in the evolution of a computer system.

Minicomputer software

System software for minicomputers is identical to the software required for large mainframes and it is just as expensive. When the PDP 8 was introduced the only users were a class of devoted assembly language coders (or professional people who became so) who were able as a class to do some rather remarkable single instance software. Unfortunately, neither system concepts nor software technology was significantly advanced by these one of a kind systems. Now that minicomputer architectures can be reasonably configured to contain several cooperating processors, extensive memory, and complex high performance peripherals, the problem of minicomputer system architecture, system design, and software maintenance is no less than what is required for the large systems of this decade and the last.

Stated simply, modular programming consists of the specification of program modules which operate on a specific data base and produce a specific result. Moreover, the system implemented with the modular approach must be organized so that each module is functionally compact and that the data processed by the module is likewise compact enough so that the input and output data stuructures can be fully described and encoded. Then if strict programming disclipline is followed, as new modules are needed they can be added, and existing modules can be modified without fear of unexpected side effects.

The modular software approach proposed here represents the only viable long term solution to the software problem available today. Software systems which 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 an attention to implementation detail which is currently almost unachievable.

NLS has over the last several years undergone major changes to improve its modularity. The file system, the command system, the editor, the programming language, the portrayal generation

system, the Journal, the user program systems, and the Output Processors represent modules which work together to effect a viable, living system which can be converted to the multi-minicomputer architecture without rethinking the basic system approach.

In the final analysis, it is the system software that forms the system and not the hardware. Systems which have been designed around existing hardware will lose their viability much sooner than systems based on genuine solutions to problems. NLS is such a solution.

Figure xx shows the organization of the modular NLS system and indicates the division of labor betweem terminal and background processors and the flexability of the modular approach.

An example of minicomputer architecture for use in the G E NLS system

Hardware Considerations

It is not the intent of this document to finalize the hardware solution to the G E requirement; however, the equipment list below, based on the PDP 11 series, represents a workable solution and provides an example of the cost of the hardware involved.

In this example, a PDP 11/10 is used as the terminal processor. The choice of an 11 series machine was made to exploit ARC's expertise in system and language development on PDP 11s. The Model 10 was chosen for minimum cost based on current availability. The PDP 11/03 is an LSI implementation of the 11/40 instruction set and the 11/20 I/O structure which has been introduced recently. The 11/03 will provide a significant price/performance improvement over the 11/10; however, at present there is not a high performance disk available for that machine. As a result the 11/03 cannot be used until a cartridge disk drive is provided by DEC. Both the 11/10 and 11/03 lack the capacity to include more that 28,000 words or central memory. No provision for the expansions to a large physical address space is anticipated from DEC for these two models. The 11/40 can provide for 128,000 words of physical memory as can the model 45. The Model 70 provides for 2,000,000 words; however, the 11/40 is significantly more expensive than the Model 10. As a result the 11/40 cannot be used as the terminal processor although an 11/40 may be indicated for the background processor.

Interprocessor communication between the PDP 11s is provided by the use of back-to-back parallel 16 bit general purpose interfaces.

Other System

Data General has provided systems of the sort described here and provides hardware and system support for applications of this sort. As a result, the new NOVA 3 might be selected as the terminal processor and an NOVA 800 or ECLIPSE used a the background machine.

The new Interdata 8/32 utilizes an IBM 360/370 instruction set and provides direct addressing for a million bytes of memory. While the 8/32 is a real candidate for the job of background machine, it is too expensive for the terminal processors. In addition, the speed of the 8/32 is not as impressive as the Eclipse for non-numerical applications.

Processors such as the System Engineering's SEL 32, the Prime 300, and the Modcomp IV are candidates for G E implementation; howvever, the data is not all in from these manufactures and independent from performance, the ability of these companies to deliver and service their equipment is a real question.

Because of our experience with the PDP 11 and the backlog of code already generated for the machine, it is unlikely that the cost advantage of an alternate manufacturer would overcome the cost of converting the system. However, ARC can only finalize the selection of processor after sufficient system design has been completed.

Figure xx shows the topology of the G E NLS system.

As the development plan shows, ARC will work with G E to select the correct hardware for the implementation that will insure the success of the project and provide the highest cost/performance ratio possible at the time the equipment is selected.

While the prices listed below were obtained from the current DEC price list they are not a quote and will not represent the exact cost.

Central Processor and File System

32K PDP 11/10 $12,000

176MB dual drive disk	60,000
9 track tape unit	11,500
Varian printer	11,000
communication gear	5,000
Cabinates, cables, etc	5,000
Total	$104,500

Terminal Processors

16K PDP 11/10	$ 8,000
2,5MB disk	11,000
Communication, cables, etc	2,000
Mouse, keyset, keyboard	1,500
Total	$22,500

Total system

1 - Central Processor	$104,500
10 - Terminal Processors	$225,000
10 - Hewlet-Packard 2460	$ 37,000
1 - Tektronix 4014 page proof station	$ 11,000
1 - backup printer and operator console	$ 5,000
1 - Photocomposer	?
Total	$376,500

(plus photocomposer)

5,2,3,6 Software maintenance

The present proposal assumes that the system will be developed

on a PDP 10 and source code compiled for running on the chosen mini, We have included a communication link as part of the system configuration to a PDP 10, This link will allow ARC and G E to reach through to maintain the system, load new systems with additional features, and load new G E written user programs for developing G E needs.

The PDP 10 could be the one operated by Tymshare for SRI at its Cupertino location or another seleted by G E at Tymshare or elsewhere, If the PDP 10 is other than the one operated by Tymshare for SRI, the system source code would have to be maintained on the publication system hardware itself, The CML and L10 compiliers can operate outside of the NLS environment on any Tenex operating system.

The arrangements and costs for such PDP 10 use are not included in this proposal, nor is the cost of moving the compilers to operate stand alone on the mini system, We would be happy to provide sych an estimate at G E request.

5,2,3,7 Bootstrapping and system recovery

The system can be bootstrapped from either tape or disk.

5,3

6 SOFTWARE

6,1 INTRODUCTION

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 are listed selected features of NLS not directly specified in the Inquiry, but which we believe would support the NED's documentation work, In most cases NLS instructions are given 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, Appendix III, 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, Appendix ???, 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,

2 SRI will provide copies of NLS software and associated compilers to the G E Nuclear divisions in the form of source tapes, and object tapes, NLS was developed largely under U,S, government sponsorhip, but SRI desires to maintain rights to the software as converted for G E needs,

3 Definitions of Terms
Certain terms common in speaking about NLS are used so frequently in this part of the proposal that we define them separately here:

6,1,3,1 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,

6.1.3.2 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 format. This statement (paragraph) is on the same level as the one preceding and following, it is a substatement of the Heading, "Definition of Terms"

6.1.3.3 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 3) Although other response formats are available, in general a user 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 when she sees that the command is implemented. NLS is a full duplex system.

6.1.3.4 "Part of a File":
The Inquiry in several places requires that a formatting function or a command be able to function over "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. Most editing commands in NLS (delete, copy, etc.) may address any string of consecutive characters in a file without regard to statement boundaries. The Replace command and a few others that would leave statement boundries ambiguous can only address strings withinstatements.

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 structe recognized by NLS as addressable entities, (See "structure" in appendix ???). One of these is, for example, a branch which comprises a statement and all it substatements.

"Directives" in the NLS formatting system generally take effect over any consequetive string of characters in the file if that is appropriate to their function.

6.1.3.5 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 operators 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 G E Nuclear Engineering Division, an operator loging in to the system will in addition supply a secrete string of characters called password.

6.1.3.6 Directives:
Formatting commands to control the layout of printed documents are imbeded in NLS text. They are called directives. Appendix ??? lists them alphabetically.

6.2 FUNCTIONAL CATEGORIES

1 Our response attempts to follow the division of software functions presented in the Inquiry at paragraph 2.2.1

6.3 SYSTEM AND FILE CONTROL

1 Required

6.3.1.1 System and Subsystem entry and exit. In present NLS an operator signs on through the timesharing systems Login command, which requires a password, selects subsystems by the NLS Goto Subsystem Command, gains access to files by the Jump to Link or other Jump command. One file is returned to storage automatically when another is displayed. The system developed for G E might have slightly different login and other operating system level type commands because of the change in operating system. At present any NLS function may be performed at any terminal or any number of terminals simultaneously, excepting output or display functions limited by the nature of the terminal and certain systems functions limited to key personnel. Queuing for access to certain formatting and global file operations might be necessary in the system proposed for G E depending on size of the central machine.

6.3.1.2 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. Similar capabilities will be provided for the G E system.

6.3.1.3 Input Control. When typing from an online keyboard, it is possible to backspace-delete single character by typing a single control character, and to backspace-delete to the previous space by typing another control character.

6.3.1.4 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.

6.3.1.5 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. Such capabilities will be provided on the G E system.

6.3.1.6 File Size. Present NLS files are limited to 370 pages of 512 36-bit words each (9.5 x 10(5)) characters). In the system proposed for G E a higher-level unit called a Document (see paragraph ????) will encompass and control many NLS files to provide the global functions G E requires.

6.3.1.7 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 will be provided.

6.3.1.8 Record Keeping. The NLS Show File Status Command displays information about file size, date, time, and the like. 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.

6.4 EDITING PROGRAM

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 his view of the location.

2 Print. The NLS Jump command displays the statement in which a specified string of characters appears. The NLS Content Analyser function allows display of all statements in a file that contain a given string. A string of characters out of the context of its statement cannot be displayed, except in some special circumstances (e.g., if it is the first string in a statement).

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.

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.

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.

6 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 G E representatives they indicated this syntax to be satisfactory, except in the case of global commands, discussed below.

7 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.

8 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 lines. We anticipate no difficulty in modifying the substitute command to conform to G E'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 documents larger than present NLS files.

9 Commands for Photocomposition. Commands that control the operation of the lineprinter or COM format are embedded in the NLS file as text. (See Appendix XXX, "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. We anticipate no difficulty converting this output to a form suitable for a photocomposer.

10 Special provisions for tables. The NLS Xtable subsystem partially fulfills NED's requirement for handling tabluar material. It allows the operator to insert tabluar 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.

6.4.10.1 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 Appendix XXX), 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 G E to specify a fully satisfactory method of handling tabular material.

11 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.

12 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.

13 Table of Contents, list of illustrations, list of tables.

Current features of NLS provide for G E'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 G E 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.

14 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.

15 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).

16 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 G E in specifying a satisfactory method of indexing as part of the function development discussed below (?????) and anticipate no programing difficulties.

