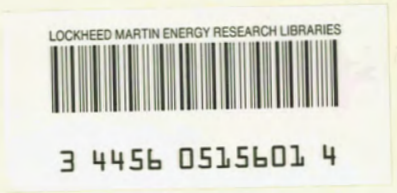
ORNL-4913



THE AEC/RECON PROJECT AT ORNL

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THE AEC/RECON PROJECT AT ORNL

N. B. Gove, editing author

A. A. Brooks, A. H. Culkowski,
C. E. Hammons, G. K. Haeuslein,
W. B. Malthouse, R. E. Plemens,
H. S. Pomerance,* D. G. Taylor

*Information Division

NOVEMBER 1973

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37830
operated by
UNION CARBIDE CORPORATION
for the
U.S. ATOMIC ENERGY COMMISSION

CONTENTS

FOREWORD

The AEC/RECON information retrieval project is operated at Oak Ridge National Laboratory for the AEC Office of Information Services and Technical Information Center. The Information Systems Laboratory of Lockheed Palo Alto Research Laboratory designed, developed, and operated the earlier version of AEC/RECON. Earlier user manuals were prepared by Lockheed, by Hugh Voress of AEC Headquarters Library, Gloria Smith of Lawrence Berkeley Laboratory, and Herb Pomerance of ORNL, all of which were liberally plagiarized in the preparation of the present report.

ACKNOWLEDGMENTS

Many people have helped and are currently helping with RECON. A few are mentioned here. At AEC Headquarters, Tom Hughes, Ed Brunenkant, and John Wilson have helped to keep RECON alive in perilous times. At the AEC Technical Information Center in Oak Ridge, Fred Marsh and Irv Lebow help with RECON management. Operational responsibility at ORNL is with the Computer Sciences Division, under H. P. Carter. Bill Tye of Instrumentation and Controls Division helps trouble-shoot the communications system. People at the Oak Ridge, Knoxville, and Washington telephone offices have been especially helpful in maintaining the RECON line (Dan Ramsey, Wendell Wyrick, Roy McCoy, Ed Melvin, Jim Blaine, and others).

Dave Meinhardt and Roger Summit of Lockheed installed the system and gave advice and encouragement long after the one-year contract was up.

The computer systems group, under J. G. Sullivan, helps cope with IBM system changes and RECON's fluctuating (mostly upward) space requirements. The operations group, under C. S. Williams, keeps the computer running, the disks humming, and the data cell chunking.

Susan Kaplan wrote the diagnostic routine which checks the phone line, modems and terminals. Allen Joseph, now at Infodata, Inc., helped install the system. Karen Barry and Janice Ellison help with RECON reports and Newsletters and thousands of pages of user-requested printout.

Nuclear Science Abstracts tapes for RECON are prepared in Oak Ridge by the Computer Sciences Division under the direction of Leon Yount. Charlie Price, who also have been consultants on operation and file

update procedures. Nuclear Science Abstracts is a publication of the Technical Information Center of the AEC Office of Information Services.

Other files have been made available by the ORNL Environmental Information System Office and the U. S. Department of Interior, Water Resources Scientific Information Center.

Van A. Wente and members of his staff at NASA have made their extensive experience available to us in operating RECON, and also supplied details of RECON history.

The real RECON experts are the users, many of whom have contributed to the present system and plans for the future. Some of these are John Norris and Don Davis of TIC, Gloria Smith and Jessie Herr of LBL, Hugh Voress and Bob Devine of AEC, Len Fisher of LLL, Linda Tafel of Bettis, Helen Kuhns and Marie Cardwell of ORNL.

Marilyn Wright did the programming to produce the RECON tapes from the NSA source data and has diligently followed the production and copying of these tapes.

ABSTRACT

The present status of the AEC/RECON project is discussed, with particular reference to the ORNL participation. A little of the history of the project is given, plus some technical description and a user's manual. AEC/RECON is an information retrieval project which uses CRT screens for rapid display of results from computerized files. Bibliographic data from Nuclear Science Abstracts and other data bases are available for searching. The project came to ORNL in 1971 with 5 terminals and 150,000 bibliographic entries. Now there are 15 terminals and 300,000 entries.

1. INTRODUCTION

1.1. Brief Description

AEC/RECON is a computerized information retrieval project. Information, such as titles, authors, and keywords from Nuclear Science Abstracts or other bibliographic data bases, is stored in the ORNL computer and can be selectively retrieved by commands typed at one of fifteen keyboard terminals at various AEC and other installations. The results may be displayed on a CRT screen or printed. The system has proven fairly popular as an information retrieval tool. The commands are easy to learn. The response of the system is rapid, usually within 10 seconds. Portions of the index can be displayed by typing only a few letters to specify which portion is desired. Selections of items from the index display can be done by typing the sequence numbers of the desired items, thus reducing the need for accurate spelling. Special commands are available for "refining" a search request by combining concepts inclusively or exclusively. At each stage the number of items meeting the specified requirements is displayed. Retrieval may be based on keywords, authors, countries, corporate codes, journal codens, or combinations of these.

From time to time, AEC/RECON Newsletters have been sent to RECON users. As each new station was added, a New User's Kit was sent consisting of all the Newsletters so far. Now that the New User's Kit contains several pounds of information, much of it outdated, it seems appropriate to summarize the Newsletters and add some new material to give an impression of coherence. Hence the present report.

1.2. Brief History

Once upon a time, before there was AEC/RECON, there was NASA/RECON. There still is. A NASA news release, dated October 20, 1965, announces a contract with Bunker-Ramo Corp. for a "small scale prototype document information retrieval system . . . designed to provide immediate and direct access to the central depository." In 1966 there was a contract with Lockheed Palo Alto Research Lab to develop their DIALOG system for use with the NASA information collection. Later, a new version of the system was called RECON and later there was a contract between Informatics, Inc. and NASA for further development. Later still, there was a contract between Lockheed and AEC under which a modification of DIALOG was called RECON and used the Lockheed computer to store portions of Nuclear Science Abstracts and supply retrieval service to DTIE, which was later called TIC. Any questions?

In December, 1970, the program and files were transferred from Palo Alto to ORNL. The phone line which linked the five terminals with the computer was rerouted and service resumed on January 11, 1971. Lockheed helped to keep it running throughout 1971, after which we were on our own. The five stations were Lawrence Radiation Laboratory, AEC Division of Technical Information Extension, Bettis Atomic Power Laboratory, ORNL, and AEC Headquarters Library.

The first few months were notable as a learning experience. The following is part of a report dated March 10, 1971:

> We still do not fully understand the RECON failures which began Thursday, March 4. Diagnosis was complicated by several suspicious events. There was a power failure at AECW at 11:00 a.m., just when RECON failed. Lockheed told us that there was once an occasion when a RECON terminal, after a power failure, emitted continuous noise. So Friday

we asked AECW to switch to Voice, which effectively disconnects their terminal. RECON came up ok which seemed to confirm the noise hypothesis. However, RECON failed again at 11:00 a.m. Friday. Actually, analysis of RECON printout indicates sporadic failure beginning at 9:00 a.m. Thursday and gradually getting worse, same on Friday. RECON service stopped about 11:00 on Friday.

Also, Thursday the carpenters were moving the X-10 terminal and its wiring.

Also, the wiring for the Y-12 terminal was being moved.

Friday, the Y-12 terminal was turned on but we could not poll them. John Thompson of CCI checked our terminal, interchanged modems, but did not solve the problem. Monday we discovered that RECON would run if we made DTIE the master terminal. RECON users got some service on Monday. However, three attempts to poll X-10 and two attempts to poll Y-12 all killed RECON instantly so that we had to cancel and reload.

Monday Charlie Hammons ran a special routine which called for data from terminal 4 (X-10). The data was not transmitted correctly. A similar test with terminal 5 (AECW), done with Hugh Voress' assistance, did give correct transmission.

Tuesday DTIE was the master terminal again and RECON operated except at X-10 and Y-12. About noon, John Thompson started working on our terminal. RECON ABENDED (0C7) about then and was down the rest of the day. John Thompson borrowed circuit boards 12 and 13 from the Y-12 terminal and installed them in our set. We changed the deck to poll 06 as master terminal. RECON started to run, then failed (0C7). Then he changed the station code to 4 and we changed the deck back to 04. This time RECON worked. Then he put the old circuit boards in again set up exactly as we had been before only this time RECON worked! John Thompson's explanation of this was that maybe there was some oxide on one of the contacts. If this happens again he says we should remove and reinsert the circuit boards.

Then he reset the boards for station 6 and we would not run with either set of boards. We also tried setting the boards at station 8. Charlie Hammons' program was able to pick up data with the boards set at 6.

About 7:30 it struck me that we had been using the RESTART version of RECON in our attempts to invoke stations 6 and 8. Perhaps the RESTART version expects the number of stations to be the same as set up by the START version.

In order to try the START version, I wanted to take off the PRINT requests. However, two attempts both resulted in RECON just sitting there for half an hour not printing, not responding, not ending. Finally, I decided the prints were somehow lost and put in the START deck.

It took five runs because of deck setup errors but eventually both sets of circuit boards worked ok.

Wednesday RECON did not come up until the third try, after Charlie Hammons ran his test program. The Y-12 station had its Voice-Date switch reversed. After this was changed and the circuit boards returned the station came up ok.

A new station was added in March, Nuclear Safety Information Center - Y-12 Technical Library.

Initially we had trouble running the file update programs so the first few updates were done in Palo Alto.

The following is from a report of May 1970:

A change of IBM operating systems was required in the name of progress. At first, RECON did not work properly under OS 19.6. The trouble symptoms were run through an IBM information retrieval program which correctly diagnosed the problem and gave the cure. On May 20, RECON ran under OS 19.6.

Charlie Hammons persuaded the telephone company to reduce the delay time in the modems from 180 milliseconds to 8 milliseconds. CCI made a corresponding change in the CC-7012. More than a second is cut off the response time for the present 6 stations. Previously, we thought the practical limit on number of stations on one line was about 8. Now we know it is much higher. With the old modems, a line with 20 terminals on it would have about 4 seconds delay from modems alone; with the new modems the delay due to modems would be less than 0.2 seconds.

On May 21 the US Army came to start the satellite test. The idea is to make RECON available to the Atoms for Peace Conference in Geneva, September 10-16. The LES-6 satellite, in a stationary orbit over South America, is to send RECON to and from Geneva. The Army transmitter was set up and voice communication with the satellite was established. However, the CC-7012 and the Army transmitter did not have compatible pulse shapes and timings. Thus there was a credibility gap between the military and the civilian section.

In July we got our own phone. We were so happy we sent out a Newsletter:

> RECON has its own extension! It is 3-1813 (local) or 615-483-1813 (FTS). It is easy to remember because something very important happened in 1813, only I can't remember what.
>
> Please call us if RECON is not behaving as you think it should.
>
> Sometimes we can only sympathize but sometimes it is something we can easily correct. If necessary, we will call the phone company, CCI company, IBM company, or Lockheed or all of these corporate giants to solve your problem.

Later, the extension number was changed to 3-1624. The full number is (615) 483-8611-1624 or FTS 615-483-1624. If there's no answer, try (615) 483-8611-1863 or FTS 615-483-1863. If there's no answer there, it's a holiday.

The high point (about 22000 miles) of RECON's first year at ORNL was the week we bounced RECON signals off a satellite. Here is part of a report written in October:

> By special arrangement, RECON was shown at the Atoms for Peace Conference in Geneva, September 6-16. A special hook-up, involving a satellite, microwave stations, and phone systems of several countries was set up to link the ORNL computer with the exhibit hall in Geneva. The hook-up worked remarkably well, with less than 1 day total malfunction time during the conference.
>
> At ORNL, special operating procedures were set up for the Geneva run. An unusually high level of back-up procedures was tested. A complete set of spare data cells and disk packs was created with identical files. A mini-RECON which does not require the data cell drive was created. All files on disks and cells were dumped to tape and restore operations were tested. The systems group checked out RECON performance on both the 360/75 and the 360/91 computers. Finally we were prepared for failure of even the card reader, by putting a copy of the RECON card deck on disk.
>
> Several independent reports indicate that the Geneva demonstration of RECON was well received.

In another report, some details of the major service outage were given:

> ...On Thursday, September 9, operations had been fine. On Friday, September 10, operations were totally unsuccessful with evidence of a very strong carrier signal to Geneva. We started at 5 a.m. Saturday to rebalance the modems to the lines. Little success was obtained by modem adjustment, but there was evidence of a +18 db change in signal strength at Geneva. In cooperation with the Stanfield, NC, test board using the Milgo 2200 modem loop capabilities and a constant signal pattern generated by the computer, it was established that the line transmission was excellent to Stanfield, good to Coltano, Italy, and poor to the Geneva exhibition. The Geneva AEC personnel contacted the phone authorities in Europe and requested maintenance on the line. Within approximately one-half hour, repairs were reported complete and operation was resumed at about 8 a.m. The lost time was approximately one day.

In 1972 RECON performance improved as mentioned in this report of April 20:

> . . .
> RECON is finally moving into a production mode. The average up-time has improved from 50% over most of last year to better than 80%. We still have bad times, almost as many as before, but the problem is usually fixed in a few minutes. In most cases of RECON trouble, corrective action is initiated immediately by the /75 operator. The major customer complaints we hear now concern the quality of indexing. At least this is an indication that people are using the system.
> . . .

Under pressure to improve the RECON response time and additional options, we prepared a new version of the program, locally called RECONX:

> RECONX began its test Thursday, May 4, more or less on schedule. Actually, a little less since we had hoped to bring it up at 0900 EDT but instead ran RECON till about noon, then RECONX for about 2 hours, then RECON again. Several users were on hand, or on terminal, and helped us run tests, which we appreciate. We gathered a lot of data and hope to have some improvements done by the next test day, May 11.
>
> We seem to have had about the same promptness as RECON, maybe a little better. However, we were using a shorter "sleep" time for RECONX than we normally use for RECON.

> Sleep time for RECON or RECONX is work time for all the other programs using the computer. We would like to use the Central Processing Unit less than 10% of the time and still provide prompt service. We did not meet this goal with RECONX. Yet.

Although 1972 was better than 1971 for RECON reliability, there were still occasional troubles. For example:

> . . .
> Thursday and Friday, June 8 and 9, were not good RECON days. At least five things went wrong. We lost some time getting familiar with the file changes required by the recent Update. The computer broke several times. Pittsburgh was putting noise on the phone lines. One part of the circuit was in TEST or LOOPBACK mode. The phone lines to the new terminal were not right and required extensive testing. And it rained.

In August, we were still debugging the new program:

> Pardon the Inconvenience While
>
> RECONX is the interim name for the program which is to replace RECON. The most important feature of RECONX is that we hope it will be easy to add improvements as users need them. We have used RECONX part of the time this summer. It has some nice features but it also has a habit of failing now and then, which is why we aren't using it more often. Every time it fails we find and fix the problem and then test the program again.
>
> The work with RECONX has given us a healthy respect for the hazards of on-line systems. For example, the failure on May 12 was not caused by a single command, but by several commands from several stations which together exhausted a pointer table. It is difficult to simulate a multi-user environment without multi-users. Consequently, not all of these bugs are caught during the test sessions. Both RECON and RECONX have the problem of not enough user work space. However, while RECON simply puts out a puzzling message "SE 113 ERROR," RECONX comes crashing down, losing all work sets.
>
> We are fixing this now and when it's fixed, we will begin using RECONX full time. Unless there's still another bug . . .

We did finally get the lethal bugs out of RECONX. Just in time to run into another problem:

> . . .RECON has filled up its data cell space so we cannot perform an update just yet . . .

That has been our major problem ever since. Each update is preceded by extensive file moving, reorganization, and, sometimes, deletion so that we can get some pieces of on-line storage big enough for the next edition.

1.3. Brief Prognosis

Some RECON predictions written over a year ago have still only partly come true. The statements below are a mixture of plans, guesses, and hopes.

More and more files will become available. There's no basic reason not to have 20 or more files going. We expect to have a schedule in which certain files will be on-line at certain times. Several additional files of environmental bibliographies are now being prepared for RECON. Some of these files include abstracts.

There has been some discussion of a possible dynamic switch between RECON systems so that AEC users could query files on the Lockheed system or the NASA system.

Update runs should become more frequent and less traumatic. In addition to update runs there will also be Edit runs. We have almost finished (this statement was made last year, too) a file edit program that will permit easy correction of any errors found in the RECON files. It will also permit addition of new keywords to old items.

It seems likely that the number of user terminals will increase. It should be possible to have several kinds of terminals, including dial-up terminals. There should be more explanatory messages for new users.

For each file there should be available a descriptive message that the user can ask for. One proposed tutorial scheme is shown in Table 1.3.1.

There are no plans to change the basic set of RECON commands but some new commands and some new options to existing commands may be added. Table 1.3.2 lists the present and some of the proposed commands. More display formats are planned, in particular a format giving titles and references for several documents in one screen display. Some method of linear search is needed; whether it should use a string-matching technique or a concordance file is not yet decided. Long overdue is an improvement to the exclusive COMBINE command so that combinations across link groups will not be kept. The TYPE command needs several improvements. In fact, most users have stopped using it. We are considering the addition of a "Mailbox" for each station. This could be used for messages that come in when no one is there.

Some specific proposals for improvements in RECON commands appear in Table 1.3.3.

Our RECONX program tries to gain speed by avoiding WAITs for input/output instructions. After initiating an input or output instruction we proceed to service some other terminal. Work on the earlier command is resumed when all data requested are in core. We further tried to improve efficiency by having a polling table not only for the telephone line but also for disks and data cells. We did not gain much by this organization because all data cells are mounted on the same unit and RECON has to compete with other programs for access. We now maintain only waiting lines for input devices other than the telephone line.

Some proposed changes in the internal structure of the RECON software are listed in Table 1.3.4. Hopefully, these would be noticed by the user only in terms of better response time and reliability. We would like to find a way to use less computer core space when user demand is low, more when it is high. The block diagram in Figure 1.3.1 shows the separation of the network input/output functions from the RECON retrieval functions. Some of the network input/output software could be moved to a Communications Controller. It may be desirable to use a polling algorithm such that a terminal which is not in use or not working gets polled less often. This would reduce waiting time for other users on the same line.

Soon we will have an additional on-line storage device (IBM 2314 or facsimile). This will double our storage capacity and will be faster than the data cell. We hope to get a programmable Communications Controller. This would allow us to service several party lines and dial-up lines and several brands of terminals. The polling of terminals will be done by the Communications Controller, relieving the big computer of a time-consuming chore. It may be possible to get a large ($>10^{12}$ bit) memory device for RECON.

Table 1.3.1. Proposed RECON Tutorial

Lead-in

1. There should be an Initial Display which comes on each screen when the system is brought up, when a session is finished, or when a station changes from disabled or active or inactive status.

WELCOME TO ORNL RECON

INFORMATION RETRIEVAL SYSTEM

DATE (today) TIME (present time)

IF YOU WISH TO USE RECON

OR LEARN MORE ABOUT IT,

PRESS THE KEY MARKED

INT

ON THE KEYBOARD

2. If the user presses the INT button, another display appears which describes RECON and the data bases and ends with

FOR INSTRUCTION ON HOW TO USE

RECON, PRESS INT KEY

3. The next display gives some of the commands available and describes the ? command for getting an explanation of any other command and offers three options: (1) begin a user session, (2) use the ? for explanation of individual commands, (3) press INT for a sample session.

