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PERFORMANCE/DESIGN REQUIREMENTS AND DETAILED TECHNICAL DESCRIPTION FOR A COMPUTER-DIRECTED TRAINING SUBSYSTEM FOR INTEGRATION INTO THE AIR FORCE PHASE II BASE LEVEL SYSTEM

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LEGAL NOTICE

FOREWORD

One of the goals of Air Force Electronic Systems Division is the development of design principles for automated training subsystems which could be built into future Air Force information systems and used for on-the-job training of personnel. Task 6917.09, Automated Training for EDP Personnel, under Project 6917, Command Management Data Systems Software, was established to develop the technology for these on-the-job training subsystems and to apply that technology in experimental computer-directed training subsystems in Air Force computer-based information systems.

This report is one in a series supporting Project 6917, Task 6917.09.001, Computer-directed Training Subsystem for the Air Force Base Level System. Dr. Sylvia R. Mayer served as Air Force Task Scientist and Contract Monitor for this effort which was accomplished between July 1967 and July 1968.

This report, the performance/design requirements specification for the computer-directed training subsystem in the Air Force Phase II Base Level System, was developed under Contract Number F19628-67-C-0427 with System Development Corporation by A. K. Butler; R. S. Cowdery; J. W. Cullen, Principal Investigator; D. K. McBane, and L. D. Peshek.

Technical advice to ensure the development of this specification in accordance with approved data automation standards was provided by Lt Richard Holmes of Air Force Technical Training Center, Mr. Frank Mezur and Miss Esther Peters of Air Force Directorate of Data Automation, and Mr. William Stevenson of Air Force Data Systems Design Center.

This technical report has been reviewed and is approved.

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ABSTRACT

This document presents the performance/design requirements and detailed technical description for a Computer-Directed Training Subsystem to be integrated in the Air Force Phase II Base Level System. The subsystem is to be used to provide a computer-assisted lesson construction and presentation capability for on-the-job training for data automation, staff, and management personnel in the operation and use of the Air Force Phase II Base Level System. System, personnel, and operational requirements specified herein are to be fulfilled by program elements of control, lesson building, lesson execution, trainee record processing, and off-line lesson building. Inputs, outputs, and internal processing are specified for each element.

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1. <u>SCOPE</u>

This part of the specification establishes the requirements for performance, design, test, and qualification of a computer program identified as the Computer-Directed Training Subsystem (CDTS), Computer Program Contract End Item (CPCEI) number SDC 101. This CPCEI is used to provide a computer-assisted lesson construction and presentation capability for on-the-job training for data automation, staff, and management personnel in the operation and use of the Air Force Phase II Base Level System.

The Phase II Base Level Project is an Air Force-wide effort to provide automated management systems at the base level. Equipment presently installed at base level will be replaced by Burroughs B 3500 computer systems. The B 3500 system is a modular system, featuring massive immediate access (disk) storage and remote communications terminals. Its Master Control Program is designed to facilitate on-line user interaction with the programs from the remote terminals.

The Computer-Directed Training Subsystem will function as other subsystems of the Phase II System. It will conform to the standards and requirements of the Phase II System, without disrupting normal system operations.

The application of the Computer-Directed Training Subsystem will vary with users of the Phase II Base Level System. The program as specified is a multi-purpose, user-oriented, interactive subsystem which permits the construction and presentation of new course material or modifications to existing material without requiring programming changes.

Courses may be designed and constructed to satisfy a variety of training requirements (e.g., initial training in a specified field, or upgrading or proficiency training). The program presents the requested course at a remote communication terminal for individual on-line training sessions. When appropriate, computer material is augmented with off-line exhibits and instructional material. The program will be used first to construct and present a computer operators training module to selected Air Force personnel at the Sheppard Technical Training Center. A test plan incorporating tutorial engineering principles will be developed to assess the interface of the program and the computer operators training module.

The elements of this CPCEI include a Control Function, a Lesson Building Function, a Lesson Execution Function, a Trainee Record Processing Function, and an Off-line Lesson Building Function.

Control Function

The Control Function performs lesson material accessing, remote terminal communication, control of program segment loading and operation, outputting of lesson material and trainee records to disk storage, and all other subfunctions necessary to provide a single interface

of the Computer-Directed Training Subsystem with the Phase II Master
Control Program and Data Communications Handler.

Lesson Building Function

The Lesson Building Function permits authorized personnel to construct
and modify course material for a variety of training purposes. This
course material will be input to the training subsystem from remote
communications terminals tied to selected Phase II B3500 computer
systems.

Lesson Execution Function

The Lesson Execution Function permits the presentation of course
material to trainees via remote communications terminals tied to
the B3500. The function evaluates trainee responses to test items
and presents additional material based upon trainee progress. The
Lesson Execution Function also permits the course designer to check-
out and evaluate the training logic and effectiveness of the course
material.

Trainee Record Processing Function

The Trainee Record Processing Function permits authorized personnel
to access the records of trainee performance that are compiled
during the execution of a lesson. These records are analyzed by the
function in a batch processing mode, and prescribed reports produced
for an individual or a group of trainees.

Off-Line Lesson Building Function

The Off-Line Lesson Building Function permits the operation of the
Execution Function of the subsystem without the requirement for a
lesson building capability which accepts inputs from remote commu-
nications terminals. It will operate in a batch processing mode,
accepting card or tape inputs and outputting lessons compatible
with the Execution Function. It permits the selective construction
of lessons which have been stored previously on one or more tapes.
Lessons desired for a training session are loaded onto disk storage
and are thereby available for use by trainees. Lessons not re-
quired or needed for specific training sessions are removed from
disk releasing unused storage space for other Phase II applications.

This part of the specification is contained in a single volume. The five major
CDTS functions are treated separately, with inputs, outputs, and information
processing specified for each.

Part I of this specification consists of the following sections and major paragraphs:

Section I indicates the scope of the CPCEI. Section 2 lists the applicable documents that form a part of the CPCEI. Section 3 contains the performance and design requirements for the CPCEI; 3.1 specifies the functional requirements; 3.1.1 specifies the system limits and capacities; 3.1.2 specifies the operational requirements; 3.1.2.1 describes function 1--Control; 3.1.2.2 describes function 2--Lesson Building; 3.1.2.3 describes function 3--Lesson Execution; 3.1.2.4 describes function 4--Trainee Record Processing; 3.1.2.5 describes function 5--Off-Line Lesson Building; 3.1.3 specifies the requirements for all parameters which affect the design of the CPCEI; 3.1.4 specifies the human performance and engineering requirements, 3.2 contains the interfacing CEI definition and specifies the requirements imposed upon the design of the CPCEI because of its relationship to equipment and other computer programs, 3.3 specifies requirements affecting the design of this CPCEI that are distinguishable from performance requirements. Section 4 specifies Category I test requirements, 4.1.1 specifies the testing required to support the design and development of CDTS, 4.1.2 specifies the Preliminary Qualification Tests, 4.1.3 specifies the Formal Qualification Tests.

2. APPLICABLE DOCUMENTS

The following documents, of exact issue shown, form a part of this specification to the extent noted here. In the event of conflict between these documents and the contents of sections 3 and 4, the latter shall take precedence.

DOCUMENT NUMBER | TITLE AND DATE

2.1 SPECIFICATIONS

1. ESD-TR-68-152
Operational Specification for a Computer-Directed Training Subsystem for Integration into the Air Force Phase II Base Level System, 15 March 1968.

2. TM-(L)-3725/001/00
    through
    TM-(L)-3725/018/00
Computer Operator Material for a Computer-Directed Training Subsystem for Integration into the Air Force Phase II Base Level System, 15 November 1967.

3. ESD-TR-66-252
Operational Specification for Computer-Directed Training in Intermediate Query Language, Mode II, for System 473L U. S. Air Force Headquarters, 15 March 1966.

DOCUMENT NUMBER	TITLE AND DATE

2.2 STANDARDS

    4. AFM 171-100 (TEST)   B3500 Automated Management Supporting Data Systems (AMSDS) Development, Maintenance, and Documentation Standards, 30 August 1968.

2.3 OTHER PUBLICATIONS

2.3.1 MANUALS

    5. Burroughs 1033099   Burroughs B2500/B3500 Information Processing System COBOL Reference Manual, June 1968.

    6. Burroughs 1031218   Burroughs B2500/B3500 Master Control Programs Information Manual, May 1968.

    7. Burroughs 1025475   Burroughs B2500/B3500 Systems Manual, May 1968.

3. REQUIREMENTS

Performance, interface, and design requirements specified herein are applicable to the Computer-Directed Training Subsystem of the Air Force Phase II Base Level System.

3.1 PERFORMANCE

The system, operational, data base and human performance requirements specified herein shall establish the performance requirements for this CPCEI.

3.1.1 System Requirements

This paragraph establishes the limits and capacities of the CPCEI, and it describes performance requirements resulting from personnel responsibilities.

3.1.1.1 System Limits

    1. On-line System Users. The subsystem will handle any combination of course designers and trainees at the same time within the system limit for total users.

2. <u>User Lesson Access</u>. All on-line users of the system may be accessing different lessons. All trainees may be accessing the same lesson, but trainees may not access a lesson while it is in the process of being edited by a course designer without course designer permission.

3. <u>Total System Users</u>. The system will have a capacity for 100 "active" users. (Active meaning that the user has started, but has not completed, either building or executing a lesson.)

4. <u>Lessons Per User</u>. No practical limit will be placed upon the number of lessons with which a user can be interacting simultaneously. (Simultaneous interaction means that a user can start one or more additional lessons before finishing the first.) The course designer (or training supervisor) can restrict access of lessons as he so desires.

5. <u>Course Material Capacities</u>.

   a. <u>Course Capacity</u>. No limit will be placed on the number of lessons that may be contained in a logical course. Phase II System Requirements may preclide the availability of all lessons at any one time.

   b. <u>Lesson Capacity</u>. Each lesson will have a maximum length of 300 frames.

   c. <u>Frame Capacity</u>. Each frame of a lesson will have a maximum length of 400 bytes of data. The 400 bytes will contain both lesson material and control information. Each line of data that appears in the frame will reduce the total amount of textual material that can be presented because of the control information associated with the line. If all data planned for a frame exceeds the capacity, the data may be split into two or more frames by the course designer. Only the group two may be split between frames.

   d. <u>Group Capacity</u>. Each frame must contain a group one. Any of the other three groups that may comprise a frame may utilize the remainder of the frame capacity not used by the group one.

   e. <u>Line Capacity</u>. The number of characters in a single line of information which may be input from the remote terminals is 150. Output messages to the remotes may contain up to 160 characters in a single line.

f. Labels Per Lesson. The number of frames per lesson to which the course designer may give an alphanumeric label is limited to 49.

g. Decision Frame. The number of frames that the course designer may specify to be examined for trainee responses is limited to 50 per decision frame. However, this limit may be further reduced by the 400 byte per frame total capacity limit.

h. Items. The number of integer items that the course designer may specify to be set/tested during the execution of a lesson is limited to 30.

6. Input Message Processing

a. Regardless of message traffic, input messages to the subsystem will be received and processed one at a time.

b. Trainee responses to lesson material at a remote terminal are limited to one line of input per response.

7. On-Line Lesson Printing. Each request by the course designer to print lesson material on-line will be limited to a maximum of three frames. This limit will be parameterized and changed if system usage dictates. (The DCH limit is 99 lines.)

8. Trainee Records. The number of trainees who may have trainee records in immediate access storage at any one time is limited to 100. As records are cleared from the file, records of additional trainees may be added.

3.1.1.2 Personnel Requirements. This paragraph establishes personnel functions which impose requirements upon the elements of the Computer-Directed Training Subsystem.

3.1.1.2/1 Trainee. The trainee uses the Lesson Execution Function of the subsystem to learn. The subsystem must give him:

1. Control over the presentation rate of course material.

2. The ability to bypass lesson material of which he demonstrates prior knowledge..

3. Feedback indicating accuracy of responses.

4. An answer evaluation capability which does not penalize him for a lack of typing competency.

5. The ability to interrupt and continue lesson sessions.

6. The ability to continue on to subsequent lessons following the successful completion of each lesson.

7. The ability to selectively review completed course material.

3.1.1.2/2 Course Designer. The course designer is charged with developing new training materials and updating existing material. To fulfill his function, the course designer must have:

1. The ability to print, on-line, selected portions of completed course material.

2. The ability to print, off-line, complete lessons.

3. The ability to selectively modify existing course material without the need for repeating unchanged portions of the material.

4. The ability to verify lesson logic by switching into the execution mode of the subsystem as a pseudo-trainee.

5. The ability to suppress the maintenance of trainee records when using the subsystem as a pseudo-trainee.

6. The ability to prevent unauthorized personnel from modifying course material.

3.1.1.2/3 Course Designer/Training Supervisor. A training supervisor monitors the progress of trainees and gives assistance as required. This training supervisor will in some instances be the designer of the course being taken by the trainees, but more frequently he will not. "Course designer" is used hereafter to refer to this function. The course designer/training supervisor task requires:

1. Records of trainee performance maintained during lesson execution.

2. The ability to execute the course material as a pseudo-trainee.

3. The ability to suppress the maintenance of records of his progress while performing as a pseudo-trainee.

4. The ability to print selected course material.

5. The ability to process individual records of trainee progress.

6. The automatic deletion of trainee records after the records have been processed and the appropriate reports produced.

7. The ability to remove trainee records from immediate access storage to make space for additional trainees.

8. The ability to examine the table of contents of course material in immediate access storage.

9. The ability to load selective lessons from a library tape of course material into immediate access storage.

3.1.1.2/4 Training Subsystem/Lesson Demonstrator. A demonstrator is anyone who functions as a trainee taking course material for the sole purpose of demonstrating the training subsystem or specific course material. The demonstrator must have:

1. The ability to modify or execute selected demonstration lessons and to suppress the permanent maintenance of records of his progress.

2. The ability to have trainee records that he creates during lesson execution immediately scheduled for printing.

3.1.2 Operational Requirements. The functional elements establish the operational requirements for this CPCEI. The functional operation of the CPCEI, the relation of the CPCEI functional elements to each other and their relation to other identified system operations are shown in figure 3.1.2-1. The block numbers correspond to the paragraphs in which elements are described.

The Computer-Directed Training Subsystem is specified to provide necessary features for a well-integrated, computer-aided training program with optimal system design and implementation.

To accomplish this goal, CDTS is required to provide capabilities for: on-line construction and editing of course material; off-line construction/loading of course material; on-line presentation of course material to trainees; maintenance of records of trainee progress through course material; off-line processing of the trainee records and outputting of specified reports.

CDTS will implement these capabilities through the functional elements: Control Function, Lesson-Building Function, Lesson Execution Function, Trainee-Record-Processing Function, and Off-Line Lesson Building Function.
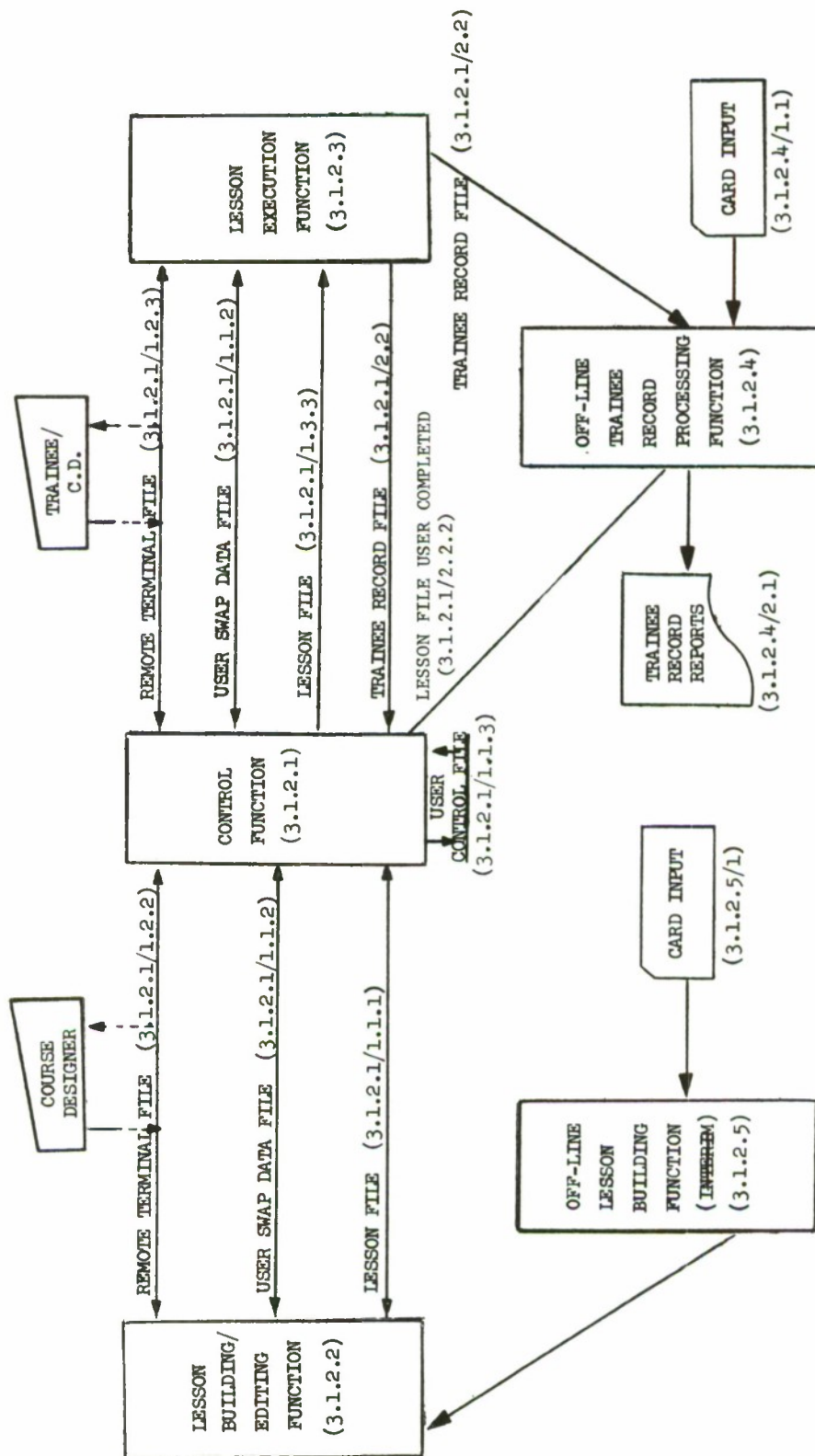
FIGURE 3.1.2-1   CDTS FUNCTION BLOCK DIAGRAM

3.1.2.1 <u>Control Function</u>. The control function of CDTS is the Functional System Analyzer (FSA) which interacts with the Data Communications Handler (DCH), the B 3500 Master Control Program (MCP), and the CDTS overlay sections to control all input-output operations and inter-segment/program communications. The major subfunctions of the Control Function are:

1. <u>Output Function</u>:

    a. Outputs an asterisk as the first operation of the system and thereafter as a cue to the user when information may be entered. Following the asterisk, the Command Interpreter Function is entered for interrogation of any subsequent response.

    b. Is entered from Lesson Building/Modification and Execution Functions to output the following types of messages to users at the remote terminals:

        1) Legality messages

        2) Cue messages

        3) Feedback messages

        4) Status information

        5) Course material

    c. Is entered from the Lesson Building/Modification and Execution Function to output the following data on immediate access storage:

        1) Course material, as it is constructed or modified.