6.5 FORMATTING PROGRAM FOR LINE PRINTING AND KEYBOARD/PRINTER

1 Required

6.5.1.1 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 Appendix XXX:) 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.

6.5.1.2 Margins. Right-hand and left-hand margins may be specified for textual output with the NLS Output Processor directives (Appendix XXX: "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" (Appendix XXX:). With the Insert Edge command she may create columns on the screen which will be reproduced when printing the screen image through a line printer.

6.5.1.3 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 Appendix XXX) Development work now going on for another project will provide hyphenation.

6.5.1.4 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 Appendix XXX: header directives beginning on page 27, with "H1"-Text of page Header 1; footer directives beginning on page 21, with "F"-Text of footer.)

6.5.1.5 Page numbering. The NLS Output Processor provides page numbering as described in the Inquiry under the control of embedded directives (Appendix XXX: "GPN"-Generate text for page number; "PNType"-Page number type).

6.5.1.6 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 (Appendix XXX: "PBL"-Paginate before this line; "PBS"-Paginate before this statement; "PEL"-Paginate at end of this line; "PES"-Paginate at end of this statement).

6.5.1.7 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 (Appendix

XXX: "YBL"-Distance between lines in a statement; "YBS"-Distance between statements).

6.5.1.8 Space and picture. Directives exist in the NLS Output Processor to set aside white space for illustrations as described in the Inquiry (Appendix XXX: "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 (Appendix XXX: "Grab"-paginate if can't fit n lines on page), the pagination requirements for handling white space are also met.

6.5.1.9 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 (Appendix ???) control indenting on the display.

6.5.1.10 Begin paragraph. Directives exist in the NLS Output Processor to control indenting and line interval between paragraphs as described in the Inquiry (Appendix XXX: "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.

6.5.1.11 Center. A directive exists in the NLS Output Processor to center any number of lines as described in the Inquiry (Appendix XXX: "Center"-Center the next n lines).

6.5.1.12 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 (Appendix XXX: "Tabto"-Tab to given character position). Note, however, the problems of handling proportionally spaced tabs discussed under "Special provisions for tables", above.

6.5.1.13 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.

6.5.1.14 Literal and ignore. Provisions exists in the NLS Output Processor to print formatting commands ("directives") as described in the Inquiry (Appendix XXX: "D"-Print directives switch). The NLS Output processor also allows text segments to be ignored (Appendix XXX: "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).

6.5.1.15 Stop. A command exists in NLS to stop a line printer. It would be duplicated in the proposed system. 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.

6.5.1.16 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 (Appendix YYY, "The Format Library"). These also allow for the insertion of further formatting by hand.

6.5.1.17 Single and continuous form. Provision exists in the NLS Output Processor to automatically output only specified pages, suppressing all others but scanning them for formatting commands (Appendix XXX: "PShow"-Output only these pages).

6.5.1.18 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 "CHANG ED" 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 (Appendix ???). The capacity to mark statements with revision bars could easily be added.

6.5.1.19 Automatic paragraph numbering. Provision exists in the NLS Output Processor for automatic paragraph (statement) numbering as described in the Inquiry and also in several other formats (Appendix XXX: "PxNShow"-Plex number level switch; "PxN"-Plex numeral style/level). Thes directives were used to number the paragraphs of this proposal. Statement numbers may be display Automatically under the control of viewspecs (Appendix ???). The format in the current NLS for display of statement

numbers differs from G E's standard format, but it could easily be made to conform to G E 's usage,.

6,5,1,20 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 G E whether the function should be based on making figures with special invisible characters or marking a strict naming convention in the text.

6,5,1,21 Automatic renumbering of references to text in paragraphs. NLS does not automatically renumber references. The feature could be developed without great difficulty.

2 Optional

6,5,2,1 Running heads. NLS does not provide for automatic creation of running heads. However, this feature could be easily developed.

6,5,2,2 Security classification in heads and feet. NLS does not provide for security classification indicators in headers and footers. Along with running heads, above, this could be developed with minimum effort.

6,5,2,3 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 ay designated character.

6,5,2,4 Equations. NLS does not have a package for the formatting of mathematical equations, though this capability could be developed, by extending our graphic capability.

6,6 INSTRUCTIONS FOR PHOTOCOMPOSITION
NLS DOES NOT PRESENTLY SUPPORT OUTPUT TO A PHOTOCOMPOSER, HOWEVER THE OUTPUT PROCESSOR (APPENDIX XXX) 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.

1 Commands to photocomposer. The commands are described in (XXX).

2 Provision for special characters. Provision for special characters for the photocomposer is discussed in connection with the NLS character set (????)..

3 Increased line spacing to allow for Overscoring, Superscripts, and Subscripts. Provision for special line spacing may be developed as described in (4.5.1.13).

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.

6.6.4.1 Commands to fill and Justify are discussed in 5.5.1.3.

6.6.4.2 Commands to Ignore and execute instructions ("directives" are discussed in paragraph 5.5.1.14

6.6.4.3 The "stop" provision is discussed in paragraph 5.5.1.15.

6.6.4.4 The "ignore" provision is discussed in paragraph 5.5.1.17.

5 Special instructions. All special instructions described under this heading in the Inquiry exist as directives discussed in 4.5 and explained further in Appendix (XXX). No difficulty is anticipated in development to transfer them to a photocomposer.

6.6.5.1 The directives to change type size begin with the word "Size" (See Appendix XXX)

6.6.5.2 The directives to change type size begin with the word "Face" (See Appendix XXX)

6.6.5.3 Provision for special characters is discussed under ?????

6.6.5.4 The directives "Ybl" and "Ybs" (See Appendix XXX) control line spacing to within the thousandth of an inch.

6.6.5.5 Several directives control page layout, see ???? and Appendix ??? page 12. They include two and three column layout.

6,6,5,6 The directive "WidowL" described in Appendix XXX 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,

6 Page layout console, NLS provides a page layout console as described in ???(1alg), For photocomposer output it would operate exactly as it does for COM,

6,7 OTHER NLS FEATURES WE BELIEVE WOULD BE USEFUL TO NED DOCUMENT PRODUCTION,

1 View control and easy accessing, NLS incorporates several important features that serve to quickly locate and manipulate large volumes of online information,

6,7,1,1 Split screen, It is possible to divide the display area of an NLS screen into several windows and display contents of separate files in each window, This greatly facilitates cross file editing, and incidentally allows the user to printout drafts of column width, the width of the display window,

6,7,1,2 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,

6,7,1,3 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,

6,7,1,4 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 which 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 Appendix ZZZ, "NLS-8 Glossary": "position", "Jump", and "contentaddress"), For example it is possible to go to the second occurence 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 text in a machine readable form and used in commands for the operator's future convenience.

6.7.1.5 Command Repetition. By ending a command with a special termination character an operator can cause a command to repeat up to the point of the address where it should take place. The command will continue to repeat until she leaves the repeat mode. This command greatly facilitates repedative 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.

6.7.1.6 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.

6.7.1.7 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.

6.7.1.8 Format. A special subsystem called Format aids the operator in formatting 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 Appendix YYY, "Format Library"; a complete description may be read in Format 10.) Format are added to the library from time to time in a few days programming time depending on complexity.

6.7.1.9 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 bibliographic or document control interest. The journal has been used to control distribution and updating or NLS user manuals.

6.7.1.10 Help. NLS provides online information about the system and how to use it with its Help command. After typing 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, Appendix ???, was derived by a semi-automatic process from the Help data base, a procedure which was itself an inovative step in computer-based documentation.

6.7.1.11 Automated Editing Commands exist 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. (Appendix ???) Others are added from time to time in the course of NLS development.

6.8

7 SYSTEM ARCHITECTURE

7.1 Essentially the architecture of the NED NLS system consists of a collection of software modules which implement the basic editor and document formatter. These modules are stored on both the terminal and background processor's disk and executed by an event driven multi-tasking operating system.

7.2 The file system module implements the well proven hierarchical file organization pioneered by SRI over the last several years.

7.3 The user interface is implemented through the use of the Command Meta System which consists of 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. (ref CHI and DIA's papers)

7.4 The CLI operates on the output of the CML compiler, called the grammar, to parse a user command. The object of the parse is a data structure which is passed to the module related to the grammar.

7.5 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 grammar 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 which modifies the file and evokes the module which updates the display.

7.6 Because of the high level description of the user command set (CML) and the interpretation of the grammar 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 commercial systems.

7.7 It is not the intent of this document to finalize the hardware solution to the G E requirement; however, the list below based on the PDP 11 series represents a workable solution and provides an example of the cost of the hardware involved. The prices quoted here are taken from the February price list and will not represent the exact cost.

1 Central Processor and File System

7.7.1.1 32K PDP 11/10 $12,000

7.7.1.2 176MB dual drive disk 60,000

7.7.1.3 9 track tape unit 11,500

7.7.1.4 Varian printer 11,000

7.7.1.5 communication gear 5,000

7.7.1.6 Cabs, cables, etc 5,000

Total $104,500

2 Terminal Processors

7.7.2.1 16K PDP 11/10 $ 8,000

7.7.2.2 2.5MB disk 11,000

7.7.2.3 Communication, cables, etc 2,000

7.7.2.4 Mouse, keyset, keyboard 1,500

Total $22,500

3 Total system

7.7.3.1 1 - Central Processor $104,500

7.7.3.2 10 - Terminal Processors $225,000

7.7.3.3 10 - Hewlett-Packared 2460 $ 37,000

7.7.3.4 1 - Photocomposer $ 20,000

Total $380,500

7.8

8 DEVELOPMENT PLAN

8.1 After the initiation of the contract period a final detailed hardware specification would be completed, in cooperation with G E, to insure that exactly the correct match of terminal, processor and storage hardware was obtained. All of the equipment would be delivered to SRI for development and subsequent testing.

8.2 In addition to the specification of the hardware, detailed acceptance criteria would be developed in conjunction with G E. An acceptance test schedule would be developed at this time to include tests both at SRI and the target G E locations.

8.3 Concurrent effort would begin to:

1 1) Remodularize the current NLS software for execution on the multi-minicomputer system.

2 2) Establish and implement communication and operating system protocols.

3 3) Specify and code the file system.

4 4) Adapt the NLS command system to the specific equipment configuration. (This involves the Command Language Interperter - CLI and related systems described below.) Effort on the CLI parallels work conducted for the National Software Works development (See - ???????? nsw literature) and would draw heavily from that work.

8.4 Reorganization of the existing Output Processor would be started as soon as the inter-module communication was established and its implementation would continue throughout the contract period.