4. The experienced user does not need to see these displays. He can do a BEGIN command at any time.

5. A question mark followed by a command (spelled out or symbol) brings an explanation of the command, with examples.

Table 1.3.2. RECON Commands

RECON Commands

Proposed List Including New Features

Command	Abbreviation(s)			Description
BEGIN	BE	!		New session
EXPAND	EX	"		Show index
SELECT	SE	#		Make a work set
COMBINE	CO	$		Combine sets
DISPLAY	DI	%		Display file item
PRINT	PR	&		High speed printer (up to 100 items)
TYPE	TY	TTY	'	Local teleprinter
KEEP	KE	(		Move to set 99
LIMIT	LI	)		Limit by year or volume
PAGE	PA	0		Next page, 0 - for previous page
SETS	@			Set history
MESSAGE	ME	MSG	]	Send message
STATUS	ST			List stations and status
EXPLAIN	?	HELP		Explain command
END	=			End session
SAVE	SA			Save present session
SCAN	SC			Linear Search
FILE	FI			Change files
RECALL	RE			Repeat a previous session

Table 1.3.3. Proposed Improvements to RECON Commands

PRINT Command

1. The request for address should not occur until the first PRINT request:

   PLEASE GIVE YOUR NAME AND LOCAL ADDRESS (IF PRINTS ARE TO BE SENT ELSEWHERE THAN YOUR LIBRARY)

2. Instead of 50, the maximum number of PRINTS per command should be 100. The PRINT command without modifier means print the next 100, if there are 100 or more, else print remainder. Perhaps there should be a specific command to print all of a work set, such as %5/2/ALL.

3. There should be some way to cancel a PRINT request, maybe

   &5/CANCEL

   to cancel all print requests from userset 5.

Table 1.3.3. Proposed Improvements to RECON Commands
(continued)

Message Switching

1. When TTY is on, both incoming and outgoing messages are typed.

2. Time of day is added to the typed message.

3. There should be a Long Message Mode command, which moves the cursor to the top and allows you to send a full screen message.

4. There should be a Hold Message command. While it is in effect (or if the terminal is off), messages should be stored for that terminal. The sender should be notified whether his message was displayed or stored. There should be a Mailbox command to display any stored messages and clear the message file.

5. There should be a command to send a message to the computer log, such as

]75/Gripe, gripe, gripe

Table 1.3.3. Proposed Improvements to RECON Commands
(continued)

TTY Control

1. Ideally, the user should be able to control his own TTY with commands such as: 'off and 'on, or TYPE ON, TYPE OFF.

2. The initial TTY status should be on a control card. However, if the TTY test is not satisfied, the computer turns that status to OFF.

3. The plan for TTY output is to type enough to enable the user to repeat the search. Thus: session number, all valid expand, select, combine, type, limit, save, or print commands.

4. In addition, all messages sent and received, with times.

5. The TYPE command has one of the hazards of the present system. If you ask for a TYPE of a long entry, you tie up the terminal for several minutes with no way to interrupt. We should have a slight pause every ten lines or so during which the blue light comes on for a few seconds. If the INT button is pressed during this time, the TYPE process will stop; otherwise, it will continue.

Table 1.3.4. Some Changes in RECON Software

1. Subtasking would allow for greater stability of the program, much easier program maintenance and additions, and better storage management..

2. Multiprocessing organization would allow for easier handling of multiple commands and users simultaneously, with more effective use of core storage.

3. A scheme of input-output queuing should be used to ease the transition to a Communications Controller and to TCAM. This scheme would also make a message switching a much simpler process.

4. A higher level language testing program would allow for testing of new algorithms which later would be written in Assembler for the production version.

5. A method of OS communication should be developed to enable system recovery from master terminal or network-wide hardware failure.

6. The RECON program would be made as fail-safe as possible. Only the subtask having an error should be refreshed.

7. Some improvements in the file structure would speed up both the retrieval and the update process.

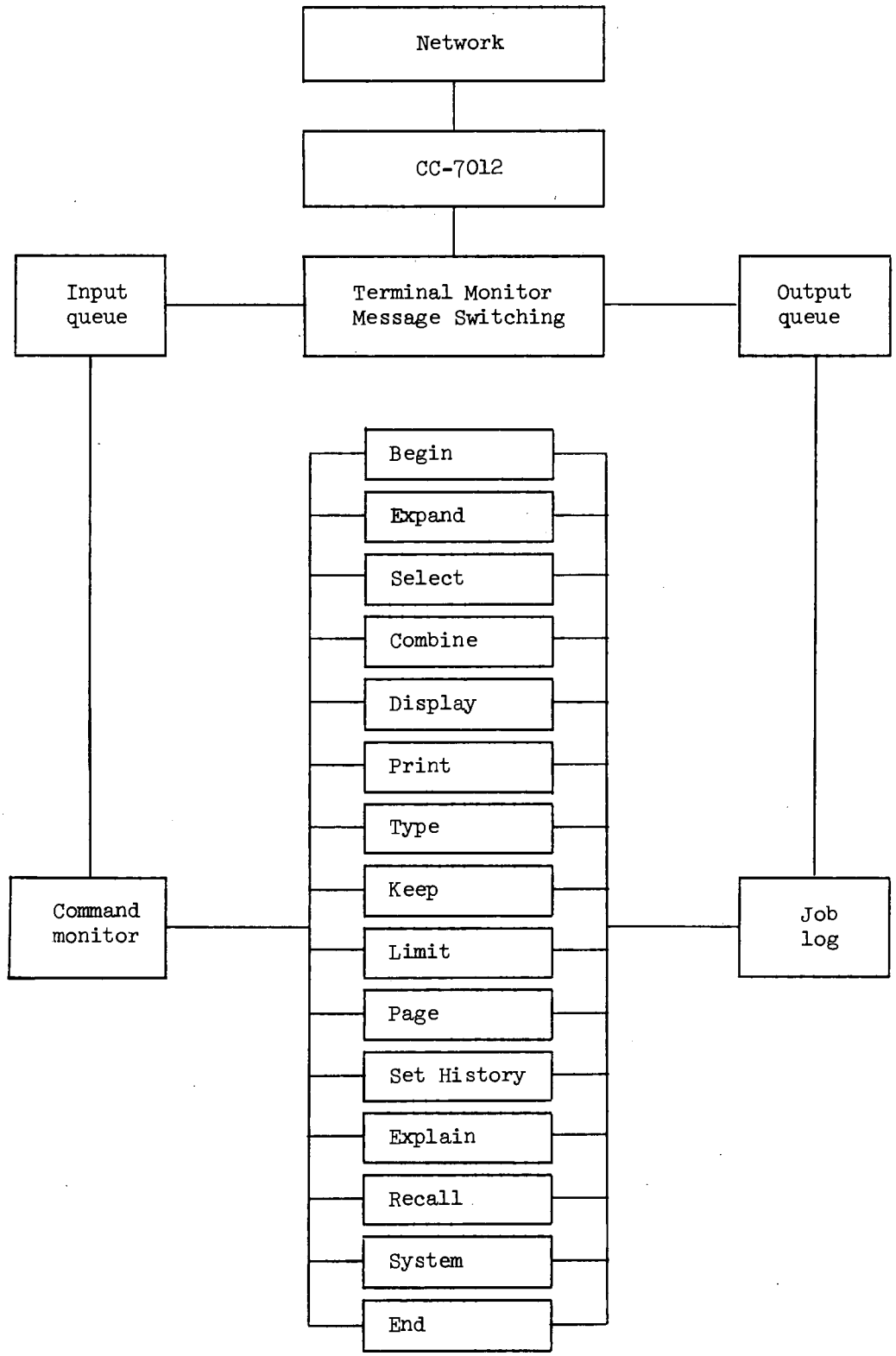

Fig. 1.3.1. Block Diagram of RECON Software

2. THE RECON NETWORK

2.1. Network Description

All the RECON stations are on a single party line. The line protocol described in Section 3.1 gives the line to each user in turn. The present line configuration is shown in Figure 2.1.1. This design was developed by AT & T and permits them to isolate troubles rather quickly. For example, if the line becomes too noisy to use, telephone engineers at the various Bridges can disconnect parts of the line until the trouble is isolated. As soon as the trouble is isolated, that part of the system is disconnected and RECON service to the rest is restored. The phone company proceeds with further tests of the disabled section and typically gets it fixed the same day.

It would be possible to design a snake-like line system with fewer total miles but it would be harder to find and remove faulty segments from the system.

Actually, the line configuration is much more detailed than shown in Figure 2.1.1. In fact, even the drawing of a specific "phone line" is an oversimplification. We do not rent a phone line from AT & T. We rent a service and they connect various existing wires to provide that service. But tomorrow they may use a different set of wires. Sometimes our west coast leg goes through Dallas, sometimes through St. Louis, although such major shifts are rare.

The line is used for data transmission but there is also a voice coupler at each station. This is used for trouble-shooting. Sometimes one can get a clue as to what is wrong by listening to the carrier signal.

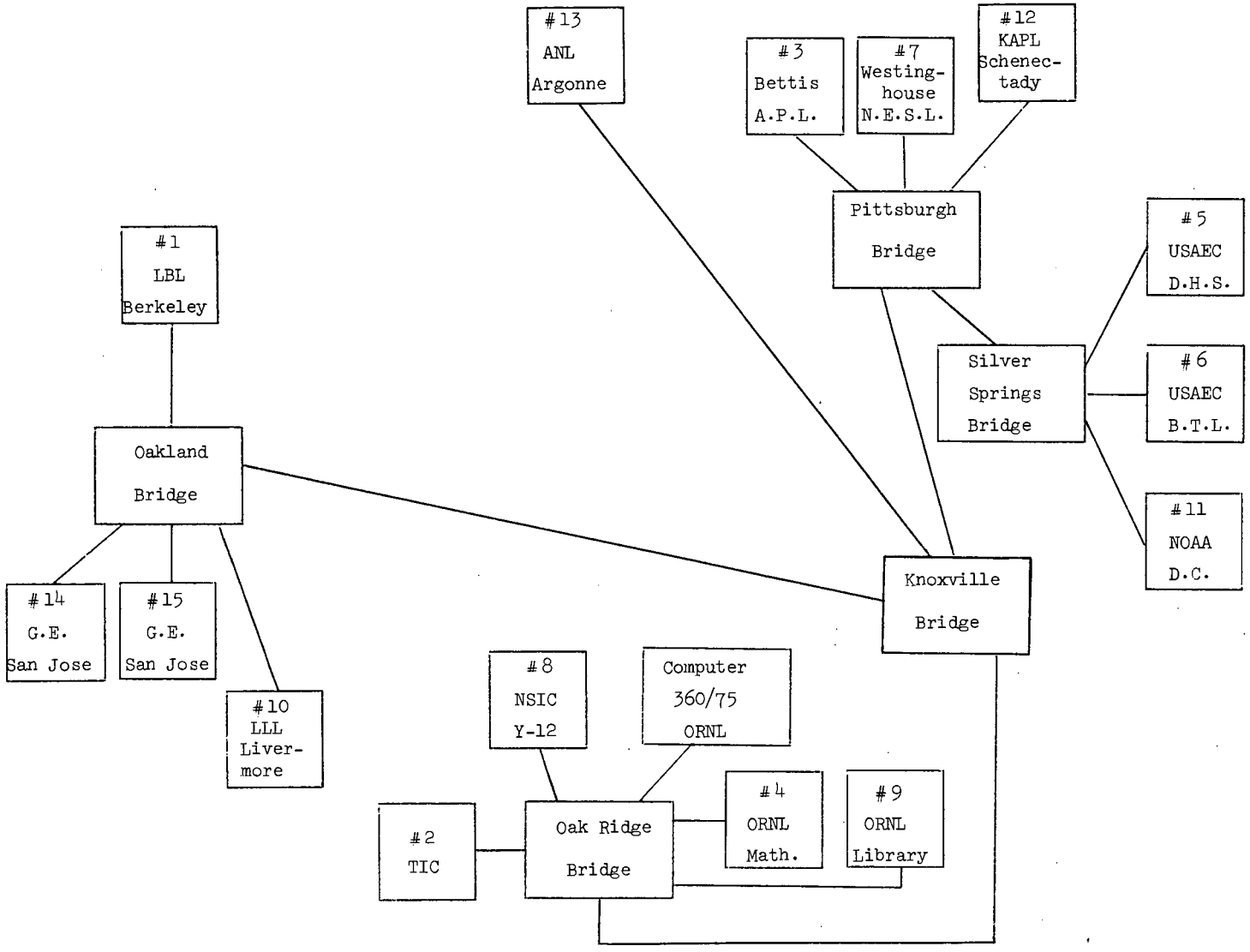

Fig. 2.1.1. RECON Network (not drawn to scale)

2.2. Station List

The present list of stations, names, addresses, and phone numbers is given below. The station number is the hard-wired address number and is used in sending messages via RECON. There is no special significance to the number or sequence. The computer gives each terminal the same priority.

Terminal 1 LBL

Gloria Smith
Technical Information Division
Building 50B, Room 4206
Lawrence Berkeley Laboratory
Berkeley, CA 94720
FTS 415-843-6368

Terminal 2 TIC

John Norris
Technical Information Center
P. O. Box 62
Oak Ridge, TN 37830
FTS 615-483-4426

Terminal 3 Bettis

Linda Tafel
Technical Information Center
2N - W1R
Bettis Atomic Power Laboratory
Box 79
West Mifflin, PA 15122
FTS 412-462-0230

Terminal 4 ORNL

Ray Plemens
4500N, E-214
Oak Ridge National Laboratory
Oak Ridge, TN 37830
FTS 615-483-1623

Terminal 5

Hugh Voress
Division of Headquarters Services
USAEC
Washington, DC 20545
FTS 301-973-4338

Terminal 6 BTL

Bob Devine
Bethesda Technical Library
USAEC
Washington, DC 20545
FTS 301-973-7748

Terminal 7 WNES

Mary Vasilakis
Westinghouse Nuclear Energy System Library
P. O. Box 355
Pittsburgh, PA 15230
412-373-4546 (FTS OP. 412-644-3311)

Terminal 8 NSIC

Marie M. Cardwell
9711-1 Technical Library, Y-12
Oak Ridge National Laboratory
Oak Ridge, TN 37830
FTS 615-483-7719

Terminal 9 ORNL-CRL

Herb Pomerance
4500NM, I-203
Oak Ridge National Laboratory
Oak Ridge, TN 37830
FTS 615-483-1961 or 615-483-1466 (H. Kuhns)

Terminal 10 LLL

Len Fisher
Lawrence Livermore Laboratory
Technical Information Department L3
Box 808
Livermore, CA 94550
FTS 415-447-8401

Terminal 11 NOAA

Bob Freeman
Technical Information Division (D83)
National Oceanographic Atmospheric Administration
Washington, DC 20235
FTS 900-343-4275

Terminal 12 KAPL

Barbara A. Rice
Document Library
Bldg. A-1, Room 112
Knolls Atomic Power Laboratory
P. O. Box 1072
Schenectady, NY 12301
FTS 518-393-4466

Terminal 13 ANL

Hyllis L. Griffin
Argonne National Laboratory
Bldg. 203 Room CE112
Lemont, IL 60439
FTS 312-739-3192

Terminal 14 GE

Alleen Thompson or Lynn Lanspery
G. E. Nuclear Energy Division
175 Curtner
Library Room 44
San Jose, CA 95114
297-3000 extension 3522
(FTS OP. 408-275-7011)

Terminal 15 GE-NED

Roger Hessenius or Ron Houston
G. E. Nuclear Energy Division
1900 South 10th Street
Room 121
San Jose, CA 95114
297-3000 extension 6223
(FTS OP. 408-275-7011)

3. HOW RECON WORKS

For the present discussion, we divide RECON into three parts, a communication system, a retrieval system, and a file management system.

3.1. Communications System

Some elements of the communications system currently used for RECON are displayed in Figure 2.1.1.

In discussing the communications system we begin with the part we understand least--the phone line. RECON uses a leased, dedicated, C-2 conditioned, 4-wire multi-drop line whose name is GDA24803. Data is transmitted in asynchronous, also called SS or Start-Stop mode. It is a characteristic of lines in general that data in the form of voltage pulses or DC voltage levels get distorted or lost in transmission over long distances. The phone lines and equipment on the lines, e.g., amplifiers, are designed to work within a narrow frequency band, 200 to 3200 Hz. Since the data from the computer is in the form of pulses, there is a conversion problem. What is done in RECON and many other systems is to transmit a "carrier" frequency and to indicate binary 1's and 0's by changes in the carrier signal. The modem is a device which changes, or modulates, the outgoing carrier signal and demodulates the incoming signal to send a stream of data pulses into the computer. We use Bell 201B modems which send data bits by introducing sudden 180° phase shifts into the carrier signal. The data transmission rate is 2400 bits per second or 2400 baud. This transmission rate is determined solely by the modems; the rest of the communications equipment can be, and has been, operated at higher speeds.

The world of modems is arcane and fascinating. There are Single Sideband modems, frequency hopping modems, automatic equalizing modems, error recovery modems. Modems were the subject of an AEC/RECON Newsletter of August, 1972.

> The complete story of ORNL and the Modems will not be recounted here. Perhaps it will be a movie someday. A modem is a black box, or sometimes a gray box, which comes between the terminal and the phone line, and between the computer and the phone line. The reason for the modems is that RECON will not work without them.
>
> Currently, we are using 201B modems supplied by the telephone company. We suspect that the modems are part of the reason RECON sometimes appears sluggish. We have tried Milgo modems with some success. Milgos were used for the special satellite link to Geneva, Switzerland in August, 1971, with a very good transmission record. However, when we created an illicit mix by putting two Milgos into the regular RECON system, we would occasionally have a small problem. The symptom of this problem was the sudden and total failure of the computer program. The cause is still unknown. IBM brought in a fancy self-testing, self-cleaning, frost-free modem which didn't work on our line--something about too many db or not enough db.
>
> Recently Bell brought in two of their new 208 modems. Two modems is not a crowd, but still the results were impressive. They worked twice as fast (4800 baud) and made fewer mistakes. The 208 is a slow learner; it takes 50 ms to match the pitch and phase of the carrier signal. Still, we think RECON would be a lot perkier if all the modems were replaced.

When the RECON program is read into the computer, it begins a process called "polling." A message is sent via the multiplexor to the CC-7012 Communications Adapter, which sends the bits one by one to the modem. The bit stream is: 0011110 0000001 0000001 0011111 (or 1E01011F in hexadecimal notation).

To each group of bits is added a START bit, a parity bit, and a STOP bit. These bits go out over the phone line and, since it is a

party line, all the modems (except the sending modem) "hear" these bits and transmit them to the CC-30 terminals.

Each terminal has an "address" wired in at installation time. The terminal is designed so that it responds only when it is addressed. In the above bit stream the first group, 0011110, is called SOA or start of address code; the second group is the address, 1; the third group is the address again; the last group, 0011111, is an end-of-poll code.

When all is working well, only terminal 1 (Berkeley) responds. It does so by first requesting the modem to turn on the carrier wave, then by transmitting one of two signals. One, called the NAK, is 1E0115 and means, roughly, "station 1 is alive and well." The other, called ACK, is 1E0105 and means "station 1 is alive and well and somebody or something has pushed the INTerrupt button."

If the NAK message arrives back into the computer, it changes the station number to 2 (0000010), and transmits another poll.

And so on, through the fifteen stations. This is the polling sequence.

If any station returns an ACK, a different sequence of activity is triggered. The computer sends out a different bit string, which is interpreted by the active station as a transmit request.* At this time the station will transmit a bit string corresponding to whatever the user has keyed in. (This information has been stored in the terminal memory and also appears on the CRT screen.)

---

*Actually, the transmit request is a sequence of commands: SOA, addr, HALT LOCAL I/O, CHARACTER MODE, INSERT END OF TEXT SYMBOL, SET CURSOR POSITION, TRANSMIT.

The terminals expect and send data in the 7-bit ASCII mode. This is translated to and from the IBM 8-bit EBCDIC as the data enters or leaves the computer.