        2) Records of trainee progress for later batch processing by the Trainee Record Processing Function.

2. <u>Command Interpreter Function</u>:

    a. Is entered from the DCH to interrogate all inputs from the remote communications terminals.

    b. Examines the first set of characters to determine if a legal command has been inserted. The system must be initialized by the insertion of commands:

#CO: Transfers control to the Lesson Building
Function for construction of a new lesson
(the name of which cannot already exist in
the lesson file table of the contents).

#GET: Instructs the program to search the lesson
file table of contents for the specified
lesson. This initializing command is re-
quired for lesson execution or lesson
building/editing of an existing lesson.

c. Controls the subsequent modes of operation by interrogating
options/commands following the Switch Mode Indicator (#, for
the course designer and ? for the trainee.) Those legal
commands are:

#EX: Places the program in the Lesson Execution
Function with the course designer in a
pseudo-trainee status. The existing lesson
operates as viewed by a trainee.

#RESTART: Instructs the program to clear all data
for this lesson stored on Immediate Access
Storage (IAS), and remove the lesson name
from the lesson file table of contents.

#SAVE:
#SAVE DONE: Instructs the program to save, onto IAS,
the label information and frame directory
of the lesson being constructed. SAVE
DONE allows the course designer to access
a different lesson.

#GET:
?GET: Instructs the program to search the lesson
file table of contents for the existance of
specified lesson, and if present, to allow
the appropriate type of access (trainee or
course designer).

#CO: Places the program in the Lesson Building
Function to continue to construct a specific
lesson. #CO following the #SAVE DONE command
permits the course designer to start building
a new lesson.

#STATUS	Instructs the program to output the current conditional state of the optional functions: KEYWORD, PHONETIC, and ORDER.
?GOTO	Instructs the program to unconditionally branch the trainee or the course designer in a pseudo-trainee role to a specified frame label within the lesson being executed.
?QUIT	Instructs the program to terminate the lesson currently being executed by the trainee and permits him to ?GET another lesson without exercising the system commands *CLOSE and *OPEN.

3. Access Priority Function: Examines CDTS user control information to determine if trainees and the course designer are attempting to simultaneously access a lesson. The course designer will be given the option of denying access to trainees at the time he requests access. Another course designer already in the process of lesson building or modification will not be affected by this action.

4. Input/Output Interface:

    a. Provides appropriate recovery procedures in the event of failure of input/output operations.

    b. Opens and closes existing CDTS files.

    c. Interfaces with the system operator to schedule required batch processing programs.

    d. Preserves and restores user specific data in a multi-user environment.'

    e. Controls lesson file access.

5. Overlay Linkage: Causes the Master Control Program to load the required CDTS overlays and establish the necessary communication links between them.

6. Lesson Linkage: Permits course material to be constructed in segments and accessed in the proper sequence as specified by the course designer.

3.1.2.1/1 Sources and Types of Inputs. To perform the control functions
specified in 3.1.2.1/2, CDTS shall be designed to accept and process control
inputs that are listed in Table 3.1.2.1-1 and system data defined in subsequent
paragraphs.

Table 3.1.2.1-1   Summary of Remote Terminal Command Inputs

| SEQUENCE | LESSON EXECUTION | | LESSON BUILDING |
	TRAINEE	COURSE DESIGNER	COURSE DESIGNER
INITIAL ACTION	*OPEN FOR E	*OPEN FOR E	*OPEN FOR E
INITIAL COMMAND TO CDTS			#CO
	?GET	#GET	#GET
SUBSEQUENT COMMANDS		#GET	#GET
		#RESTART	#RESTART
		#STATUS	
		#SAVE	#SAVE
		#CO	#CO
	?QUIT	#EX	#EX
	?GOTO	?GOTO	
FINAL ACTION	*CLOSE	*CLOSE	*CLOSE

3.1.2.1/1.1 CDTS Input File Structure. CDTS will maintain three data files for use as input to the Control, Lesson Building, and Lesson Execution functions. These files will be accessed from immediate access storage during on-line use of the system, and will have backup storage on magnetic tape.

3.1.2.1/1.1.1 Lesson File. The Lesson File will contain the material for all lessons to be used by course designers and trainees. The file is composed of four elements:

3.1.2.1/1.1.1.1 Frame/Label Data. The label information contains the frame number of all frames within a lesson that have been assigned an alphameric label by the course designer.

3.1.2.1/1.1.1.2 Frame/Record Directory. The frame directory contains the relative record number of all frames within a lesson. Since frames of a lesson are not necessarily constructed in sequence, the purpose of the directory is to associate frame numbers with record numbers. This permits direct lesson frame access rather than requiring the disk file to be searched record by record.

3.1.2.1/1.1.1.3 Lesson (Frame) Content. The lesson contains the course material as defined by the course designer. It is comprised of 400 byte frames, with 300 frames being the maximum length of a lesson. Frames will be constructed sequentially from frame 1.0 until a frame must be inserted into existing material. Inserted frames are added as the course designer deems necessary with the frame directory pointing to the location of each insert.

3.1.2.1/1.1.2 User Swap Data File. CDTS is unlike most Phase II applications, in that:

1. Many users require simultaneous access to the same program.

2. Many users require simultaneous access to the same input data from immediate access storage (the lesson file.)

3. Many users will have the requirement to terminate their interaction with an input file (the lesson) prior to completion of the lesson. Additionally, the user may be involved with taking more than one lesson at a time and requesting restarting of each from the appropriate point.

To accommodate these requirements, CDTS will implement a concept of maintaining extensive data on the exact position of each user of the system with respect to the lesson(s) being used or constructed. These data will be maintained in a Swap Data File, on immediate access storage during CDTS operation. It is anticipated that the permanent residency of these data will be on tape storage. The User Swap Data will be maintained by the Control Function for each user/ lesson combination until the user completes the lesson, and will contain the following data:

. Frame/record directory for the lesson.

. Frame/label data for the lesson.

. Lesson content (one frame at a time.)

. Records of trainee responses to lesson material.

3.1.2.1/1.1.3 <u>User Control File.</u> The User Control File always defines the current status of CDTS operations. All users who are considered "active" by the system will have an entry in the table, to a maximum limit of 100. Each entry of the table will define the User Swap Data necessary to resume presentation or construction of any lesson previously referenced but not completed.

3.1.2.1/1.2 <u>Inputs from the DCH Program</u>

3.1.2.1/1.2.1 <u>Functional System Control Inputs.</u> Functional system control inputs indicate requirements for initialization or closing the CDTS system and responses required of the FSA by the DCH.

3.1.2.1/1.2.2 <u>Functional System Messages from Remote Terminals.</u> Functional System Messages from remote terminals contain: (1) commands governing the functions of CDTS which are interpreted only by the FSA; and (2) messages which are interpreted by overlay sections which can contain data to be evaluated or data to be formatted for file content. The structure of the Remote Terminal Data File (TTY) is as follows:

1. DATA ITEM: TTY-TER-ID

<u>Description</u>:	Remote Terminal Identification Number The device ID received from the DCH for any message input from a terminal.
<u>Type - Size</u>:	Hollerith - 2 characters
<u>Legal values</u>:	ØA through 9Z
<u>Input Source</u>:	DCH
<u>When Set</u>:	Any time an input message is read from a terminal.

2. DATA ITEM: TTY-BIC3

<u>Description</u>:	Remote Terminal Buffer Information. Character #3. Prime device ID.
<u>Type - Size</u>:	Hollerith - 1 character
<u>Legal values</u>:	P or blank
<u>Input source</u>:	DCH
<u>When set</u>:	Any time an input message is read from a terminal.

3. DATA ITEM: TTY-BIC4

        Description: Remote Terminal Buffer Information.
                         Character #4. Recovery image.
        Type - size: Hollerith - 1 character
        Legal values: R or blank
        Input source: DCH
        When set: Any time an input message is read from a
                         terminal.

4. DATA ITEM: TTY-BIC68

        Description: Remote Terminal Buffer Information.
                         Character #6 through 8. Number of
                         data characters.
        Type - size: Numeric - 3 characters
        Legal values: 1 through 160
        Input source: DCH
        When set: Any time an input message is read from a
                         terminal.

5. DATA ITEM: TTY-BCD-WD

        Description: Remote Terminal BCD Word. Defines 4
                         characters of an input message.
        Type - size: Hollerith - 4 characters
        Legal values: Any character that can be input from a
                         terminal.
        Input source: User input at terminal
        When set: When a message is read from a terminal.

6. DATA ITEM: TTY-BYTE1 through TTY-BYTE4

        Description: Remote Terminal Byte1 through Byte4. Sub-
                         items to TTY-BCD-WD. Used to extract any
                         single character from an input message.
        Type - size: Hollerith - 1 character
        Legal values: Any character that can be input from a
                         terminal.
        Input source: User input at terminal
        When set: When a message is read from a terminal.

7. DATA ITEM: TTY-CNTRL

        Description: Remote Terminal control overlay item.
                         Used to set "GO AHEAD" message to DCH.
        Type - size: Hollerith - 8 characters
        Legal values: Any legal Hollerith characters
        Input course: Generated by the Control Function
        When set: Whenever the Control Function is required
                         to send the "GO AHEAD" to the DCH.

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3.1.2.1/1.3 Inputs from Disk Files

3.1.2.1/1.3.1 User Control File

    1. DATA ITEM: US-SWAP-MATRIX

Description:	User Swap Matrix. Indicates which physical records are available for User Swap data records.
Type - size:	Computational - 8 digits
Legal values:	0 or 1
Input source:	Generated by the Control Function
When set:	When a new user/trainee logs in at a terminal or when the lesson designer deletes the trainee's data. This item is referenced through data item number 2.

    2. DATA ITEM: UC-FRM-K

Description:	User Frame K Factor. Contains the count to establish the physical record number of the first record of a lesson.
Type - size:	Computational - 8 digits
Legal values:	1-199980
Input source:	Generated by the Control Function.
When set:	Each time a user builds a new lesson or accesses an existing lesson.

    3. DATA ITEM: UC-ID-NUM

Description:	User Identification Number. A unique number to identify each user/trainee. (i.e., Social Security Number.)
Type - size:	Hollerith - 12 characters
Legal values:	000000000000 - 999999999999
Input source:	User input at terminal
When set:	When a user logs in and is not present in the User Control Table.

    4. DATA ITEM: UC-ACTIVE

Description:	Number of incompleted lessons associated with this user in the User Swap Data.
Type - size:	Computational - 2 digits
Legal values:	0 - 99
Input source:	Generated by the Control Function
When set:	Incremented when a new lesson is started and decremented when a lesson is completed.

5. DATA ITEM: UC-Mode

    Description: User Mode. Indicates the System Mode in
                    which the user is interacting with a lesson.
    Type - size: Computational - 1 digit
    Legal values: Ø - Null
                    1 - Trainee
                    2 - Course Designer
                    3 - Pseudo Trainee
    Input source: Set by the Control Funciton.
    When set: Whenever the user "GETs," "COs," or "EXs,"
                    a lesson.

6. DATA ITEM: UC-TERM-ID

    Description: User Terminal Identification. The identifi-
                    cation of the terminal the user/trainee is
                    using at this session.
    Type - size: Hollerith - 2 characters
    Legal values: Any two characters the DCH passes with the
                    "*OPEN"
    Input source: User input at terminal
    When set: At any "*OPEN" statement from the DCH.

7. DATA ITEM: US-SWAP-REC-NUM1

    Description: User Master Swap Record Number. The number
                    of the physical record for a user/trainee's
                    master swap record.
    Type - size: Computational - 3 digits
    Legal values: Ø - 400
    Input source: Generated by the Control Function
    When set: When a user logs in and is not present in
                    the User Control Table. Reset if item
                    UC-ACTIVE is equal to Ø when the CLOSE
                    command is issued at the remote terminal.

8. DATA ITEM: UC-COMMD-CNT

    Description: Command count governing trainee usage of
                    the system. Used to restrict attempts to
                    violate CDTS rules for lesson access.
    Type - size: Computational - 1 digit
    Legal values: Ø - "GET" command will not be legal
                    1 - "GET" command will be legal
    Input source: Generated by the Control Function
    When set: Each time a trainee attempts to access a
                    lesson via the "GET" command, if not
                    already set. Reset on "QUIT" command or
                    lesson completion.

9.　DATA ITEM:　　　　　　UC-LES-NAM

      Description:　　　Contains the name of the lesson currently
      　　　　　　　　being accessed by the user/trainee.
      Type - size:　　　Hollerith - 8 characters
      Legal values:　　Any DCH accepted characters
      Input source:　　User input at the terminal
      When set:　　　　Whenever the user-trainee "GETs" or "COs"
      　　　　　　　　a different lesson.

10.　DATA ITEM:　　　　　　US-SWAP-REC-NUM2

      Description:　　　The physical record number of the user/trainee's
      　　　　　　　　current user swap record.
      Type - size:　　　Computational - 4 digits
      Legal values:　　0001 - 9999
      Input source:　　Generated by the Control Function
      When set:　　　　Whenever the user/trainee "GETs" or "COs"
      　　　　　　　　a different lesson.

3.1.2.1/1.3.2 User Swap Data File. The User Swap Data File is the lesson
control file for individual users of CDTS. The file is divided into two sets
of data: the Master Swap Control Data and the User Swap Data.

3.1.2.1/1.3.2.1 Master Swap Control Data. The Master Swap Control Data con-
tains the basic control information for all users of CDTS. This portion of
the User Swap Data File will contain up to 100 randomly accessed records that
should reside permanently on disk. A record will be brought in from disk, or
a new record established after a user logs in, based upon the content of the
User Control Table.

1.　DATA ITEM:　　　　　　MS-LES-NAM

      Description:　　　Contains the name of a lesson that is active
      　　　　　　　　for this user.
      Type - size:　　　Hollerith - 6 characters
      Legal values:　　Any DCH accepted characters
      Input source:　　Generated by the Control Function
      When set:　　　　Whenever the user does not finish a
      　　　　　　　　lesson in one session.

2.　DATA ITEM:　　　　　　MS-REC-NUM2

      Description:　　　The record number of the User Swap Data
      　　　　　　　　required by CDTS to resume processing of
      　　　　　　　　the lesson.
      Type - size:　　　Numeric - 3 digits
      Legal values:　　1 - 500
      Input source:　　Generated by the Control Function
      When set:　　　　When a user does not finish a lesson in
      　　　　　　　　one session.

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3.   DATA ITEM: MS-DATE

Description   Date of lesson when last accessed by this user.
Type - size: Computational - 16 digits
Input source: Generated by the Control Function
When set: When the trainee initially "GETs" a lesson.

3.1.2.1/1.3.2.2 User Swap Data.   The User Swap Data are all the information
necessary to reflect the user/trainee's exact position and status within a
lesson at each point in time. It is a randomly accessed table that contains a
record for every unfinished lesson for each user. When the course designer
completes building the lesson, or the trainee completes his execution of the
lesson, that entry in the file is deleted. The data items used by the Control
Function are shown in the following paragraphs. Those data used by the Lesson
Building/Editing and Lesson Execution Functions are shown in sections 3.1.2.2/
1.2.2 and 3.1.2.3/1.2.1, respectively.

1.   DATA ITEM: US-FRM-K

Description: Swap User Frame K Factor. Contains the count
                      to establish the physical record number of
                      the first record of a lesson.
Type - size: Computational - 8 digits
Legal values: 1 - 199980
Input source: Generated by the Lesson Building Function
When set: Each time a new lesson is built or an
                      existing lesson is accessed.