8.5 NLS features not currently provided by the existing system (such as tables) would be designed in cooperation with G E and added to the modular framework. These features are independent of the central architecture of the NLS system and can be completed in parallel with the rest of the system development.

8.6 Early capability demonstration would be conducted about six months after the receipt of the complete hardware system with subsequent modification and final cleanup continuing for about three months followed by delivery of the system to G E.

8.7 The system will be developed on a PDP 10 and cross compiled to run on the chosen minicomputer. We presently have such software for the PDP 11 family of machines.

8.8 We have NOT included in the cost estimate an item to move all compilers to run stand alone on the minicomputer system. We do not think this cost effective for G E and discuss this issue under Software Maintenance (Above).

8.9 NLS is written in a block structured high level language called L10. L10 was developed by ARC and has been in use by ARC for 5 years. It is part of the powerful systems building environment used at ARC that consists of NLS itself, L10, interactive source level debugging system, Command Meta System mentioned above, Tree Meta compiler building system, and other tools. The full power of this environment extends across machine boundaries to the PDP 11 presently.

8.10 A man-power utilization estimate for the project is tabulated below for the various development and implementaion tasks (person-months):

TASK AREAS	Months 1-3	4-6	7-9	10-12	Total
Leadership/coordination	1	1	1	1	4
Detailed design	3				3
Hardware selection	1				1
Software development					
Operating system	1 2				3
File system	1 5				6
Editor	6 6	6	6		24
Output processor	3 3	3	3		12
New features	3 3	3	3		12
Acceptance testing	1		1	2	4
Training				3	3
Documentaion		3	3	3	9

Training

Totals	---	---	---	-----	-----
	20	23	17	21	81

TRAINING

9.1 MANAGEMENT

1 A three-day version of the seminar currently given to potential clients (Appendix???) 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.

9.2 SYSTEM SUPERVISOR

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.

9.3 OPERATORS

1 Training will be conducted 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 will 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 concentrating on Formatting and Photocomposition. There will be a one-week break between the two weeks of training; there will be 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.

9.4 PROGRAMMERS

Training

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.

2 If G E is interested in developing an NLS programming capability beyond modest user programming and a general understand of system operation, more extensive training will have to be negotiated on the basis of G E's needs and the background of the programmers involved.

9.5

10 SYSTEM SUPPORT ;

10.1 HARDWARE UPDATING AND MAINTENANCE

1 The equipment selected will be maintained through a separate aggreement between G E and the manufacturer. 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. Manufacturers updates wil be installed in coperation with both G E and ARC to insure that the system software is not impacted by these additions.

10.2 SOFTWARE UPDATING AND IMPROVEMENTS

1 The present proposal assumes that the system will be developed on a PDP 10 and source code cross compiled for running on the chosen mini. We have included a communication link as part of the system configuration to a PDP 10. This link will allow ARC and G E to reach through to maintain the system, load new systems with additional features, and load new G E written user programs for developing G E needs.

2 The PDP 10 could be the one operated by Tymshare for SRI at its Cupertino location or another seleted by G E at Tymshare or elsewhere. If the PDP 10 is other than the one operated by Tymshare for SRI, the system source code would have to be maintained on the publication system hardware itself. The CML and L10 compiliers can operate outside of the NLS environment on any Tenex operating system.

10.3 TRAINING IN THE USE OF NEW HARDWARE AND SOFTWARE FEATURES

1 One week of trainer's time per year will be provided for training in new features or changes in old ones.

10.4

11 UNIQUE ADVANTAGES OFFERED BY SRI FOR THE GE SYSTEM

11,1 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,

11,2 The NLS system contains many features, in addition to the requested requirements, useful to GE's application needs,

11,3 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,

11,4 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,

1 The modular NLS system structure provides for ease of maintenance and evolution,

2 The User Interface system provides ease of tailoring and the addition of new features,

3 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,

4 NLS is display system independent and provides for easy display upgrading as GE's needs change and the display market matures,

5 NLS contains a rich modular set of system primitives for easy addition of new features,

11,5 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 significant possibility that even the proposed developments to meet GE special requirements might be cost shared with others,

11,6 The broad applicability of the system that makes it suitable for much wider application with n GE once successfully introduced in NED,

11,7 The proposed architecture will yield high reliability,

excellent responsiveness, and will maintain these characteristics during low cost expansion steps should these be required,

11,8 The power of the development environment in which the system will be implemented will be available to GE for its ongoing maintenance and evolution,

11,9

12 BACKGROUND

12.1 GENERAL CAPABILITIES OF SRI

1 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.

2 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,

3 biologists, and metallurgists, economists computer scientists, psychologists, market analysts, educators, and many others representing a variety of professional and technical skills.

4 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.

5 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.

6 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.

7 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.

8 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.

12,2 INFORMATION SCIENCE AND ENGINEERING DIVISION

1 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.

2 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.

12,3 AUGMENTATION RESEARCH CENTER

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 G E would gain by engaging ARC to provide this service,

2 Summary

12,3,2,1 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,

12,3,2,2 Internally the NLS software is grouped into subsystems that briefly perform the following asks:

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,

12,3,2,3 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,

12,3,2,4 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 developing experience on several fronts. These focus on:

he 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 R&D community

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

3 Documentation Production Activity

12,3,3,1 General

Documentation Production through NLS

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 group of commands beginning with "Insert" in the NLS Editor Subsystem. The basic insert commands are illustrated in the accompanying Glossary (Appendix ????).

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 translations 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 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 more rapidly and flexible than is the case with paper copy or online online systems that address text line by line. This facility is particularlly useful 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. Basic information about editing can be found in the accompanying Editing Sample Sessions.

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.

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 Sessionn.

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.

12.3.3.2 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 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 G E and are biging 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 by 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 and $15,000, although the figures are not strictly comparable because of overhead differences. 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??????

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 cassett tapes later read online (DEX), or by authors usually at display stations, and occasionally by translation from sources 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 online. 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.

All the document attached to this proposal as appendixes 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-operationwith ARC has proposed to the National Science Foundation to develope and evaluate an Editorial Procesing Center for Academice journals. This proposal is closely reated to G E's requirements because

it would involve deloping a version of NLS that would make editing commands available on a small local processor. The requirements for academic journals are different from those at G E particularly because they represent smaller operations, but there is enough overlap to indicate substantial development costs could be shared. The proposal has not been accepted at this writing but after a period of length negociations were are expecting its form acceptance at any time.

4 Recent Development Work Of Particular Relevance

12.3.4.1 In cooperation with several DoD agencies the Defense Advanced Research Project Agency is managing ad 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 Appendix ???), were developed under sponsorship of the National Software Works which continues to sponsor development in this area at about $250,000$ per year.

Modification and expansion of ARPANET protocols to support these developments. These protocols function in the environment of the ARPA network but they are relevant to development of a system architectures suitable to NED's needs in that they establish techniques for allowing machines of the type proposed to communicate reliably and efficiently.

12.3.4.2 During 1973 ARC Developed a microcomputer-based device (APPENDIX ??) that makes any of a class of alphanumeric display terminals useful as high quality two-dimensional interactive workstation. The device supports a mouse pointing device, a five-finger keyset, a medium-speed printer, and a graphics display and requires no hardware modifications either to the display terminal or to the main computer The techniques developed in this device will be incorporated within the software

for each NED workstation and will simplyfy upgrading display systems as the terminal market develops.

5 Development Community and Utility

12.3.5.1 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.

12.3.5.2 Elements Of The Workshop Utility Service Relevant to G E

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 (???) below. 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 G E 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.

12.3.5.3 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.

6 History

12.3.6.1 A brief description of some of the accomplishments of ARC over the past 12 years will attest to to its substantial position in the development of effective services to 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.

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.

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 prototype 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.

12.4 INFORMATION SCIENCE LABORATORY

1 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.

2 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.

3 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.

12.5 THE INFORMATION SYSTEMS GROUP

1 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.

2 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.

3 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.

4 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.

12.6 MANAGEMENT SYSTEMS DIVISION

1 For the Hanford Engineering Development Labs the Industrial Management Department of the Management Information Systems Division designed a Documentation Control and Retrieval System.

2 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.

3 The document and location identification system developed is conputerized 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.

12.7 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. Dr. Robert Belleville would be project leader under the project supervision of Dr. Watson. We include the resumes or other programmers from ARC and supporting groups who are knolwedgabe in this area and might be expect to work on the project anlong with the resmues of specialists in training and application of computer-based systems to text processing

1 DOUGLAS C. ENGELBART, DIRECTOR
AUGMENTATION RESEARCH CENTER
INFORMATION SCIENCE AND ENGINEERING DIVISION

12.7.1.1 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

12.7.1.2 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

12.7.1.3 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)

12.7.1.4 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

12,7,1,5 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)

2 RICHARD W. WATSON ASSISTANT DIRECTOR
AUGMENTATION RESEARCH CENTER
INFORMATION SCIENCE AND ENGINEERING DIVISION

12,7,2,1 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

12,7,2,2 Representative research assignments at SRI

. Assistant director, Augmentation Research Center
. Manager, ARPA Network Information Center

12,7,2,3 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

12,7,2,4 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

12,7,2,5 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

3 JAMES C. NORTON, ASSISTANT DIRECTOR
AUGMENTATION RESEARCH CENTER
INFORMATION SCIENCE AND ENGINEERING DIVISION

12,7,3,1 Specialized professional competence

. Research management; man-computer system development and operation; information system development operation

12,7,3,2 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

12,7,3,3 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

12,7,3,4 Academic background

. B.A. in economics (1953), Stanford University

12,7,3,5 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)

4 ROBERT L. BELLEVILLE, RESEARCH ENGINEER
AUGMENTATION RESEARCH CENTER
INFORMATION SCIENCE AND ENGINEERING DIVISION

12.7.4.1 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

12.7.4.2 Representative research assignments at SRI

. Design and implementation of a computer graphics extension to NLS, adaptation of NLS to minicomputer-based systems.

12.7.4.3 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

12.7.4.4 Academic background

. B.S.M.E. (1968), M.S. in computer graphics (1969), and Ph.D. in man-machine communication (1974), Purdue University

12.7.4.5 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)

12.7.4.6 Honors

. Crozier Award for outstanding achievement in the development of
the Automotive Data System at Aberdeen Proving Ground

5 DIRK H. van NOUHUYS, RESEARCH ANALYST
INFORMATION SCIENCES LABORATORY
INFORMATION SCIENCE AND ENGINEERING DIVISION

12,7,5,1 Specialized professional competence

. Technical writing; all types of writing; technical publications management; application of computer based techniques to technical publications; teaching writing

12,7,5,2 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 andpromoting development of computer-based text processing systems.