The list of things that can go wrong with the transmission process is enough to chill an optimist. The signal on the line may suffer Frequency Distortion, Delay Distortion, White Noise, Impulse Noise, or Phase Jitter. A sample of our phone log is given in Table 3.1.1. The data can come in too fast (OVERRUN) or too slow (TIME OUT) or with parity errors (DATA CHECK). Sometimes we hear birds chirping on the line. Sometimes one station answers a call to another station or gets a display intended for another station. Occasionally a stray signal sends a station into graph mode and covers the screen with dots or puts the teleprinter into continuous typing mode. Transmission is poorer on rainy days; this may be due to people using the lines for target practice.

All of which serves to increase one's wonderment when it actually works.

Table 3.1.1. Sample from RECON Phone Log

5-2	1315	Lost polling signal. Calling KTB. REP
	1325	Line came clear. REP
5-7	1055	Dial pulses on line has RECON locked out. Calling KTB. REP
	1110	Line cleared. REP
5-21	0830	Noise on line. Calling KTB (Wyrick). Every terminal except the ones in Oak Ridge are off due to line failure. Wyrick will call back. REP
5-31	0850	Line noise and data phone ringing. Calling KTB. REP
	0915	Ringing stopped. Line cleared. REP
	1425	Berkeley having trouble with noise on line. Calling KTB. Could be 301 overheating. REP

NOTE: KTB is Knoxville Test Board. REP is Ray Plemens.

3.2. Retrieval System

The RECON file for Nuclear Science Abstracts contains about 300 million characters. It is not practical to scan this much text for every request. RECON uses index and pointer schemes to find the items needed. The descriptive cataloging data is in a series of computer files known collectively as the Linear File or LF. Another file contains a list of identification numbers (for Nuclear Science Abstracts this is the same as the NSA number) and, for each I.D. number, a computer pointer to the place in the Linear File where the descriptive cataloging for that item is stored. This file is called the Linear Index or LX.

When the user requests a display of a specific item, RECON looks in the Linear Index to see if the item is present, and where it lives in the Linear File. The Linear Index is itself arranged in a hierarchical fashion (IBM's Indexed Sequential Access Method) so that the request goes first to a short index (somewhat like a Table of Contents) to locate a section in the LX where the desired pointer, if it exists, can be found.

When the Linear File is built, or added to, a special list of Descriptors is created. This contains the Authors, the Keywords, the Subject Categories and whatever else has been designated as a searchable parameter or access point. With each Descriptor is included the identification whence it came. This list of Descriptors and I.D. numbers is sorted alphabetically and merged with the previous similar material to form the Inverted File or IF. A record in the Inverted File consists of a Descriptor, followed by a list of I.D. numbers associated with that Descriptor. Each Descriptor is preceded by a key

according to which type of Descriptor it is, for example, AU= for authors, IT= for keywords.

When the Inverted File is moved to on-line storage, an index is prepared as in the case of the Linear File. This index is called the Inverted Index or IX and contains, for each Descriptor, the number of relevant items and a pointer to the Inverted File. The IX is also arranged hierarchically so that only a small amount of scanning is needed to find a requested item or to determine that it isn't there.

When the EXPAND command is given, RECON can satisfy the request with only the IX. It simply looks for whatever you typed and when it finds the appropriate place in the IX it backs up a little and then sends you a whole page from the IX. The EXPAND command is usually executed quite rapidly.

When the SELECT command is given, the computer first checks whether you have asked for a single item, for example # e9, or for more than one item, for example # e9,e10. In the first case, RECON simply moves a pointer into a work set to indicate which item was SELECTed. In the second case, RECON must perform a logical operation combining the items of e9 with those of e10 and reducing duplicate entries to single entries. To do this RECON goes to the Inverted File, extracts the two lists (corresponding, for example, to e9 and e10), performs the logical operation, and puts the resulting list in the user work file.

The COMBINE command operates on user work files. If a user work file needed for the COMBINE contains a pointer into the IF, that list is fetched from the IF before the COMBINE operation begins. If the

COMBINE request contains more than one operation, it is broken down to a sequence of single operations, checked to see that the total request is possible, and then executed in steps. The user sees only the final result, in the form of a new user work set.

When the user requests a DISPLAY of a user work file, the system goes to the indicated work file and takes the first (and most recent) I.D. number to the Linear Index to get the pointer to the Linear File. The desired item is brought from LF into the computer and sent to the user station.

When the user gives a PRINT command, the command is stored in the RECON log but not executed. The user gets almost immediately a message that his command was obeyed but in fact nothing has happened. In the evening another program looks at the log, recreates the user work set and executes the PRINT command. This is one of several features that were added to speed up the response during the user session.

There is another file, called Related Terms File or RF. The list that is shown after an EXPAND command may also contain a count of the related terms for each item. Pointers to the RF are contained in the Inverted Index. When a Related Terms Expand request is given, the system gets the pointer from the IX, the list of Related Terms from the RF and then goes back to the IX to get the counts and pointers for each related term in the list. Only then can it send out the Related Terms display. A Related Terms EXPAND thus takes a little longer to perform than a regular EXPAND.

The RECON run deck is read into the computer in the morning around 8 a.m. The first thing it does is ask, via the CRT screen in the computer room, whether this is to be a WARM or COLD start. If the

PRINT requests from the previous day have been successfully printed, we reply COLD, which erases the log from the files and starts a new log. Then by special commands, the various terminals are added to the polling sequence until all are on. During the day any terminal can be removed from the polling list at the request of the user and later put back on.

On good days RECON requires no servicing between start-up and shut-down around 5 p.m. On bad days (machine break-down, phone line noise) it may be necessary to start RECON several times; for these the WARM start is used. This preserves any PRINT requests that have been issued. At present, we still lose user work sets even with the WARM starts. Hopefully, this will soon be fixed.

Figure 3.2.1 is a caricature of the RECON system showing the files and their relationship to the various RECON commands.

For those familiar with IBM 360, one glimpse of the Job Control Language may be worth a thousand words about the files used by RECON. Others may ignore the JCL listing shown in Figure 3.2.2. The JCL changes all too frequently; the listing shown is for June 12, 1973.

3.3. File Management System

Many of the details of the file management system can be deduced from the preceding section which includes some description of the various RECON files. When a new issue of Nuclear Science Abstracts is prepared, a tape is sent to ORNL with the descriptive cataloging and keywords. The elaborate procedure used to update the RECON files is shown in Figure 3.3.1 with the corresponding JCL in Figure 3.3.2. Not shown there are the dozen or so extra steps that are taken to provide back-up

copies of the various disk and cell files. We keep two copies of everything and are pretty well protected against events involving one file or one faulty data set. Sometimes we get caught up in disasters involving multiple failures or failures before the back-up files are ready.

A common problem is shortage of on-line storage space. Sometimes we take some data off and reorganize to fit in less space. Sometimes we borrow space temporarily from other ORNL projects.

The File Update Procedure shown in Figure 3.3.1 is used for Nuclear Science Abstracts and other files. The step labelled LFLOAD takes the new material and adds it to the Linear File on the data cell. At the same time it makes a list of pointers to the LF and a list of new Descriptors (authors, keywords, subject categories, etc.). The LF pointers follow the path on the left side of Figure 3.3.1. They are sorted, if necessary, and merged with a tape file containing all the LF pointers so far. The new tape (which will soon become the old tape in the next cycle) is used in a Load program, LXLOAD, which creates the Linear Index using the IBM Indexed Sequential Access Method.

Similarly, the new Descriptors are sorted. The prefixes AU=, IT=, etc., automatically route the items to the proper part of the file. The Sorted New Descriptor file is merged with the Cumulative Descriptor file in step IFLOAD and the result put on the data cell as well as a tape (for the next cycle). Also, pointers to the resulting Inverted File are saved to make the Inverted Index. Currently, the Inverted Index is in two parts, called IX and CX in Figure 3.3.1, with the author (AU=) part on the data cell, the remainder on the disk.

Figure 3.3.2 shows the JCL of the Update Procedure.

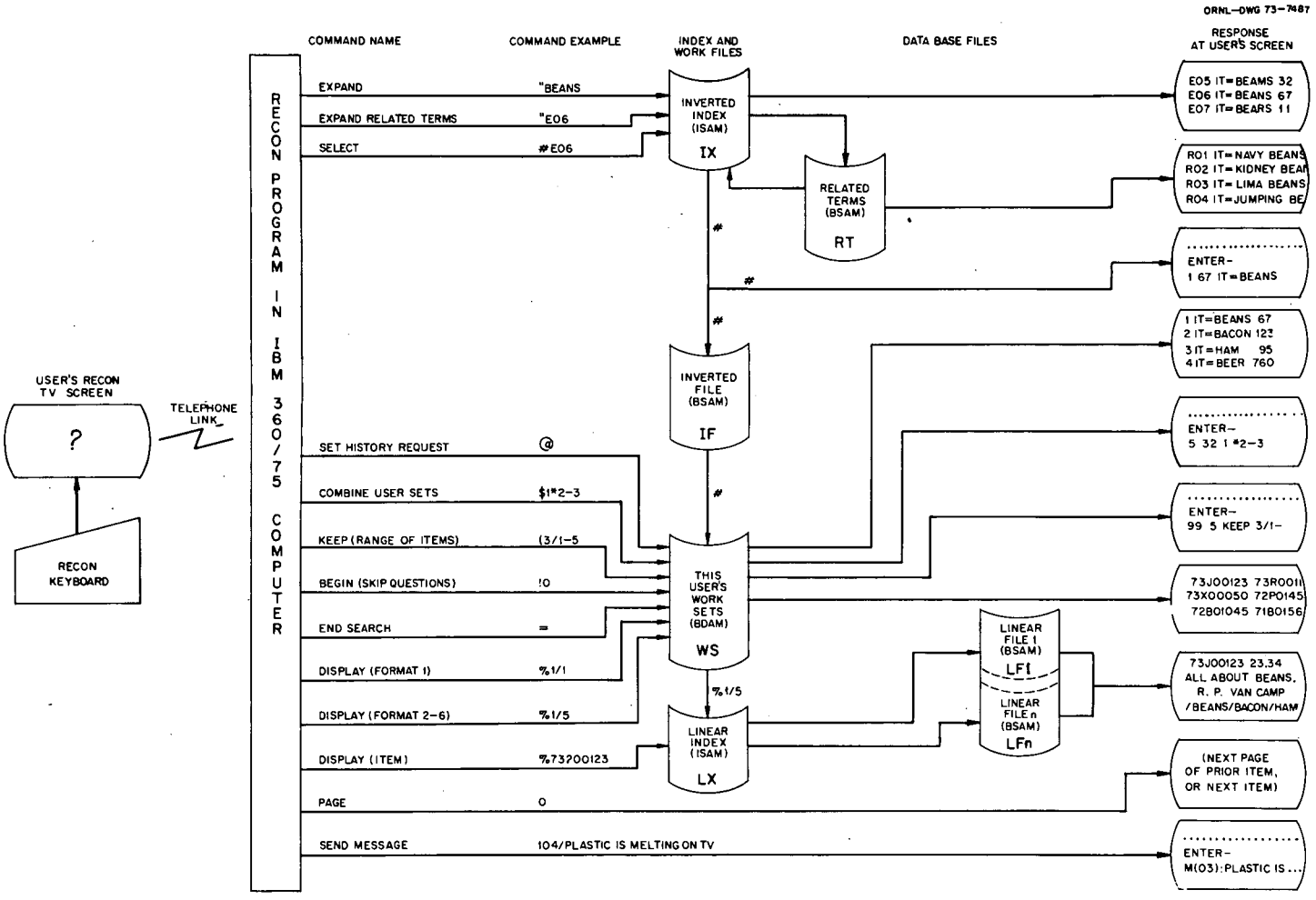

Fig. 3.2.1. RECON Files Used for Various Commands

```
//D1120K#S EXEC PGM=RECONX,REGION=270K
//SYSUDUMP DD SYSOUT=E,DCB=(RECFM=VBA,LRECL=125,BLKSIZE=1628),
//      SPACE=(CYL,(0,10))
//U50      DD  UNIT=024,DISP=SHR
//LFAE00 DD DUMMY
//LFAE01 DD DUMMY
//LFAE02   DD  UNIT=2321,VOL=SER=RECON1,DISP=SHR,DSN=AECLF2
//LFAE03   DD  UNIT=2321,VOL=SER=RECON1,DISP=SHR,DSN=AECLF3
//LFAE04   DD  UNIT=2321,VOL=SER=RECON3,DISP=SHR,DSN=AECLF4
//LFAE05   DD  UNIT=2321,VOL=SER=RECON7,DISP=SHR,DSN=AECLF5
//LFAE07 DD UNIT=2321,VOL=SER=RECON7,DSN=AECLF7,DISP=SHR
//LFAE08 DD UNIT=2321,VOL=SER=RECON6,DISP=SHR,DSN=AECLF8
//LFAE09 DD UNIT=2321,VOL=SER=RECCN0,DSN=AECLF9,DISP=SHR
//LFAE0A   DD UNIT=2321,VOL=SER=RECON6,DSN=AECLF10,DISP=SHR
//LFAE0B DD UNIT=2321,VOL=SER=RECON5,DISP=SHR,DSN=AECLF11
//IFAE00 DD UNIT=2321,VOL=SER=RECON5,DSN=AECIF11,DISP=SHR
//CFAE00 DD UNIT=2321,VOL=SER=RECON5,DSN=AECIF11,DISP=SHR
//LXAEC DD UNIT=2311,VOL=SER=RECONA,DISP=SHR,DSN=AECLX11,DCB=DSORG=IS
//IXAEC DD UNIT=2311,VOL=SER=RECOND,DISP=SHR,DSN=AECIX11,DCB=DSORG=IS
//CXAEC DD UNIT=2321,VOL=SER=RECON3,DISP=SHR,DSN=AECCX11,DCB=DSORG=IS
//R0     DD UNIT=2321,VOL=SER=RECON7,DSN=AECRF6,DISP=SHR
//W0         DD   UNIT=2314,DISP=(NEW,PASS,DELETE),SPACE=(TRK,(500)),
// VOL=SER=RECONZ
//JLF DD DSN=GKH.JOBLOG,DISP=SHR,UNIT=2314,VOL=SER=CRECON
//SYSABEND DD SYSOUT=E,DCB=(RECFM=VBA,LRECL=125,BLKSIZE=1628),
//      SPACE=(CYL,(0,10))
//LXEN01 DD UNIT=2314,VOL=SER=RECONZ,DISP=SHR,DCB=DSORG=IS,
// DSN=WBM3167.NBG13400.RECON.LX.TOXIC
//LFEN01 DD UNIT=2314,VOL=SER=RECONZ,DISP=SHR,DCB=(RECFM=VB,
// LRECL=1996,BLKSIZE=2000),DSN=WBM3167.NBG13400.RECON.LF.TOXIC
//IFEN01 DD UNIT=2321,VOL=SER=RECON0,DISP=SHR,
// DSN=WBM3167.NBG13400.RECON.IF.TOXIC
//IXEN01 DD UNIT=2321,VOL=SER=RECON0,DISP=SHR,DCB=DSORG=IS,
// DSN=WBM3167.NBG13400.RECON.IX.TOXIC
//CXEN01 DD UNIT=2321,VOL=SER=RECON0,DISP=SHR,DCB=DSORG=IS,
// DSN=WBM3167.NBG13400.RECON.CX.TOXIC
//IFHG01 DD UNIT=2321,VOL=SER=RECON0,DISP=SHR,
// DSN=WBM3167.NBG13400.RECON.IF.ENERGY2
//IXHG01 DD UNIT=2314,VOL=SER=RECONZ,DISP=SHR,
// DSN=WBM3167.NBG13400.RECON.IX.ENERGY2
//CXHG01 DD UNIT=2314,VOL=SER=RECONZ,DISP=SHR,
// DSN=WBM3167.NBG13400.RECON.CX.ENERGY2
//LXHG01 DD UNIT=2314,VOL=SER=RECONZ,DISP=SHR,
// DSN=WBM3167.NBG13400.RECON.LX.ENERGY2
//LFHG01 DD UNIT=2321,VOL=SER=RECON0,DISP=SHR,
// DCB=(RECFM=VB,LRECL=1996,BLKSIZE=2000),
// DSN=WBM3167.NBG13400.RECON.LF.ENERGY2
//LFWR01 DD UNIT=2321,VOL=SER=RECON0,DISP=SHR,
// DCB=(RECFM=VB,LRECL=1996,BLKSIZE=2000),
// DSN=WBM3167.NBG13400.RECON.LF.WRSIC
//LXWR01 DD UNIT=2314,VOL=SER=RECONZ,DISP=SHR,
// DSN=WBM3167.NBG13400.RECON.LX.WRSIC
//IFWR01 DD UNIT=2321,VOL=SER=RECON0,DISP=SHR,
// DSN=WBM3167.NBG13400.RECON.IF.WRSIC
//IXWR01 DD UNIT=2314,VOL=SER=RECONZ,DISP=SHR,
// DSN=WBM3167.NBG13400.RECON.IX.WRSIC
//CXWR01 DD UNIT=2314,VOL=SER=RECONZ,DISP=SHR,
// DSN=WBM3167.NBG13400.RECON.CX.WRSIC
//CAIN       DD  *
T     84,C2,C5,C6,41,C3,C7,48,49,4A,CB,CC,CD,4E,4F
/*
```