2.   DATA ITEM: US-FRM-TYPE

Description: Swap User Frame Type. The frame type of the
                      current frame for this user/trainee.
Type - size: Hollerith - 2 characters
Legal values: Qb, Mb, Q1, M1, or Db. b equals blank
Input source: User input at terminal to Lesson Building
                      Function.
When set: Each time a new frame is read.

3.   DATA ITEM: US-CD-ID

Description: Swap User course designer identification.
                      The ident of the course designer to control
                      the type of access of a lesson.
Type - size: Hollerith - 16 characters
Legal values: Any characters that can be input from a terminal.
Input source: User input at terminal
When set: Each time a course designer starts building
                      a new lesson or "GET" command is issued
                      for the lesson.

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4. DATA ITEM: US-US-ID

        Description: Swap User Identification. The ID of the
                           user of this lesson. When compared with
                           US-CD-ID determines the type of access
                           allowed to the lesson.
        Type - size: Hollerith - 16 characters
        Legal values: Any characters that can be input from a terminal.
        Input source: User input at terminal
        When set: Each time a user/trainee accesses a lesson.

5. DATA ITEM: US-LABEL

        Description: Swap User Frame Label. The name of a label
                           assigned to a specific frame within the lesson.
        Type - size: Hollerith - 6 characters
        Legal values: Any characters that can be input from a terminal.
        Input source: User input at terminal to the lesson Building
                           Function.
        When set: Each time the course designer specifies a
                           label for a frame.

6. DATA ITEM: US-LAB-FRM-NUM

        Description: Swap User Label Frame Number. The number of
                           the frame that the label references.
        Type - size: Computational - 4 digits
        Legal values: 10 - 3000 (representing 1.0 through 300.0)
        Input source: Generated by the Lesson Building Function
        When set: Each time the course designer specifies a
                           label for a frame.

7. DATA ITEM: US-ITEM∅ through US-ITEM 29

        Description: Swap User Item∅ through Swap User Item29.
                           Items used by the course designer to control
                           the flow of the lesson by the trainee responses.
        Type - size: Computational - 4 digits
        Legal values: 1 - 9999
        Input source: Generated by the Lesson Execution Function
        When set: As specified by lesson content.

8. DATA ITEM: US-DEC-FRM-OVLY

        Description: Used to clear all items required by the decision
                           frame overlay within the Lesson Execution Function.
        Type - size: Hollerith - 4 characters
        Legal values: Any legal Hollerith characters
        Input source: Generated by the Lesson Execution Function.
        When set: Reset by the Control Function when decision frame
                           data are to be cleared.

9. DATA ITEM: US-PHONETIC

    Description: Phonetic indicator. Reflects the status of the phonetic service function.
    Type - size: Computational - 1 digit
    Legal values: ∅ - Phonetic is off
                     1 - Phonetic is on
    Input source: Generated by the Lesson Execution Function
    When set: Whenever the content of a frame reverses the status of the function.

10. DATA ITEM: US-ORDER

    Description: Order indicator. Reflects the status of the order service function.
    Type - size: Computational - 1 digit
    Legal values: ∅ - Order is off
                     1 - Order is on
    Input source: Generated by the Lesson Building Function.
    When set: Whenever the content of a frame reverses the status of the function.

11. DATA ITEM: US-KEYWORD

    Description: Keyword indicator. Reflects the status of the keyword service function.
    Type - size: Computational - 1 digit
    Legal values: ∅ - Keyword is off
                     1 - Keyword is on
    Input source: Generated by the Lesson Execution Function
    When set: Whenever the content of a frame reverses the status of the function.

12. DATA ITEM: US-PROC

    Description: Swap User Procedure Switch Flag. This item tells the FSA to which procedure it should pass control for the current user.
    Type - size: Computational - 2 digits
    Legal values: 1 - 99
    Input source: Set by the Control Funciton and by the overlay procedures
    When set: As required to control the sequencing of processing.

13. DATA ITEM: US-PROC-BR1

    Description: Swap User Procedure Branch. This item tells
                    a procedure to which paragraph to pass control
                    for the current user.
    Type - size: Computational - 2 digits
    Legal values: 1 - 99
    Input source: Generated by any overlay
    When set: Each time a procedure passes control to the
                    FSA and wants the control passed back to a
                    different paragraph or overlay.

14. DATA ITEM: US-MODE

    Description: The CDTS mode that is to operate for this user.
    Type - size: Computational - 1 digit
    Legal values: ∅ - null   1 - trainee execution
                    2 - lesson building   3 - pseudo-trainee execution
    Input source: Generated by the Control Function
    When set: When the user/trainee identifies himself, or
                    course designer switches modes.

15. DATA ITEM: US-ID-DUE

    Description: User identification due. Indicates the user
                    has not yet identified himself with respect
                    to this lesson.
    Type - size: Computational - 1 digit
    Legal values: ∅ - identification not due
                    1 - identification due
    Input source: Generated by the Control Function
    When set: Whenever the user "GETs" a lesson.

16. DATA ITEM: US-LAST-FRM

    Description: Last frame indicator. Indicates that the
                    last frame to be executed within a lesson has
                    or has not been reached.
    Type - size: Computational - 1 digit
    Legal values: ∅ - last frame has not been read
                    1 - last frame has been read
    Input source: Generated by the Control Function
    When set: When the last frame of a lesson is read from
                    the Lesson File on immediate access storage.

17. DATA ITEM: US-DIR-FRM-NUM

    Description: Directory frame number. Contains the frame
                    number of every frame in the lesson, as de-
                    fines by the Frame Directory Table.
    Type - size: Computational - 4 digits
    Legal values: 10 through 3000 (representing 1.0 through 300.0)
    Input source: User input at the terminal or generated by the
                    Lesson Building Function.
    When set: Each time the course designer builds or
                    deletes a frame.

18. DATA ITEM: US-DIR-REC-NUM

    Description: Directory record number. The relative record
                    number associated with each frame in the
                    Frame Directory Table.
    Type - size: Computational - 3 digits
    Legal values: 1 through 300
    Input source: Generated by the Lesson Building Function
    When set: Each time the course designer builds or
                    deletes a frame.

3.1.2.1/1.3.3 Lesson File

1. DATA ITEM: LE-FRM-NUM

    Description: Frame number. The number of the associated
                    frame data multiplied by 10.
    Type - size: Computational - 4 digits
    Legal values: 10 through 3000 (representing 1.0 through 300.0)
    Input source: Program generated or course designer input
                    at terminal
    When set: Each time a frame has been completed or an
                    insert is requested by the course designer.

2. DATA ITEM: LE-FRM-TYPE

    Description: Frame Type. Identifies the frame type, as ques-
                    tion, multiple choice, decision, or copy.
    Type - size: Hollerith - 2 characters
    Legal values: Qb, Mb, Db, Q1, or M1. b means blank.
    Input source: User input at terminal
    When set: Each time a new frame is built by the
                    course designer.

3. DATA ITEM: LE-FRM-LTH

        Description: Frame Length in entries, where an entry con-
                             sists of 4 bytes.
        Type - size: Computational - 2 digits
        Legal values: 2 through 96
        Input source: Program generated, governed by user input.
        When set: For each line of text input by the course
                             designer during lesson building or editing.

4. DATA ITEM: LE-GRP-NUM

        Description: Group Number. Indicates what group the
                             associated data belongs to, to determine what
                             action can be taken with regard to the data.
        Type - size: Computational - 1 digit
        Legal values: 1 through 4
        Input source: Generated by the Lesson Building Function
        When set: When the course designer indicates he is
                             finished with a group, or when a new frame
                             is started.

5. DATA ITEM: LE-GRP-LTH

        Description: Group Length. Gives the count of the
                             number of entries in a group, where an entry
                             consists of 4 bytes.
        Type - size: Computational - 2 digits
        Legal values: 1 through 96
        Input source: Generated by the Lesson Building Function
        When set: Each time a line is added or deleted by the
                             course designer for the associated group.

6. DATA ITEM: LE-LINE-NUM

        Description: Line Number. The line number of the textual
                             input, multiplied by 10.
        Type - size: Computational - 4 digits
        Legal values: 10 through 1300 (reprsenting 1.0 through 130.0)
        Input source: Program generated or assigned by lesson
                             designer when inserting a line.
        When set: Each time a line of data is input from the
                             terminal by the course designer for inclusion
                             in a frame.

7. DATA ITEM: LE-LINE-LTH

    Description: Line Length. Specifies the number of
                            characters in a line of textual data.
    Type - size: Computational - 3 digits
    Legal values: 1 through 160
    Input source: From the DCH upon reading of each input
                             from a terminal.
    When set: Each time a line of data is input by the
                             course designer for inclusion in a frame.

8. DATA ITEM: LE-BCD-WD

    Description: BCD Word. An item that defines 4 bytes
                             of Hollerith text.
    Type - size: Hollerith - 4 characters
    Legal values: Any legal character that can be input from
                             a terminal
    Input source: User input at terminal
    When set: Any time a line of data is input from a
                             terminal by the course designer for inclusion
                             in a frame.

9. DATA ITEM: LE-BYTE1 through LE-BYTE4

    Description: Byte1 through Byte4. Sub-items to BCD-WD.
                             Used to extract the 1st, 2nd, 3rd, or 4th
                             character of a BCD-WD entry.
    Type - size: Hollerith - 1 character
    Legal values: Any legal character that can be input from a
                             terminal.
    Input source: User input at terminal
    When set: Any time a line of data is input from a
                             terminal by the course designer for inclusion
                             in a frame.

10. DATA ITEM: LE-LES-NAM

    Description: Frame Lesson Name. The name of a lesson
                             assigned by the course designer.
    Type - size: Hollerith - 6 characters
    Legal values: Any character that can be entered from a terminal.
    Input source: User input at terminal
    When set: When the course designer commences building
                             a lesson.

11. DATA ITEM: LE-CD-ID

      Description: Course Designer Identification. Contains the
                        identification of the only person allowed
                        access to the lesson and associated trainee
                        records, other than during Lesson Execution
      Type - size: Hollerith - 2 characters
      Legal values: Any character than can be entered from a
                        terminal.
      Input source: User input at terminal
      When set: When the course designer commences building
                        a lesson.

12. DATA ITEM: LE-LABEL

      Description: Frame Label. The name of a label assigned to
                        a specific frame within the lesson.
      Type - size: Hollerith - 6 characters
      Legal values: Any Hollerith characters
      Input source: User input at terminal
      When set: Each time the course designer specifies a
                        label for a frame.

13. DATA ITEM: LE-LAB-FRM-NUM

      Description: Label Frame Number. The number of the frame
                        with which a label is associated.
      Type - size: Computational - 4 digits
      Legal values: 10 - 3000 (representing 1.0 through 300.0)
      Input source: Generated by the Lesson Building Function
      When set: Each time the course designer specifies a
                        label for a frame.

14. DATA ITEM: LE-DIR-NENT

      Description: Directory Number of Entries. The count of
                        the number of frames currently in the lesson.
      Type - size: Computational - 8 digits
      Legal values: 0 - 300
      Input source: Generated by the Lesson Building Function
      When set: Each time the course designer builds or
                        deletes a frame.

15. DATA ITEM: LE-DIR-FRM-NUM

        Description: Frame number of each frame in the lesson.
        Type - size: Computational - 4 digits
        Legal values: 10 through 3000 (representing 1.0 through 300.0)
        Input source: User input at the terminal or generated by the
                            Lesson Building Function.
        When set: Each time the course designer builds or
                            deletes a frame.

16. DATA ITEM: LE-DIR-REC-NUM

        Description: Directory Record Number. The relative record
                            number associated with each frame number in the
                            directory.
        Type - size: Computational - 3 digits
        Legal values: 1 through 300
        Input source: Generated by the Lesson Building Function
        When set: Each time the course designer builds or
                            deletes a frame.

3.1.2.1/2 Destination and Type of Outputs

3.1.2.1/2.1 Messages and Textual Data Output to the Remote Terminal. Control
data is passed to the DCH to signal state of general or remote keyboard specific
processing. Messages are passed to the remote keyboards as often as directed by
the CDTS overlay sections and the Control Function. The TTY file is used for
output of all data to the remote terminals, as well as input from the terminals.

3.1.2.1/2.1.1 Format of Messages Output to the Remote Terminal

1. DATA ITEM: TTY-TER-ID

        Description: Remote Terminal Identification. Identifies
                            the terminal for which the message is intended.
        Type - size: Hollerith - 2 characters
        Legal values: ØA through 9Z
        Input source: Generated by the Control Function
        When set: When a message is to be output to a terminal.

2. DATA ITEM: TTY-BIC3

        Description: Remote Terminal Buffer Information.
                            Character #3. The write directive.
        Type - size: Computational - 2 digits
        Legal values: 1 through 7
        Input source: Generated by the Control Function
        When set: When a message is to be output to a terminal.

3. **DATA ITEM:** TTY-BIC4

    Description: Remote Terminal Buffer Information. Character #4. Write Terminator.
    Type - size: Hollerith - 1 character
    Legal values: 1 through 3 or blank
    Input source: Generated by the Control Function
    When set: When a message is to be output to a terminal.

4. **DATA ITEM:** TTY-BIC68

    Description: Remote Terminal Buffer Information. Characters #6 through 8. Number of data characters.
    Type - size: Computational - 3 characters
    Legal values: 1 through 160
    Input source: Generated by the Control Function
    When set: When a message is to be output to a terminal.

5. **DATA ITEM:** TTY-BCD-WD

    Description: Remote Terminal Output BCD Word. Defines 4 characters of an output message.
    Type - size: Hollerith - 4 characters
    Legal values: Any character acceptable by a terminal
    Input source: Program Generated
    When set: When a message is to be output to a terminal.

6. **DATA ITEM:** TTY-BYTE1 through BYTE4

    Description: Remote Terminal Byte1 through Byte4. Sub-items to TTY-BCD-WD. Used to place a single character in the output message.
    Type - size: Hollerith - 1 character
    Legal values: Any character acceptable by a terminal
    Input source: Program generated
    When set: When a message is to be output to a terminal.

3.1.2.1/2.1.2 Content of Messages Output to the Remote Terminal. To facilitate system/user interaction, the complete message number will be output at the remote terminal whenever possible. The messages will be further explained in the system users manual. Messages generated by the Control Function are as follows:

1. E-1-1. "ILLEGAL USE OF SYMBOL." An illegal symbol has been used in conjunction with an action command.

2. E-1-2. "UNDEFINED COMMAND/OPTION." An attempt has been made to input a command or option which does not conform to system restrictions.

3. E-1-34. "ENTER INITIAL COMMAND TO NEET ∅∅." System response to user's "OPEN" command, indicating CDTS (NEET ∅∅) is ready to accept command inputs.

4. E-1-18. "NO SUCH FRAME OR LABEL." The trainee or course designer has attempted to "EX" or "GOTO" a non-existent frame label.

5. E-1-32. "ILLEGAL FIRST COMMAND." The user's first command to CDTS was other than "GET" or "CO."

6. E-2-15. "ENTER COMMAND." CDTS is ready to resume processing, but needs a command from the user.

7. E-1-33. "ILLEGAL COMMAND/OPTION." The user has attempted to enter a command which is not permitted for his user status.

8. E-1-35. "UCT FULL." A new user has attempted to enter an initial command and the User Control Table already contains 100 users.

9. E-3-5. "KEYWORD (ON/OFF)
        ORDER (ON/OFF)
        PHONETIC (ON/OFF)"
Response to the course designer who has requested the status of the service functions.

10. E-3-13. "SAVED." Indicates to the course designer that his request to "SAVE" a lesson on IAS has been successfully completed.

11. "GONE-ENTER INITIAL COMMAND." Indicates to the course designer that his request to "RESTART" a lesson has been completed.

12. E-2-12. "LESSON NOT ON DISK." An attempt has been made to access a lesson which is not currently stored on disk.

13. E-1-40. "LESSON ACCESS NOW DENIED BY CD." Notice to trainees attempting to access a lesson that access has been temporarily denied by the course designer

14. E-1-41. "TABLE OF CONTENTS FULL." An attempt has been made to construct a new lesson when the lesson file table of contents already contains the maximum number of lessons.

15. E-1-42. "LESSON ALREADY EXISTS." An attempt has been made to create a new lesson, whose name already exists in the lesson file table of contents.

16. E-1-43. "LESSON IN MSD NOT ON DISK." The user has attempted to access a lesson he has previously accessed, and it does not currently exist on disk storage.

17. E-1-44. "MSD FULL." An attempt has been made to exceed the system limit for active users.

18. E-1-45. "PROGRAM/COMPUTER ERROR." An invalid key has been encountered when attempting to read or write a disk error. The device attempting to access that disk record is closed.

19. E-3-18. "LESSON CONCLUDED, ENTER COMMAND." Feedback to trainee, following his completion of a lesson which does not automatically branch him to a subsequent lesson.

20. E-3-20. "USER SWAP MATRIX FULL." The User Swap Matrix cannot define another record. The user should see that corrective action is taken as the matrix probably defines records no longer needed.

3.1.2.1/2.2 Disk Output Records

3.1.2.1/2.2.1 The Trainee Display File, in blocked format, is written in a sequential access file for subsequent dumping to tape (for processing by a batch program) as often as directed by the CDTS overlay sections.