12,7,5,3 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)

12,7,5,4 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

12,7,5,5 Publications

. Coauthor of one 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

6 ELIZABETH K. MICHAEL, PROGRAMMER
AUGMENTATION RESEARCH CENTER
INFORMATION SCIENCE AND ENGINEERING DIVISION

12,7,6,1 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

12,7,6,2 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

12,7,6,3 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 statistician, Office of the Dean of Students, Stanford University

12,7,6,4 Academic background

. B.S. in physical science/organic chemistry (1947) and M.A. in economic statistics (1948), Stanford University

12.7.6.5 Publications

. Various articles and manuals for the Stanford Computation Center; articles on computer measurement and accounting for the SHARE Computer Measurement and Evaluation Project

12.7.6.6 Professional association

. Association of Computing Machinery (former member)

7 HARVEY G. LEHMAN, SYSTEMS PROGRAMMER
AUGMENTATION RESEARCH CENTER
INFORMATION SCIENCE AND ENGINEERING DIVISION

12,7,7,1 Specialized professional competence

. Design and development of large software systems; applications programming; experimental high energy physics; technical writing

12,7,7,2 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

12,7,7,3 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

12,7,7,4 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)

12,7,7,5 Publications

. L10 Manual; TreeMeta Report; 1972 Rome Report; 1972 ICCC Video Tape

8 JOSEPH L, EHARDT, RESEARCH ENGINEER
AUGMENTATION RESEARCH CENTER
INFORMATION SCIENCE AND ENGINEERING DIVISION

12,7,8,1 Specialized professional competence

. Design and implementation of man-machine interactive software, with emphasis on text manipulation systems; evaluation of minicomputer networks and distributed processing systems; evaluation of operating system structure; design and implementation of mass storage data management systems; specification and implementation of computer programming languages; systems programming

12,7,8,2 Representative research assignments at SRI

. Development of an advanced interactive display text editor on a PDP-11 minicomputer
. Development of an advanced interactive display text editor on a CDC 3300 medium-scale computer
. Development of line-oriented text editor using a minicomputer with both direct-coupled and remote teletypes
. Specification of a highly reliable programming language to be used in real-time process control environment
. Development of software for communication between two minicomputers
. Specification and implementation of mass storage data management systems
. Optimization of systems executing on multiprogramming machines with uniprocessor or multiprocessor configurations

12,7,8,3 Other professional experience

. EDMAP Industries; specification of machine-independent programming language translators
. R&S, Service Bureau Division of Sperry Rand Corporation
. Miller Freeman Publications; design and implementation of computer programs for magazine publishing and text processing

12,7,8,4 Publications

. SRI client and internal reports

12,7,8,5 Professional associations and honors

- Association for Computing Machinery--special interest groups on operating systems (SIGOPS), programming languages (SIGPLAN), microprogramming (SIGMICRO), architecture of computer systems (SIGARCH), computer graphics (SIGGRAPH), and symbolic and algebraic manipulation (SIGSAM)
- Institute of Electrical and Electronics Engineers (Computer Society)
- Sigma Xi/Scientific Research Society of America

9 THOMAS L. HUMPHREY, SENIOR RESEARCH ENGINEER
INFORMATION SCIENCE LABORATORY
INFORMATION SCIENCE AND ENGINEERING DIVISION

12.7.9.1 Specialized professional competence

- Analysis, design, and implementation of real-time/online as well as off-line batch processing computer systems; human/machine interactive computer systems; distributed computer systems having both centralized and remote processors and utilizing telecommunications networks; text manipulation and computer composition systems; information and process control systems; operations research (queueing theory); applied numerical analysis

12.7.9.2 Representative research assignments at SRI

- Technoeconomic analysis and design consultation for a large distributed online banking and MIS system having both central and distributed processors interconnected by a telecommunications network
- Technoeconomic analysis, specification, and implementation of a complete automated editorial and prepress production system, including associated manual procedures and management information
- Analysis, design, and implementation of a computerized traffic control system
- Analysis, design, and implementation of several human/machine interactive systems for text processing, data reduction, and data file manipulation
- Analysis and specification of algorithms and design and implementation of a real-time online control for a gas pipeline network

12.7.9.3 Other professional experience

- Research engineer, AC Spark Plug Division, General Motors Corporation; logical design of ground support and airborne digital computers; reliability analysis and design studies for spaceborne digital computers
- Analysis, design, and implementation of a numerical queue simulator using multidimensional Markov processes, Stanford University

12,7,9,4 Academic background

. B.S. in physics (1960), University of California (Los Angeles);
M.S.E.E. (1961) and Ph.D. in electrical engineering (1966), Stanford University

12,7,9,5 Honors

. Phi Beta Kappa; Pi Mu Epsilon; Sigma Pi Sigma

10 PATRICIA M. WHITING-O'KEEFE, SENIOR RESEARCH ENGINEER
INFORMATION SCIENCE LABORATORY
INFORMATION SCIENCE AND ENGINEERING DIVISION

12,7,10,1 Specialized professional competence

- System development and installation of online, real-time material handling systems; text-processing systems; inventory control systems; management information systems; distributed computer control systems; physical and chemical process modeling

12,7,10,2 Representative research assignments at SRI

- Concepts study on distributed computer system to automate the operation of a series of hydroelectric power plants
- Specification of the system configuration, software, and components required to implement a production-oriented computer-aided document generation system
- Security assessment of computer procedures, user practices, and the potential for compromise in several major computer networks
- Design and implementation of a marketing information system using a powerful interactive computer system developed at SRI

12,7,10,3 Other professional experience

- Assistant professor, Mathematics Department, San Francisco State University: classes on operating systems, systems design, and systems programming
- Senior systems analyst, senior project engineer, and systems analyst, Kenway, Inc.: development and installation of software systems controlling automated high rise stacker storage/retrieval and close tracking material flow warehousing facilities; software simulation of stacker network in real-time environment
- Senior systems engineer, Computer Logic Corp.: design of online real-time system for automated supermarket incorporating complete inventory control, automated front end, a management information system, and automated order retrieval and assembly; development of computer optimization model for latter system; management of a stock transfer system; design of JCL translator package

12,7,10,4 Academic background

. B.S. in chemistry and mathematics (with distinction, high honors, and honors in course, 1965), University of Delaware; Ph.D. in chemical physics (1970), California Institute of Technology

12.7.10.5 Publications

. Publications in transport properties, many-body effects and band calculation methods applied to alkali metals, and scattering theory

12.7.10.6 Honors

. Phi Kappa Phi; Sigma Pi Sigma; Sigma Xi; IBM fellowship; NDEA fellowship; 1965 Delaware Chapter American Chemical Society Award

11 THOMAS P. BUN, SENIOR SYSTEMS ANALYST

12.7.11.1 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

12.7.11.2 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

12.7.11.3 Academic background

. Degree of Engineer in planning (1944), Budapest University; M.S.E.E. in digital systems (1968), Stanford University

12.7.11.4 Languages

. German, French, Spanish, Portuguese, Hungarian, and some Russian

12 KENNETH E, VICTOR, SYSTEMS PROGRAMMER
AUGMENTATION RESEARCH CENTER
INFORMATION SCIENCE AND ENGINEERING DIVISION

12,7,12,1 Specialized professional competence

. Operating systems; interactive editing systems

12,7,12,2 Representative research assignments at SRI

. Maintenance and development of Tenex and Exec
. Maintenance and development of NLS

12,7,12,3 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

12,7,12,4 Academic background

. B.A. in physics (1968), Brandeis University

12,7,12,5 Publications

. Coauthor of IBM Manual on FORMAC; IBM Manual on CPS; SRI-ARC Reports
. Coauthor of various Augmentation Research Center documents

13 DAVID L, RETZ, RESEARCH ENGINEER
AUGMENTATION RESEARCH CENTER
INFORMATION SCIENCE AND ENGINEERING DIVISION,Pbs

12,7,13,1 Specialized professional competence

. Design, implementation, and analysis of interactive time sharing systems, digital signal processing systems, performance evaluation and measurement, minicomputer and terminal control systems, computer control, and data acquisition

12,7,13,2 Other professional experience

. Speech Communications Research Laboratory: design and imple-

mentation of PDP-11 time sharing system (ELF) for terminal access to the ARPANET
. Systems programmer and research assistant, University of Califor-
nia (Santa Barbara): interactive and control computer systems
design implementation

12,7,13,3 Academic background

. B.S. in chemistry (1967), Florida Atlantic University; M.A. in
chemistry (1968), and M.S. (1970) and Ph.D. (1972) in electri-
cal engineering, University of California (Santa Barbara)

12,7,13,4 Publications

. Several publications in time sharing system design

12,7,13,5 Professional associations and honors

. Association for Computing Machinery
. Institute of Electrical and Electronics Engineers
. Eta Kappa Nu

14 JAN H. KREMERS SYSTEMS PROGRAMMER
ARTIFICIAL INTELLIGENCE CENTER
INFORMATION SCIENCE AND ENGINEERING DIVISION

12.7.14.1 Specialized professional competence

. Software systems

12.7.14.2 Representative research assignments at SRI

. Design and implementation of digital-to-analog converter soft-
ware on a large coupled computer system
. Design of hardware and software for interfacing a Unimate industrial robot to a large computer system
. Implementation of a large time-sharing operating system
. Management of a large, research-oriented time-sharing computer
installation

12.7.14.3 Other professional experience

. University of Illinois; design and implementation of a Fortran IV compiler on a large computer system
. Participated in the design and development of a large system for bubble chamber data acquisition and reduction
. Design and implementation of operating system software (assemblers and file management systems) for large scale computer systems (IBM 7094, 1401, university-built CSX-1)

12.7.14.4 Academic background

. A.A.S. in mechanical technology (1964), State University of New York Agricultural and Technical College (Farmingdale); B.S. (1969) and M.S. (1971) in physics, University of Illinois (Urbana)

12.7.14.5 Professional association

. Association for Computing Machinery

12.7.14.6 Languages

15 DONALD ANDREWS, SYSTEMS PROGRAMMER
AUGMENTATION RESEARCH CENTER
INFORMATION SCIENCE AND ENGINEERING DIVISION

12,7,15,1 Specialized professional competence

- Systems programming; compiler writing and compiler writing systems; time sharing systems; interactive systems; analysis of system efficiency; micro computer devices

12,7,15,2 Representative research assignments at SRI

- Development of special purpose language for implementing NLS control language; development of TREE META compiler writing 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 line processor micro computer device

12,7,15,3 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

12,7,15,4 Academic background

- B.S. in physics (1965), University of Washington; M.S. in computer science (1967), Stanford University

12,7,15,5 Publications

- Coauthor of "Tree Meta, a Meta Compiler System for the SDS 940," SRI internal report (1967)

12,7,15,6 Professional association

- Association of Computing Machinery (past member)

16 BEVERLY R, BOLI, RESEARCH ANALYST
AUGMENTATION RESEARCH CENTER
INFORMATION SCIENCE AND ENGINEERING DIVISION

12,7,16,1 Specialized professional competence

. Technical writing and editing, particularly instructional writing; documentation of computer systems, software, hardware, and electronic components; teaching writing

12,7,16,2 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

12,7,16,3 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)

12,7,16,4 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

17 ANN C. WEINBERG, RESEARCH ASSOCIATE
AUGMENTATION RESEARCH CENTER SYSTEMS
INFORMATION SCIENCE AND ENGINEERING DIVISION

12,7,17,1 Specialized professional competence

Technical writing; computer-based publications procedures; educational writing; educational publications; educational consulting; psychological counseling; elementary teaching

12,7,17,2 Representative research assignments at SRI

Technical writer; development of an advanced computer based interactive text handling information retrieval system; participation in on-line composistion of reports and proposals; participation in desgin 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.