Fig. 3.2.2. RECON JCL

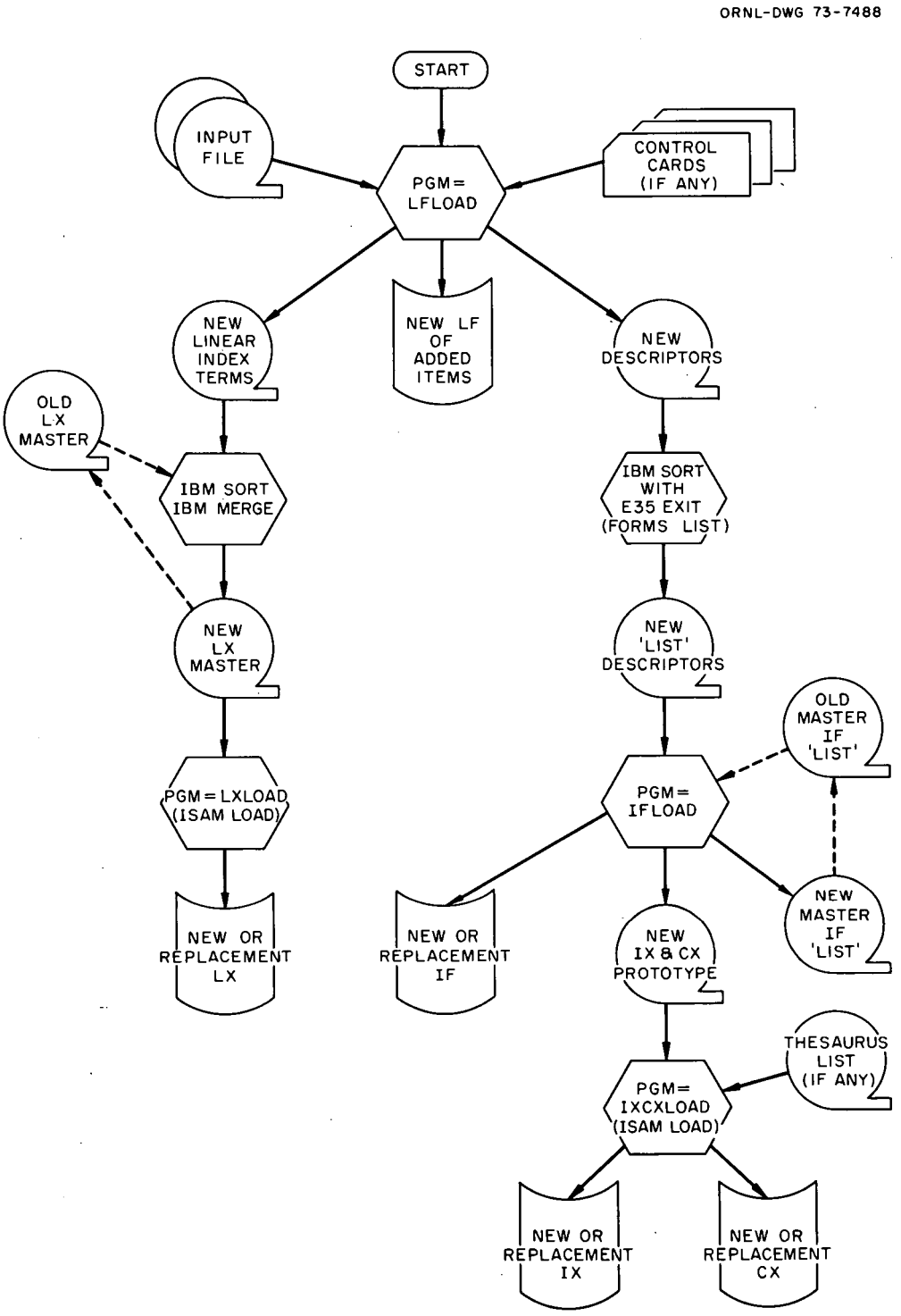

Fig. 3.3.1. RECON File Update Procedure

```
//READSEP  PROC FIL=NEWFILE,
//            OUTDSN='WBM3167.NBG13400.RECON.',
//            OUTL1=NL,OUTL2=NL,OUTL3=NL,OUTL4=NL,
//            OUTV1=11,OUTV2=21,OUTV3=31,OUTV4=41,
//            OUTU1=TAPE9,OUTU2=TAPE9,OUTU3=TAPE9,OUTU4=TAPE7,
//            INU=TAPE9,INV=01,INL=NL,
//            INDCB='DCB=(RECFM=VBS,LRECL=5000,BLKSIZE=2000),',
//            INDSN=ADSEP,
//            LFU=2321,LFS=50,LFV=RECONO,
//            IFU=2321,IFS=25,IFV=RECONO,
//            LXU=2314,LXS=01,LXV=RECONZ,
//            IXU=2314,IXS=05,IXV=RECONZ,
//            CXU=2314,CXS=05,CXV=RECONZ,
//            LBU=2314,LBV=RECONZ,LBN='READSEP.LIBRARY',
//            DSP1='(NEW,KEEP,DELETE)',
//            DSP2='(OLD,DELETE,KEEP)',
//            DSP3='(NEW,PASS,DELETE)',
//            DSP4='(OLD,PASS, DELETE)',
//            SCRTCH='(CYL,(20),RLSE)',
//            TEMP='(CYL,(2,2),RLSE)'
//LFLOAD   EXEC PGM=READSEY,PARM='0',REGION=270K
//STEPLIB  DD DSN=&LBN,UNIT=&LBU,VOL=SER=&LBV,DISP=SHR
//SYSPRINT DD SYSOUT=A
//TRACE    DD DUMMY    SYSOUT=A IS NORMAL IF NOT DUMMY
//DIAG     DD DUMMY    SYSOUT=(J,,1001) DUR TO SPECIAL CHARACTERS
//ADSEP    DD UNIT=&INU,LABEL=(,&INL),VOL=SER=&INV,
//            &INDCB.DISP=OLD,
//            DSN=&INDSN
//TARGET   DD UNIT=&LFU,VOL=SER=&LFV,DISP=&DSP1,
//            DSN=&OUTDSN.LF.&FIL,
//            SPACE=(CYL,(&LFS,&LFS),RLSE),
//            DCB=(RECFM=VB,LRECL=1996,BLKSIZE=2000)
//INDEX    DD UNIT=SYSDA,DISP=&DSP3,
//            DSN=&OUTDSN.NEWINDEX.&FIL,
//            SPACE=&TEMP,
//            DCB=(RECFM=FB,LRECL=20,BLKSIZE=7200)
//DESCF    DD UNIT=SYSDA,DISP=&DSP3,SPACE=(CYL,(10,10),RLSE),
//            LABEL=(,SL),
//            DSN=&OUTDSN.DESCS.&FIL,
//            DCB=(RECFM=FB,LRECL=46,BLKSIZE=3220)
//SYSIN    DD UNIT=&LBU,VOL=SER=&LBV,DISP=SHR,
//            DSN=WBM3167.NBG13400.LFLOAD.SYSIN
//LXSORT   EXEC PGM=IERRC000,PARM='CORE=100000,MSG=AP',REGION=128K
//SORTLIB  DD DSN=SYS1.SORTLIB,DISP=SHR
//SYSOUT   DD SYSOUT=A
//SORTWK01 DD UNIT=SYSDA,SPACE=&SCRTCH,DISP=&DSP3,DSN=&&S1
//SORTWK02 DD UNIT=SYSDA,SPACE=&SCRTCH,DISP=&DSP3,DSN=&&S2
//SORTWK03 DD UNIT=SYSDA,SPACE=&SCRTCH,DISP=&DSP3,DSN=&&S3
//SORTIN   DD DSN=&OUTDSN.NEWINDEX.&FIL,DCB=*.LFLOAD.INDEX,
//            DISP=&DSP2,VOL=REF=*.LFLOAD.INDEX
//SORTOUT  DD DSN=&OUTDSN.SORINDEX.&FIL,DCB=*.LFLOAD.INDEX,
//            SPACE=&TEMP,UNIT=SYSDA,DISP=&DSP3
//SYSIN    DD DSN=WBM3167.NBG13400.LXSORT.SYSIN,UNIT=&LBU,
//            VOL=SER=&LBV,DISP=SHR
//LXMERGE  EXEC PGM=IERRC000,PARM='CORE=60000,MSG=AP',REGION=76K
//SORTLIB  DD DSN=SYS1.SORTLIB,DISP=SHR
//SYSOUT   DD SYSOUT=A
//SORTWK01 DD DSN=&&S1,DISP=DSP4
//SORTWK02 DD DSN=&&S2,DISP=&DSP4
//SORTWK03 DD DSN=&&S3,DISP=&DSP4
//SORTIN01 DD DSN=&OUTDSN.SORINDEX.&FIL,DCB=*.LXSORT.SORTOUT,
//            DISP=&DSP2,VOL=REF=*.LXSORT.SORTOUT
//SORTIN02 DD DUMMY,UNIT=TAPE9,LABEL=(,NL),DISP=OLD,
//            DCB=*.LXSORT.SORTOUT,DSN=CUMLX
//SORTOUT  DD DSN=&OUTDSN.CUM.LX.&FIL,UNIT=&OUTU1,
//            DISP=&DSP3,VOL=SER=&OUTV1,LABEL=(,&OUTL1),
//            DCB=*.LXSORT.SORTOUT
//SYSIN    DD DSN=WBM3167.NBG13400.LXMERGE.SYSIN,VOL=SER=&LBV,
//            UNIT=&LBU,DISP=SHR
//LXLOAD   EXEC PGM=UPDT2,REGION=64K
```

Fig. 3.3.2. Job Control Language for Update Procedure

```
//STEPLIB  DD DSN=UPDTLIB,VOL=SER=CRBCON,DISP=SHR,UNIT=2314
//SYSPRINT DD SYSOUT=A
//#AECLX   DD DSN=&OUTDSN.LX.&FIL,UNIT=&LXU,VOL=SER=&LXV,
//            SPACE=(CYL,(&LXS,,1)),
//            DISP=&DSP1,
//            DCB=(DSORG=IS,RECFM=FB,LRECL=16,BLKSIZE=320,
//            KEYLEN=4,RKP=0,OPTCD=UR)
//INPUT    DD DSN=&OUTDSN.CUM.LX.&FIL,DISP=&DSP2,LABEL=(,&OUTL1),
//            DCB=*.LXMERGE.SORTOUT,VOL=REF=*.LXMERGE.SORTOUT
//SEQOUT   DD DUMMY,DCB=BLKSIZE=3536
//SYSIN    DD DSN=WBM3167.NBG13400.LXLOAD.SYSIN,UNIT=&LBU,
//            VOL=SER=&LBV,DISP=SHR,DCB=BLKSIZE=80
//SORTDESC EXEC PGM=IERRCOOO,PARM='CORE=200000,MSG=AP',REGION=256K
//SORTLIB  DD DSN=SYS1.SORTLIB,DISP=SHR
//LOADLIB  DD DSN=&LBN,VOL=SER=&LBV,UNIT=&LBU,DISP=SHR
//SYSOUT   DD SYSOUT=A
//SORTWK01 DD DSN=&&S1,DISP=&DSP4
//SORTWK02 DD DSN=&&S2,DISP=&DSP4
//SORTWK03 DD DSN=&&S3,DISP=&DSP4
//SORTIN   DD VOL=REF=*.LFLOAD.DESCF,DCB=*.LFLOAD.DESCF,
//            DSN=&OUTDSN.DESCS.&FIL,DISP=(OLD,DELETE),
//            LABEL=(,SL)
//SORTOUT  DD DUMMY,DCB=*.LFLOAD.DESCF
//REPORT   DD SYSOUT=A,DCB=BLKSIZE=3500
//PSORTOUT DD UNIT=&OUTU2,VOL=SER=&OUTV2,LABEL=(,&OUTL2),
//            DISP=&DSP3,DCB=(RECFM=U,BLKSIZE=5000),
//            DSN=&OUTDSN.SRT.DESC.&FIL
//SYSIN    DD DSN=WBM3167.NBG13400.SORTDESC.SYSIN,
//            VOL=SER=&LBV,UNIT=&LBU,DISP=SHR
//IFLOAD   EXEC PGM=CIFAEC,PARM='0',REGION=128K
//STEPLIB  DD DSN=&LBN,UNIT=&LBU,VOL=SER=&LBV,DISP=SHR
//SYSPRINT DD SYSOUT=A
//OMASTER  DD VOL=REF=*.SORTDESC.PSORTOUT,DISP=(OLD,DELETE),
//            DSN=&OUTDSN.SRT.DESC.&FIL,DCB=*.SORTDESC.PSORTOUT,
//            LABEL=(,&OUTL2)
//NMASTER  DD DSN=&OUTDSN.CUM.DESC.&FIL,UNIT=&OUTU3,VOL=SER=&OUTV3,
//            LABEL=(,&OUTL3),DCB=(RECFM=U,BLKSIZE=5000)
//UPDATE   DD DUMMY,DCB=(RECFM=F,LRECL=5000,BLKSIZE=5000)
//*
//* WARNING...IF THERE IS AN OLD MASTER FILE, SWAP THE FILES ABOVE.
//* BUT KEEP THE DCB'S AS SHOW.  NOTE, THAT WHEN WE DO NOT HAVE
//* ANY OLDMASTER, THE NEW MATERIAL MUST...MUST BE GIVEN TO
//* THE UPDATE PROGRAM AS 'OLDMASTER', NOT...NOT 'UPDATE'
//*
//INVINDX  DD UNIT=&OUTU4,VOL=SER=&OUTV4,DISP=&DSP3,
//            DSN=OUTDSN.IXCX.&FIL,LABEL=(,&OUTL4),
//            DCB=(RECFM=FB,LRECL=56,BLKSIZE=2800,TRTCH=C)
//INVFILE  DD UNIT=&IFU,VOL=SER=&IFV,DISP=&DSP1,
//            DSN=&OUTDSN.IF.&FIL,
//            SPACE=(CYL,(&IFS,&IFS),RLSE),
//            DCB=(RECFM=F,LRECL=2000,BLKSIZE=2000)
//ISAMLOAD EXEC PGM=AECIXL,REGION=128K
//STEPLIB DD UNIT=2314,VOL=SER=CRBCON,DISP=SHR,DSN=LIBAEC
//INPUT    DD VOL=REF=*.IFLOAD.INVINDX,DCB=*.IFLOAD.INVINDX,
//            DISP=(OLD,DELETE),LABEL=(,&OUTL4),
//            DSN=&OUTDSN.IXCX.&FIL
//SEQOUT   DD DUMMY,DCB=BLKSIZE=6600
//#AECIX0  DD UNIT=&IXU,VOL=SER=&IXV,DISP=&DSP1,
//            DSN=&OUTDSN.IX.&FIL,
//            SPACE=(CYL,(&IXS,,1)),
//            DCB=(DSORG=IS,KEYLEN=42,RKP=0,LRECL=66,RECFM=FB,
//            BLKSIZE =660,OPTCD=UR)
//#AECIX1  DD UNIT=&CXU,VOL=SER=&CXV,DISP=&DSP1,
//            DSN=&OUTDSN.CX.&FIL,
//            SPACE=(CYL,(&CXS,,1)),
//            DCB=(DSORG=IS,RKP=0,KEYLEN=42,LRECL=66,RECFM=FB,
//            BLKSIZE=660,OPTCD=UR)
//SYSIN    DD DSN=WBM3167.NBG13400.ISAMLOAD.SYSIN,
//            VOL=SER=&LBV,UNIT=&LBU,DISP=SHR,DCB=BLKSIZE=80
//         PEND
```

Fig. 3.3.2. Job Control Language for Update Procedure (continued)

3.4. RECON Hardware

The RECON program runs in the IBM 360/75 computer, which we share with CRBE, ATS, RJE, Culler-Fried, TSO, and batch processing. The /75 has 1/2 million bytes of fast core (1 μs) and 2 million bytes of slow core (8 μs). RECON uses about 1/4 million bytes of slow core. The bulk of the RECON data resides on a 2321 data cell, which we also share. Some of our files, including the space for user work sets, are on 2314 or 2311 disk drives.

RECON sends messages via the multiplexor to the CC-7012 Communications Adapter. This device converts the signal from parallel 7-bit ASCII to serial 10 bit (ASCII + parity + start + stop) pulse trains. This pulse train is sent to a 201B Modem and a corresponding signal is sent over the phone line.

At each receiving station the pulse train is demodulated by a 201B and sent to the CC-301 controller. Our CC-301 Controllers operate in PLSI (Party Line Serial Interface) mode. Only if the message has the right address bits does the CC-301 respond. The CC-301 contains a 1024 character memory. The contents of this memory can be displayed on the screen. During display mode, each character in the memory is sent 60 times a second to a character generator which "draws" the character on the screen by activating several dots in a 5 by 7 dot matrix. Any of 62 addresses can be assigned to a CC-301 by soldering jumper wires to the PLSI board. No two stations may use the same address. There is a "broadcast" mode in which a certain bit pattern in the message from the computer will cause all the terminals in a certain broadcast group to receive and display a message.

The CC-301 sends the display signals to a CC-300 Display, which is a TV set with a special input plug and a special switch to change from regular TV reception to CC-301 signal. The screen display has 24 lines of 40 characters each.

The CC-303 Keyboard is discussed in Section 5.4. It is similar to a typewriter keyboard but several control keys have been added. Data keyed in goes to the CC-301 and appears on the TV screen at the "current" position as indicated by a cursor. There are special cursor control keys. The Interrupt key on the keyboard is used to initiate communication with the computer.

The communication follows a protocol discussed in Section 3.1. When the CC-301 receives the Transmit command from the computer, it raises voltage on the Request-To-Send wire. The modem then turns on the carrier signal and after a decent interval to allow the computer's modem to synchronize, it raises voltage on the Clear-To-Send wire to the CC-301. The CC-301 uses the clock pulses from the modem to time its delivery of data. The modem samples the voltage on the data wire 2400 times a second.

Meanwhile, the modem at the computer is listening for data and sending that data to the CC-7012. If nothing happens for 2 seconds after a polling signal, the CC-7012 sends a TIME-OUT message to the computer and a RETRY cycle is initiated.

When the CC-7012 has collected seven bits (and checked the parity against the eighth bit) it sends a request to the multiplexor for permission to send the data into the computer. Meanwhile, the eight bits reside in a buffer in the CC-7012. If permission is not received before the next eight bits come in (about 5 ms), a bad condition known as

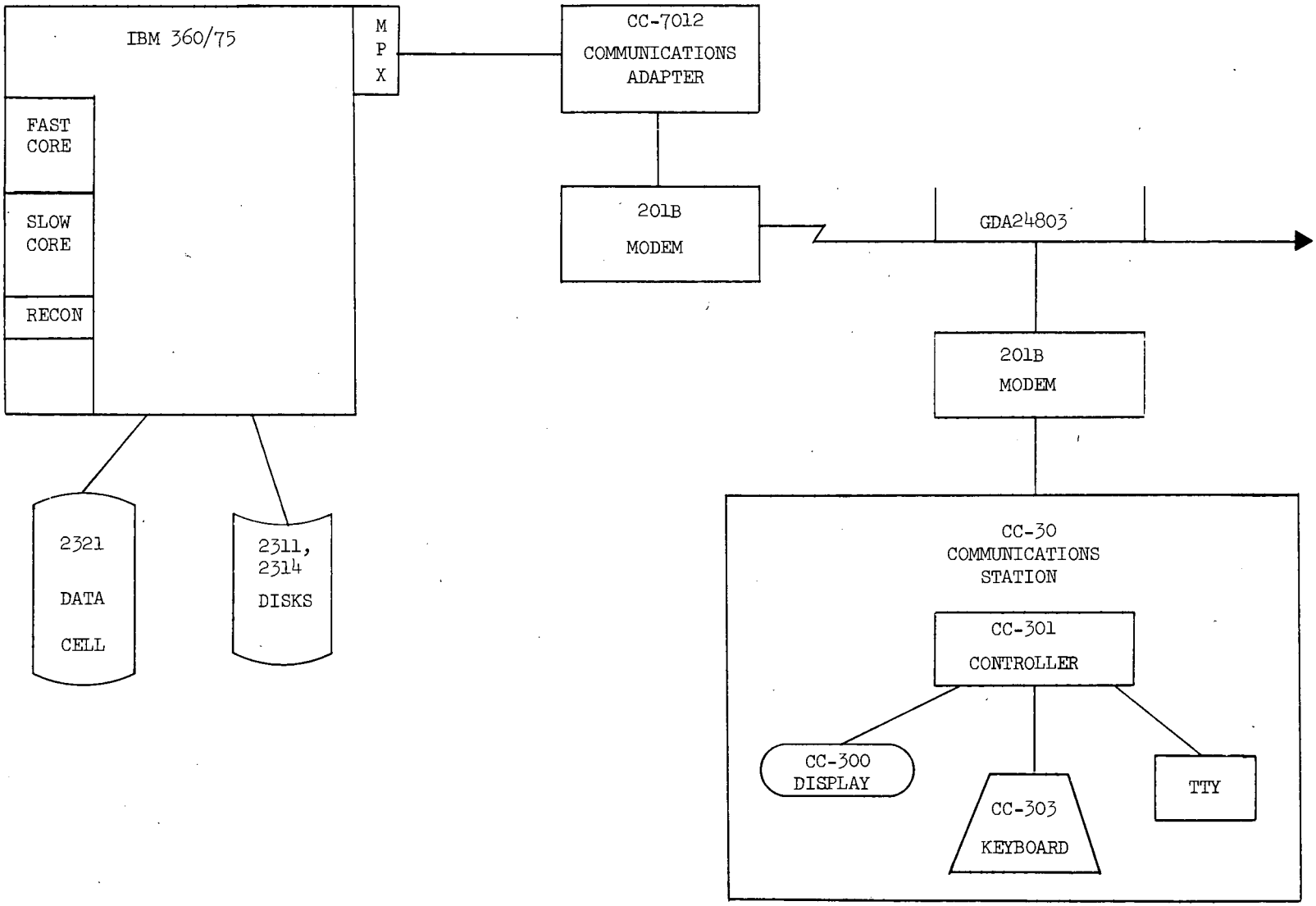

Fig. 3.4.1. RECON Hardware

OVERRUN occurs. Normally, however, the multiplexor finds time to receive one byte before it's too late.

Like the CC-301, the CC-7012 also uses the clock pulses of the modem. Thus, to change operation to another speed, say 4800 baud instead of 2400 baud, only the modems need to be changed. The CCI equipment is capable of working at much higher speeds.