1. DATA ITEM: TR-ID-NUM

    Description: User Identification Number. A unique number
                     to identify each user.
    Type - size: Hollerith - 12 digits
    Legal values: 1 - 999999999999
    Input source: User input at terminal
    When set: Every time display records are written

2. DATA ITEM: TR-NAME

    Description: User's name
    Type - size: Alphabetic - 16 characters
    Legal values: Alphabetic and blank characters
    Input source: User input at terminal
    When set: Every time a display word is written

3. DATA ITEM: TR-LES-NAM

        Description: The name of the lesson being executed
        Type - size: Hollerith - 6 characters
        Legal values: Any combination of alphanumeric characters
        Input source: User input at terminal
        When set: Every time a display record is written

4. DATA ITEM: TR-FRM-NUM

        Description: Frame number
        Type - size: Computational - 4 digits
        Legal values: 10 through 3000 (representing 1.0 through 300.0)
        Input source: User Swap Data
        When set: Every time a display record is written

5. DATA ITEM: TR-ANS

        Description: The answer tag representing student response.
        Type - size: Hollerith - 7 characters
        Legal values: A - Z
        Input source: User input at terminal
        When set: Every time a display record is written.

6. DATA ITEM: TR-RGT-WRG

        Description: The right or wrong indication of student response.
        Type - size: 1 special character
        Legal values: + or -
        Input source: Generated by the Lesson Execution Function
        When set: Every time a display record is written.

7. DATA ITEM: TR-FRM-TYPE

        Description: Indicates the frame type
        Type - size: Hollerith - 1 character
        Legal values: Q, M, or D
        Input source: User Swap Data
        When set: Every time a display record is written.

8. DATA ITEM: TR-DATE

        Description: The date this given frame number was presented.
        Type - size: Computational - 6 digits
        Legal values: 000001 - 999999
        Input source: MCP
        When set: Every time a display record is written.

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3.1.2.1/2.2.2 The User-Completed File is output by the Control Function to permit automatic production of trainee records for all students that complete a lesson. It is used by the Trainee Record Processing Function to search the Trainee Record Display File for entries for appropriate trainee/lesson combinations.

1. DATA ITEM: STUD-ID

    Description: Student Identification (name)
    Type - size: Hollerith - 16 characters
    Legal values: Any combination of alphameric characters
    Input source: User input at terminal
    When set: When the trainee completes a lesson.

2. DATA ITEM: LESSON NAME

    Description: Name of the lesson to which this record applies.
    Type - size: Hollerith - 6 characters
    Legal values: Any combination of alphameric characters
    Input source: User input at terminal
    When set: When the trainee completes a lesson

3. DATA ITEM: SS-NUM

    Description: Social Security Number
    Type - size: Computational - 9 digits
    Legal values: 000000001 - 999999999
    Input source: User input at terminal
    When set: When the trainee completes a lesson

4. DATA ITEM: RECORD-COUNT

    Description: Number of individual entries the trainee
                     has for this lesson
    Type - size: Computational - 3 digits
    Legal values: 1 - 999
    Input source: Set by the Lesson Execution Function
    When set: Moved from the Trainee Record Display file
                     when the trainee completes a lesson.

3.1.2.1/3 Information Processing. The point at which the Control Function is entered from overlay sections is determined by the paragraph name referenced. Initially, the first instruction will gain control for initializing CDTS by the MCP transferring control to that address. Subsequently switch item US-PROC (3.1.2.1/1.3.2.2 Item 12) will be set either by the Control Function or the overlay sections to cause the required processing to be accomplished.

The current user (UCTXR) and the last user of CDTS (UCTXRIC) are defined by items contained within the working storage area. This technique, in conjunction with write flag, (USD-CHANGE - working storage item) is used to reduce the

number of disk accesses by not writing an unchanged record or by not reading a record already in core. When these determinations have been made, the current user becomes the last user.

Disk random access of all files used by CDTS is effected by a simple algorithm, a matrix and chaining technique.

a) The User Control Table is read into core. All users are assigned a unique entry number. Item UC-SWAP-REC-NUM1 (3.1.2.1/1.3.1 Item 7) of all entries points to the record number of the Master Swap Control record within the USD file.

b) The Master Control Swap record contains the lesson names of all incomplete lessons associated with the user and record number (within the same file) of the associated User Swap Data records.

c) The Lesson File table of content records lists all available lessons currently on disk. The first record of any lesson is determined by multiplying the table of contents (subscript value -1) *304+25. Each lesson has 304 record area reserved and the first 25 records are the table of contents records.

d) The availability of record space within the USD file is determined by examining item UC-SWAP-MATRIX of the UCT file. This item occurs 400 times, allowing for 400 records. A value of zero denotes available record space. This matrix is maintained by the Control Function.

3.1.2.1/3.1 CFENT. Control is passed to overlay section CFOPEN.

3.1.2.1/3.2 CFOPEN. The User Swap Data file (3.1.2.1/1.3.2.2) User Control Table (3.1.2.1/1.3.1) Lesson (3.1.2.1/1.3.3) and Trainee Display Record (3.1.2.1/ 2.2) files are opened. The User Control Table is read from disk. Item TTY-CNTRL (3.1.2.1/1.2.2 Item 7) of table TTY is set to GO AHEAD and control is passed to CFRDO.

3.1.2.1/3.3 CFRDI. A FILL TTY from DCH is executed. If item TTY-TERM-ID (3.1.2.1/1.2.2 Item 1) of table TTY contains the value CS, control is passed to overlay section CFCLOSE. Otherwise, item TTY-TERM-ID of table TTY is matched versus the UC-TERM-ID (3.1.2.1/1.3.1 Item 6) items. If a match does not occur, control is passed to CFNIN, otherwise control is passed to CFIN.

3.1.2.1/3.4 CFIN. If UC-LES-NAM (3.1.2.1/1.3.1 Item 9) is blank, control is passed to CFPMSG. Item UCTXR is matched versus item UCTXRIC. If equal control is passed to CFPMSG. If not equal and item USD-CHANGE is not zero, the USD record in core is written to disk after setting ACT-KEY-VALUE equal to UC-SWAP-REC-NUM2 (3.1.2.1/1.3.1 Item 10) and USD-CHANGE is set to zero. UCTXRIC is set equal to UCTXR. Control is passed to CFINIT.

3.1.2.1/3.5 CFINIT. If item UC-INIT (3.1.2.1/1.3.1 Item 5) is equal to 1, the USD record area is initialized and UC-INIT is set to Ø. Item USD-CHANGE is set to 1. Control is passed to CFPMSG. Otherwise, item ACT-KEY-VALUE is set equal to item UC-SWAP-REC-NUM2 and the users USD record is read from disk. Control is passed to CFPMSG.

3.1.2.1/3.6 CFNIN. The users identity supplied as a parameter of the * OPEN request is extracted from table TTY and matched versus the UC-ID-NUM (3.1.2.1/ 1.3.1 Item 3) items of the UCT table. If a match does not occur, control is passed to CFNIN1. If UC-TERM-ID is not blank, TTY-BIC4 (3.1.2.1/1.2.2 Item 3) is set to 3 and control is passed to CFRDO. Item TTY-TERM-ID is stored in UC-TERM-ID. Item TTY-BYTE is set equal to an asterisk and control is passed to CFRDO.

3.1.2.1/3.7 CFNIN1. Items UC-ID-NUM of the UCT table are searched for a zero entry. If the UCT table is full, item TTY-BIC4 is set to 3 and control is passed to CFRDO. Else the users identification is stored in UC-ID-NUM and item TTY-TERM-ID is stored in UC-TERM-ID. Item UC-INIT is set to 1 and item TTY-BYTE1 (3.1.2.1/1.2.2 Item 6) is set to an asterisk. Control is passed to CFRDO.

3.1.2.1/3.8 CFRDO. If TTY-BIC4 is not equal to a 3 or A, it is set equal to a blank. Item TTY-BIC3 (3.1.2.1/1.2.2 Item 2) is set to 1. A FILL TTY INTO DCH is executed and control is passed to CFRDI.

3.1.2.1/3.9 CFPMSG. If US-ID-DUE is 1, control is passed to CFGETID. The message in table TTY is examined for the first non-blank character. If the character is an *, #, or ?, control is passed to CFAST, CFHM, or CFQM respectively. If UC-LES-NAM is blank, table TTY is set to E-1-32 and control is passed to CFRDO. Otherwise, control is passed to CFOVLY.

3.1.2.1/3.10 CFAST. If UC-ACTIVE is zero, the UC-SWAP-MATRIX entry is set to zero, and the UCT entry is released for other users. Otherwise, items UC-COMMD-CNT, UC-TERM-ID, UC-LES-NAM, UC-SWAP-REC-NUM2 are cleared. TTY-BIC4 is set to 3 and control is passed to CFRDO.

3.1.2.1/3.11 CFHM. If item US-MODE (3.1.2.1/1.3.2.2 Item 14) is 1, table TTY is set to E-1-33 and control is passed to CFRDO. If the first two characters following the # are CO or GE, control is passed to CFCO or CFGET respectively. If UC-LES-NAM is blank, table TTY is set to E-1-33 and control is passed to CFRDO. If the characters are EX, ST, RE, SA or none of these, control is passed to CFEX, CFST, CFRE, CFSA, or CFOVLY respectively.

3.1.2.1/3.12 CFQM. If the first two characters immediately following the ? in table TTY are GE, GO, QU, or none of these, control is passed to CFGET, CFGOTO, CFQUIT, or CFOVLY respectively.

3.1.2.1/3.13 CFGET. Control is passed to CFOVLY if US-MODE is 1 and UC-COMMD-CNT (3.1.2.1/1.3.1 Item 8) is not zero. The lesson file table of contents records are searched for a match of the requested lesson versus LE-LES-NAM (3.1.2.1/1.3.3 Item 10). If a match does not occur, E-2-12 is set in table TTY and control is passed to CFRDO. Otherwise, US-FRM-K (3.1.2.1/1.3.2.2 Item 1) is set equal to 25+304* (table of contents index value -1) and UC-COMMD-CNT is set to 1. UC-LES-NAM is set equal to LE-LES-NAM, US-CD-ID (3.1.2.1/1.3.2.2 Item 3) is set equal to LE-CD-ID (3.1.2.1/1.3.3 Item 11). If item UC-SWAP-REC-NUM1 is not zero control is passed to CFGET1, otherwise UC-SWAP-MATRIX is searched for two zero entries. If not found, table TTY is set to E-3-20, the user is terminated and control is passed to CFRDO. If found, items UC-SWAP-REC-NUM1 and UC-SWAP-REC-NUM2 are set to the values of the subscript item used to search the matrix. Control is passed to CFGET2.

3.1.2.1/3.14 CFGET1. Table TTY is set to E-2-8. The Master Swap Control record is read from disk. UC-LES-NAM is matched versus the MS-LES-NAM (3.1.2.1/1.3.2.1 Item 1). If a match occurs, UC-SWAP-REC-NUM2 is set equal to MS-REC-NUM2 and the Users Swap Data record is read from disk. US-ID-DUE is set to 1. The Frame Label and Frame Directory records are read from disk and USD-CHANGE item is set to 1. Control is passed to CFRDO. If a match does not occur the UC-SWAP-MATRIX is searched for an available USD record. If not found, table TTY is set to E-3-20 and the user is terminated. Control is passed to CFRDO. If found, UC-SWAP-REC-NUM2 is set, MS-LES-NAM and MS-REC-NUM2 are set, the USD record space is marked not available in US-SWAP-MATRIX and the MSC record is written to disk. UC-ACTIVE is incremented by 1. The Frame Label and Frame Directory records are read from disk and USD-CHANGE is set to 1. Control is passed to CFRDO.

3.1.2.1/3.15 CFGET2. The Master Swap Control record for user is initiated, and MS-LES-NAM is set to UC-LES-NAM. Item MS-REC-NUM2 is set to US-SWAP-REC-NUM2. The new MSC record is written to disk. UC-ACTIVE is incremented by 1 and US-ID-DUE is set to 1. Table TTY is set to E-2-8 and control is passed to CFRDO.

3.1.2.1/3.16 CFGETID. Item US-ID-DUE is set to zero and USD-CHANGE is set to 1. The identity supplied is extracted from table TTY and is matched versus US-CD-ID. If a mismatch occurs US-MODE is set to 1, US-PROC (3.1.2.1/1.3.2.2 Item 12) is set to cause control to be passed to CFRLR, and REL-FRAME-NUM is set to US-FRM-K. Control is passed to CFOVLY. If a match occurs, US-MODE is set to 2, table TTY is set to E-2-15 and control is passed to CFRDO.

3.1.2.1/3.17 CFQUIT. UC-COMMD-CNT is set to zero and UC-LES-NAM and US-CD-ID are set to blanks. Item USD-CHANGE is set to 1. Table TTY is set to E-2-15 and control is passed to CFRDO.

3.1.2.1/3.18 CFGOTO. If US-MODE equals 2, it is set to 3. The frame label is extracted from table TTY and compared versus LE-LABEL (3.1.2.1/1.3.3 Item 12) items. If a match does not occur, table TTY is set to E-1-15 and control is passed to CFRDO. Otherwise REL-FRAME-NUM is set to LE-LAB-FRM-NUM (3.1.2.1/1.3.3 Item 13) and item US-PROC is set to cause control to be passed to CFRLR. Control is passed to CFOVLY.

3.1.2.1/3.19 CFCO. If a lesson name parameter is found in table TTY and UC-LES-NAM is blank, control is passed to CFCO1. If UC-LES-NAM is not blank and does match the name extracted from table TTY, US-MODE is set to 2 and US-PROC is set to cause LBEX to operate and control is passed to CFOVLY. Otherwise, table TTY is set to E-1-6 and control is passed to CFRDO.

If a lesson name parameter is not input and UC-LES-NAM is blank, table TTY is set to E-1-32 and control is passed to CFRDO. If UC-LES-NAM is not blank, US-MODE is set to 2 and US-PROC is set to cause LBEX to operate. Control is passed to CFOVLY.

3.1.2.1/3.20 CFCO1. If the lesson name parameter does not match any of the LE-LES-NAM items, LE-LES-NAM, LE-CD-ID are set from table TTY and the US-FRM-K value is stored. Otherwise table TTY is set to E-1-6 and control is passed to CFRDO. The lesson file table of contents record is written to disk and US-MODE is set to 2.

If US-SWAP-NUM1 is not zero, control is passed to CFCO2. Otherwise, the UC-SWAP-MATRIX is searched for two available records. If not found, table TTY is set to E-3-20 and control is passed to CFRDO. Otherwise, UC-SWAP-REC-NUM1 and UC-SWAP-REC-NUM2 are set, the UC-SWAP-MATRIX is updated. The MSC record area is initialized and items MS-LES-NAM and MS-REC-NUM2 are set to US-LES-NAM and UC-SWAP-REC-NUM2 respectively. Control is passed to CFCO4.

3.1.2.1/3.21 CFCO2. The MSC record is read from disk. UC-LES-NAM is matched versus the MS-LES-NAM items. If match does not occur, control is passed to CFCO3. Otherwise, UC-SWAP-REC-NUM2 is set to MS-REC-NUM2 and the USD record is read. US-MODE is set to 2 and US-PROC is set to cause LBEX to operate. Control is passed to CFOVLY.

3.1.2.1/3.22 CFCO3. UC-SWAP-MATRIX is searched for an available record. If not found, table TTY is set to E-3-20 and control is passed to CFRDO. Otherwise UC-SWAP-REC-NUM2 is set and MS-LES-NAM is set to UC-LES-NAME. Control is passed to CFCO4.

3.1.2.1/3.23 CFCO4. The updated MSC record is written to disk. The USD record area is initialized and US-PROC is set to cause LBEX to operate. Control is passed to CFOVLY.

3.1.2.1/3.24 CFEX. The frame number parameter is extracted from table TTY and is matched versus the US-DI-FRM-NUM (3.1.2.1/1.3.2.2 Item 17) items of the frame directory record. If the frame number does not exist, table TTY is set to E-1-18 and control is passed to CFRDO. Otherwise, REL-FRAME-NUM is set to US-DI-REC-NUM (3.1.2.1/1.3.2.2 Item 18) and US-PROC is set to cause control to be passed to CFRLR. If the C parameter is found in table TTY, the US-DEC-FRM-OVLY (3.1.2.1/1.3.2.2 Item 8) items are reset. US-MODE is set to 2 and control is passed to CFOVLY.

3.1.2.1/3.25 CFRE. The Lesson File table of contents and the Master Swap Control records are read from disk. The UC-LES-NAM is matched versus LE-LES-NAM and MS-LES-NAM items. The lesson is then removed from the records and the records are written to disk. The UC-SWAP-MATRIX entry and UC-SWAP-REC-NUM2 and set to zero. UC-LES-NAM is set to blank. UC-ACTIVE is decremented by 1. US-PROC is set to cause LBEX to execute and control is passed to CFOVLY.

3.1.2.1/3.26 CFST. Table TTY is set to PHONETIC (ON/OFF) ORDER (ON/OFF) KEYWORD (ON/OFF) as defined by the contents of items US-PHONETIC, US-ORDER, US-KEYWORD where 0 is off and 1 is on. Control is passed to CFRDO.

3.1.2.1/3.27 CFSA. The Frame label, and frame directory records of the Lesson file are written to disk after being sorted on LE-LABEL and US-DI-REC-NUM respectively. If the D parameter is present in table TTY, the Master Swap Control record is read from disk, UC-LES-NAM is matched versus MS-LES-NAM. When found, MS-LES-NAM is set to blanks and the MSC record is written to disk. UC-SWAP-MATRIX and UC-SWAP-REC-NUM2 are set to zero. UC-ACTIVE is decremented by 1. UC-LES-NAM is set to blanks. Table TTY is set to E-3-13. Control is passed to CFRDO. Otherwise, the USD record is written to disk and table TTY is set to E-3-13. Control is passed to CFRDO.