12,7,17,3 Other professional experiences

Westinghouse Learning Corporation, Sunnyvale, California; designing, writing, and editing of learning units, tapes and filmstrips for an individualized computer managed learning system;

Westinghouse Learning Corporation; instructing and consulting in the implementation of an individualized computer managed learning system.

12,7,17,4 Academic Background

B.A. in psychology (1969), Connecticut College, New London, Connecticut and M.A. in Counseling Psychology (1971), Stanford University

12,7,17,5 Publications

Various Learning Units and Teacher Materials for Project PLAN*, Westinghouse Learning Corporation

Various Tapes and filmstrips for Project PLAN*, Westinghouse
Learning Corporation

12,7,17,6 Honors

Cum Laude Graduate from Connecticut College

18 SUSAN G. ROETTER, RESEARCH ANALYST
AUGMENTATION RESEARCH CENTER
INFORMATION SCIENCE AND ENGINEERING DIVISION

12,7,18,1 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

12,7,18,2 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

12,7,18,3 Academic background

- B.S. in mathematics and psychology (magna cum laude, 1972) Milligan College, Tennessee; Graduate work, San Jose State University

13 Part Two--Contractual Provisions

I. Estimated Time And Charges .

It is proposed that the work outlined herein be performed during a period of 12 months commencing 18 March 1976.

Attached are a cost estimate and support.

Hardware for delivery to G E is estimated FOB SRI, Menlo Park, CA.

II. Contract Form

Because of the nature of the work proposed, it is requested that any contract resulting from this proposal be awarded on a cost-plus-fixed-fee basis.

III. Acceptance Period

This proposal will remain in effect until 15 December 1975. If consideration of the proposal requires a longer period, the Institute will be glad to consider a request for an extension of time.

IV. Source Code and Object Code

ARC will supply copies of the software in the form of Source tapes and compilers as well as object tapes. NLS code was developed largely under government contract. Hence it is available to all government contractors and no agreement to protect the sellers rights is necessary.

V. Documentation and Reports

ARC will provide user documentation and system documentation. User documentation will take the form of command summaries and command descriptions. We will provide additional user documentation as provided our PDP 10 clients. G E can use this extra documentation as a model for additional user documentation it may desire to provide its users itself or contract for with SRI. See Appendixes XXX for sample user documentation.

System documentation will take the form of commented source code, a system design overview, and operating instructions.

Documentation will be in online form usable with the system and in hardcopy.

COST ESTIMATE FOR PROPOSAL

For 12 Months starting March 18, 1976.

Personnel Costs

Supervision xxx hours at jj.jj = YYYYYYY

Professional xxx hours at jj.jj = YYYYYYY

Technical xxx hours at jj.jj = YYYYYYY

Clerical xxx hours at jj.jj = YYYYYYY

Total Direct Labor zzzzzzzz

Payroll Burden @ zzzzzzz

Total Labor and Burden xxxxzzzzz

Overhead @ sss% xxxxxxx

Total Personnel Costs $xxx,xxx

Direct Costs (See Schedules that follow)

Travel

Computer Facility and Terminals

Materials and Supplies

Documentation and Reports

Total Direct Costs

Total Estimated Cost

Fixed Fee

Total Estimated Cost Plus Fixed Fee

Schedule A LBS=0;

Direct Labor LBS=1;

Direct labor charges are based on the actual salaries for the

staff members contemplated for the project work plus a factor of X% of base salary for merit increases during the contract period of performance. The precise factor applied is dependent on the estimated period of performance, Frequency of salary reviews and level of merit increases are in accordance with the Institutes Salary and Wage Payment Policy as published in Topic No. 505 of the SRI Administration Manual.

Schedule B LBS=0;

Overhead and Payroll Burden LBS=1;

Schedule C LBS=0;

Materials and Services LBS=1;

Travel

25 trips to San Jose at $4,00

n trips to syracuse N.Y.

Communication

This is an estimate of the toll charges for telephone calls during the period of performance.

Materials and supplies

This is an estimate of the cost of materials and supplies based on previous experience with similar projects.

Schedule D LBS=0;

Documentation Costs LBS=1;

Documentation and report costs are estimated on the basis of the number of pages of text and illustrations and the number of copies of items to be produced, in accordance with the following rates per page:

Editing	$2.55
Composition	2.50
Coordination	.74
Proofreading	.77
Illustrations	21.96
Press and Binding	.022 per impression

The following is a breakdown of the estimated cost of report production:

Printing 150 pages at $ 6,56 per page = xxxxxxx
(including editing, composition, report coordination, proofreading)
Illustrations, 10 @ 21,96 = xxx Press and bindery @ yyyyyyy printed
pages @ $,022 per printed page = xxxxxx
Additional Copying Estimated = xxx Total
Estimated Documentation Costs = $xxxxxx

n tapes @ $x each

n manuals, glossaries, etc.

Schedule E LBS=0;

Computer Costs LBS=1;

Equipment to be purchased for delivery to GE. Costs are FOB SRI.

Central Processor and File System

32K PDP 11/10	$12,000
176MB dual drive disk	60,000
9 track tape unit	11,500
Varian printer	11,000
communication gear	5,000
Cabs, cables, etc	5,000

Total $104,500

Terminal Processors

16K PDP 11/10	$ 8,000
2.5MB disk	11,000
Communication, cables, etc	2,000
Mouse, keyset, keyboard	1,500

Total $22,500

Development computer costs

1) PDP-10 TENEX Computer Time

12 Months of Tenex time from BBN, 20 units at $6,000/unit

2) ARC PDP 11 Systems

Need to proportion ELF time for 6.75 man development effort

3) Terminals

a) NLS Workstations (4)

b) Proof Station

c) TNLS Terminals

d) Modems

e) Leased Lines

4) Miscellaneous Estimated

Total

COST

Hardware

Central Processor and File System

32K PDP 11/10	$12,000
176MB dual drive disk	60,000
9 track tape unit	11,500
Varian printer	11,000
communication gear	5,000
Cabs, cables, etc	5,000
Total	$104,500

Terminal Processors

16K PDP 11/10	$ 8,000
2.5MB disk	11,000
Communication, cables, etc	2,000
Mouse, keyset, keyboard	1,500
Total	$22,500

Development

Supervision:

2 Months: Watson

2 Months: Belleville

Professional

3 months Boli

6 months van Nouhuys

66 months programmers

3 months trainers

Other

Travel

25 trips to San Jose at $4.00

Computer

Purchase of DEC equipment

PDP-10 time at BBN for Programming work and testing =$90,000

Document Production:

200 pages

n tapes @ $x each

n manuals, glossaries, etc.

Communication to link G E system to Office-1 for at least field checkout.

M & S $5000

Shipping and Installation to G E site.

Training

Management

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.

Cost

Personnel

Preparation

1 day Professional 1/21 man mos. x $1480

1 day Technical 1/21 man mos. x $1000

Training

1 day Professional Staff 1/21 man mos. x $2575

1 day Professional 1/21 man mos. x $1480

2 days Technical 2/21 man mos. x $1000

Room & Terminal rent

3 days @ $25/terminal/week = $30

System Supervisor

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.

Cost

Personnel

Preparation

1 day Professional 1/21 man mos. x $1480

4 days Technical 4/21 man mos. x $1000

Training

.5 day Professional Staff .5/21 man mos. x $2575

1 day Professional 1/21 man mos. x $1480

16 days Technical 16/21 man mos. x $1000

Room & Terminal rent

2 weeks (2 terminals) @ $25/ter/week = $100

Operators

Training will be conducted 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 will 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 concentrating on Formatting and Photocomposition. There will be a one-week break between the two weeks of training; there will be 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.

Cost

Personnel

Preparation

2 days Technical 2/21 man mos. x $1000

Training

22 days Technical 22/21 man mos. x $1000

Travel ($.15/mi, 40 mi/trip)

12 trips @ $4.00/trip = $48.00

Programmers

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 programmer's time will be provided to cover questions and problems that may come up after these training sessions.

Cost

Personnel

Preparation

1 day Programmer 1/21 man mos. x $1480

1 day Technical 1/21 man mos. x $1000

Training (the first three below should be split equally with system supervisor)

.5 day professional Staff .5/21 man mos. x $2575

1 day Professional 1/21 man mos. x $1480

10 days Technical 10/21 man mos. x $1000

20 days Programmer 20/21 man mos. x $1475

Room & Terminal rent

2 weeks (2 terminals) @ $25/ter/week = $100
(shared equally with system supervisor)

3 weeks (2 terminals) @ $25/ter/week = $150

Training in the Use of New Hardware and Software Features

One week of a trainer's time per year will be provided for training as the result of new features or changes to old ones.

Cost

Personnel

5 days Technical 5/21 man mos. x $1000

Travel ($.15/mi, 40 mi/trip)

5 trips @ $4.00/trip = $20.00

APPENDIXES:

The Augmented Knowledge Workshop, Douglas C, Engelbart, Richard W, Watson, and James C Norton, The Augmentation Research Center, SRI, Menlo Park, Calif, March 1973,

Coordinated Information Services for a Discipline or Mission-Oriented Community, Douglas C, Engelbart, The Augmentation Research Center, SRI, Menlo Park, Calif, March 1973,

RWW NLS Usr Interface Paper

The Output Processor Users' Guide, The Augmentation Research Center SRI, Menlo Park, Calif, July 1975,

Format Library, The Augmentation Research Center SRI, Menlo Park, Calif, March 1975,

TNLS-8 Quick Reference, The Augmentation Research Center SRI, Menlo Park, Calif, May 1975,

NLS-8 Command Summary, The Augmentation Research Center SRI, Menlo Park, Calif, May 1975,

NLS-8 Glossary, The Augmentation Research Center SRI, Menlo Park, Calif, September 1975,

DLA Line Processor: A device for Amplification of Display Terminal Capabilities for Text Manipulation, Donald I Andrews,..... Paper

Display Techniques for Interactive text Manipulation, Charles H, Irby,.....