Several brands of teleprinters are in use at RECON stations, for example, GE Terminet 300, Texas Instruments Silent 700, Repco 120. We use a vintage ASR-33 Teletypewriter which is slow and noisy. Teleprinters are not required; some stations do not use them at all. Other stations plug in a teleprinter as needed.

Some suggestions for care and maintenance of the CC-30 stations are given in Section 5.4.

4. DATA BASES

The number and size of the RECON data bases are expected to increase. The following description applies to June, 1973. As more data is put into the system, it is likely that certain data bases will be available on certain days. The scheduling details are not yet arranged.

4.1. Nuclear Science Abstracts

Nuclear Science Abstracts is published twice a month by the AEC-OIS Technical Information Center. It consists of bibliographic data and abstracts in the area of nuclear science and technology taken from reports, journals, books, patents, reviews, theses, and conferences.

The subject scope is defined in TID-4552 (Rev. 8) January 1972:

> Nuclear Science is the study of the production, properties, and phenomena of atomic nuclei, subatomic particles, gamma rays, and nuclear X rays.

> Nuclear technology is the application of nuclear science to other sciences and engineering and conversely, the application of other sciences and engineering to the problems of nuclear science.

At present, NSA bibliographic entries, not including abstracts, are available for RECON searching from 1969 through part of 1973 (NSA Volume 23, Issue 1, through Volume 27, Issue 7). In addition, the Inverted Files (authors, keywords, etc.) for 1968 (Volume 22) are available for searching but only NSA Abstract Numbers can be retrieved.

Approximately 50000 items per year are added to NSA. Some 297306 items have been put into RECON.

RECON searches may be done via authors, corporate codes, contract number codes, countries, keywords, codens, patent countries, or report codes. The number of each type of descriptor is shown in Table 4.1.1. (Some examples of these nine descriptor categories are given in Part 5.2.)

Beginning in April 1972, (Volume 26, Issue 7) the keywords are taken from the INIS (International Nuclear Information System) thesaurus given in IAEA-INIS 13 (Rev. 2). At present, the INIS keywords are not distinguished in the Inverted File from the earlier Euratom keywords, for which the thesaurus was given in TID-25439.

At the same time, the subject categories changed. The major subject headings are shown in Table 4.1.2. The detailed subject headings are given in TID-4552.

In SELECTing subject categories for user work sets (the RECON commands are described in Part 5.2) the user may want to SELECT both the new and the old subject number. The use of numbers 40.00 and above is in effect a crude form of LIMIT command, since only NSA items from

April 1972 on will be retrieved. If you SELECT 40.00, you get all subjects from 40.00 up to, but not including, 50.00. If you SELECT 40.10, you get all subjects from 40.10 up to, but not including, 40.20.

Retrieval by country may be done using a two-letter code to designate the country. The countries, codes, and number of NSA items from that country are shown in Table 4.1.3. A few special codes for international organizations are included.

Some of the codes are double because country coding is now done according to IAEA-INIS 5 (Rev. 2) Terminology and Codes for Countries and International Organizations. In such cases the earlier (before NSA Volume 27, Issue 7) code is listed first.

To retrieve by corporate codes, you will need a copy of the Corporate Authority, TID-5059, latest revision. Or DISPLAY some item that you know to be from the institution you are going to search for.

To retrieve by report number codes, see Appendix A of NSA Cumulative Report Number Index.

Journals scanned for NSA have been assigned a 5-letter CODEN. You can ask RECON for all items of a particular CODEN, if you wish. If you plan to do searching by CODEN, you may wish to consult TID-4579 (6th ed.). From this remarkable document you can find

(1) if a journal is scanned for NSA and
(2) if so, what is its CODEN and
(3) its country of publication,
(4) or the reverse, that is, given a CODEN, find the name of the journal.

You can sometimes find the CODEN for a particular journal using RECON. If you can remember the name of an author who publishes in that journal, DISPLAY his publications until the right journal and its coden appear.

Table 4.1.1. Descriptor Counts for Nuclear Science Abstracts (Volumes 22:1 to 27:7)

Type	Prefix	Number of Distinct Entries
AUTHOR	AU=	243344
CORPORATE CODE	CC=	4877
CONTRACT NUMBER CODE	CN=	254
COUNTRY	CO=	122
KEYWORDS	IT=	21298
CODEN	JO=	5486
SUBJECT	NC=	718
PATENT COUNTRY	PN=	22
REPORT CODE	RN=	962

Total Number of Distinct Descriptors: 268183

Total Number of NSA Items (including) 1968: 297307

Table 4.1.2. Major NSA Subject Categories
Before and After April 1972

BEFORE		AFTER	
20.00	CHEMISTRY	40.00	CHEMISTRY
22.00	EARTH SCIENCES	44.00	ENVIRONMENTAL AND EARTH SCIENCES
24.00	ENGINEERING	42.00	ENGINEERING
26.00	INSTRUMENTATION	46.00	INSTRUMENTATION
		47.00	ISOTOPE AND RADIATION SOURCE TECHNOLOGY
28.00	LIFE SCIENCES	48.00	LIFE SCIENCES
30.00	METALS, CERAMICS, and OTHER MATERIALS	50.00	MATERIALS
		52.00	NUCLEAR MATERIALS AND WASTE MANAGEMENT
		54.00	PARTICLE ACCELERATORS
32.00	PHYSICS (GENERAL)	56.00	PHYSICS (ASTROPHYSICS AND COSMOLOGY)
		58.00	PHYSICS (ATMOSPHERIC)
		60.00	PHYSICS (ATOMIC AND MOLECULAR)
		62.00	PHYSICS (ELECTROFLUID AND MAGNETOFLUID)
34.00	PHYSICS (HIGH-ENERGY)	64.00	PHYSICS (HIGH-ENERGY)
		66.00	PHYSICS (LOW-TEMPERATURE)
36.00	PHYSICS (NUCLEAR)	68.00, 69.00	PHYSICS (NUCLEAR)
		70.00	PHYSICS (PLASMA AND THERMONUCLEAR)
		72.00	PHYSICS (RADIATION AND SHIELDING)
		74.00	PHYSICS (SOLID STATE)
		76.00	PHYSICS (THEORETICAL)
38.00	REACTOR TECHNOLOGY	78.00	REACTOR TECHNOLOGY
00.00	GENERAL	80.00	GENERAL

Table 4.1.3. NSA Codes for Countries and International Organizations

Afghanistan	AF	2	Ghana	GH	13	Nicaragua	NA,NU	1
Algeria	AG	62	Greece	GR	235	Nigeria	NI	20
Antarctic	AC	10	Greenland	GL	1	Norway	NO	802
Argentina	AR	433	Guatamala	GU,GT	1	Pakistan	PA,PK	344
Australia	AS	3206	Guyana	GY	1	Paraguay	PR,PA	13
Austria	AT	1703	Honduras	HO	2	Peru	PE	33
Bahama	BH	1	Hong Kong	HK	25	Philippines	PH,RP	62
Belgium	BE	2532	Hungary	HU	1693	Poland	PO,PL	3155
Bolivia	BO,BL	18	IAEA, Vienna	IA	88	Portugal	PT,PO	160
Brazil	BR	450	Iceland	IC	13	Puerto Rico	PU,RQ	39
Bulgaria	BU	580	India	IN	5704	Rhodesia	RH	9
Burma	BA,BM	9	Indonesia	ID	8	Rumania	RU,RO	1490
Burundi	BN,BY	2	Iran	IR	26	Saudi Arabia	SU,SA	1
Canada	CA	6280	Iraq	IQ,IZ	26	Senegal	SK,SG	8
CERN, Geneva	CX	419	Ireland (South)	IL,EI	97	Singapore	SI	14
Ceylon	CY,CE	10	Israel	IS	1587	South Africa	SA,SF	639
Chile	CH,CI	127	Italy	IT	7183	Spain	SP	531
China, Mainland	CI,CH	72	Ivory Coast	IV	1	Sudan	SD	11
China, Taiwan	TA,TW	207	JINR, Dubna	DX	714	Sweden	SW	2780
Columbia	CO	30	Jamaica	JM	16	Switzerland	ST,SZ	2969
Congo	CL	20	Japan	JA	13965	Thailand	TH	45
Costa Rica	CR,CS	47	Kenya	KE	13	Trinidad	TI,TD	2
Cuba	CU	6	Korea, South	KS	265	Tunisia	TU,TS	7
Czechoslovakia	CZ	3040	Korea	KO	15	Turkey	TR,TU	95
Denmark	DE,DA	1324	Kuwait	KU	1	Uganda	UD,UG	5
Dominican Republic	DP,DR	1	Lebanon	LE	38	USSR	UR	35576
Euratom	EX	197	Libya	LY	2	United Arab Republic	UP,EG	498
Ecuador	EC	7	Liechtenstein	LI,LS	5	USA	US	112863
El Salvador	EL	3	Luxemberg	LX,LU	66	Uruguay	UG,UY	24
England, UK	UK	17247	Madagascar	MS,MA	2	Vatican City	VC,VT	1
Ethiopia	ET	2	Malaysia	MA,MY	15	Venezuela	VE	65
Eurochemic	EU	24	Malta	ML	2	Vietnam, North	VN	14
Finland	FI	746	Mexico	MX	302	Vietnam, South	VS	7
France	FR	15685	Monaco	MN	9	Yugoslavia	YU,YO	1074
Gabon	GB	1	Morocco	MO	3	Zambia	ZA	3
Germany (East)	GD,GC	1860	Netherlands	NE,NL	2621	Unknown	ZZ	46
Germany (West)	GF,GE	17070	New Zealand	NZ	255			

For Patent Country, there is little need to consult an authority. Simply EXPAND PN=A and all the patent countries will appear.

4.2. Other Files

A program has been written to simplify the preparation of new files for RECON display. It is fairly easy to put in a new file if there is enough on-line storage space for it. There is a small increase in RECON core storage required for each additional file.

This section will be out-of-date as soon as it is typed, if not before. It is included only to give an idea of some of the available files. The RECON BEGIN command will cause a list to be displayed on the CRT screen showing what files are available on any particular day.

4.2.1. Energy

The Energy Data Base is a collection of bibliographic references related to the field of Energy. The Data Base is supported by the National Science Foundation and is part of the Environmental Information System Office, an affiliation of Information Centers and specialized data bases at Oak Ridge National Laboratory. The Energy Data Base contains references to books, reports, technical and semi-technical journal articles, symposium papers and proceedings, and Congressional committee prints.

References in the Energy Data Base are grouped into the following general subject categories: AIR POLLUTION; COAL; ELECTRICITY GENERAL; ELECTRICITY FORECASTS; ELECTRICITY GENERATION; ELECTRICITY MARKETS; ELECTRICITY TRANSMISSION; ENERGY GENERAL; ENERGY FORECASTS; ENERGY MARKETS; ENERGY POLICY; ENERGY RESOURCES; ENVIRONMENT; FOSSIL FUELS; HYDROELECTRIC POWER; HYDROGEN; NATURAL GAS; NUCLEAR ENERGY; PETROLEUM;

SOLAR ENERGY; RESIDENTIAL BUILDINGS; TRANSPORTATION; UNCONVENTIONAL ENERGY SOURCES; WASTE HEAT; and WATER POLLUTION.

At the present time, the Energy Data Base contains almost 2000 references and is continually increasing. The Data Base is coordinated by Miriam P. Guthrie. Questions concerning the Data Base should be addressed to her, Building 3603, ORNL (Tel 615-483-8611, ext. 3-1289). Copies of documents cannot be obtained from the Energy Data Base. If no availability is listed, please contact the author at the corporate-author address.

4.2.2. Water Resources Abstracts

This is a bibliographic data base prepared and maintained by the Water Resources Scientific Information Center, Department of Interior.

At present only a sample of this file is available, consisting of 1822 items with abstracts. Searching may be done by author (AU=), descriptors (IT=) or identifiers (SU=). Identifiers are usually names of specific things or species. Abstracts are displayable (use format 5 or 6).

4.2.3. Toxic Materials in the Environment

This file is managed by Emily Copenhaver of the Toxic Materials Information Center of the ORNL-NSF Environmental Systems Information Office. The scope includes all toxic materials, but with particular emphasis on metals and organo-metallic compounds.

There are about 4000 items which may be searched by authors (AU=) or keywords (IT=). Abstracts are displayable (format 5 or 6).

```
 DIS 01/6/00002-00002//     2  PAGE  1
73J02054  X10-01-01  00.00  (EN-2054)
  COAL  IS  CHEAP,  ..ATED,  ABUNDANT,
FILTHY, NEEDED\
  STEIN, J.\  (SMITHSONIAN ASSOCIATES)
  1973, FEBRUARY \
  JOURNAL \
  SMITHSONIAN,  3 ( 11 ), 18-27\  ENERGY
LIBRARY (XEROX COPY)\
  COAL \
  DIST \
  THIS  U. S.  IS  GOING TO HAVE TO TURN
BACK  TO  COAL AS THE MAJOR RESOURCE FOR
ENERGY  PRODUCTION  BECAUSE OF SHORTAGES
OF  PETROLEUM  AND NATURAL GAS RESERVES,
DELAYS  IN  NUCLEAR  POWER  PLANT
CONSTRUCTION,  AND  THE  HIGH  PRICE  OF
FUEL  IMPORTS.  COAL  IS  OUR  MOST
ABUNDANT  RESOURCE.  IT  IS FOUND IN 38
STATES,  AND  THERE  ARE  STILL

ENTER:
                                    -MORE-

 DIS 01/6/00002-00002//     2  PAGE  2
APPROXIMATELY  ONE - AND-A-HALF TRILLION
TONS  OF  IT UNMINED.  AT TODAY ' S
RECOVERY  AND CONSUMPTION RATES, THIS IS
A  1,000  YEARS '  SUPPLY.  HOWEVER, THE
AIM  IS  TO  PRODUCE  PIPELINE  QUALITY,
POLLUTION - FREE GAS FROM THE COAL--A
PROCESS  CALLED  COAL  GASIFICATION.  THE
GAS  WILL  THEN  PROVIDE  FUEL FOR POWER
PLANTS.  THIS  ARTICLE  DISCUSSES  THE
STATE  OF  THE  ART OF COAL GASIFICATION
AND  SOME  OF  THE ATTENDANT PROBLEMS OF
THE PROCESS. (DCM)\
    COAL  \  MINING  \ COAL MINING\ STRIP
MINING  \  SURFACE  MINING  \  MINES  (
EXCAVATIONS )  \  ELECTRIC POWER DEMAND\
ELECTRIC  POWER  GENERATION  \  ELECTRIC
POWER  PLANTS  \  FUELS  \  FOSSIL FUELS\
POLLUTION  \  AIR  POLLUTION  \  COAL
GASIFICATION \  RESOURCES  \  RESERVES

ENTER:
                                    -MORE-

 DIS 01/6/00002-00002//     2  PAGE  3
LAND  USE\ LAND RECLAMATION \RECLAMATION
\  SULFUR  OXIDES  \  FUEL CONSUMPTION\
UNDERGROUND  MINING  \  CONSERVATION \
SHORTAGES  \  POLICIES  \  GOVERNMENT
POLICIES  \  LEGISLATION\ EMISSION\ FLUE
GASES\ COAL GASIFICATION \
```

Fig. 4.2.1. Sample of Energy File

```
 EXPAND  IT=CADMIUM
REF   DESCRIPTOR                          CIT  RT
E01  IT=CABBAGES: BEETS<-----              1
E02  IT=CABLE SCRAP<-----------            1
E03  IT=CABLES<----------------            1
E04  IT=CACHEXIA<--------------            1
E05  IT=CACODYLIC ACID<-------             26
-E06 IT=CADMIUM<---------------            846
E07  IT=CADMIUM ACETATE<-----              4
E08  IT=CADMIUM BINDING<-----
      PROTEIN<-----------------            1
E09  IT=CADMIUM CARBONATE<----             2
E10  IT=CADMIUM CARBONATE-MAG
     NESIUM CARBONA<----------             1
E11  IT=CADMIUM CHLORIDE<-----             29
E12  IT=CADMIUM COMPOUNDS<----             6
E13  IT=CADMIUM CONTAMINATED
      CROPS<-------------------            1
E14  IT=CADMIUM COPPER ALLOY
      PRODUCTION<--------------            1
E15  IT=CADMIUM DISODIUM
      ETHYLENEDIAMINETET<-----             1
```

```
 DIS 04/6/00001- END //     1  PAGE  1
71R00205  TOX-01-01  00.00  (M-S5)
  REPORT  OF  CONFERENCE  OF  SPECIAL
COMMITTEE  ON HEALTH SURVEY CONDUCTED OF
POLLUTION IN OSAKA PREFECTURE\
  1971, JANUARY 27\
  REPORT\
  OSAKA  PREFECTURE,  DEPARTMENT  OF
ENVIRONMENTAL  HYGIENE,  45  P.  \  (IN
JAPANESE)
  04\08\
  GENERAL METALS\
  (JAPAN, OSAKA PREFECTURE)
  RESULTS  ARE  REPORTED  FOR SURVEYS OF
THE  HEALTH EFFECTS OF EMISSIONS FROM AN
ARTIFICIAL  LEATHER  COMPANY, A CHEMICAL
COMPANY,  A  COTTON  CLOTH  BLEACHING
COMPANY,  AND  A ZINC PLATING PLANT.  IN
ADDITION,  DATA  ARE  PRESENTED  FOR  A
SURVEY  OF  THE  EFFECTS OF LEAD IN AUTO

 DIS 04/6/00001- END //     1  PAGE  2
EXHAUST  ON HOUSEWIVES AND FOR A SURVEY
OF  THE  EFFECTS OF CADMIUM CONTAMINATED
CROPS.  BASED  ON  INTERVIEWS AND BLOOD
AND  URINE  TESTS,  THE  SURVEY  OF
HOUSEWIVES  AND  FOR  A  SURVEY  OF  THE
EFFECTS ATTRIBUTABLE TO LEAD.  OF 111
PERSONS  IN  YAO  CITY WHO WERE EXAMINED
FOR  THE  EFFECTS  OF CADMIUM, 11 SHOWED
POSITIVE  URINE  PROTEIN.  THESE SURVEYS
WERE  CONDUCTED  IN  OSAKA PREFECTURE. (
APA)\
    ARTIFICIAL LEATHER COMPANY\ CHEMICAL
COMPANY  \ COTTON CLOTH BLEACHING COMPANY.
\  ZINC  PLATING  PLANTS  \  AUTOMOBILE
EMISSIONS  \     HOUSEWIVES  \  CADMIUM
CONTAMINATED  CROPS  \  URINE  PROTEIN  \
METALS  \  CADMIUM  \  COTTON  \ FEMALES\
URINE\ ZINC\
```

Fig. 4.2.2. Sample of Toxic Materials File

DIS 01/6/00002-00018// 9 PAGE 1
69R09882 TST-W2-24 00.00 (W69-09882)
WATER REUSE: A TEXAS NECESSITY\
FLEMING, R. D.\JOBES, H. D.\ (TEXAS WATER QUALITY BOARD, AUSTIN.)
J WATER POLLUT CONTR FEDERATION, VOL 41, NO 9, P 1564-1569, SEPT 1969. 6 P, 2 FIG, 1 TAB.\
TEXAS WATER PLAN\
FIELD 05D\06D\
BY THE YEAR 2020, TEXAS' ESTIMATED 33.5 MILLION PEOPLE WILL NEED 12 MIL ACRE - FT OF WATER FOR MUNICIPAL AND INDUSTRIAL USES, AND OVER 16 MIL ACRE-FT FOR IRRIGATION. BECAUSE THE ANNUAL SAFE YIELD OF GROUND AND SURFACE WATER IS ONLY 20 MIL ACRE-FT DEVELOPMENT OF OTHER WATER SOURCES IS A NECESSITY. TO PLAN FOR THE FUTURE NEED, SEVERAL PROCESSES (DESALINIZATION, WEATHER

ENTER:

-MORE-

DIS 01/6/00002-00018// 9 PAGE 2
MODIFICATIONS, AND WATER IMPORTATION) ARE BEING INVESTIGATED. TO DEVELOP THE IMPORTATION IDEA, THE TEXAS WATER PLAN WAS INITIATED IN 1964. THIS PAPER DESCRIBES THE MAIN ASPECTS OF THE PLAN (WATER REUSE, TAPPING THE MISSISSIPPI RIVER, CONTROL OF IRRIGATION) TO HELP MEET TEXAS' FUTURE NEEDS. (KNAPP-USGS)\
WATER REUSE \ WATER DEMAND\ TEXAS\ IRRIGATION WATER \ INDUSTRIAL WATER\ MUNICIPAL WATER\ WASTE WATER TREATMENT\ ECONOMICS \ WATER ALLOCATION(POLICY)\ WATER MANAGEMENT(APPLIED)\

Fig. 4.2.3a. Sample of Water Resources Abstracts

DIS 01/5/00004-00018// 4 PAGE 1
69R10212 TST-W2-24 00.00 (W69-10212)
ARIZONA V. CALIFORNIA - - A BRIEF REVIEW\
HABER, DAVID \ (RUTGERS - THE STATE UNIV., NEW BRUNSWICK, N.J.)
NATURAL RESOURCES JOURNAL, VOL 4, NO 1, P 17-28, MAY 1964. 41 REF.\
THE U. S. SUPREME COURT RULED ON THE STRUGGLE BETWEEN CALIFORNIA AND ARIZONA FOR COLORADO RIVER WATER. ITS DECISION RECOGNIZED FOR THE FIRST TIME THE POWER OF CONGRESS TO CONTROL APPORTIONMENT\ AND ITS LANGUAGE SUGGESTED THAT THE POWER CAN BE EXTENDED TO NON-NAVIGABLE STREAMS. SECOND, THE OPINION HOLDS THAT THE SECRETARY OF THE INTERIOR HAS THE POWER TO ALLOCATE WATER WITHIN A STATE THROUGH CONTRACTS WITHOUT REGARD TO THE STATE 'S WATER ALLOCATION LAWS AND UNDER

ENTER:

-MORE-

DIS 01/5/00004-00018// 4 PAGE 2
VERY BROAD STANDARDS ESTABLISHED BY FEDERAL LAW. POLICY ACCOMPLISHMENTS OF THE DECISION ARE AS FOLLOWS: (1) THE ALLOCATION PROBLEM WAS TRANSFERRED FROM THE COURT TO THE POLITICAL AND ADMINISTRATIVE ARENAS \ (2) THE GREAT POWER GIVEN TO THE FEDERAL GOVERNMENT HAS CREATED THE LEVERAGE TO FORCE STATES TO MAKE AGREEMENTS \ (3) THESE POWERS MAKE IT POSSIBLE TO ACCOMPLISH A FULLY INTEGRATED DEVELOPMENT-ALLOCATION SCHEME WITHOUT INTERFERENCE OF CONFLICTING STATE AUTHORITY\AND (4) NO UNDUE SHARE OF THE COST WILL BE PLACED ON INDIVIDUAL USERS FOR THE BENEFIT OF THE ENTIRE COMMUNITY OR OF OTHER USERS. THERE ARE AMBIGUITIES IN THE DECISION\ BUT IT OFFERS CONGRESS THE OPPORTUNITY TO INTEGRATE WATER DEVELOPMENT AND USE

ENTER:

-MORE-

Fig. 4.2.3b. Sample of Water Resources Abstracts

5. USER'S GUIDE

These user instructions are intended for a new user who is at one of the existing RECON stations. Details of acquiring a station and getting it connected to the network are not covered in this report. The number of available user instructions is expected to increase; users are invited to send in suggestions. Partial corrections and amendments to this section will probably be issued. You may want to have this report punched for loose-leaf binding. The last page of this section is a one-page summary of RECON instructions, following the style used by Herb Pomerance.

5.1. Getting Started

We assume that you have found the keyboard, the CRT display screen, and that the system is up and running (sometimes a rash assumption). We assume the previous user has left. The first thing to do is a BEGIN command. Find the SHIFT key (there is a picture of the keyboard in Section 5.4 and, holding it down, press the key marked (! 1). The symbol ! should appear on the screen. (If it doesn't, there is something wrong with the terminal; see Section 5.5.) Next press the key marked (INT). This stands for Interrupt although some prefer to call it the PLEASE button. For the INT key, it doesn't matter whether the SHIFT key is depressed or not.

With a little luck and patience you will soon see a "Welcome to ORNL's RECON" message, after which the computer will ask who you are. You need not divulge such personal data if you do not care to. It is used to address any computer printout you may request in the course of

your session. Whether you answer the questions or not, you should press the INT key each time you are ready to proceed.

Next the system will list the files that are available for searching and ask you to choose a file. A display is provided (even if there is only one file) in which each file is given a number, 0 for NSA, 1 for the next file, if any, and so on. You have merely to key in a number and then press INT. If you do not key in a number you get Nuclear Science Abstracts, but in any case you must press INT or the system will wait for you forever.

After these preliminaries are out of the way, the system will clear the CRT screen and then put the ENTER message in the lower left corner of the screen followed by BEGIN SESSION 0001 (or some other session number). Now you are ready to enter search terms. This is discussed in some detail in the next section. We conclude this section with some general notes on use of the terminals.

1. Typing a command at the keyboard does not automatically send the command to the computers. This is done when you press the key marked INT. Then whatever you have typed will be processed by the computer and maybe you will get an answer.
2. The keyboard has a blue light. When the light is on, the system is waiting for you to do something. After you press the INT key, the blue light goes off until the computer finishes processing your command. During this period the keyboard is dead; i.e., anything you type will not be accepted by the local terminal and will not appear on the screen.

3. You may try out different commands to see what they do. The system is supposedly programmed so that nothing you can type at the keyboard will stop RECON. (This is not intended as a challenge; rather, as encouragement to learn by experience how the various commands work.)

4. On the other hand, the switches on the CC-301 controller should not be changed without good reason. The same goes for the phone line test switches.

5. The commands are given by typing a particular character as shown below. For example, the BEGIN command is given by the ! key, rather than by spelling out BEGIN.

BEGIN	!	TYPE	'	
EXPAND	"	KEEP	(	
SELECT	#	LIMIT	)	not presently working
COMBINE	$	PAGE	0	
DISPLAY	%	SET HISTORY	@	
PRINT	&	SEND MESSAGE	]	

6. Depending on where you learned typing you might think the 1 (number) and the l (letter) are equivalent. In RECON they aren't.

7. Precautions

If something goes wrong, read Section 5.5 before attempting repairs. Striking the keyboard or TV violently does not improve performance; better to call ORNL and shout over the telephone. Leaving a full coffee cup on the TV or CC-301 is risky. Somebody at each installation should clean the CC-301 filter every other month or so, and

check that the fan(s) are running. Otherwise it may get hot and indicate its discomfort with square blocks on the screen, etc.

5.2. Commands and Options

5.2.1. BEGIN !

This is normally the first command you give. It causes the computer to erase any work sets from the previous session. The system then asks for your name and address. This is needed only if you are going to ask for a computer printout to be sent to you. If you do not give any address and still use the PRINT command during your session, the computer printout will be sent to the address for your terminal (as given in Section 2.2). The possible formats are:

! Regular sequence with questions

!0 Skip the questions, choose file 0

!1 Skip the questions, choose file 1

⋮

5.2.2. EXPAND "

The system has a special index of all the descriptors which can be used in making a search. The EXPAND command is essentially a request to see part of this index. To do this you key in a descriptor and the system will show the part of the file which contains that descriptor. If the descriptor is not in the file, that is no problem. The system simply shows the part of the index where the term would appear. A sample EXPAND display is shown in Figure 5.3.1.

```
WELCOME TO ORNL'S RECON

ANY PRINT REQUEST WILL BE MAILED TO YOUR
LIBRARY, BUT THEY NEED YOUR NAME SO THAT
THEY CAN FORWARD THEM TO YOU. TYPE IN UP
TO 10 LINES OF ADDRESS INFORMATION, YOUR
SEARCH TITLE, OR OTHER COMMENTS BELOW,
THEN PRESS -INT- KEY.

A LIST OF FILES NOW AVAILABLE FOR RECON
SEARCHING WILL REPLACE THIS TEXT WHEN
YOU HAVE ENTERED THE ADDRESS INFORMATION
NEEDED.
ENTER:
```

Fig. 5.2.1. Result of BEGIN Command

PLEASE CHOOSE THE FILE YOU WISH TO USE.

THE FOLLOWING FILES ARE AVAILABLE:

0 = NUCLEAR SCIENCE ABSTRACTS (TIC)
(297,304 ITEMS THRU 4/73)
1 = ENERGY DATA BASE (EISO)
(2086 ITEMS THRU 4/73)
2 = TOXIC MATERIALS DATA BASE (EISO)
(4000 ITEMS THRU 4/73)
3 = WATER RESOURCES ABSTRACTS (WRSIC)
(1800 ITEMS SAMPLE FROM 1969)

PLEASE ENTER NUMBER OF FILE CHOSEN
(IF NO NUMBER IS ENTERED FILE 0 WILL BE
SELECTED) - THEN PUSH INT KEY
ENTER:

Fig. 5.2.2. Example of File Selection List

The index is in several parts. In the author part, for instance, each item begins with AU=. For example, AU=SMITH, A. B. To see part of the author index, say part near Gopasyuk, one could key "au=gopas. (It is not necessary to type all the letters and it doesn't matter whether you type upper or lower case letters.) In Figure 5.2.3 there appears GOPASYUK, S. and GOPASYUK, S. I. as terms E07 and E08. RECON does not tell you whether these are the same person.

Besides the author or AU= section, each data base has an Index Term or IT= section. This section is assumed when you do not specify which section of the index you want. For example,

"rabbit

and

"it=rabbit

are equivalent, while

"rabbit,p.

and

"au=rabbit,p.

are not equivalent.

There are other sections, such as SU=, CO=, for various files. These are discussed in Part 4, Data Bases.

5.2.3. SELECT

This command is used to move items from the inverted file into a user work file so that one can use the commands, such as COMBINE and PRINT, which operate on work files. There are two forms of the SELECT command, direct and indirect.

```
 EXPAND  AU=GOPAS
 REF   DESCRIPTOR                      CIT   RT
 E01  AU=GOPALAKRISHNAN, V.←←←          1
 E02  AU=GOPALAN, K.←←←←←←←←←←          5
 E03  AU=GOPALAN, T. V.←←←←←←←          2
 E04  AU=GOPALARAMAN, C. P.←←←          1
 E05  AU=GOPALARAO, NALAMOLU.←          1
-E06  AU=GOPAS←←←←←←←←←←←←←←←
 E07  AU=GOPASYUK, S.←←←←←←←←←          1
 E08  AU=GOPASYUK, S. I.←←←←←←         12
 E09  AU=GOPEL, R.←←←←←←←←←←←          1
 E10  AU=GOPIENKO, V. G.←←←←←←         1
 E11  AU=GOPINATH, A.←←←←←←←←←         1
 E12  AU=GOPINATH, D. V.←←←←←←         9
 E13  AU=GOPINATH, N.←←←←←←←←←         1
 E14  AU=GOPINATHAN, C.←←←←←←←         8
 E15  AU=GOPINATHAN,
       CHAKRAPANI←←←←←←←←←←←←←         1
 E16  AU=GOPINATHAN,
       CHAKRAPANY←←←←←←←←←←←←         3
 E17  AU=GOPINATHAN, K. P.←←←←←         5
 E18  AU=GOPINATTHAN, C.←←←←←←←         1
ENTER:
                                    -MORE-
```

Fig. 5.2.3. EXPAND au=gopas

In the direct mode, you give the term of interest, for example:

power reactors

co=uk

nc=38.00

gibberellic acid

au=jones, john j., jr.

The terms must be spelled exactly; there is no provision for errors or unfinished terms. The direct mode is not recommended until you have acquired some familiarity with the data base.

The indirect mode relies on the labels generated by the EXPAND command, that is, the E01, E02, . . . or R001, R002, ... For a single term, say E08, the SELECT commands #E08, #E8, #e08, #e8 are equivalent. The last form is recommended. Similarly, #R1, #R01, #R001, #r001, #r01, #r1 are equivalent. This mode refers to the most recent EXPAND or RELATED TERMS EXPAND command. It is not necessary that the EXPAND display be showing on your screen.

In indirect mode, two or more items may be SELECTed into a single user work set. For example:

#e6,e9,e4

#r1,r4

(Note: spaces are not allowed here. #e6, e7 is wrong.)

In addition, the indirect mode permits SELECTion of several consecutive items:

#e6 - e9 is equivalent to #e6,e7,e8,e9

(Note: #e6 - 9 is wrong. So is #e6,7,8,9)

Not working at present but scheduled is a special SELECT option which makes more than one set. The format will be:

#e6:e9

This will create four user work sets and is equivalent to four separate commands:

#e6

#e7

#e8

#e9

5.2.4. COMBINE $

This is used to make new user sets by combining existing user sets. There are basically three kinds of combination, as shown in the following example:

Set 1	Set 2
72J12345	72J33333
72J12343	71J12345
71J12345	

$1+2	$1*2	$1-2	$2-1
72J33333	71J12345	72J12345	72J33333
72J12345		72J12343	
72J12343			
71J12345			

In each case a new set is created with the lowest unused set number. The plus sign, +, indicates OR logic. The asterisk, *, indicates AND logic. The minus sign, -, indicates BUT NOT logic.

More complicated COMBINE commands are possible. For example,

$1+2+3

$1*2*3

$3*1*2

$ 1+2*3
$ (1+2)*3
$ 1+(2*3)
$ 1-2+3

are all valid (provided Sets 1, 2, and 3 all exist).

There is a shorter notation for some COMBINE requests:

$ 1-4/+ is the same as $ 1+2+3+4
$ 1-4/* is the same as $ 1*2*3*4

Notice that $ 1+(2-3) is not the same as $ (1+2)-3. Thus, the request $ 1+2-3 is ambiguous. If the user does not supply parentheses, the system performs the indicated operations in the following order:

/ - * +

Combine commands which would require scanning the entire inverted file, such as $ -3, are not valid. However, a number of strange constructions are accepted, such as $ -(-3) or $ -(-4*(-3)).

Parentheses may be nested. The only limitation on the size or complexity of the COMBINE command is that it must fit on one line of the CRT

5.2.5. DISPLAY %

This command is used to display items from the Linear File. As with the SELECT command, there is a direct and an indirect mode.

The direct mode involves an identification number; for example,

%71J12345

This would cause a display of item 71-12345. The J (for Journal) is the type code but is not actually checked; i.e., 71-12345 would be retrieved even if it is type R (Report). %71?12345 is equivalent.

The indirect, but more common, mode is to display an item from a user set. For example, %3 would bring the first item from user set 3. After this has been displayed, the command % with no number is interpreted by RECON as a request for the next item in the set. This may be repeated until the set has been all displayed.

There are several display formats. The one you get if you don't specify is Format 2, Title, Authors, Reference, Keywords. There is also Format 1, consisting of just a list of identification numbers for the work set. For example, %3/1 would display Set 3 in Format 1.

Format 3 is a display of everything, including system pointers and count fields. It's only used for checking the files.

Format 4 (not yet available for Nuclear Science Abstracts) consists of titles and authors. Format 5 (not available for Nuclear Science Abstracts) consists of titles, authors, references, and, if available, abstracts. Format 6 (not available for Nuclear Science Abstracts) displays all available information, including abstract, if available, and keywords.

Some notes on the DISPLAY command:

1. An example of a DISPLAY is given in Figure 5.3.9.
2. The normal format of a direct DISPLAY command is 2 digits, character, 5 digits. However, you may give less than 5 digits at the end. For example:

   %72?234 is equivalent to %72?00234

3. In the direct mode, if the item you request is not in the Linear Index, the next available item will be retrieved.
4. Format 4 will be modified so that titles and authors for several items will appear on the screen.

To display a specific item other than the first in a user set, use $3/2/7, for example, to get Set 3, Format 2, item 7. The lone % does not work after this command; but if you say %3/2/7-12, then you can use the lone %, up to five times, provided there are at least 12 items in the set.

There are two special uses of the DISPLAY command:

%e DISPLAY most recent EXPAND list

%r DISPLAY most recent RELATED TERMS EXPAND list

These can be useful if, for example, you wish to go back and SELECT some more terms from an EXPAND list that is no longer on the screen.

5.2.6. PRINT &

This command is used to send user sets to the printer at the ORNL computer center. The results will be mailed to you if you gave your name and address during the BEGIN sequence. If not, they will be mailed to the person in charge of your terminal (list given in Part 2).

There are several PRINT formats, just as with the DISPLAY command. If you do not specify a format, you get Format 2 (title, authors, reference, keywords).

To PRINT Set 1 (in Format 2), the command is

& 1

but there is a slight catch. If there are more than 50 items in Set 1, you do not get them all with one command. Suppose there are 187 items in Set 1 and you wish to PRINT them all (in Format 2). The sequence of commands is

```
& 1
& 1/2/51 - 100
& 1/2/101 - 150
& 1/2/151 - 187
```

As another example, suppose there are 97 items in Set 12 and you wish to print in Format 5, which includes abstracts if available. The sequence would be

```
&12/5
&12/5/51-97
```

To PRINT the items you have set aside with the KEEP command:

```
&99
```

for up to 50 items in Format 2.

5.2.7. TYPE '

This is used with teleprinters. It is just like DISPLAY except that the item comes to the teleprinter instead of the CRT screen.

This command has the disadvantage that it is slow and once it gets started it must finish the item--you cannot stop it.

A faster method of getting things typed on the teleprinter is to use the OUT key as described in Section 5.4.

Please don't use this command if your station doesn't have a teleprinter or if it isn't turned on.

5.2.8. KEEP (

This is used to move a pointer from one work set to a special set called Set 99. If you are scanning through a user set or sets you can KEEP each item on the screen that you like by doing a (command. Then you can have Set 99 PRINTed.

If the item you want is not currently on the screen but you remember what it is, for example item 9 in Set 3, you can KEEP it by sending (3/9-9. For items 9, 10, and 11, the command would be (3/9-11.

5.2.9. PAGE 0 (zero, not the letter O)

Whenever a display or list that you have requested is too long for one screen display, the word -MORE- will appear at the bottom of the screen. You can see the next part of the display with the page command.

At present, only forward paging is possible and any characters after the 0 are not checked. It is hoped that backward paging, 0-, will be added soon.

In scanning through a user set with the DISPLAY command, the PAGE command may be used. If there is a -MORE- on the screen, it will show the next part of the current item. If there is no -MORE- showing, it will advance to the next item.

5.2.10. END =

This terminates your work session. It is not required but it does free some computer space and improve service a little for the other users.

5.2.11. SET HISTORY @

This is a review of the sets you have created. An example of a Set History display is given in Figure 5.3.6.

5.2.12. MESSAGE]

To send a message to Station 4 (ORNL), for example:

]4/hello, ornl

For Station 10:

]10/good morning, livermore

One full line of message plus about 3 more characters can be sent. The list of stations is given in Part 2.

5.3. Performing a Search

Let's suppose our assignment is to find out what Nuclear Science Abstracts has to say about the Effect of Gamma Radiation on Man-in-the-Moon

Marigolds. We begin a session (see Section 5.1) and choose File 0, Nuclear Science Abstracts.

Where to start? We could try Moon--not a particularly wise choice, but suppose we do an EXPAND on the term moon, by keying "moon. We get the display of Figure 5.3.1. The dash in front of E06 indicates that this is the term requested. In the column marked CIT (for CITations) the number 595 shows how many items in the file have the index term Moon. Under RT (Related Terms) there is a 1, that is, the list of terms related to Moon contains one term.