3.1.2.1/3.28 CFOVLY. USD-CHANGE is set to 1 and control is passed to CFRLR, CFWDR, LEQFRM, LEMFRM, LEDFRM, CFWLR, LBEX, or CFWRD depending on US-PROC.

3.1.2.1/3.29 CFRLR. If US-LAST-FR (3.1.2.1/1.3.2.2 Item 16) equals 1, table TTY is set to E-3-18. If US-MODE is not 1, it is set to 2 and control is passed to CFRDO. Otherwise, UC-ACTIVE is decremented by 1, UC-SWAP-REC-NUM2 and UC-SWAP-MATRIX are set to zero. UC-COMMD-CNT is set to zero. The USD record area is initialized and the Master Swap Control record is read from disk. UC-LES-NAM is matched versus MS-LES-NAM. When found, MS-LES-NAM is set to blanks and the MSC record is written to disk. UC-LES-NAM is set to blanks and control is passed to CFRDO.

If US-LAST-FR equals 0, US-FRM-K is added to REL-FR-NUM to give the ACT-KEY-VALUE of the lesson file. The Frame record is read into core and if it is the last frame, US-LAST-FR is set to 1. US-PROC is set relative to US-FRM-TYPE (3.1.2.1/1.3.2.2 Item 2) to cause CFOVLY to pass control to LEMFR, LEDFR, or LEQFR. Control is passed to CFOVLY.

3.1.2.1/3.30 CFWDR. A student display record is written sequentially to disk. US-PROC is set to US-PROC-BR1 (3.1.2.1/1.3.2.2 Item 13) and control is passed to CFOVLY.

3.1.2.1/3.31 CFWLR. US-FRM-K is added to REL-FR-NUM to produce the ACT-KEY-VALUE. A frame record is written randomly to the lesson file. US-PROC is set to US-PROC-BR1 and control is passed to CFOVLY.

3.1.2.1/3.32 CFWRD. OUT-REQ is set to zero. If TTY-BIC4 is blank, control is passed to CFRDO. Otherwise a FILL TTY INTO DCH is executed. Item US-PROC is set to US-PROC-BR1 and control is passed to CFOVLY.

3.1.2.1/3.33 CFCLOSE. All UC-TERM-ID, UC-LES-NAM items are set to zero. All UC-ACTIVE entries equal to zero are made available for other users and the UC-SWAP-MATRIX is updated. The USD record in core is written to disk if USD-CHANGE is non zero. All UC-SWAP-REC-NUM2 items are set to zero. All files are closed and a request to schedule background programs displayed to the system operator. CDTS is terminated.

3.1.2.2 Lesson Building/Editing Function. The Lesson Building/Editing Function permits authorized personnel to construct and modify course material for a variety of training purposes. This course material is input to CDTS from remote communications terminals tied to selected Phase II B3500 computer systems.

The Lesson Building/Editing Function allows a course designer to enter lesson content, specify answers, and indicate actions to be taken (in the Execution Function) as a result of trainee responses. It also allows a course designer to edit (add, delete, or modify) any portion of a lesson. Interaction with the Data Communications Handler (DCH), as well as any other input-output operations for all overlay section of the Lesson Building/Editing Function, is via the CDTS Control Function.

The material is inserted and processed by the function as "frame" units. Each frame is further segmented into groups, which are composed of a sequence of individual lines of information. A course is, therefore, composed of a sequence of frames input to the function by the course designer.

The Lesson Building Functtion shall provide for:

1. Selection of frame types for course content insertion by the course designer. The four frame types at his disposal are:

    a. Question Frame - Used to present course material to inform or require a constructed response.
    b. Multiple-Choice Frame - Used to present course material and alternate answer-choices for selection.

      c.   Decision Frame - Used to establish conditional statements
           for controlling the trainee's path through the lesson,
           depending upon his responses.
      d.   Copy Frame - Used as a lesson building aid to copy any
           previously built frame.

2. Identification of frames to be used as input to decision frames.

3. Labeling of selected frames by the course designer to facilitate
    the identification and execution of major break points in the
    course material.

4. On-line assistance to the course designer, via:

      a.   Cueing of his required inputs at certain points in the
           frame building process.
      b.   On-line printout, upon request, of selected portions of
           completed course material.
      c.   On-line indication of the status of the service functions
           (whether he currently has turned the PHONETIC comparison,
           KEYWORD match, and ORDER permutation functions on or off.)

5. On-line editing capability, to permit selective modification of
    existing course material or the addition of new material to a
    completed lesson. Within the editing capability any line, group,
    or frame may be added, changed, or deleted.

3.1.2.2/1 Sources and Types of Inputs

3.1.2.2/1.1 Inputs from the DCH Program via CDTS Control Function. The two
types of input are lesson text and editing directive data. Lesson text is
interpreted and formatted into the Lesson File format for later output. The
editing directive data is interpreted and evaluated for the action (add, delete
or change) to be taken with respect to a frame in the Lesson-File. The format
of the TTY File is described in Section 3.1.2.1/1.2.2.

3.1.2.2/1.2 Inputs from Disk Files

3.1.2.2/1.2.1 Lesson File. While the Lesson File is primarily an output of
the Lesson Building Function, it also serves as an input to the editing subfunc-
tion. The contents of the Lesson File are accessed by the Lesson Building Func-
tion through the User Swap Data and are not directly referenced by Lesson File
item names.

3.1.2.2/1.2.2 User Swap Data. The User Swap Data contains the control informa-
tion for individual users of CDTS. It is a randomly accessed file that contains
a record for every unfinished lesson for each user. It is used by the Lesson

Building/Editing Function to contain all needed data about the frame currently being constructed or modified by a course designer. There will be a record in the file for each lesson that is in the process of being constructed by each course designer. When the lesson is completed, that entry in the file is deleted. Those User Swap Data items used by the Lesson Building/Editing Function are shown in the following paragraphs. Those data in the file used only by the Lesson Execution Function are shown in Section 3.1.2.3/1.2.1.

1. DATA ITEM: US-FRM-NUM

     Description: Swap User Frame Number. The current frame number that the course designer is using.
     Type - size: Computational - 4 digits
     Legal values: 10 through 3000 (representing 1.0 through 300.0)
     Input source: Generated by the Lesson Building Function
     When set: Each time a new frame is built.

2. DATA ITEM: US-FRM-TYPE

     Description: Swap User Frame Type. The frame type of the current frame for this course designer.
     Type - size: Hollerith - 2 characters
     Legal values: Qb, Mb, Q1, M1, or Db. b equals blank.
     Input source: User input at terminal
     When set: Each time a new frame is built.

3. DATA ITEM: US-FRM-LTH

     Description: Swap User Frame Length. The number of entries in the current frame.
     Type - size: Computational - 2 digits
     Legal Values: 1 - 96
     Input source: Generated by the Lesson Building Function
     When set: Each time a frame is completed and is ready for output to I.A.S.

4. DATA ITEM: US-GRP-NUM

     Description: Swap User Group Number. The Group number with which the data to follow governed by US-GRP-LTH, will be associated.
     Type - size: Computational - 1 digit
     Legal values: 1, 2, 3, or 4
     Input source: Generated by the Lesson Building Function
     When set: Each time the course designer specifies a new group.

5. DATA ITEM: US-GRP-LTH

    Description: Swap Group Length. The number of entries in
                        the current group.
    Type - size: Computational - 2 digits
    Legal values: 1 - 96
    Input source: Generated by the Lesson Building Function
    When set: Each time a line is added or deleted in
                        this group.

6. DATA ITEM: US-LINE-NUM

    Description: Swap User Line Number. The line number of the
                        following data, governed by US-LINE-LTH.
    Type - size: Computational - 4 digits
    Legal values: 10 - 1300
    Input source: Generated by the Lesson Building Function or
                        user inserted at the terminal.
    When set: Each time a line of data is to be entered in
                        the frame.

7. DATA ITEM: US-LINE-LTH

    Description: Swap User Line Length. The number of
                        characters in a line of text.
    Type - size: Computational - 3 digits
    Legal values: 1 - 160
    Input source: The DCH
    When set: Each time a line of data is to be entered
                        in a frame.

8. DATA ITEM: US-BCD-WD

    Description: Swap User BCD Word. An overlay item used to
                        extract 4 characters of Hollerith text from
                        a frame for any action that must be taken.
    Type - size: Hollerith - 4 characters
    Legal values: Any characters that can be input from a
                        terminal.
    Input source: User input at terminal.
    When set: Each time a line of data is to be entered
                        in a lesson.

9. DATA ITEM: US-BYTE1 through US-BYTE4

    Description: Swap User BYTE1 through Swap User BYTE4. Four
                           overlay items used to extract the 1st, 2nd, 3rd,
                           or 4th character of a US-BCD-WD for whatever
                           action may be necessary.
    Type - size: Hollerith - 1 character
    Legal values: Any character that can be input from a terminal.
    Input source: User input at terminal.
    When set: Each time a line of data is to be entered
                           in a lesson.

10. DATA ITEM: US-LABEL

    Description: Swap User Frame Label. The name of a label
                           assigned to a specific frame within the lesson.
    Type - size: Hollerith - 6 characters
    Legal values: Any characters that can be input from a terminal.
    Input source: User input at terminal.
    When set: Each time the course designer specifies a label
                           for a frame.

11. DATA ITEM: US-LAB-FRM-NUM

    Description: Swap User Label Frame Number. The number of
                           the frame that the label references.
    Type - size: Computational - 4 digits
    Legal values: 10 - 3000 (representing 1.0 through 300.0)
    Input source: Generated by the Lesson Building Function
    When set: Each time the course designer specifies a
                           label for a frame.

12. DATA ITEM: US-PROC-BR1 through US-PROC-BRn

    Description: Swap User Procedure Branch1 through Swap User
                           Procedure Branchn. This item tells a procedure
                           to which paragraph to pass control for the
                           current user.
    Type - size: Computational - 2 digits
    Legal values: 1 - 99
    Input source: Generated by any overlay
    When set: Each time a procedure passes control to the
                           FSA and wants the control passed back to a
                           different paragraph or overlay.

13. DATA ITEM: US-PROC

     Description: Swap User Procedure Switch Flag. This item
                      tells the FSA to which procedure it should
                      pass control for the current user.
     Type - size: Computational - 2 digits
     Legal values: 1 - 99
     Input source: Set by the Control Function and by the overlay
                      procedures.
     When set: Each time a procedure passes control to the
                      FSA and wants the control passed back to a
                      different paragraph or overlay.

3.1.2.2/2   Destination and Types of Outputs

3.1.2.2/2.1   Textual Outputs to the Remote Terminal via CDTS Control Function.
Lesson text is output at the course designer's remote terminal whenever he
requests to function as a pseudo-trainee and review the lesson he is building.
The lesson content is output to the terminal through the CDTS Control Function
and the DCH program, using the Remote Terminal (TTY) file specified in section
3.1.2.1/2.1.

3.1.2.2/2.2   Output Messages to the Remote Terminal. Cue messages, telling the
course designer what legal actions are available to him, and error messages,
indicating what he has done illegally, are output to the course designer's ter-
minal during lesson building sessions. To facilitate system/user interraction,
the complete message number will be output at the terminal whenever possible.
The messages will be further explained in the system users manual.

     1. Legality Messages

         a. E-1-8. "ILLEGAL FRAME NUMBER." An attempt has been made to
             insert a frame using a number that does not follow system
             restrictions.

         b. E-1-9. "FRAME NUMBER DOES NOT EXIST." An attempt has been
             made to modify a nonexistent frame.

         c. E-1-10. "ILLEGAL GROUP/LINE NUMBER." An attempt has been made
             to modify a frame, using an illegal group or line number.

         d. E-1-11. "MUST INSERT A LINE INTO AN EXISTING GROUP." An
             attempt has been made to insert a line of data into a group
             that does not exist within the frame specified.

         e. E-1-13. "ILLEGAL FRAME TYPE." An attempt has been made to
             specify a frame type of other than Q, M, D, or C.

f.   E-1-14. "FRAME XXX.X IS USING THAT LABEL." A frame has been
     identified with a label already existing within the lesson.

g.   E-1-15. "NO SUCH FRAME OR LABEL." A frame label has been
     inserted that does not follow system restrictions.

h.   E-1-16. "GROUP NUMBER NOT FOUND." An attempt has been made
     to modify a line within a group number that does not exist
     within the frame specified.

i.   E-1-17. "LINE NUMBER NOT FOUND." An attempt has been made
     to change a line that does not exist within the group and
     frame specified.

j.   E-1-21. "ILLEGAL ENTRY. ALL DECISION STATEMENTS MUST START
     WITH EITHER IF, AND, or END, F:, or B:."

k.   E-1-42. "ILLEGAL FUNCTION TYPE." An attempt has been made
     to set service functions on or off, using an illegal format.

l.   E-1-43. "ILLEGAL SECOND CHARACTER." A group 3 has been in-
     serted that has other than blank or "+" following the answer tag.

2. Cue Messages

a.   E-2-1. "ENTER FRAME TYPE." Cues the course designer to
     select one of the four legal frames types for the current frame.

b.   E-2-3. "Q/M/D/C." Cue to course designer, indicating legal
     frame types at his disposal.

c.   E-2-4. "FRAME (ddd.d) LABEL=*." Cue to course designer that
     the next frame is ready for building and that he may insert
     a label for the frame.

d.   E-2-5. "G.2 TEXT." Cue to course designer to insert textual
     material.

e.   E-2-6. "G.3 ANSWERS." Cue to course designer to specify the
     correct and anticipated incorrect answers for the current frame.

f.   E-2-7. "G.4 ACTIONS." Cue to course designer to specify the
     actions to be taken, dependent upon the answer inserted for
     the frame.

g. E-2-10. "G.2 CONDITIONS." Cue to course designer to insert the condition for the current frame (which has been identified as a decision frame.)

3. Feedback Messages

a. E-3-10. "LESSON CAPACITY REACHED. DELETE FRAMES TO CONTINUE." The editing commands must be used to reduce the size of this lesson, or another lesson started.

b. E-3-11. "NOT ENTERED. LABEL CAPACITY REACHED." An attempt to label a frame has been made, and the system limit of 25 labels per lesson has already been reached.

c. E-3-12. "FRAME FULL." Frame data has been input which exceeds the frame limit of 400 characters. The frame must be split into two or more frames.

3.1.2.2/2.3 Disk Output Records

3.1.2.2/2.3.1 Lesson File. The lesson records, containing the course material defined by the course designer, are randomly written based on the relative frame number and constant obtained from the table contents entry associated with the lesson.

3.1.2.2/3 Information Processing. Each line of input from a remote terminal (via the FSA), to the Lesson Building/Editing Function (LBEF) is examined at 3010LBEX to determine if it is a command directive. The first input to LBEF must be "#CO." This allows LBEF to set the necessary switch items to control the operation of the appropriate paragraphs.

3.1.2.2/3.1 3010LBEX. The course designer input found in TTY-BCD-WD (item 5 of 3.1.2.2/1.2.2) is examined to determine if it is a command directive. If the first character of the input is not a Hash-mark, control is passed to 3080LBEX. If the command is "#CO," control is passed to 3050LBEX. If not, it is assumed to be an editing command and control is passed to 3600LBED.

3.1.2.2/3.2 3050LBEX. If US-LB-CUR-FRM-NUM is not equal to 10, control is passed to 3060LBEX, as this indicates that a new lesson is not being built.

3.1.2.2/3.3 3060LBEX. US-PROC-BR2 (item 12 of 3.1.2.2/1.2.2) is set to pass control to 3120LBFTY. New frame initialization is completed and control is passed to 3100LBSW.

3.1.2.2/3.4 3080LBEX. The course designer input is checked to see if the first character is a dollar sign. If it is not, control is passed to 3100LBSW. It is then determined if the contents of the frame constitute a legal frame. If not control is passed to 3060LBEX.

3.1.2.2/3.5 3085LBEX. If the maximum number of frames for a lesson has been exceded, control is passed to 3090LBEX. Otherwise, if the frame has a label, the number of labels in the lesson in incremented. The current frame number is incremented and the number of frames in the directory table is incremented. The FSA is instructed to output the frame. US-PROC-BR2 is set to pass control to 3060LBEX and control is passed to the FSA.

3.1.2.2/3.6 3090LBEX. The error message "TOO MANY FRAMES FOR THIS LESSON" is put in TTY, (frame capacity reached). US-PROC-BR2 is set to pass control to 3060LBEX. The FSA is instructed to output the error message and control is passed to the FSA.

3.1.2.2/3.7 3100LBSW. Control is passed to the proper paragraph depending on US-PROC-BR2.

3.1.2.2/3.8 3120LBFTY. The frame type options are stored in TTY-BCD-WD and the number of characters to be output in TTY-BIC68 (item 4 of 3.1.2.1/2.1.2). US-PROC-BR2 is set to pass control to 3130LBFTY. US-PROC-BR3 (item 12 of 3.1.2.3/1.2.2) is set to pass control to 3140LBFTC.

3.1.2.2/3.9 3125LBFTY. TTY-BIC3 (item 2 of 3.1.2.1/2.1.1) and TTY-BIC4 (item 3 of 3.1.2.1/2.1.1) is set for the FSA to pass control back to 3100LBSW, and then control is passed to the FSA to output the contents to TTY.

3.1.2.2/3.10 3130LBFTY. An asterisk is stored in TTY-BCD-WD; US-PROC-BR3 is stored in US-PROC-BR2. US-PROC-BR1 is set to pass control to 3010LBEX. The FSA is instructed to output the asterisk and control is passed to the FSA.