Charles CLI Paper

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,

Title PAGE: IGS;

Proposal for Research
SRI Number ISC 75-218

A TEXT PROCESSING SYSTEM FOR GENERAL ELECTRIC'S NUCLEAR ENGINEERING DIVISION

Part One--Technical Poroposal

Prepared for:

D.S. Quigg, Senior Buyer
General Electic Company
117 Curtner avenue
San Jose, California 95125

Prepared by:
Robert L.
Belleville
Augmentation
Research Center

Dirk H. van
Nouhuys
Iformation
Sciences
Laboratory

Richard W. Watson
Augmentation
Research Center

Approved:

Part
Two--Contractual

DVN 14-OCT-75 10:24 26673

SRI-ARC Proposal
No. ISC 75-218 A
Text Processing
System for G E
Nuclear
Engineering
Division DRAFT

Douglas C.
Engelbart,
Director
Augmentation
Research Center

David R. Brown,
Director
Iformation
Sciences
Laboratory

Bonnar
Cox,Executive
Director
Information
Science and
Engineering
Division
Stanford Research
Institute

Part
Two--Contractual

SRI-ARC Proposal No, ISC 75-218 A Text Processing System for G E Nuclear Engineering Division DRAFT

Introduction

(J26673) 14-OCT-75 10:24;;;; Title: Author(s): Dirk H, Van Nouhuys/DVN; Distribution: /DMB([ACTION] NOT for the DPCS notebook) KLM([ACTION] NOT for the docplan notebook) RLB2([INFO-ONLY]) RWW([INFO-ONLY]) DCE([INFO-ONLY]) BEV([INFO-ONLY]) POOH([INFO-ONLY]) &DPCS([INFO-ONLY]) &DOCPLAN([INFO-ONLY]) EKM([INFO-ONLY]) ; Sub-Collections: SRI-ARC DPCS DOCPLAN; Clerk: DVN; Origin: < VANNOUHUYS, GEPROP.NLS;108, >, 14-OCT-75 09:48 DVN ;;;;; Title:

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26673 Distribution

Delorse M. Brooks, Kathey L. Mabrey, Robert Louis Belleville, Richard W. Watson, Douglas C. Engelbart, Beverly Boli, Ann Weinberg, Documentation Production and Control System Interest Group , Documentation Development Production and Control Community Planning Group , Elizabeth K. Michael,

RLL 14-OCT-75 16:17 26674

CONTACT: CERL, Mike Knowles on 14 Oct 75, Visit to be 20 OCT 75

They will contact JCN onarrival. See at BBNB
<arc-log,names,knowles:w> for phone, address, and other info on
Knowles.

RLL 14-OCT-75 16:17 26674

CONTACT: CERL, Mike Knowles on 14 Oct 75, Visit to be 20 OCT 75

(CERL) Contact report 26674 1

(DATE) 14 Oct 75 1a

(BY) Lieberman 1b

(ATTENDEES) 1c

Mike Knowles - CERL 1c1

Robert Lieberman - SRI-ARC 1c2

(MEDIUM) PHONE 1d

(WHERE) Menlo Park, CA and Champaign, IL 1e

(ACTION-ITEMS) 1f

Be ready for visit on 20 Oct 75 1f1

(DISTRIBUTION) ARC-LOG DCE JCN RLL RA3Y DVN RLB 1g

(REFERENCES) 1h

RLL 10-OCT-75 04:02 26651 VISIT: Mike Knowles of CERL coming 14 OCT 75
Location: (JOURNAL, JRNL31,j26651:ge) 1h1

Comments: CERL = Construction Engineering Res, Lab par tof Army corps of Eng, 1h1a

RLL 22-SEP-75 17:58 26533 CONTACT: CERL, Mike Knowles on 10 Sept 75, Request for documents
Location: (JJOURNAL, 26533, 1:w) 1h2

RLL 18-SEP-75 00:10 26498 LETTER: To Knowles of Costruction Engineering Res, Lab, Re: document request
Location: (JOURNAL, JRNL30, J26498:gw) 1h3

Comments: Letter and enclosures sent 18 Sept 75, 1h3a

DCE 31-AUG-75 11:29 33383 Phone Log, 29 Aug 75: Michael Knowles, CERL
Location: (JOURNAL, JRNL29, J33383:gw) 1h4

Comments: Interest in AKW Utility, Lieberman to follow up, 1h4a

(DOCUMENTS) Hard copy given and received 1i

RLL 14-OCT-75 16:17 26674

CONTACT: CERL, Mike Knowles on 14 Oct 75, Visit to be 20 OCT 75

(GIVEN) Date and documents given 111

(RECEIVED) Date and documents received 112

(REMARKS) 1j

I received a phone call today from Mike. He and the Principal Investigator for his project, Doug Hill, will be arriving at SRI Monday, 20 OCT 75 about Noon to 1:00 PM (NOT as previous announced -14 OCT). 1j1

They would like to spend the entire afternoon with us. If necessary they can be back Thursday or Friday for more conversations. 1j2

See references for background. 1j3

RLL DCE JHB will be gone next week so I left JCN's name for the person to contact when he arrives. If JCN is busy, Dirk said he would be backup. RA3Y may be here to help out also. (You all might want to spread the afternoon among you.) 1j4

Dirk mentioned that CERL's close relationship with Univ of Ill. as well as the name 'Construction Engineering' might mean they would be interested in graphics, so I am warning Belleville of their visit. 1j5

In my talks with Mike it seems that they are sincerely interested in getting a piece of the utility action. Good luck JIM. 1j6

RLL 14-OCT-75 16:17 26674

CONTACT: CERL, Mike Knowles on 14 Oct 75, Visit to be 20 OCT 75

(J26674) 14-OCT-75 16:17;;;; Title: Author(s): Robert N. Lieberman/RLL; Distribution: /JCN([ACTION]) ARC-LOG([INFO-ONLY]) DCE([INFO-ONLY]) RLL([INFO-ONLY]) RA3Y([INFO-ONLY]) DVN([INFO-ONLY]) RLB([INFO-ONLY]) ; Sub-Collections: SRI-ARC ARC-LOG; Clerk: RLL;

26674 Distribution
James C. Norton, James C. Norton, Log Augmentation, Douglas C. Engelbart, Robert N. Lieberman, Raymond R. Panko, Dirk H. Van Nouhuys, R. L. Balluff,

BVH 14-OCT-75 19:21 26676

ed masonis

ed masonis called me concerning a nls-system in columbia,south carolina in conjumction with u, of south carolina, i looked through the arpanet directory and the nearest host is the national climatic center in asheville, n.c...what should i tell him? he needs this info tomorrow, enjoy yourself bill nemceff 1

BVH 14-OCT-75 19:21 26676

ed masonis

(J26676) 14-OCT-75 19:21;;;; Title: Author(s): Bill Van Hassel/BVH; Distribution: /DAP([ACTION]) DAP([INFO-ONLY]) ; Sub-Collections: NIC; Clerk: BVH;

26676 Distribution
David A. Potter, David A. Potter,

POOH 14-OCT-75 17:55 26677

first day at gunter

just to keep you informed...things have not changed much since i last left, there is one new dnls dtation in the blockhouse in sgt, crabtrees office and he is using that, he is doing a document for fischer,,it is the one that i wanted to get going and apparently lynne got it started, it is good that she did that, but as usual they starteed something without condulting and now when i got involved in it, there are lots of mistakes that could have been avoided if they had consulted us in the first pplace, they look pretty minor and i shoudl be able to straighten it out for them, pete is working on 66-1, appartenly there still is no official ok, and the letter that is being written has not yet been written from washington, i spoke to coffin and he doesn't think that garrett et al are writting it, they are still trying to get the official ok to be in charge of 66-1 down here, all i wanted was for them to get approval of doing this rewrite, well, pete is going to go ahead and we will see what comes, i have a meeting with pr in the morning to show them the formatting that i have sone and to discuss their deadlines, i talked with cindy who said that the reson it was delayed was do to internal problems down here, i also talked with mcleod who was not so willing to admit that was the problem , he implied that nls was the probelm,although we never failed to meet any of hs deadlines, he is a hard nut to crack, brunner is out of town, so i have not seen him,, maj, hearn said that larry has ordered more lines to hook up another dnls station adn has sent back the two modems that were not working and they are waiting replacements, we shall see,, i will be in touch soon, bye ann 1

POOH 14-OCT-75 17:55 26677

first day at gunter

(J26677) 14-OCT-75 17:55;;;; Title: Author(s): Ann Weinberg/POOH;
Distribution: /EKM([INFO-ONLY]) JBP([INFO-ONLY]) JCN([
INFO-ONLY]) ; Sub-Collections: SRI-ARC; Clerk: POOH;

26677 Distribution
Elizabeth K. Michael, Jonathan B. Postel, James C. Norton,

tektronix

Vaanhassel said their is some interest in the tektronix terminal but not model 4014-1,but a model 4010-1 instead. he said the screen is a bit smaller, and the price will continue dr. lewis is here from m.i.t. bye 1

tektronix

(J26678) 15-OCT-75 13:52;;;; Title: Author(s): Bill Van Hassel/BVH;
Distribution: /DAP([ACTION]) DAP([INFO-ONLY]) ; Sub-Collections:
NIC; Clerk: BVH;

26678 Distribution
David A. Potter, David A. Potter,

tekttronix continued

as i was saying, model 4010 would be the model that would suit them the best, so far their has been no formal paper work to purchase, i took today as a personal business i've been tide up with the tm seminar,, which was a sucess over85 people, tomorrow i'm going to west new york(which is new jersey) to observe the classrooms for taping,so i won't be in until friday.....your plants are alive and well

1

tekttronix continued

(J26679) 15-OCT-75 15:50;;;; Title: Author(s): Bill Van Hassel/BVH; Distribution: /DAP([ACTION]) DAP([INFO-ONLY]) ; Sub-Collections: NIC; Clerk: BVH;