Let's look at the term related to Moon. To do this we EXPAND E06; the actual keystrokes are "e6 (INT) . What we see is shown in Figure 5.3.2. The code 5R001 indicates two things: (a) it's a Type 5 term and (b) it is the first related term and may be SELECTed or EXPANDed by the label r1. Type 5 means Narrower Term--Project Apollo is smaller than the Moon--and not much help for the present search. We'll save the Moon by doing a SELECT e4 (key "e4 (INT)).

Next let's try Marigolds. We key in "marigolds and see Figure 5.3.3. Here E06 is the term in question and the blanks indicate that there are no citations and no related terms. Next we could try Man in the Moon. This leads to Figure 5.3.4. Again, no hits. (The hyphenated version man-in-the-moon would also give no hits, as you can tell from Figure 5.3.4 if you know the IBM sort sequence.)

Next let's try Gamma Radiation, Figure 5.3.5. Here we hit a jackpot of sorts, 20330 citations. We SELECT e6 (key "e6) and do a Set History command (key @) to see where we are. This brings us to Figure 5.3.6. We could COMBINE moon and gamma radiation (key $1*2). This gives 23 hits, as shown in the middle part of Figure 5.3.6. We can then DISPLAY the first of these (key %3).

```
 EXPAND  IT=MOON
 REF   DESCRIPTOR                    CIT  RT
 E01   IT=MONTEREY AGN REACTOR←            5
 E02   IT=MONTICELLO REACTOR←←←      180   3
 E03   IT=MONTMORILLONITE←←←←←←       18   4
 E04   IT=MONTROSEITE←←←←←←←←←←            2
 E05   IT=MONZONITES←←←←←←←←←←←       1   1
-E06   IT=MOON←←←←←←←←←←←←←←←←←     595   1
 E07   IT=MORAESITE←←←←←←←←←←←←           2
 E08   IT=MORAINES←←←←←←←←←←←←←       1   3
 E09   IT=MORGANITE←←←←←←←←←←←←           5
 E10   IT=MORIN←←←←←←←←←←←←←←←←      15   3
 E11   IT=MORMONIELLA←←←←←←←←←←       1   2
 E12   IT=MOROCCO←←←←←←←←←←←←←       3   1
 E13   IT=MORPHINE←←←←←←←←←←←←      11   5
 E14   IT=MORPHOLINE←←←←←←←←←←       3
 E15   IT=MORPHOLINES←←←←←←←←←←           1
 E16   IT=MORPHOLOGICAL CHANGES     147
 E17   IT=MORPHOLOGY←←←←←←←←←←←     365   1
 E18   IT=MORSE CODE←←←←←←←←←←←       1
 E19   IT=MORSE CURVE←←←←←←←←←←           4
 E20   IT=MORSE EQUATION←←←←←←←           4
ENTER:
                                        -MORE-
```

Fig. 5.3.1. EXPAND Moon

```
REL. KEYS e6   IT=MOON
T R.   DESCRIPTOR                   CIT  RT
 R000-IT=MOON←←←←←←←←←←←←←←←←←     595   1
5R001 IT=PROJECT APOLLO←←←←←←←       88   2
```

Fig. 5.3.2. EXPAND e6 After the EXPAND Shown in Fig. 5.3.1

```
 EXPAND  IT=MARIGOLDS
 REF   DESCRIPTOR                    CIT  RT
 E01  IT=MARCOULE LABORATORY←        7    3
 E02  IT=MARCOULE REACTOR 1←←        7
 E03  IT=MARCOULE REACTOR 2←←        7
 E04  IT=MARCOULE REACTOR 3←←        7
 E05  IT=MARIGNACITE←←←←←←←←←        8
-E06  IT=MARIGOLDS←←←←←←←←←←
 E07  IT=MARINE DISPOSAL←←←←←←  11
 E08  IT=MARINE ECOSYSTEMS←←←←  8
 E09  IT=MARINE INSURANCE←←←←←  2    6
 E10  IT=MARINER SPACE PROBES←  28   1
 E11  IT=MARITIME GAS COOLED
       REACTOR←←←←←←←←←←←←←←←        4
 E12  IT=MARITIME LAW←←←←←←←←  3    2
 E13  IT=MARITIME LAWS←←←←←←←  1
 E14  IT=MARITIME NUCL. STEAM
       GEN. 630A←←←←←←←←←←←←←       4
 E15  IT=MARIUS←←←←←←←←←←←←←  2    3
 E16  IT=MARIUS REACTOR←←←←←←  4
 E17  IT=MARK GENERATORS←←←←←←        5
 E18  IT=MARK V SYNCHROTRON←←←        4
ENTER:
                                          -MORE-
```

Fig. 5.3.3. EXPAND Marigolds

```
 EXPAND  IT=MAN IN THE MOON
 REF   DESCRIPTOR                    CIT  RT
 E01  IT=MAMMALS←←←←←←←←←←←←  644  25
 E02  IT=MAMMARY CARCINOMA←←←←        4
 E03  IT=MAMMARY GLANDS←←←←←←  305   2
 E04  IT=MAMMOTROPIN←←←←←←←←←         3
 E05  IT=MAN←←←←←←←←←←←←←←←←←  9995  5
-E06  IT=MAN IN THE MOON←←←←←
 E07  IT=MANAGEMENT←←←←←←←←←  264   4
 E08  IT=MANCHESTER-LIVERPOOL
       UNIV. R.←←←←←←←←←←←←←        5
 E09  IT=MANDELIC ACID←←←←←←←  11   1
 E10  IT=MANDELIC ACIDS←←←←←←  3
 E11  IT=MANDELSTAM
       REPRESENTATION←←←←←←←←  133  3
 E12  IT=MANGANATES←←←←←←←←←  1
 E13  IT=MANGANESE←←←←←←←←←←  1297 4
 E14  IT=MANGANESE ADDITIONS←←  31   1
 E15  IT=MANGANESE ALLOYS←←←←  351  7
 E16  IT=MANGANESE BASE ALLOY←  1    1
 E17  IT=MANGANESE BASE ALLOYS  1
 E18  IT=MANGANESE BORIDES←←←←  17
ENTER:
                                          -MORE-
```

Fig. 5.3.4. EXPAND Man in the Moon

```
 EXPAND  IT=GAMMA RADIATION
REF   DESCRIPTOR                    CIT  RT
E01  IT=GAMMA DOSIMETRY<<<<<<        4
E02  IT=GAMMA ENCEPHALOGRAPHY        9   4
E03  IT=GAMMA FUEL SCANNING<<       12   4
E04  IT=GAMMA FUNCTION<<<<<<<      177   1
E05  IT=GAMMA LOGGING<<<<<<<<            2
-E06 IT=GAMMA RADIATION<<<<<< 20330   5
E07  IT=GAMMA RADIOGRAPHY<<<<       24
E08  IT=GAMMA SCANNING<<<<<<<      207   4
E09  IT=GAMMA SOURCES<<<<<<<<     1007
E10  IT=GAMMA SPECTRA<<<<<<<<     1701   1
E11  IT=GAMMA SPECTROMETERS<<     1781   2
E12  IT=GAMMA SPECTROSCOPY<<<      180
E13  IT=GAMMA TRANSITION<<<<<      378   1
E14  IT=GAMMA TRANSPORT
      THEORY<<<<<<<<<<<<<<<<<       14
E15  IT=GAMMA-II<<<<<<<<<<<<<            4
E16  IT=GAMMAGRAPHY<<<<<<<<<<            2
E17  IT=GAMMASCOPY<<<<<<<<<<<            1
E18  IT=GAMMEL-CHRISTIAN-THAL
     ER THEORY<<<<<<<<<<<<<<<           11
ENTER:
                                      -MORE-
```

Fig. 5.3.5. EXPAND Gamma Radiation

```
 SET HISTORY  -   2 SETS ARE DEFINED
SET   DESCRIPTOR                    CIT
  1  IT=MOON<<<<<<<<<<<<<<<<<<<<     595
  2  IT=GAMMA RADIATION<<<<<<< 20330
 99  KEEP - DATA SET<<<<<<<<<


  3   23  1*2


 DIS 03/2/00001- END //      1   PAGE   1
73R15624  NSA-27-07  56.70  (N--72-26578
)
   /SUP 252/CA NEUTRON CAPTURE AND DECAY
METHODS  FOR ELEMENTAL ANALYSIS.   FINAL
REPORT.\
  GEOLOGICAL SURVEY, WASHINGTON, D. C. \
  32P\  NTIS.\
  CC=351 3000\
    CALIFORNIUM  252 \ CAPTURE\ CHEMICAL
COMPOSITION \   DECAY \ GAMMA RADIATION\
MOON \   NEUTRON BEAMS\ NEUTRON SOURCES\
PLANETS\
```

Fig. 5.3.6. Top: Set History Display
Middle: Result of COMBINE 1*2
Bottom: Display of First Item in Set 3

The result is shown in the bottom of Figure 5.3.7. Nothing about marigolds. Other items of Set 3 are also no help. Clearly we are on the wrong track.

Let's back up a little and EXPAND plants, as shown in Figure 5.3.7. This yields a harvest of 2545 plants, which we SELECT. Before we leave the plants, notice that in Figure 5.3.7 terms E02, E03, E04, and E05 all have to do with parts of plants and might be relevant. So we SELECT them by keying # e2 - e5.

Perhaps we haven't completely given up on the Moon. We might ask for items on both Moon and Plants. If we include the plant parts we just SELECTed, the COMBINE expression is $1*(4+5), which yields 2 items. We can look at these with the DISPLAY command. One of them is shown in Figure 5.3.8.

Perhaps a better course would be to COMBINE Gamma Radiation with Plants plus plant parts. This leads to $2*(4+5), which yields 931 items, one of which is shown in Figure 5.3.9.

That's still quite a few items to look at--perhaps we should try to weed out some of the unwanted plants. Let's go back to the EXPAND plants (key %e) and take a look at the 71 Related Terms (key "e6). This takes a minute or two because of the roundabout way the computer collects the data for the Related Terms display.

We get the top part of Figure 5.3.10. As we scan this list we already know we will not find any marigolds. So as not to go away empty-handed we pick some carnations (key # r12). Then we would like to key in a 0 (zero) to get the next page, but there's a bug in the system which clobbers the next page option after any SELECT command. To get

around this without another long Related Terms Expand, we do a %r to refresh the screen and bring back the -MORE- message. Then we can do a PAGE command (key 0) to get the bottom part of Figure 5.3.11. Now we can pick some FLOWERS (key #r26).

Let's review what we have done (key @). The nine sets we have created are shown in the top part of Figure 5.3.11. Since we already have 931 items on Gamma Radiation and Plants, we could try crossing this group with carnations and flowers, key $7*(8+9), to get Set 10, which turns out to be 40 items. The most recent of these 40 is shown in Figure 5.3.11 and items 4 and 10 are shown in Figure 5.3.12.

At this point we might ask to have these 40 items PRINTed and mailed to us for further study. We key the PRINT command, &10, END the session, (=), and go to lunch. Or supper.

```
 EXPAND  IT=PLANTS
REF   DESCRIPTOR                      CIT  RT
E01   IT=PLANT BREEDING<-------        34   1
E02   IT=PLANT CELLS<---------        406   2
E03   IT=PLANT GROWTH<--------        369   7
E04   IT=PLANT STEMS<---------         26   3
E05   IT=PLANT TISSUES<-------          6
-E06  IT=PLANTS<-------------        2545  71
E07   IT=PLASKON<------------              1
E08   IT=PLASMA<------------       14660  44
E09   IT=PLASMA ACCELERATION<--      139   3
E10   IT=PLASMA ARC SPRAYING<--       5
E11   IT=PLASMA ARC WELDING<---       2
E12   IT=PLASMA BETATRONS<-----       5
E13   IT=PLASMA CELLS<---------       14   1
E14   IT=PLASMA DENSITY<-------      960   1
E15   IT=PLASMA DIAGNOSTICS<---     1831   1
E16   IT=PLASMA DIAMAGNETISM<--       25   1
E17   IT=PLASMA DRIFT<---------      900   2
E18   IT=PLASMA EXPANSION<-----        1
E19   IT=PLASMA FLOW<---------       41
E20   IT=PLASMA FOCUS<---------       17
ENTER:
                                    -MORE-
```

Fig. 5.3.7. EXPAND Plants

```
6     2  1*(4+5)
```

```
 DIS 06/2/00001- END //     1   PAGE   1
70J00912  NSA-24-01  28.70
  EFFECTS  OF  RADIATION  DURING  SPACE
FLIGHT  ON  MICROORGANISMS AND PLANTS ON
THE   BIOSATELLITE   II   AND   GEMINI   XI
MISSIONS.\
  DE  SERRES,  FREDERICK  J\  (OAK RIDGE
NATIONAL LAB., TENN.)
  PP  62 - 6  OF LIFE SCIENCES AND SPACE
RESEARCH  VII.  VISHNIAC,  W.- FAVORITE,
F.  G.  ( EDS. )  .    AMSTERDAM,  NORTH-
HOLLAND PUBLISHING CO., 1969\
     BACTERIA  \     FUNGI  \   GENETICS  \
MICROORGANISMS  \   MOON  \   PHYSIOLOGY  \
PLANTS  \  RADIATION EFFECTS\ RADIATIONS\
SATELLITES  \    SPACE FLIGHT\  NEUROSPORA\
TRADESCANTIA  \    BIOSATELLITES  \  PROJECT
APOLLO\
```

Fig. 5.3.8. Top: COMBINE 1*(4+5)
Bottom: Display of Set 6, Item 1

DIS 07/2/00001- END// 1 PAGE 1
73J15026 NSA-27-07 48.41
EFFECTS OF GAMMA-IRRADIATION ON GROWTH AND ENERGY METABOLISM OF WHEAT SEEDLING.\
SRIVASTAVA, H. K. \ (HARYANA AGRICULTURAL UNIV., HISSAR, INDIA)
CURR. SCI. (INDIA)- 42- NO. 3, 81-84(5 FEB 1973)\ (CUSCA)
BIOLOGICAL RADIATION EFFECTS\ ENZYMES \ GAMMA RADIATION \ IRRADIATION \ METABOLISM \ PLANT GROWTH\ SEEDLINGS\ SEEDS\ WHEAT\

DIS 07/2/00001- END// 2 PAGE 1
73J15023 NSA-27-07 48.41
CURVED SPINE MUTANT IN SOLANUM KHASIANUM CLARKE, INDUCED BY GAMMA - RADIATION.\
BHATT, B. \ (BHABHA ATOMIC RESEARCH CENTRE, TROMBAY, INDIA)
CURR. SCI. (INDIA)- 41- NO. 24, 889-90(20 DEC 1972)\ (CUSCA)
FRUITS \ GAMMA RADIATION\ GENETIC RADIATION EFFECTS \ MUTATIONS\ PLANTS\ RADIATION DOSES\

Fig. 5.3.9. DISPLAY First Item of Set 7

```
REL. KEYS E6   IT=PLANTS
T R.    DESCRIPTOR                    CIT  RT
 R000-IT=PLANTS<-------------------  2545  71
5R001 IT=ALFALFA<-----------------     27   2
5R002 IT=ALOE<--------------------           1
5R003 IT=ANTHERS<-----------------      2   5
5R004 IT=ARABIDOPSIS<-------------     38   1
5R005 IT=ATROPA BELLADONNA<-------           1
5R006 IT=AUXINS<------------------     37   4
5R007 IT=BARK<--------------------      3   3
5R008 IT=BEANS<-------------------     91   4
5R009 IT=BUCKWHEAT<---------------      5   2
5R010 IT=BUDS<--------------------     25   3
5R011 IT=BULBS<-------------------      7   6
5R012 IT=CARNATIONS<--------------      7   2
5R013 IT=CHARA VULGARIS<----------           1
5R014 IT=CLOVER<------------------     32   2
5R015 IT=COFFEE PLANT<------------           2
5R016 IT=COFFEE PLANTS<-----------      1
5R017 IT=CORCHORUS<---------------      2   1
5R018 IT=CORK<--------------------      2   4
5R019 IT=COTTON<------------------     99   3
ENTER:
                                        -MORE-
```

```
REL. KEYS E6   IT=PLANTS
T R.    DESCRIPTOR                    CIT  RT
5R020 IT=CREPIS<------------------     35   1
5R021 IT=CUCUMBERS<---------------     14   2
5R022 IT=DIGITALIS<---------------      2   4
5R023 IT=DIGITOXIN<---------------          7
5R024 IT=ESSENTIAL OILS<----------          2
5R025 IT=FERNS<-------------------     16   1
5R026 IT=FLOWERS<-----------------     89   6
5R027 IT=FORESTS<-----------------    131   2
5R028 IT=GIBBERELLIC ACID<--------     39   6
5R029 IT=GRASS<-------------------    153   2
5R030 IT=GREEN BEANS<-------------          4
5R031 IT=GYMNOSPERMS<-------------     16   1
5R032 IT=HAY<---------------------      8   2
5R033 IT=HELIANTHUS<--------------     12   1
5R034 IT=HEVEA<-------------------          1
5R035 IT=KINETIN<-----------------      7  10
5R036 IT=LEAVES<------------------    282   1
5R037 IT=LEGUMINOSAE<-------------    193  12
5R038 IT=LILIUM<------------------      2   1
5R039 IT=LUPINUS<-----------------      9   3
ENTER:
                                        -MORE-
```

Fig. 5.3.10. EXPAND e6 Related Terms for Plants

```
      SET HISTORY  -   9 SETS ARE DEFINED
SET   DESCRIPTOR                    CIT
  1   IT=MOON<-------------------     595
  2   IT=GAMMA RADIATION<--------   20330
  3   1*2<-----------------------      23
  4   IT=PLANTS<-----------------    2545
  5   E2-E5<---------------------     767
  6   1*(4+5)<-------------------       2
  7   2*(4+5)<-------------------     931
  8   IT=CARNATIONS<-------------       7
  9   IT=FLOWERS<----------------      89
 99   KEEP - DATA SET<----------


 10    40  7*(8+9)


 DIS 10/2/00001- END //      1   PAGE   1
73J07743  NSA-27-04  48.41
  RELATIVE MERITS OF THE THREE METHODS
OF MEASURING MUTATION FREQUENCY IN
BARLEY.\
  MOHAN RAO, P. K. \ (UNIV. OF MALAYA,
KUALA LAMPUR)
  RADIAT. BOT. - 12- NO. 5, 323-9(OCT
1972)\ (RABOA)
   BARLEY\ BIOLOGICAL RADIATION EFFECTS\
CHLOROPHYLL \ DOSE - RESPONSE
RELATIONSHIPS \ ETHANOL \ FLOWERS \ GAMMA
RADIATION \ IRRADIATION \ MUTATION
FREQUENCY \ PLANT GROWTH \
RADIOSENSITIVITY \ RADIOSENSITIZERS \
RESPONSE MODIFYING FACTORS \ SEEDLINGS \
SEEDS \ SULFATES\ SYNERGISM\ X RADIATION
\
```

Fig. 5.3.11. Creation and Display of Set 10

DIS 10/2/00004-00030// 4 PAGE 1
72J50838 NSA-26-21 48.41
EFFECTS OF LOW DOSES OF X-RAYS ON ROOTING AND YIELD OF CARNATION.\
BORS, J. (TECHNISCHE UNIV., HANOVER) \ZIMMER, K.\
STIMULATION NEWSLETT.- NO. 1, 15-17 (1970)\ (STNLB)
BIOLOGICAL RADIATION EFFECTS\ FLOWERS \ GAMMA RADIATION\ GROWTH\ PLANT STEMS\ RADIATION DOSES\ ROOTS\ X RADIATION\

DIS 10/2/00004-00030// 10 PAGE 1
72J12265 NSA-26-06 28.30
GAMMA IRRADIATION OF POT MUM SEEDLINGS AND ITS BREEDING EFFECT. II.\
MATSUBARA, HISAO (TOKYO METROPOLITAN ISOTOPE RESEARCH CENTER) \ HASHIMOTO, SADAO. \
NOGYO OYOBI ENGEI- 46- NO. 4, 651-4(APR 1971)\ (IN JAPANESE) (NOOEA)
COLOR\ GAMMA RADIATION\ MUTATIONS\ RADIATION EFFECTS \ RADIOSENSITIVITY\ FLOWERS \ PLANT GROWTH \ SEEDLINGS\ VEGETATIVE PROPAGATION\

Fig. 5.3.12. Two More Items (# 4 and # 10) of Set 10

5.4. CC-30 Terminal Use and Maintenance

5.4.1. General Description of the Terminals

At present, all the user stations have CC-30 terminals, obtained from Computer Communications, Inc., Englewood, California. A block diagram is shown in Figure 5.4.1. A few additional items of telephone equipment are not shown. Also, some terminals have a teletype controller, not shown. In the newer terminals, the teletype controller is on a circuit board inside the CC-301.