3.1.2.2/3.11 3140LBFTC. The frame type option selected by the course designer is checked for legality. If it is a "C" type frame control is passed to 3500LBPGR. If the frame type is not legal error message "ILLEGAL FRAME TYPE" is stored in TTY-BCD-WD, US-PROC-BR2 is set to pass control to 3120LBFTY, and control is passed to 3125LBFTY. Otherwise the frame type is stored in the current frame.

3.1.2.2/3.12 3160LBLB. The frame label option is stored in TTY-BCD-WD to be presented to the course designer. US-PROC-BR2 is set to pass control to 3130LBFTY. US-PROC-BR3 is set to pass control to 3170LBLB. Control is then passed to 3125LBFTY.

3.1.2.2/3.13 3170LBLB. If the course designer chooses not to label the frame, control is passed to 3250LBLBC. If the label passes all legality checks, control is passed to 3200LBLB.

3.1.2.2/3.14 3180LBLB. The error message "ILLEGAL FRAME LABEL" is moved to TTY-BCD-WD. This is to inform the course designer that his label has not been accepted. US-PROC-BR2 is set to pass control to 3160LBLB and control is passed to 3125LBFTY.

3.1.2.2/3.15 3200LBLB. The label is now processed against all existing labels. If it is not in use control is passed to 3250LBLBC. Otherwise error message "FRAME XXX.X IS USING THAT LABEL" is stored in TTY-BCD-WD. US-PROC-BR2 is set to pass control to 3160LBLB, and control is passed to 3125LBFTY.

3.1.2.2/3.16 3250LBLBC. Group 1 of the frame is initialized. This consists of setting US-FRM-LTH (item 3 of 3.1.2.2/1.2.2), US-GRP-NUM (item 5 of 3.1.2.2/1.2.2), US-GRP-LTH (item 5 3.1.2.2/1.2.2), US-FRM-NUM (item 1 of 3.1.2.2/1.2.2).

3.1.2.2/3.17 3300LBGRH. Group 2 control is set up. If US-FRM-TYPE is a decision type frame, control is passed to 3310LBGRH. Otherwise group 2 heading is stored in TTY-BCD-WD, US-PROC-BR2 is set to pass control fo 3130LBFTY, US-PROC-BR3 is set to pass control to 3350LBPGR, and control is passed to 3125LBFTY.

3.1.2.2/3.18 3310LBGRH. Group 2 heading for a decision frame is stored in TTY-BCD-WD, US-PROC-BR2 is set to pass control to 3130LBFTY, US-PROC-BR3 is set to pass control to 3350LBPGR, and control is passed to 3125LBFTY.

3.1.2.2/3.19 3350LBPGR. If the input is TTY does not terminate the group, control is passed to 3370LBPGR. If the frame is decision type frame, or this is the end of group 4, control is passed to 3085LBEX. Otherwise the group 3 or group 4 heading, depending on which group it is , is put in TTY-BCD-WD. US-FRM-LTH, US-GRP-LTH, and US-GRP-NUM are incremented. US-PROC-BR2 is set to pass control to 3130LBFTY, US-PROC-BR3 is set to pass control to 3350LBPGR, and control is passed to 3125LBFTY.

3.1.2.2/3.20 3370LBPGR. If the current line of text found in TTY would exceed the maximum frame length, control is passed to 3394LBPGR. If this is a decision type frame control is passed to 3450LBPGR. If this is not group 3 or a question type frame, control is passed to 3400LBPGR. Since status type requests can only be entered in group 3 of a question type frame, a check must be made, to insure proper handling of the request during lesson execution. If the first character of the input is not numeric, control is passed to 3400LBPGR, as status type requests can only be entered when the first character of input is numeric. If the request is legal, control is passed to 3400LBPGR, otherwise the error message is stored in TTY-BCD-WD, US-PROC-BR2 is set to pass control to 3130LBFTY, US-PROC-BR2 is set to pass control to 3350LBPGR, and control is passed to 3125LBFTY.

3.1.2.2/3.21   3394LBPGR.   The error message that the frame capacity has been reached is stored in TTY-BCD-WD. US-PROC-BR2 is set to pass control to 3130LBFTY, US-PROC-BR3 is set to pass control to 3350LBPGR, and control is passed to 3125LBFTY.

3.1.2.2/3.22   3400LBPGR.   The lesson text found in TTY-BCD-WD is stored in US-BCD-WD (item 8 of 3.1.2.2/1.2.2). US-LINE-NUM (item 6 of 3.1.2.2/1.2.2) is set to LB-LIN-NUM, LB-LIN-NUM is incremented, and US-LINE-LTH (item 7 of 3.1.2.2/1.2.2) is set equal to the number of characters in the line of text. US-FRM-LTH and US-GRP-LTH are incremented. US-PROC-BR3 is set to pass control to 3350LBPGR, and control is transferred to 3130LBFTY.

3.1.2.2/3.23   3450LBPGR.   The input to group 2 of a decision frame is checked for legality. If the text is legal, control is passed to 3400LBPGR. Otherwise error message "REJECTED. ALL DECISION STATEMENTS MUST BEGIN WITH IF, AND, F:, B:, ELSE, or %:" is moved to TTY-BCD-WD. US-PROC-BR2 is set to pass control to 3130LBFTY, and US-PROC-BR3 is set to pass control to 3350LBPGR. Control is then passed to 3125LBFTY.

3.1.2.2/3.24   3500LBPGR.   The copy frame input is checked for legality. If the frame to be copied is not indicated by a label, control is passed to 3550LBPGR. Otherwise the input label is checked against the label table. If it cannot be found, control is passed to 3515LBPGR. Otherwise the frame number associated with the label is obtained and control is passed to 3550LBPGR.

3.1.2.2/3.25   3515LBPGR.   Error message "NO SUCH FRAME OR LABEL" is moved to TTY-BCD-WD. US-PROC-BR1 is set to pass control to 3060LBEX, and control is passed to 3125LBFTY.

3.1.2.2/3.26   3550LBPGR.   The relative record number of the frame is obtained. US-PROC-BR2 is set to pass control to 3580LBPGR. The FSA is instructed to read the frame and return control to 3100LBSW. Control is then passed to the FSA.

3.1.2.2/3.27   3580LBPGR.   Any label associated with the copied frame is deleted. The copied frame's US-FRM-NUM is set to LB-CUR-FRM-NUM. Control is then passed to 3080LBEX.

3.1.2.2/3.28   3600LBED.   The editing directive is parsed according to frame extent, group extent, line extent and the type of editing desired. If the editing directive is illegal, the appropriate error message, "ILLEGAL FRAME NUMBER" (item 1a of 3.1.2.2/2.2), "FRAME NUMBER DOES NOT EXIST" (item 1b), "ILLEGAL GROUP/LINE NUMBER" (item 1c), "MUST INSERT A LINE INTO AN EXISTING GROUP" (item 1d), "ILLEGAL FRAME TYPE" (item 1e), "GROUP NUMBER NOT FOUND (item 1h), or "LINE NUMBER NOT FOUND" (item 1i of 3.1.2.2/2.2) is stored in TTY-BCD and a directive issued to the course designer to input a new command. If the editing directive is legal LBEF switch is set to pass control to 3700LBEDP, 3800LBEDD, or 3900LBEDI depending on the type of editing required.

3.1.2.2/3.29   3700LBEDP. The request portion of a lesson is stored in TTY-BCD-WD.
The FSA is instructed to print the request information at the remote terminal.
When all of the requested portion of a lesson has been printed, LBEF switch is
set to pass control to 3600LBED. The FSA is instructed to obtain the next command
directive from the course designer and control is passed to the FSA.

3.1.2.2/3.30   3800LBEDD. The requested portion of a lesson is deleted. LBEF
switch is set to pass control to 3600LBED. The FSA is instructed to obtain the
next course designer command directive and control is passed to the FSA.

3.1.2.2/3.31   3900LBEDI. LBEF switch is set to pass control to 3950LBINS. The
FSA is instructed to obtain the line of text the course designer wants to insert.
Control is returned to the FSA.

3.1.2.2/3.32   3950LBINS. The insert line of text found in TTY-BCD-WD is inserted
into US-BCD-WD. LBEF switch is set to pass control to 3600LBED. The FSA is
instructed to get the next command directive, and control is returned to the FSA.

3.1.2.3 Lesson Execution Function. The Lesson Execution Function will provide:

1. Selective access (through the Control Function) to lessons contained in a library of course material.

2. Lesson execution in three modes; training, lesson evaluation, and demonstration.

3. Trainee control over the presentation rate of course material, subject to the constraints of the Master Control Program and the intent of the course designers.

4. Service functions (PHONETIC comparison, KEYWORD match, and/or ORDER permutation) to provide latitudes in evaluating trainee answers that do not identically match anticipated responses.

5. Automatic evaluation of trainee responses.

6. Immediate feedback, if required, to the trainee after his response.

7. Detection of illegal actions by the trainee and initiation of appropriate recovery actions.

8. Dynamic sequencing of course material resulting from trainee responses and course design.

9. Lesson continuation by a trainee at any appropriate entry point if a lesson is interrupted prior to completion.

10. Creation of trainee performance records.

3.1.2.3/1 Sources and Types of Inputs

3.1.2.3/1.1 Inputs from the DCH Program via CDTS Control Function. Inputs to the Lesson Execution Function from the remote terminal consist solely of trainee or pseudo/trainee (course designer) responses to lesson material. The responses are evaluated for correctness and used to control trainee progress through lesson material through decision frames. These data are input to the Lesson Execution Function via the TTY file, described in section 3.1.2.1/1.2.2.

3.1.2.3/1.2 Input from Disk Files

3.1.2.3/1.2.1 User Swap Data. The User Swap Data are all the information necessary to reflect the user/trainee's exact position and status within a lesson at any point in time. It is a randomly accessed table that contains a record for every unfinished lesson of each user. Those User Swap Data items

used by the Lesson Execution Function are shown in the following paragraphs. Those data used only by the Lesson Building Function are shown in section 3.1.2.2/1.2.2.

1. <u>DATA ITEM</u>:   US-ID-NUM

     <u>Description</u>:   Swap User Identification Number. Is used to associate all data for one user to one lesson.

     <u>Type - size</u>:   Hollerith - 12 characters

     <u>Legal values</u>:   000000000000 - 999999999999

     <u>Input source</u>:   User input at terminal.

     <u>When set</u>:   When a user logs in with "*OPEN".

2. <u>DATA ITEM</u>   US-LES-NAM

     <u>Description</u>:   Swap User Lesson Name. Contains the name of a lesson that the user/trainee is using.

     <u>Type - size</u>:   Hollerith - 6 characters

     <u>Legal values</u>:   Any character that can be input from a terminal.

     <u>Input source</u>:   User input at terminal.

     <u>When set</u>:   When the user/trainee "GETS" a lesson.

3. <u>DATA ITEM</u>:   US-FRM-NUM

     <u>Description</u>:   Swap User Frame Number. The current frame number that the user/trainee is using.

     <u>Type - size</u>:   Computational - 4 digits

     <u>Legal values</u>:   10 through 3000 (representing 1.0 through 300.0).

     <u>Input source</u>:   Generated by the Lesson Execution Function

     <u>When set</u>:   Each time a new frame is executed.

4. <u>DATA ITEM</u>:   US-FRM-TYPE

     <u>Description</u>:   Swap User Frame Type. The frame type of the current frame for this user/trainee.

     <u>Type - size</u>:   Hollerith - 2 characters

	Legal values:	Qb, Mb, Q1, M1, or Db. b equals blank.
	Input source:	User input at terminal to Lesson Building Function.
	When set:	Each time a new frame is executed.

5. DATA ITEM: US-FRM-LTH

	Description:	Swap User Frame Length. The number of entries in the current frame.
	Type - size:	Computational - 4 digits.
	Legal values:	1 - 96
	Input source:	Generated by the Lesson Building Function
	When set:	Each time a new frame is executed.

6. DATA ITEM: US-GRP-NUM

	Description:	Swap User Group Number. The group number with which the data to follow, governed by US-GRP-LTH, will be associated.
	Type - size:	Computational - 1 digit.
	Legal values:	1, 2, 3, or 4
	Input source:	Generated by the Lesson Building Function.
	When set:	Each time a new frame is executed.

7. DATA ITEM: US-GRP-LTH

	Description:	Swap Group Length. The number of entries in the current group.
	Type - size:	Computational - 2 digits.
	Legal values:	1 - 96
	Input source:	Generated by the Lesson Building Function
	When set:	Each time a new frame is executed.

8. DATA ITEM: US-LINE-NUM

	Description:	Swap User Line Number. The line number of the following data, governed by US-LINE-LTH.
	Type - size:	Computational - 4 digits.

	Input source:	Generated by the Lesson Building Function.
	When set:	Each time a new frame is executed.

9. DATA ITEM: US-LINE-LTH

	Description:	Swap User Line Length. The number of characters in a line of text.
	Type - size:	Computational - 3 digits.
	Legal values:	1 - 160
	Input source:	The DCH
	When set:	Each time a line of text is entered in a lesson.

10. DATA ITEM: US-BCD-WD

	Description:	Swap User BCD Word. An overlay item used to extract 4 characters of Hollerith text from a frame for any action that must be taken.
	Type - size:	Hollerith - 4 characters
	Legal values:	Any characters that can be input from a terminal.
	Input source:	User input at terminal to Lesson Building Function.
	When set:	Each time a line of data is entered in a lesson.

11. DATA ITEM: US-BYTE1 through US-BYTE4

	Description:	Swap User BYTE1 through Swap User BYTE4. Four overlay items used to extract the 1st, 2nd, 3rd or 4th character of an US-BCD-WD for whatever action may be necessary.
	Type - size:	Hollerith - 1 character.
	Legal values:	Any character that can be input from a terminal.
	Input source:	User input at terminal to Lesson Building Function.
	When set:	Each time a line of data is entered in a lesson.

12. DATA ITEM: US-LABEL

      Description: Swap User Frame Label. The name of a label assigned to a specific frame within the lesson.

      Type - size: Hollerith - 6 characters

      Legal values: Any characters that can be input from a terminal.

      Input source: User input at terminal to the Lesson Building Function.

      When set: Each time the course designer specifies a label for a frame.

13. DATA ITEM: US-LAB-FRM-NUM

      Description: Swap User Label Frame Number. The number of the frame that the label references.

      Type - size: Computational - 3 digits.

      Legal values: 10 - 3000 (representing 1.0 through 300.0)

      Input source: Generated by the Lesson Building Function.

      When set: Each time the course designer specifies a label for a frame.

14. DATA ITEM: US-US-ID

      Description: Swap User Identification. The ID of the user of this lesson. When compared with US-CD-ID determines the type of access allowed to the lesson.

      Type - size: Hollerith - 16 characters.

      Legal values: Any characters that can be input from a terminal.

      Input source: User input at terminal.

      When set: Each time a user/trainee accesses a lesson.

15. DATA ITEM: US-PHONETIC

      Description: Phonetic indicator. Reflects the status of the phonetic service function.

      Type - size: Computational - 1 digit.

Legal values:	∅ - Phonetic is off	
	1 - Phonetic is on	
Input source:	Generated by the Lesson Execution Function.	
When set:	Whenever the content of a frame reverses the status of the function.	

16. **DATA ITEM:**   US-ORDER

Description:	Order indicator. Reflects the status of the order service function.
Type - size:	Computational - 1 digit.
Legal values:	∅ - Order is off.
	1 - Order is on
Input source:	Generated by the Lesson Execution Function.
When set:	Whenever the content of a frame reverses the status of the function.

17. **DATA ITEM:**   US-KEYWORD

Description:	Keyword Indicator. Reflects the status of the keyword service function.
Type - size:	Computational - 1 digit.
Legal values:	∅ - Keyword is off.
	1 - Keyword is on
Input source:	Generated by the Lesson Execution Function.
When set:	Whenever the content of a frame reverses the status of the function.

18. **DATA ITEM:**   US-DEC-FRM-NUM

Description:	Swap User Decision Frame Number. The number of a frame that is to be used in a decision frame.
Type - size:	Computational - 4 digits.
Legal values:	10 - 3000 (representing 1.0 through 300.0)
Input source:	Generated by the Lesson Execution Function.
When set:	Each time a trainee encounters a frame that is flagged for use in a decision frame.

19. DATA ITEM: US-LAST-ANS

    Description: Swap User Last Answer. The answer tag of the last answer for a frame given by the trainee.

    Type - size: Hollerith - 1 character.

    Legal values: A - Z

    Input source: Generated by the Lesson Execution Function.

    When set: Each time a trainee responds to a frame that is to be used in a decision frame.

20. DATA ITEM: US-TIM-THRU

    Description: Swap User Times Through. A count of the number of times a trainee has been through a frame.

    Type - size: Computational - 1 digit.

    Legal values: 1 - 9

    Input source: Generated by the Lesson Execution Function.

    When set: Each time a trainee encounters a frame that is to be used in a decision frame.

21. DATA ITEM: US-TOT-RES

    Description: Total Response Indicators. Indicators which relate the responses given by a trainee.

    Type - size: Computational - 1 digit.

    Legal values: 1 = All responses right
2 = All responses wrong
3 = Has responded wrong, but last response right
4 = Has responded right, but last response wrong

    Input source: Generated by the Lesson Execution Function.

    When set: Each time the trainee responds to a frame that has been flagged for use by a decision frame.

22. DATA ITEM: US-PROC

    Description: Swap User Procedure Switch Flag. This
                        item tells the FSA to which procedure it
                        should pass control for the current user.

    Type - size: Computational - 2 digits.