26679 Distribution
David A. Potter, David A. Potter,

DAP 15-OCT-75 16:30 26680

Management Information System

to Don Melville, c/o Fortna

DAP 15-OCT-75 16:30 26680

Management Information System

Just thought I'd let you know that things look promising. I think I have the foundation for the Management Information System which wwe discussed last Friday. I don't yet know how much effort will be required to develop it from where it is now; I'll talk this over with you next week. 1

Management Information System

(J26680) 15-OCT-75 16:30;;;; Title: Author(s): David A. Potter/DAP;
Distribution: /ROF([ACTION]) ; Sub-Collections: NIC; Clerk: DAP;

26680 Distribution
Richard O. Fortna,

RG 16-OCT-75 19:07 26682

BUG: content pattern filter is automatically deinstituted after a jump

It seemstha the content pattern i was using (BBNB) SINCE (13-oct-75 00:00) was deinstituted after i did a jump, setting viewspec i and f ain did not restore it, I had to go to programs a i n pro as content ana, Seems like a bug, ROb 1

RLL 16-OCT-75 19:07 26682

BUG: content pattern filter is automatically deinstituted after a jump

(J26682) 16-OCT-75 19:07;;;; Title: Author(s): Robert N. Lieberman/RLL; Distribution: /FEED([ACTION]) ARC-APP([INFO-ONLY]) ; Sub-Collections: SRI-ARC ARC-APP; Clerk: RLL;

26682 Distribution

Special Jhb Feedback, Israel A. Torres, Buddie J. Pine, Laura J. Metzger, Priscilla A. Wold, Pamela K. Allen, Jeffrey C. Peters, Marcia L. Keeney, Jeanne M. Beck, Rodney A. Concurant, Douglas C. Engelbart, Jeanne M. Leavitt, Susan Gail Rotter, Raymond R. Panko, Adrian C. McGinnis, James C. Norton, J. D. Hopper, Elizabeth J. Feinler, James H. Bair, Robert N. Lieberman, N. Dean Meyer, Sandy L. Johnson, Martin E. Hardy,

RL'. 16-OCT-75 19:14 26683

ANNOUNCEMENT: AKW Seminar for 17 November 1975,

This covering letter to a brochure JHB composed is available inhardcopy from RLL. Any leads would be appreciated. Let me know any interest, thanks Rob.

ANNOUNCEMENT: AKW Seminar for 17 November 1975.

A SEMINAR ON THE AUGMENTED KNOWLEDGE WORKSHOP

The Augmentation Research Center (ARC) of Stanford Research Institute (SRI) has been developing for the past 13 years a computer-based system to help people and organizations with their information handling. Our goal is the evolution of a working environment (a workshop) with a coherent set of facilities to aid people with their reading, writing, communicating, and management of information. We feel that a large and diverse community of users is necessary for the continuation of these workshop developments.

As part of the effort to transfer our developments to a growing community of users, we are offering an intensive, one week seminar on the capabilities and use of ARC's Workshop facilities. The participants will gain insight into the tools, techniques, and methodology of the Augmented Workshop.

This seminar is intended for people who wish to begin assessing the Workshop capabilities and its potential value to their organization. Those individuals whose job is to give experience-based appraisals of new working methods and new technology will find this week particularly beneficial.

Training in many of the Workshop features will be given with several additional hours of individual, on-line, interactive computer experience.

Documentation, training aids, and demonstrations will illustrate, in more breadth and depth, the Workshop's facilities.

This five day seminar will be held at SRI from 17 November to 21 November 1975. The seminar will be limited to ten active participants so that individualized and in depth training, consulting, and discussion can take place.

The cost of this seminar will be $750 per person and will include all materials and computer time. Travel, local lodging, and meals will be the responsibility of the client.

For additional information, registration, or interest in future seminars, please contact:

Dr. Robert Lieberman
Augmentation Research Center
Stanford Research Institute
333 Ravenswood Road
Menlo Park, CA 94025
415-326-6200 x4119

RLL 16-OCT-75 19:14 26683

ANNOUNCEMENT: AKW Seminar for 17 November 1975.

(J26683) 16-OCT-75 19:14;;;; Title: Author(s): Robert N. Lieberman/RLL; Distribution: /KWAC([INFO-ONLY]) SRI-ARC([INFO-ONLY]) ; Sub-Collections: SRI-ARC KWAC; Clerk: RLL;

26683 Distribution

Richard W. Watson, Don I. Andrews, 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, 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 Joseph L. Ehardt, Marilynne A. Sims, Elizabeth F. Kinney, Lawrence A. Crain, E. S. VonGehren, Glenn A. Sherwood, Kathey I. Mabrey, Jeanne M. Beck, David A. Potter, Robert N. Lieberman, Terry H. Proch, Ronald P. Uhlig, Susan Gail Roetter, Michael A. Placko, Stanley M. (Stan) Taylor, Elizabeth J. Feinler, Rudy L. Ruggles, Frank G. Brignoli, Robert M. Sheppard, Richard W. Watson, Douglas C. Engelbart, James C. Norton, James H. Bair, Duane L. Stone, Inez M. Martinez, Connie K. McLindon, Israel A. Torres, Jan H. Kremers, Susan F. Ocken, Raphael Rom, David C. Smith, Buddie J. Pine, Andy Poggio, David L. Retz, Laura J. Metzger, Karolyn J. Martin, Jan A. Cornish

CONTACT: IBM, Paul Friedl on 16 Oct 75, interest in man/machine interface and analysis of it.

(IBM) Contact report 26684 1

(DATE) 16 Oct 75 1a

(BY) Lieberman 1b

(ATTENDEES) 1c

Paul J. Friedl - IBM 1c1

Data Processing Division 1c1a

Scientific Center 1c1b

2670 Hanover Street 1c1c

Palo Alto, CA 94304 1c1d

415-493-3000 1c1e

Robert Lieberman - SRI-AC 1c2

(MEDIUM) FACE-TO-FACE 1d

(WHERE) SRI, Menlo park, CA 1e

(ACTION-ITEMS) 1f

Actions taken, to be taken, etc,, dated 1f1

(DISTRIBUTION) ARC-LOG DCE JCN RLL RWW RLB 1g

(REFERENCES) 1h

(DOCUMENTS) Hard copy given and received 1i

(GIVEN) Date and documents given 1i1

(RECEIVED) Date and documents received 1i2

(REMARKS) 1j

Paul called for DCE but was re-directed to me in Doug's absence. 1j1

Apparently Paul is an old friend of Doug's that wanted see more on our current developments. 1j2

RWL 16-OCT-75 21:08 26684

CONTACT: IBM, Paul Friedl on 16 Oct 75, interest in man/machine interface and analysis of it.

His immediate interest stems from a talk he will be giving at Case Western Reserve University on "How to Augment scientific workers." 1j3

I gave him a brief view of our system with emphasis on the things in which he was particularly interested. 1j4

His main concern was with any analysis that we have done on how people and machine interact. 1j5

Exactly what do people do - which commands, how frequently do they access the system, etc. 1j5a

Regretably we have very little recent data on these such things but I indicated that we are anxious to get them. 1k

[Of interest to ARC Development] Paul mentioned that he had developed a small computer which cost about $9000 and can be carried in a suitcase. It has the power of a PDP11. He promised to send the literature to me. 1l

If he needs more information or slides, etc. he will contact DCE. 1m

RLL 16-OCT-75 21:08 26684

CONTACT: IBM, Paul Friedl on 16 Oct 75, interest in man/machine interface and analysis of it.

(J26684) 16-OCT-75 21:08;;;; Title: Author(s): Robert N. Lieberman/RLL; Distribution: /ARC-LOG([INFO-ONLY]) DCE([INFO-ONLY]) JCN([INFO-ONLY]) RLL([INFO-ONLY]) RWW([INFO-ONLY]) RLB([INFO-ONLY]) ; Sub-Collections: SRI-ARC ARC-LOG; Clerk: RLL;

26684 Distribution
James C. Norton, Log Augmentation, Douglas C. Engelbart, James C. Norton, Robert N. Lieberman, Richard W. Watson, R. L. Balluff,

NLS design recommendation

How about a new type of text entity, the PHRASE? A PHRASE is one or more WORDs. Frequently I want to delete or replace a group of words; Delete/Replace Phrase would enable me to do it. Delete/Replace Text requires me to deal with the surrounding spaces, so PHRASE would be a little nicer. It is also an easily-understood concept. Additional benefit: it makes text entities complete. 1

entity	one	several	all	
character:	CHARACTER	TEXT	WORD	1b
word:	WORD	PHRASE	STATEMENT	1c
statement:	STATEMENT	GROUP	PLEX	1d

DAV 16-OCT-75 17:46 26685

NLS design recommendation

(J26685) 16-OCT-75 17:46;;;; Title: Author(s): David C. Smith/DAV;
Distribution: /FEEDBACK([ACTION]) ; Sub-Collections: SRI-ARC
FEEDBACK; Clerk: DAV;

26685 Distribution
Special Jhb Feedback,

Weekly report for DAV

Week of Oct.13-17 1

DONE 1a

Converted the HELP CML to NLS 9 form. Assembled it into the system. 1a1

Read a few reports, particularly the HELP documents that are scattered around. 1a2

Wrote a design memo of suggestions for an improved user language. 1a3

IN PROGRESS 1b

Debugging the interface between the HELP 9 CML and the xroutines. It's pretty obscure stuff. 1b1

Writing down my thoughts on HELP. They are beginning to crystallize. Should be finished by the weekend. 1b2

Continuing to read whatever I can get my hands on. However, the ratio of reading/coding time is decreasing, and will continue to decrease for the rest of the month as I try to get HELP 9 working. Nevertheless, I consider reading and writing to be 50% of my job. (Correct me if I'm wrong.) 1b3

DAV 16-OCT-75 18:11 26686

Weekly report for DAV

(J26686) 16-OCT-75 18:11;;;; Title: Author(s): David C. Smith/DAV; Distribution: /EKM([INFO-ONLY]) ; Sub-Collections: SRI-ARC; Clerk: DAV;

26686 Distribution
Elizabeth K. Michael,

RLL 17-OCT-75 02:58 26689

BUG: Infinite loop on error message when bugging TTY simulated window

If one mistakenly leaves the curso in a wndow that has been set to simulate TTY window then the error messge "no valid file windows fond in findda" is infintely repeated, BBNB, with bottom half of screen the simulated TTY window. 1

RLL 17-OCT-75 02:58 26689

BUG: Infinite loop on error message when bugging TTY simulated window

(J26689) 17-OCT-75 02:58;;;; Title: Author(s): Robert N. Lieberman/RLL; Distribution: /FEED([ACTION]) ; Sub-Collections: SRI-ARC; Clerk: RLL;

26689 Distribution
Special Jhb Feedback,

RLL 17-OCT-75 04:27 26690

URGENT: ONR report draft / Spencer pressure

Jim, I have another draft of the ONR report. It cleans some thing s up and has the right format (I think - just sort of copied it from J. North's report of last year), see <arc-log,report,> also will hav hard copy on your chair. Clearly some sections could stand more going over; let me know your reaction and amount of time I should spend on it. (I have not charged any time to ONR lproject). Spencer has been calling me on it, sooo he apparently is anxious. I told him toa that another draft was ready for your look see. He will callu abot it MOnday. P.S. visitor due next week from CERL see your mail. RObWill work on ONR repot remotely per your instructons.