In general, the terminals do not require much user maintenance. If something is not working properly, check Part 5.4.5 to see if the symptom is listed there. If not, call ORNL or call whoever is locally responsible for your station.

Some users turn off the power after each day's operation. Our ORNL terminal is on all the time, except for the teletype.

5.4.2. Modems

The modems take the modulated carrier signal and send a bit stream of data to the Controller. On output, the modem takes the bit stream and creates a modulated signal to go on the phone line back to the computer.

There are no user instructions connected with the modems. They are maintained by the phone company. We usually can't distinguish between modem trouble and phone line noise.

5.4.3. CC-301 Controller

This device receives data from the modem and the keyboard and transmits data to the modem, the TV, and the teleprinter, if there is one.

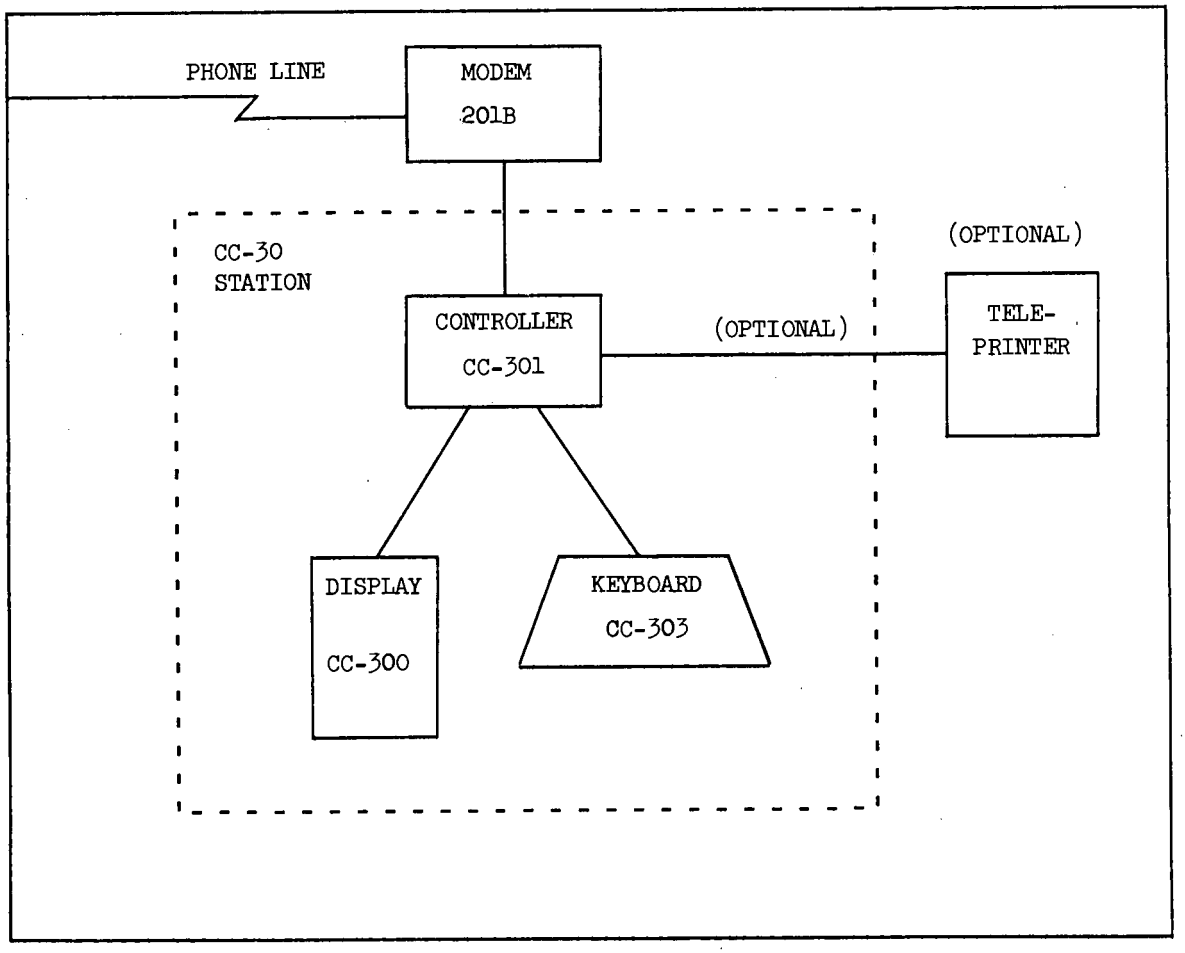

Fig. 5.4.1. AEC/RECON Terminal

It has a memory of 1024 characters and refreshes the TV image 60 times a second. Data from the modem is checked for correct address and parity.

The Controller needs a little space around it for air circulation. It should not have papers piled on it. The five switches should all be in the same position (ON,BLOCK,NORMAL,ALPHA,READ).

The following are normal CC-301 maintenance items and do not require special training:

1. Cleaning the filter on the bottom side of the CC-301, with power off.
2. Removing obstructions from the fan blades, with power off.
3. Replacing the fan units.

The following are special CC-301 maintenance items and require special training:

1. Everything else.

5.4.3. CC-300 Display

These are basically TV sets with a special input plug to receive signals from the CC-301. It is subject to "normal" TV problems like rolling, wavy lines, etc.

The only user instruction that CCI has suggested to us concerning care of the CC-300 is that we don't spill coffee on it.

5.4.4. The CC-303 Keyboard

The keyboard is shown in Figure 5.4.2. Most of the keys are arranged as in a typewriter and have similar functions. The row of boxes with words "BEGIN," "EXPAND," etc., is not a row of keys but a row of labels for the row of keys below. Certain characters are interpreted by the computer as RECON commands. They are ! " # $ % & ' ( ) 0 = @] and are discussed in Section 5.2. All but the 0, @, and]

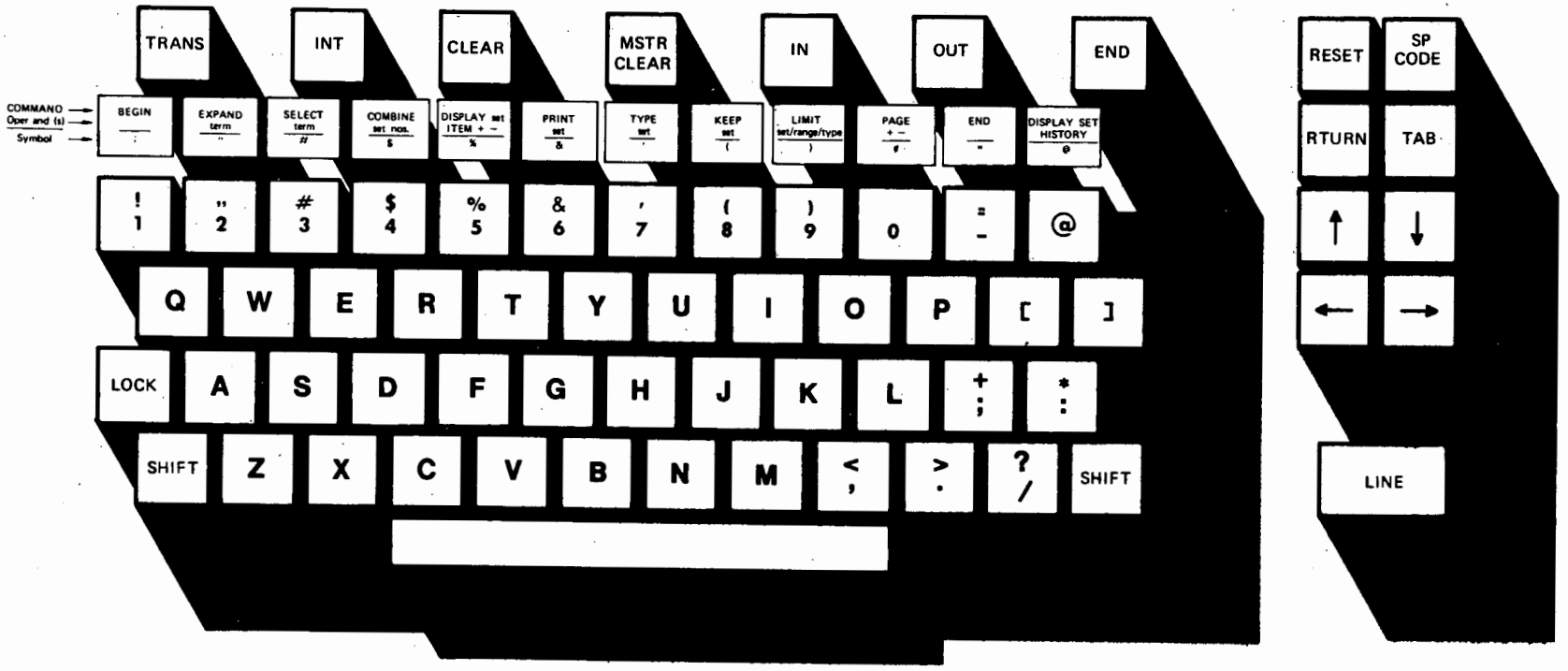

Fig. 5.4.2. CC-303 Keyboard

are keyed with the SHIFT button held down. Letters typed as part of RECON commands may be upper or lower case.

In this report, we do not distinguish between the various verbs "press," "depress," "type," "key," "hit," all referring to the process of finding the desired key (sometimes called button) and pushing it down long enough to cause the desired effect. Usually a short gentle push is sufficient. You will notice, if you haven't already, that holding a key down too long will cause the character (or space) to repeat.

The right and left SHIFT keys are equivalent and the LOCK key operates as in a typewriter to hold or release the SHIFT key.

There is a row of seven keys above the regular keyboard:

TRANS (for TRANSMIT)	This causes a message to be sent to the computer but not in a form usable by RECON.
INT (for INTERRUPT)	This causes a message to be sent to the computer in a manner that can be used by RECON. Normally, the message consists of whatever you typed before you pressed the INT key. This key is used after every command.
CLEAR	This clears the CRT screen. Not normally used in RECON, sometimes useful in trouble-shooting.
MASTER CLEAR	This turns on the blue keyboard light and reactivates the keyboard. Not normally needed. However, if RECON seems dead, try pressing this key, then INT key and maybe that will restore service.

IN — Local INPUT button. Not used for RECON.

OUT — Local OUTPUT button. This has a useful function for those stations which have teleprinters attached. Any display which appears on the screen may be printed.

To type out entire screen:

1. Press RESET
2. Press OUT.

To type out part of a screen display starting at the top:

1. Using arrow keys, position cursor where you wish typing to stop.
2. Press END.
3. Press RESET.
4. Press OUT

To type out part of a screen display ending at bottom:

1. Using arrow keys, position cursor at beginning of first line to be typed.
2. Press OUT.

To type out part of a screen display not beginning at the top or ending at the bottom:

1. Position cursor where typing is to stop.
2. Press END

3. Position cursor at beginning of first line to be typed.
4. Press OUT.

Some notes on use of OUT button:

1. This method of typing is faster than using the TYPE command.
2. You can stop the typing by pressing MASTER CLEAR. This may leave the teleprinter in the middle of the line. To correct this press (END), then (←), then (OUT).
3. For all of these options the teleprinter must be in LINE mode, i.e., able to accept data from the CC-301.
4. You can separate typed displays by using the hand roller on the teleprinter.
5. If you wish, you can turn the teleprinter to LOCAL and add headings or comments.
6. After the OUT operation is finished, the cursor may be in the wrong position for a RECON command. To correct this move the cursor to the position following the ENTER:

END

This key replaces a special code (shown on the screen by a triangle) at the current cursor position. This is used to preset

where the typing initiated by the OUT command will stop. This is not the END command described in Section 5.2.

On the right side of the keyboard there is a group of nine cursor control keys. The cursor is a pointer in the CC-301 that determines where the next character will appear on the screen. The location of the cursor is indicated on the screen by an underline mark: _. For most RECON commands it is not necessary to use the cursor control characters. However, for the OUT command described above the cursor usually needs to be positioned. Also, if a RECON command is misspelled and you notice this before pressing INT, you can simply move the cursor back to the mistake and type a correction. Most RECON commands are processed from the "Enter:" position to the cursor position. Thus, if you type "au=joness, the cursor will be ready for another character; so you will see on the screen: "au=joness_. Now if you move the cursor one space left, you will see "au=joness. Now if you press INT, the command "au=jones will go to the computer; it is not necessary to erase the extra s although you could do so with the space bar.

RESET — This moves the cursor to the upper left-hand corner.

SP CODE — Special characters. Not used for RECON.

RETURN — This moves the cursor to the beginning of the current line.

TAB — This moves the cursor to the middle of the current line if the cursor is left of the middle. Otherwise, it does nothing.

The four arrow buttons move the cursor in the indicated direction. If the button is held down, the cursor will keep moving and will eventually loop around.

LINE — This moves the cursor to the beginning of the next line. It also inserts a special character which causes carriage return and line feed when typing is done via the OUT command.

5.5. Error Conditions and Strange Events

5.5.1. Keyboard Blue Light is Off

Occasionally phone line noise will cause the light to go off, or the computer may still be processing a previous command, or the computer may have died while processing your last command.

Press the key marked MASTER CLEAR. This should turn on the blue light unless there is a power failure or the bulb has burned out.

Type a command or simply press INT. If the system is alive, it will respond (i.e., something will appear on the screen) in a few seconds.

5.5.2. Nothing Appears on the Screen

Check that blue light is on (see 5.5.1). Then type any letter. If it fails to appear on the screen, one or more of the following may be suspected:

1. intensity knob on TV is set too low
2. video-synch switch in wrong position (see 5.5.3)
3. cable from CC-301 to TV disconnected

4. TV broken or not plugged in. Also, some TV's have a clock with an automatic timer switch. Check that it is in manual mode.

5. CC-301 is broken, turned off, or not plugged in

5.5.3. Wavy Lines on Screen

Video-synch switch on back of TV may be switched to aerial rather than CC-301 position. Also, check Horizontal Hold control knob.

5.5.4. Screen Displays Erratic and Changing

This happens when phone line noise causes the computer to retransmit its message. Usually it clears up in a minute or two.

5.5.5. The Dash, or Cursor, Does Not Stay in One Place

This is also probably due to line noise. If it persists, call ORNL.

Occasionally this is a symptom of CC-301 trouble (see also Section 5.5.7).

5.5.6. Command Stays on Screen Even After INT is Pressed

1. RECON is not running, just crawling.

2. RECON is dead.

Call ORNL (615-483-1624 or 615-483-1863) to find out which. Sometimes we can't tell either.

5.5.7. Square Blocks Appear on Screen

If the blocks come and go or reappear on a different part of the screen, it is probably phone line noise.

If blocks persist in one place even if you do several commands, it is probably CC-301 trouble. If the CC-301 is too hot to touch or if either fan is not running, turn off the power. Remove the filter from the bottom of the unit and clean it. Check that nothing is draped over the CC-301 to cut off air circulation.

5.5.8. Dancing Dots Appear on Screen

Press Master Clear button.

5.5.9. Teleprinter Goes Wild

Press Master Clear button.

5.5.10. Display is Rolling or ENTER is in Middle Instead of Bottom

Adjust Vertical Hold knob.

5.5.11. CC-301 Makes Noise

Send message to ORNL such as "turn me off asap. 301 trubl." Then turn off power. If very noisy, turn off power first, then call us. Then check both fans in the CC-301; maybe something is stuck in one of them; maybe one is broken.

5.5.12. RECON Messages

COMMUNICATION LINE FAILURE	This message appears when the computer thinks it did not receive your command correctly. It is usually a phone line noise problem. If it persists, call ORNL.
INVALID COMMAND FORMAL ERROR IN COMBINE	The computer thinks you goofed. Sometimes the computer is wrong. Anyway, try again or try something else.
NOT IN FILE LIN.FILE I/O ERROR	The SELECT request is for an item that is not in the file. Check the spelling of the SELECT command.

	If you are SELECTing from an EXPAND display, remember to use an e or r, for example, #el2 or #r1,r5.
NO SETS SELECTED AT THIS TIME	This is not an error condition. It simply means you asked for the SET HISTORY before any sets were SELECTED.
PLEASE PRESS INT KEY (NEVER TRANS)	This is not an error condition. The TRANS key is not used in RECON and this message appears if you press it. Sometimes phone line noise will trigger this message.
ADDRESSEE HAS TERMINAL TURNED OFF	You can't send them a message right now. Try again later or call them on the phone.
FORMAT ERROR IN MESSAGE COMMAND	You typed the letter 'O' instead of the number zero, or you forgot the slash in a message command.

5.6. RECON One-Page Guide

(Partial List of Commands and Options)

Command	Key	Description/Examples
BEGIN	!	Start new session
	!0	Fast BEGIN, File 0
	!1	Fast BEGIN, File 1
EXPAND	"term	Show index terms/"radiation "ecolo
	"au = name	Show author list/"au = jones "au = smith, j
	"cc = number	Show corporate code numbers/"617 1000 for ORNL
	"nc = subject	"nc = 22.00 Earth Sciences (old style)
		"nc = 44.00 Environmental and Earth Sciences (new style)
	"jo = coden	"jo = nsena Nuclear Science and Engineering
	"co = country	"co = ur USSR "co = mx Mexico
		"co = uk England, United Kingdom
	"rn = report	"rn = ucrl UCRL reports
	"cn = contract	"cn = nas Contracting agency = N.A.S.
	"pn = patent	"pn = british Patent country = GB
EXPAND RELATED TERMS	"e	"e9 Related terms for item E9 of current index display
	"r	"r2 Related terms for item R2 of current display of related terms
SELECT	# e	# e9 Build a user work set from item E9 of current index display
		# e7,e9,e6 Combine (OR-logic) three items from index display and make a user work set
		# e5-e9 Select E5,E6,E7,E8,E9
		# e10,e12-e15 Select E10,E12,E13,E14,E15
	# r	# r11 Build a user work set from item R11 of current related terms display
		# r9-r12 Select R9,R10,R11,R12
COMBINE	$	Logical combinations of user work sets
		$1+3 Combine set 1 with Set 3, OR-logic (Union)
		$2*4 Combine set 2 with Set 4, AND-logic (Intersection)
		$1-2 Combine set 1 with Set 2, NOT-logic (Exclusion)
		$6-9/+ Same as $6+7+8+9
		$6-9/* Same as $6*7*8*9
		$1+(2-4) Parentheses may be used to control the order of combinations
DISPLAY	%	Display reference and keywords
		%4 Display first item of Set 4
		% (Following %4): Display next item of Set 4
PRINT	&	Store items for later printing
		&9 Print all items in Set 9 (up to 50)
		&9/2/51-100 Print items 51 to 100 in Set 9
PAGE	0	(zero) Give next page of current display
		Valid when "MORE" appears
END	=	End user session
SET HISTORY	@	Show list of user work sets
MESSAGE	]	]4/any message (to Station 4)
		]10/goes to Station 10

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