    Legal values: 1 - 99

    Input source: Set by the Control Function and by the
                       overlay procedures.

    When set: Each time a procedure passes control to
                       the FSA and wants the control passed back
                       to a different paragraph or overlay.

23. DATA ITEM: US-PROC-BR1 through SW-PROC-BRn

    Description: Swap User Procedure Branch1 through Swap
                        User Procedure Branchn. This item tells
                        a procedure to which paragraph to pass
                        control for the current user.

    Type - size: Computational - 2 digits.

    Legal values: 1 - 99

    Input source: Generated by any overlay.

    When set: Each time a procedure passes control to
                       the FSA and wants the control returned
                       to a different paragraph or overlay.

24. DATA ITEM: US-TR-BCD-WD

    Description: Swap User Trainee BCD Word. An overlay
                        item for storing Hollerith text.

    Type - size: Hollerith - 4 characters.

    Legal values: Any characters that can be input from a
                       terminal.

    Input source: User input at terminal.

    When set: Each time a trainee display record is to
                       be output.

25. DATA ITEM: US-TR-FRM-NUM

    Description: Swap User Trainee Frame Number. The
                          frame number the trainee has encountered.

    Type - size: Computational - 4 digits.

    Legal values: 10 - 3000 (representing 1.0 through 300.0)

    Input source: Generated by Lesson Execution Function.

    When set: Each time a trainee encounters a frame
                          during execution.

26. DATA ITEM: US-ITEM0 through US ITEM29

    Description: Swap User Item0 through Swap User Item29.
                          Items used by the course designer to con-
                          trol the flow of the lesson by the trainee
                          responses.

    Type - size: Computational - 4 digits.

    Legal values: 1 - 9999

    Input source: Generated by the Lesson Execution Function.

    When set: When the trainee encounters a frame at
                          which the course designer has specified
                          an item be set.

27. DATA ITEM: US-TR-ANS

    Description: Swap User Trainee Answer. Designates the
                          answer tag given by the trainee in response
                          to a frame.

    Type - size: Hollerith - 1 character.

    Legal values: A - Z, blank, prime or minus.

    Input source: Generated by the Lesson Execution Function.

    When set: Each time a trainee enters a response to a
                          frame.

28. DATA ITEM: US-TR-RGT-WRG

    Description: Swap User Trainee Right Wrong. Indicates
                          the response to a frame as right or wrong.

    Type - size: Hollerith - 1 character.

    Legal values: Plus, minus or blank.

| Input source: | Generated by the Lesson Execution Function. |
| When set: | Each time a trainee responds to a frame. |

29. DATA ITEM: US-TR-FRM-TYPE

Description:	Swap User Trainee Frame Type. Indicates the type of frame as designated by the course designer.
Type - size:	Hollerith - 1 character.
Legal values:	Q, M or D
Input source:	Generated by the Lesson Execution Function.
When set:	Each time a trainee encounters a frame.

30. DATA ITEM: US-DI-FRM-NUM

Description:	Directory frame number. Contains the frame number of every frame in the lesson, as defined by the Frame Directory Table.
Type - size:	Computational - 4 digits.
Legal values:	10 through 3000 (representing 1.0 through 300.0).
Input source:	User input at the terminal or generated by the Lesson Building Function.
When set:	Each time the course designer builds or deletes a frame.

31. DATA ITEM: US-DI-REC-NUM

Description:	Directory record number. The relative record number associated with each frame in the Frame Directory Table.
Type - size:	Computational - 3 digits.
Legal values:	1 - 300
Input source:	Generated by the Lesson Building Function.
When set:	Each time the course designer builds or deletes a frame.

3.1.2.3/1.2.2 <u>Lesson File</u>. The Lesson File contains the course material as defined by the course designer. While the Lesson File is used during the execution of any lesson, it is accessed by the Control Function, rather than the Lesson Execution Mode. The Control Function updates the User Swap Data with the contents of a specified frame, when directed to do so.

3.1.2.3/2 <u>Destination and Types of Outputs</u>

3.1.2.3/2.1 <u>Textual Outputs to the Remote Terminal via CDTS Control Function</u>. Lesson text is output to the trainee (or course designer functioning as a pseudo-trainee) at the remote terminal, as specified by the content of the course. These outputs include text, multiple-choice answers, and feedback in response to trainee answers. These data are output to the terminal through the CDTS Control Function, using the Remote Terminal (TTY) File specified in section 3.1.2.1/2.1.

3.1.2.3/2.2 <u>Output Messages to the Remote Terminal</u>. Cue messages, telling the trainee what actions are expected of him when starting to execute a lesson; legality messages, showing the course designer what errors have been found in the construction of the lesson; and feedback messages, reflecting trainee responses are output at the remote terminal. To facilitate system/user interaction, the complete message number will be output at the terminal whenever possible. The messages will be further explained in the system users manual.

1. <u>Legality Messages</u>

   a. <u>E-1-25</u>. "ILLEGAL DECISION STATEMENT CONTINUE? TYPE YES/NO." A decision statement has been input which does not entirely conform to system requirements.

   b. <u>E-1-26</u>. "ILLEGAL BRANCH CONTINUE? TYPE YES/NO." A branch has been specified within a frame which does not conform to system restrictions.

   c. <u>E-1-27</u>. "ILLEGAL ITEM NAME CONTINUE? TYPE YES/NO." An item which is not one of the 30 system items has been referenced within a frame.

   d. <u>E-1-28</u>. "ILLEGAL VALUE FOR ITEM CONTINUE? TYPE YES/NO." An attempt has been made to set or test an item, using an illegal value.

   e. <u>E-1-30</u>. "NO CORRECT ANSWER IS IDENTIFIED CONTINUE? TYPE YES/NO." An attempt has been made to use the automatic correct answer feedback function, without a correct answer in the specified frame.

2. Feedback Messages

   a. E-3-3. "THE CORRECT ANSWER IS." Feedback to the trainee showing what the course designer has designated as the correct answer to the frame he has just answered incorrectly.

   b. E-3-4. "WRONG, TRY AGAIN." Automatic feedback to the trainee, when specified by the course designer to be output when an incorrect answer is input.

   c. E-3-19. "CHOOSE ONE OF THE ABOVE LETTERS." Feedback to the trainee, during the execution of a multiple choice frame, that he has not input one of the answers presented for his evaluation.

3.1.2.3/2.3 Disk Output Records

3.1.2.3/2.3.1 User Swap Data. The User Swap Data (described in section 3.1.2.3/1.2.1) is primarily an input to the Lesson Execution Function. The function does set data items reflecting trainee performance through a lesson, that may be saved for later continuation of the lesson. Therefore, it is also listed here, for reference purposes, as an output of the Lesson Execution Function.

3.1.2.3/2.3.2 Trainee Record File. Trainee record data are output by the Lesson Execution function, through the CDTS Control Function for later processing by a Batch Processing program. The table contains information relating to each frame that the trainee has encountered. Each frame executed requires two entries in the table to define the various actions and conditions that occurred due to the trainee's responses to course material. The format of the Trainee Record File is specified in section 3.1.2.1/2.2.

3.1.2.3/3 Information Processing. The Lesson Execution Function is divided into 3 major overlay sections: Q frame processor (LEQFRM), M frame processor (LEMFRM), and D frame processor (LEDFRM). In addition to the paragraphs unique to each of the major overlays, the following subfunctions will be repeated within the major overlay sections to obviate each overlay calling upon additional overlays to completely perform its tasks: Trainee record updating (LETRUP); group four processor (LEG4); frame directory search (LEFRDS); and item setting routine (LEITM).

3.1.2.3/3.1 LEQFRM. The Q frame processor is entered from the Control Function each time a Q frame is moved into a User Swap data record.

The Swap User group number, US-GRP-NUM (item 6 of 3.1.2.3/1.2.1) is examined to determine if a group 2 exists within the frame. If so, the group length US-GRP-LTH (item 7 of 3.1.2.3/1.2.1), line number US-LINE-NUM (item 8 of

3.1.2.3/1.2.1) and line length US-LINE-LTH (item 9 of 3.1.2.3/1.2.1) are used to transfer textual material to the TTY File (for output to the terminal). If US-LINE-LTH is greater than one, TTY-BIC-4 is set to 1, until the last line of text is to be output, at which time it is set to blank. If the group 2 group length, US-GRP-LTH, indicates that the group 2 fills the entire frame, US-PROC (item 22 of 3.1.2.3/1.2.1) is set to cause CFWRD to operate and US-PROC-BR1 (item 23 of 3.1.2.3/1.2.1) is set to cause CFRLR to operate. The frame directory search paragraph (LEFRDS) is operated and working storage item REL-FR-NUM is set with the relative record number of the next frame to be read. Otherwise US-PROC-BR1 is set to return to the Q frame group 3 paragraph (LEQG3). Control is passed to the FSA.

3.1.2.3/3.2 LEQG3. The Swap User group number US-GRP-NUM is examined to determine if a group 3 exists within the frame. If not, control is passed to LEQG4. The group is examined for the setting on or off of any of the service functions. Items US-PHONETIC, US-KEYWORD, and US-ORDER (items 15, 17 and 16, respectively of 3.1.2.3/1.2.1) are set to the appropriate value, if necessary. If any items are to be set, control is passed to the item processor, LEITM. Control is then passed to the group 3 processor (LEQG3P).

3.1.2.3/3.3 LEQG3P. The items US-PHONETIC, US-KEYWORD, and US-ORDER are examined to determine which, if any, of the service function paragraphs are to be invoked prior to answer evaluation.

The phonetic encoding routine (LEPHON) is executed first. The combination of items US-KEYWORD and US-ORDER are then used to branch to the Keyword routine (LEKWD), the Order routine (LEORD), or the combination Keyword and Order routine (LEKWOR).

3.1.2.3/3.4 LEQG3P1. After execution of the necessary paragraph(s), answer evaluation is attempted. If a match does not occur with the first lesson specified answer, the above paragraphs are repeated until a match does occur or until all specified answers are exhausted. At the conclusion of answer evaluation, items 25, 27, 28, 29, and 21, of 3.1.2.3/1.2.1 are set in the User Swap data: US-TR-FRM-NUM, set to US-FRM-NUM; US-TR-ANS, set to the tag of the current trainee answer; US-TR-RGT-WRG, set to + or -; US-TR-FRM-TYPE, set to US-FRM-TYPE, and US-TOT-RES is updated to reflect this response. Control is then passed to the group 4 processor (LEG4).

3.1.2.3/3.5 LEG4. The Swap User Group Number, US-GRP-NUM, is examined to determine if a group 4 exists within the frame. If not, LEFRDS is performed to determine the next frame to be read from immediate access storage. US-PROC is set to cause CFRLR to operate and control is passed to the FSA.

The response of the trainee, US-TR-ANS, is examined to determine which alternative action is to be selected from the group 4. (Any unconditional command is executed first.) The group 4 data is then searched for a matched answer tag.

If a match does not occur, or an unanticipated response is not provided for, LEFRDS is performed and REL-FR-NUM set to the next frame to be read. US-PROC is set to cause CFRLR to operate. Control is passed to the FSA. Otherwise, action is taken as follows:

ACTION COMMAND	ACTION TO FOLLOW
F:	Feedback as specified
R:	Feedback as specified, or output, "Wrong, try again"
C:	Feedback: "The correct answer.........."
B:	Branch to specified frame or label

3.1.2.3/3.6 **LEG41.** LEG41 uses US-GRP-LTH and US-LINE-LTH to parse the lines containing action commands. A switch is set to pass the starting byte and number of bytes of data to each appropriate group 4 processor in turn, until the end of the frame is reached. If the last action command is not a "B", control is passed to LEG4B to prepare operation of the next sequential frame.

3.1.2.3/3.7 **LEG4B.** LEG4B, the branch processor, performs LEFRDS setting REL-FR-NUM to the relative record number of the next frame to be read. If OUT-REQ contains a value other than zero, US-PROC is set to cause CFWRD to oper- ate and US-PROC-BR1 is set to CFRLR and control is passed to the FSA with TTY-BIC4 set to 1.

3.1.2.3/3.8 **LEG4F.** LEG4F, the feedback processor, sets up lines of feedback in the TTY file as required, setting TTY-BIC4 to 1, until the last line is ready to be output. If no message is specified after the feedback command, LEG4F will select an appropriate message from an internally stored table. Item OUT-REQ is set to 1. Control is returned to LEG41.

3.1.2.3/3.9 **LEG4R.** LEG4R, the repeat command processor, transfers the line of feedback specified, if any, to the TTY file. If no feedback is specified, the words "WRONG, TRY AGAIN" are transferred to TTY. US-PROC is set to operate CFWRD, US-PROC-BR1 to operate LEG3, TTY-BIC4 to blank and control is passed to the FSA.

3.1.2.3/3.10 **LEG4C.** LEG4C, the C command processor, searches the group 3 to find a correct (+) answer. If no correct answer is found, error message E-1-30, "NO CORRECT ANSWER," is stored in the TTY file. LEFRDS is performed and REL-FR-NUM set to the next frame to be read. US-PROC and US-PROC-BR1 are set to operate CFWRD and CFRLR, respectively. TTY-BIC4 is set to 1 and control is passed to the FSA. If one or more correct answers are found, the last correct answer is added to E-3-3, "The correct answer is:" and stored in the TTY file. OUT-REQ is set to 1 and control is returned to LEG41.

3.1.2.3/3.11 <u>LEKWD</u>. LEKWD compares lesson and inserted answers for the match of words existing in the lesson answer, ignoring nonmatched words in the inserted answer. The routine begins by comparing the first word of the lesson answer (obtained from the appropriate US-BCD-WD entries or PH-BCD-WD, if PHONETIC is on), with the first word of the inserted answer, obtained from TTY-BCD-WD entries. If the entries match, the next two entries in each table are compared. If the entries do not match, the keyword (lesson answer) is matched with the next word of the inserted answer. This process repeats until the last word of the inserted answer has been examined, or until the last keyword has been successfully matched. The item ANSMCH is set to "Match" if every keyword is matched in order by an inserted answer word, regardless of how many nonmatching words are inserted in the answer, and control is passed to LEQG3P1.

3.1.2.3/3.12 <u>LEORD</u>. LEORD compares every word in the group 3 and trainee inserted answers, irrespective of the order of words in each answer. Each word of the inserted answer is obtained in turn from TTY-BCD-WD and compared with every unmatched word in the lesson answer, obtained from US-BCD-WD (or PH-BCD-WD, if PHONETIC is on). As soon as an inserted answer cannot be matched, control is returned to LEQG3P1 with the item ANSMCH set to "No Match." The process continues until all words of the inserted answer have been examined. At this point, if any words in the lesson answer remain unmatched, control is returned to LEQG3P1 with item ANSMCH set to "No Match." If no words remain unmatched, control is returned with item ANSMCH set to "Match."

3.1.2.3/3.13 <u>LEPHON</u>. LEPHON phonetically encodes each word of the group 3 and trainee inserted answers. The lesson answers are phonetically encoded and stored in working storage table PHON-ANS, and a switch set to indicate that the lesson answers have been encoded. The trainee inserted answer is then phonetically encoded and replaced in TTY-BCD-WD. Each time the routine is entered for a repeat answer, only the new trainee answer will be encoded. Control is returned to LEQG3P1.

3.1.2.3/3.14 <u>LEKWOR</u>. LEKWOR compares group 3 answers with trainee inserted answers, ignoring unmatched words in the inserted answer and the order of words in each answer. Item ANSMCH is initialized to "No Match." If all group 3 answer words are matched by inserted answer words, ANSMCH is set to "Match." In any case, control is returned to LEQG3P1.

3.1.2.3/3.15 <u>LEITM</u>. The item assignment statement is tested for legality. If an illegality occurs, the assignment statement, followed by the expression "ILLEGAL. --- CONTINUE? TYPE YES/NO" is set into TTY-BCD-WD. US-PROC and US-PROC-BR1 are set to cause CFWRD and LEITM1, respectively to operate. If legal, the specified value is computed and stored in the appropriate US-ITEM. Control is passed to LEG3.

3.1.2.3/3.16 LEITM1. If the trainee response is "YES," LEFRDS is performed, US-PROC set to CFWRD, US-PROC-BR1 to CFRLR and control is passed to the FSA. Otherwise US-PROC is set to cause CFQUIT to operate and control is passed to the FSA.

3.1.2.3/3.17 LEMFRM. The M frame processor is entered from the Control Function each time an M frame is moved into the User Swap Data Record. The group number, (US-GRP-NUM), is examined to determine if a group two or three exists within the frame. If either or both groups exist, the text and/or answer alternatives (with the correct answer indicator suppressed) are placed in table TTY and US-PROC is set to repeatedly call on CFWRD until the last line is ready for output. At this time TTY-BIC4 is set to blank, causing CFRDO to operate. US-PROC-BR1 is set to cause LEMB3P to operate when the trainee responds. In the event the group 3 is not completed in the current frame, LEFRDS is set to cause CFWRD to operate, US-PROC-BR1 is set to cause CFRLR to operate, TTY-BIC4 is set to 1 and control is passed to the FSA.

3.1.2.3/3.18 LEMG3P. LEMG3P initially examines TTY-BCD-WD for the insertion of a single letter. The letter is matched with the answer tags specified in the group 3 by looping through the group, using US-GRP-LTH and US-LINE-LTH to get from entry to entry and examine US-BYTE1 of each entry. If a single letter is not inserted, or the inserted letter does not match any of the entries, feedback message E-3-2, "CHOOSE ONE OF THE ABOVE LETTERS" is stored in TTY-BCD-WD entries and control passed to the FSA with US-PROC-BR1 set to operate LEMG3P. When one of the specified answers has been matched, US-PROC is set to cause LEMG4P to operate, and control is passed to LETRUP, for updating of the trainee's records and decision table, if required.