1

RLL 17-OCT-75 04:27 26690

URGENT: ONR report draft / Spencer pressure

(J26690) 17-OCT-75 04:27;;;; Title: Author(s): Robert N. Lieberman/RLL; Distribution: /JCN((ACTION)) ; Sub-Collections: SRI-ARC; Clerk: RLL;

26690 Distribution
James C, Norton,

POOH 17-OCT-75 07:10 26691

Letter sent from Vice Commander to all directorates about documentation

This was handed to me (sort of under the table) by a friend who thought I would be interested, I sent it to elizabeth, dick, jim, and jon and you all may forward to anyone that you think should see it. Major Hearn know I saw it and he said that he had taken care of it. He refused to elaborate on what he meant by that. Let me know if you feel there is anything I should do, ann

Letter sent from Vice Commander to all directorates about documentation

Letter sent from Robert F. Godec Colonel, USAF Vice Commander to all directorates. 1

During the past few weeks there have been several instances of questions posed regarding the plan to be used for documentation and administrative correspondence within the Center. Some of these questions have pertained to need for additional funds, future of ARPANET and publications using microfiche methods. The many varied views that have been expressed have led me to the following conclusions: 1a

There is no Center-wide program designed to produce a single method for documentation. 1a1

Several unilateral actions have been accomplished by various directorates to alleviate existing workload and test selected methods of documentation (e.g., Mag-card II, and Savin). 1a2

Many of the actions indicated by the above have been accomplished by diversion of budget dollars from other requirments. In effect, they have been, and continue to be, absorbed out of the directorates resources. 1a3

There is no single leader designated in the Center for this all important area that is consuming more and more of our budget dollars. 1a4

There was a general consensus that ARPANET may be the cure in the furture; however, it is premature at this time to formally accept this concept until more data is known. For example, how many terminals will be available at AFDSDC or what will be the cost of large scale documentation, etc.? 1a5

The growth of documentation within AFDSDC is growing at a rapid pace as evidenced by the recent study we provided to General Edge. In addition to this growth, which centers on publication of manuals and changes, there is a relatively new facet of DPD and DPP production that is also assuming significant proportions. A third area of concern deals with the constant burden of administrative correspondence. All of these three areas need to be addressed in a plan that will focalize AFDSDC resources and manpower. 1b

The discussion presented above has led me to the following decision. Mr. Jacob Fischer of your organization is hereby designated to conduct an analysis of the methods that have been pursued within the Design Center and to select a proposal that can

be used for our current needs. The following guidance is offered to Mr. Fischer as a preliminary step in launching this effort: 1c

There should not be any need to conduct a long study of methods that could be used to solve our documentation problems. Numerous studies have been conducted within the Design Center and throughout the Air Force. The results of these efforts should provide the necessary basic data. 1c1

The primary problem is the area of publication and manuals. Secondary consideration is methods to be used for administrative correspondence. 1c2

Whatever method is selected must be adaptable to computer methodology. 1c3

The future of ARPANET as it pertains to documentation is uncertain at this time. Therefore, a proposal may be presented in two phases. The first phase should be a short term solution in the sense that it could be implemented immediately in order to provide a standard method for doumentation within the AFDSDC. The second phase would be the long term solution that could only be realized after the ARPANET/NSW situation has been tried and proven. Mr Fischer's efforts need not address the second phase. 1c4

Mr. Fischer is to be detailed to the command section on a full-time basis for a period not to exceed 45 days. He is to be permitted to call for assistance from all directorates within the Center. Normally, this will be on a part-time or ad hoc basis that hopefully can be worked out with the cooperation of all who is concerned. 1d

It is essential that the Design Center agree upon a uniform method for accomplishing our documentation requirements. We are spending an ever-increasing amount of our resources to accomplish the growing task of documentation by means of antiquated and outdated methods. Your cooperation and that of every directorate in the Center is requested. 1e

POOH 17-OCT-75 07:10 26691

Letter sent from Vice Commander to all directorates about documentation

(J26691) 17-OCT-75 07:10;;;; Title: Author(s): Ann Weinberg/POOH; Distribution: /EKM([INFO-ONLY]) JCN([INFO-ONLY]) JBP([INFO-ONLY]) RWW([INFO-ONLY]) ; Sub-Collections: SRI-ARC; Clerk: POOH;

26691 Distribution
Elizabeth K. Michael, James C. Norton, Jonathan B. Postel, Richard W. Watson,

Gunter Gossip for week ending 10/17/75

The Week Ending 10/17/75 1

66-1 1a

Pete Lambert has been working on 66-1 all week, I have not touched a terminal as far as work, but have been available for any questions and to help him become more proficient in the procedures, I have been in touch with Betty Finney and Jan Cornish to get all the final details straightened out as far as the changes go, Progress has been slow, but moving, 1a1

PR Document 1b

I have given the Pr group formatted copies of the entire PR document, They are looking them over for more changes that are to come, I also took the formatted copies to the people in standards and the editors in Quality Control, Both of these groups were pleased with the format and said it would be acceptable to them, I have worked with Jan Cornish on the programs and we have been able to solve all the problems that we have encountered so far,The format procedure is just about stable enough that the work can be handed over to the people in PR to do their own work, 1b1

Fischer and his little Document 1c

I had talked before about getting Mr, Fischer to put one of his small documents online so that it can be easily updated each month, I arrived to find out that it had already been done, It was due to be printed this week, and there were some problems with it, that we managed to fix and get printed, Some changes need to be made in the structure so that it will be easier to change next month, but it went to press Wednesday, He has been out of town all week, so I do not know his reaction, 1c1

Hardware 1d

There is one new DNLS terminal in SGT, Crabtrees office, Lg still does not have the correct wiring to have a terminal there, and PR does not have a DNLS terminal either, There are still only 3 modems to the elf as the others have not yet arrived, Larry returns today and he has some plans for more terminals,,i don't know what the plans are at this point, 1d1

Future 1e

Next week, Susan will be here to do some more training, We hope to have several of the advanced users get some training in

sendmail, process branches and formatting. Jo and Cindy will get training in FTP so that they can transfer over thier own files from ISIC. There are also several new people that want to be trained (a new person working for larry, one of the editors from fischer's office, crabtree's secretary and a new person from pr (probably from Mr. Spires group--he is the one I did the base tops document for and he is extremely supportive of nls)) 1e1

Concerns 1f

The attitude in Pr (Mr. McLeod and some other writers) is not as positive as I would have hoped. Mc Leod is very slow to accept NLS. He complains alot about all the time that it takes for Jo to do things. It is hard for me to explain that. The terminal situation is still not the best, but I guess they are working on that as quickly as they know how. Pete Lambert has expressed concern that he is the only one in his group that knows all that he is doing. He has requested from his Col. (Coffin) that he get another person to work with him and to learn what is going on. I fully support this idea, but he doublts whether he will get it. 1f1

Weather 1g

Lots of rain, hurricane warnings and tornados in the area...makes me a little nervous and it is not much fun to so my running in the rain with a 30mph wind..but I keep trying..bye for now..pooh. 1g1

POOH 17-OCT-75 07:30 26692

Gunter Gossip for week ending 10/17/75

(J26692) 17-OCT-75 07:30;;;; Title: Author(s): Ann Weinberg/POOH;
Distribution: /SRI-ARC([INFO-ONLY]) ; Sub-Collections: SRI-ARC;
Clerk: POOH;

26692 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, 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, 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

FE Weekly Status Report 1

DIA 2

In progress: 2a

Initial debugging of display package. Created a window and blew. 2a1

Continuing to nurse my understanding of CLI/CML. 2a2

With CHI, ANDY, mapped out possible memory configuration for PDP-11 CLI. Determined that we HAVE to have partial length pages (not now supported by ELF) to run more than, say, 12 users. 2a3

Interfacing with HGL concerning NLSBE display usage. Changed the display primitives specs somewhat. 2a4

Coding of display package still in progress. Yet to do: Top level routines with PCP conversion, some string,linesegment manipulation procedures and sequential window output. 2a5

CHI 3

Done: 3a

added global help facility for NSW people. All seems ok on that front. 3a1

Helped isolate the problem with encapsulated tools immediately terminating. Larry Garlick is pursuing a fix in pseudo telnet. Having some trouble, I beleive, because of funny timing problems. 3a2

Wrote first rough draft of cli implementation appendix to final report and gave it to others for comment. 3a3

Wrote <nsw-sources>fe-files-directory.nls. 3a4

In progress: 3b

editing new cli sources so they will run on PDP-11 (word vs. byte addressing problems). 3b1

continue writing final report. 3b2

continue transfer of cli knowledge to others. 3b3

ANDY 4

DONE 4a

Compactor for CML grammars to run on PDP-10 4a1

Merge of code of CLI for compacted grammars and new CLI 4a2

IN PROGRESS 4b

Modification of CML compiler to output compactable grammars 4b1

Must produce distinction between kw's and selector kw's 4b1a

Must produce distinction between local and global variables in grammar 4b1b

Modification of compactor to produce grammars loadable on PDP-11 4b2

DAV 5

DONE 5a

Converted HELP L10 files to NLS 9 format. (Actually done several weeks ago, but on Monday I discovered to my considerable surprise that all the changes had gone away!) 5a1

Converted HELP CML to new CML, but not tested yet. Biggest problem: understanding where the new CML fits in, and how the arguments to xroutines change. I just don't have a clear model of what's going on. It simply can't be (shouldn't be) that complicated! Suggestions welcome. 5a2

IN PROGRESS 5b

Debugging the CML/L10 interface, including finding simple equivalents for the numerous HELP parsefunctions. 5b1

Continuing to write down my ideas on HELP. Should be out over the weekend. (I didn't say WHICH weekend!) 5b2

Still wondering whether to write the CML manual. What do people think? 5b3

Fe Weekly Status Report

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