3.1.2.3/3.19 LEMG4P. The multiple-choice frame group 4 processor functions exactly as the Q-frame group 4 processor with the following exceptions: No unanticipated responses ever reach LEMG4P. The automatic feedback message, "CHOOSE ONE OF THE ABOVE ANSWERS," prevents the execution of LEMG4P until one of the alternates presented in group 3 is input.

3.1.2.3/3.20 LEDFRM. Items IF-FLAG, IF-ELSE, IF-TRUE, ENTITY-START, and ENTITY-END are set to zero. Control is passed to LEDFRM1.

3.1.2.3/3.21 LEDFRM1. ENTITY-START is incremented by ENTITY-END. If ENTITY-START is equal to US-FRM-LTH, control is passed to LEFRDS. If ENTITY-END is equal to US-LINE-LTH, ENTITY-START is incremented to point to the next line. ENTITY-END is set to zero; US-BCD-WD is scanned to determine the entity length and ENTITY-END is set equal to the number of characters. The next delimiter is extracted from US-BCD-WD and is matched versus the following delimiter items; FD-BCK, BRNCH, ITEM-FN, IF-COND, AND-COND and OR-COND. Control is passed to LEDFRM2, LEDFRM3, LEDFRM4, LEDFRM5, LEDFRM6, LEDFRM7 or LEDERR respectively.

3.1.2.3/3.22 <u>LEDFRM2</u>. If IF-FLAG is zero, FEEDBACK is executed and control is passed to LEDFRM1. If IF-TRUE and IF-ELSE are zero, US-BCD-WD is searched for an ELSE or an IF. If found ENTITY-START is set to point to the first byte of US-BCD-WD containing the entity. If an ELSE, IF-ELSE is set to 1, ENTITY-END is set to zero and control is passed to LEDFRM1. Otherwise control is passed to LEFRDS. If IF-TRUE or IF-ELSE is 1, FEEDBACK is executed and control is passed to LEDFRM1.

3.1.2.3/3.23 <u>LEDFRM3</u>. If IF-FLAG is zero, or if IF-TRUE or IF-ELSE is 1, FRAME-TAG-NUM is set to the word in US-BCD-WD immediately following the delimiter and control is passed to LEFRDS. Otherwise US-BCD-WD is searched for an ELSE or IF. If found ENTITY-START is set to point to the first byte of US-BCD-WD con-training the entity, if an ELSE, IF-ELSE is set to 1, ENTITY-END is set to zero and control is passed to LEDFRM1. Otherwise control is passed to LEFRDS.

3.1.2.3/3.24 <u>LEDFRM4</u>. If IF-FLAG is zero, LEITM is executed and control is passed to LEDFRM1. If IF-TRUE or IF-ELSE is set to 1, LEITM is executed and control is passed to LEDFRM1. Otherwise US-BCD-WD is searched for an ELSE or IF. If found, ENTITY-START is set to point to the first byte of US-BCD-WD containing the entity. If an ELSE, IF-ELSE is set to 1, ENTITY-END is set to zero and con-trol is passed to LEDFRM1. Otherwise control is passed to LEFRDS.

3.1.2.3/3.25 <u>LEDFRM5</u>. If IF-FLAG is zero it is set to 1 and IF-TRUE is set to zero. Otherwise IF-ELSE. IF-AND, IF-OR are set to zero. US-BCD-WD delimited by ENTITY-START and ENTITY-END are examined and control is passed to LEDQUAN, LEDALL, LEDTAG or to LEDITM. If a format is not determined, control is passed to LEDERR.

3.1.2.3/3.26 <u>LEDFRM6</u>. If IF-TRUE is 1, control is passed to LEDFRM5. Other-wise US-BCD-WD is searched for the delimiters OR, ELSE, or IF. IF-ELSE is set to 1 if ELSE is found. ENTITY-START is set to point to the first byte of US-BCD-WD containing the delimiter, ENTITY-END is set to zero and control is passed to LEDFRM1. If a delimiter is not found, control is passed to LEFRDS.

3.1.2.3/3.27 <u>LEDFRM7</u>. If TRUE is zero, control is passed to LEDFRM5, otherwise US-BCD-WD is searched for the delimiters F: B: or %:. If one of these delimit-ers is found before an ELSE, ENTITY-START is set to point to the first byte of US-BCD-WD containing the delimiter, ENTITY-END is set to zero and control is passed to LEDFRM1. Otherwise control is passed to LEDERR.

3.1.2.3/3.28 <u>LEDERR</u>. Table TTY is set to DEC. FRAME ddd.d IN ERROR. Items US-PROC-BRI are set to cause CFWRD and CFRLR to operate. REL-FR-NUM is incre-mented by 1 and control is passed to CFOVLY.

3.1.2.3/3.29 LEDQUAN. SPEC-COND is set to 1, 2, or 3 if US-BCD-WD contains RIGHT, WRONG, or SEEN respectively. The frame numbers to be tested are extracted from US-BCD-WD and SPEC-COND-CNT is incremented conditionally based on US-RT-WRG and SPEC-COND. After tabluation, SPEC-COND-CNT is matched versus the number extracted from US-BCD-WD. If SPEC-COND-CNT is less, IF-TRUE is set to zero. Otherwise IF-TRUE is set to one. Control is passed to LEDFRM1.

3.1.2.3/3.30 LEDALL. The frame numbers to be examined are extracted from US-BCD-WD. For each frame specified FR-CNT is incremented by 1. For each frame found, DEC-SEEN is incremented by 1, DEC-RT is incremented by 1 if US-RT-WRG is +, otherwise DEC-WRG is incremented by 1. If the ALL, EVER, NEVER, LAST, parameter is not found in US-BCD-WD, ALL is assumed. If ALL is specified, DEC-SEEN is matched versus FR-CNT if the condition SEEN is specified. If RIGHT is specified, DEC-SEEN is matched versus DEC-RT. If WRONG is specified DEC-SEEN is matched versus DEC-WRG. If the condition is satisfied, IF-TRUE is set to 1, otherwise it is set to 0. DEC-SEEN, DEC-RT, DEC-WRG, FR-CNT are set to zero. Control is passed to LEDFRM1.

3.1.2.3/3.31 LEDTAG. The frame numbers to be tested are extracted from US-BCD-WD. Each frame number is matched versus all US-DEC-FRM-NUM items. If not found IF-TRUE is set to zero and control is passed to LEFRM1. Otherwise, US-LAST-ANS is compared versus the answer tags extracted from US-BCD-WD. If a match does not occur for each frame, IF-TRUE is set to zero and control is passed to LEFRM1. Otherwise IF-TRUE is set to 1 and control is passed to LEFRM1.

3.1.2.3/3.32 LEDITM. The item number portion of the ITEM dd name is extracted from US-BCD-WD and used as the subscript value to reference ITEM-VAL in table ITEM. The value is extracted from US-BCD-WD and is matched versus ITEM-VAL. If the match is equal and the condition specified is LQ, GQ, or EQ, IF-TRUE is set to 1. If the match is greater and the condition specified is GR or GQ, IF-TRUE is set to 1. If the match is less than and the condition specified is LS or LQ, IF-TRUE is set to 1. Otherwise IF-TRUE is set to zero and control is passed to LEDFRM1.

3.1.2.3/3.33 LEFRDS. LEFRDS searches the Lesson Frame Directory for the relative record number of the frame specified by the procedure performing LEFRDS. If item FRM-TAG-NUM is set to zero, US-FRM-NUM is used to search the frame directory for the next sequentially numbered frame. If FRM-TAG-NUM is set to a non-zero integer value, the specified frame number is searched for. If FRM-TAG-NUM is set to an alphameric frame label, the Label Table is examined, the frame number for the label extracted and its relative record number obtained from the Frame Directory. The frame number abstracted is placed in FRM-TAG-NUM. If at any time during the search process, a frame number or label cannot be found, error message E-1-26 is placed in TTY-BCD-WD, followed by "CONTINUE? TYPE YES/NO." US-PROC and US-PROC-BR1 are set to cause CFWRD and LEFRDS1 respectively to operate. Control is passed to the FSA. Otherwise LEFRDS is exited.

3.1.2.3/3.34 LEFRDS1. If the trainee response is "YES", LEFRDS is performed to obtain the next sequential frame number, US-PROC set to CFWRD, US-PROC-BR1 to CFRLR and control passed to the FSA. Otherwise US-PROC is set to cause CFQUIT to operate and control is passed to the FSA.

3.1.2.4 Trainee Record Processing Function. The Trainee Record Processing Function permits authorized personnel to access the records of trainee performance that are compiled during the execution of a lesson. These records are analyzed by the function and prescribed reports produced for an individual or group of trainees. The Trainee Record Processing Function will operate entirely in a batch processing mode. The time consuming process of searching trainee records in immediate access storage is not appropriate to on-line processing. Further, since there is no requirement for program-training supervisor interaction after the program is initiated, no on-line trainee record processing functions are currently planned.

3.1.2.4/1 Source and Type of Inputs

3.1.2.4/1.1 Input from Cards. The lesson name and the identity number of the trainees, for which reports are to be generated, are input via the Cards-Record file. The identity number and lesson name are matched against those in the Trainee-Record file to determine if the data is to be used on a report.

3.1.2.4/1.2 Input from Tape. The Trainee-Record file (3.1.2.1/2.2) generated by the Execution Function of the on-line CDTS system, contains the responses to all frames that a trainee encounters. These responses are formatted into a report for each trainee/lesson as requested by the input in the Cards-Record file.

3.1.2.4/1.3 Input from Disk. The User Completed File (3.1.2.1/2.2.2), if present, is read from disk to determine if any complete reports are to be automatically produced from the Trainee-Record file. This file is purged after being read.

3.1.2.4/2 Destination and Types of Outputs

3.1.2.4/2.1 Line Printer Output. Individual History Data Reports and/or Individual Summary Data Reports are written on the line printer, for each trainee identified in the Card-Record file, and for each entry in the User Completed file. Figures 3.1.2.4/2-1 and 3.1.2.4/2-2 show the format of each report.

3.1.2.4/2.2 Output to Tape. A new Trainee-Record File is created which contains all Trainee-Record data for each incompleted lesson or lessons for which a request for a report has not been indicated.

Table 3.1.2.4/2-1.   Individual History Data

PREPARED -----   INDIVIDUAL HISTORY -----

LESSON NAME -----   TRAINEE NAME -----   TR-ID -----

	OPTION (a)	FRAME	TYPE (b)	ANSWER (c)	RIGHT/WRONG (d)
	GOTO	ddd.d	Q/M/D	A-Z	+ (plus)
		or		(blank)	- (minus)
	QUITE	DONE		-(minus)	(blank)
1.	-----	-----	-----	-----	-----
2.	-----	-----	-----	-----	-----
3.	-----	-----	-----	-----	-----
	LESSON NAME ----- (e)				
4.	-----	-----	-----	-----	-----

1. TOTAL NUMBER OF RIGHT RESPONSES ----- (f)

2. TOTAL NUMBER OF WRONG RESPONSES ----- (g)

3. TOTAL OF UNANTICIPATED RESPONSES ----- (h)

4. TOTAL NUMBER OF RESPONSES ----- (i)

    a. The Option inserted and the frame number or DONE
        GOTO = exit frame number
        QUIT = frame number of DONE
    b. The frame type
    c. A-Z = the answer tag inserted
        (blank) = decision frame or frame for which no response is required.
        (-) minus = unanticipated Response Indicator
    d. (+) plus = correct (responses that match with answer tab
                associated with plus sign)
        (-) minus = incorrect (responses that match with answer tags without
                a plus sign or the Unanticipated Response Indicator)
        (blank) = decision frame
            = frame for which no response is required
    e. Indicates branch to a second lesson
    f. Sum of the plus signs in the Right/Wrong column
    g. Sum of the minus signs in the Right/Wrong column
    h. Sum of the minus signs in the Answer column
    i. Sum of the plus and minus signs in the Right/Wrong column

Table 3.1.2.4/2-2   Individual Summary Data

PREPARED -----   INDIVIDUAL SUMMARY -----

LESSON NAME -----   TRAINEE NAME -----   TR-ID -----

1. POSITION IN LESSON ----- (a)

2. TOTAL NUMBER OF RIGHT RESPONSES ----- (b)

3. TOTAL NUMBER OF WRONG RESPONSES ----- (c)

4. TOTAL NUMBER OF UNANTICIPATED RESPONSES ----- (d)

5. TOTAL NUMBER OF RESPONSES ----- (e)

    a. The current frame number or DONE
    b. Sum of the plus signs in the Right/Wrong column*
    c. Sum of the minus signs in the Right/Wrong column*
    d. Sum of the minus signs in the Answer column*
    e. Sum of the plus and minus signs in the Right/Wrong Column*

---

*Refer to Table 3.1.2.4/2-1. Individual History Data

3.1.2.4/3 Information Processing

3.1.2.4/3.1 TRIT. The Users Completed Lesson file, if present, is opened. The Card-Record file is opened. The trainee/lesson name cards are read and stored in working storage. After all cards have been read the file is closed and control passes to TRRC.

3.1.2.4/3.2 TRRC. The temporary Trainee-Disc-Record file is opened with the New-Trainee-Record file. The Trainee-Record file is opened. Each record from the Trainee-Record file is read. If the record is for a trainee/lesson name combination for which a report is to be produced it is examined to determine if the trainee has finished the lesson. If so, an indicator is set in working storage. The record is output in the Trainee-Disk-Record file. If the record is not to be used in a report it is output on the New-Trainee Record file. When all Trainee-Records have been examined the Trainee-Record file is closed and control is passed to TRPR.

3.1.2.4/3.3 TRPR. Each record from the Trainee-Disk Record file is read and formatted according to Figures 3.1.2.4/2-1 and/or 3.1.2.4/2-2. If the trainee has not completed the lesson the record is output in the New-Trainee-Record file and control passes back to TRPR. If the trainee has completed the lesson, control passes back to TRPR. When all Trainee-Disk-Records have been processed control passes to TREND.

3.1.2.4/3.4 TREND. The Users Completed Lesson file, if open, is closed and purged. The Trainee-Disk-Record file and the New-Trainee-Record files are closed and the program terminates.

3.1.2.5 CDTS Off-Line Lesson Building Function. The Off-Line Lesson Building Function is used to construct course material for a variety of training purposes. This course material will be input to CDTS via magnetic tape or punched cards.

The Off-Line Lesson Building Function allows a course designer to enter lesson content, specify answers, and indicate the action to be taken (in the Execution Function) as a result of trainee response. No editing capability is provided in the Off-Line Lesson Building Function.

The material is inserted and processed by the function as frame units. Each frame is further segmented into groups, which are composed of a sequence of individual card line images of information. A course is constructed from a sequence of cards (frames) input by the course designer.

The Off-Line Lesson Building Function shall provide the following capabilities:

1. Selection of frame types for course insertion by the course designer. The three frame types at his disposal are:

    a. Question Frame - Used to present course material to inform or require a constructed response.

    b. Multiple-Choice Frame - Used to present course material and alternate answer choices for selection.

    c. Decision Frame - Used to establish conditional statements for controlling the trainee's path through the lesson, depending upon his responses.

2. Labeling of selected frames by the course designer to facilitate the identification and execution of major break points in the course material.

3. Selective construction (through control card input) of lessons which have been stored previously on one or more tapes. Lessons desired for a training session are loaded onto disk storage and are thereby available for use by trainees. Lessons not required or needed for specific training sessions are removed from disk releasing unused storage space for other Phase II applications.

3.1.2.5/1 Sources and Types of Inputs. Lesson text is interpreted and formatted into the Lesson-File format for later output. This data is input to the Off-Line Lesson Building Function via the Cards-Records File. The card format for Off-Line Lesson Building is as follows: Column 1 contains the group number to which the data in columns 2-74 is related. Columns 75-79 contain a sequence number. If column 1 contains a 1, the information relates the header information for a frame (frame number, frame type, and frame label, if any). If column 1 contains a 2, 3, or 4, the information is processed as complete lesson text.

3.1.2.5/1.1 <u>Lesson File - Card Input</u>. The deck structure for a lesson to be processed by the Off-Line Lesson Building program will be as follows:

- ° Data card, having:

Col. 1	=	Illegal B3500 character (i.e., 1-2-3 punch)
Col. 2-5	=	DATA
Col. 7-12	=	AEEC9B

- ° Control card, having:

Col. 1	=	L
Col. 2-7	=	A 1 to 6 alphanumeric lesson name. The first character must be a letter.
Col. 8-9	=	A two character course designer ID.
Col. 10-13	=	FLAG or Blank

  FLAG instructs the program during lesson generation to associate a decision statement indicator for all "Q" and "M" frame types within the lesson table. All frames are thereby established for use by decision statements constructed within the lesson. If not used, the course designer must insert the decision statement indicator into column 17 of the group 1 card for <u>each</u> frame he desires to have considered for use by a decision statement.

- ° Lesson deck

  A blank card must follow the last card of each frame. No check is made by the program for frame number sequencing.

- ° End card, having:

Col. 1	=	Illegal B3500 character (i.e., 1-2-3 punch)
Col. 2-4	=	END

3.1.2.5/1.2 <u>Lesson File - Tape Input</u>. Lessons may be loaded from one or more lesson tapes for a specific training session. The program will permit the option of either adding lessons to the current file of lessons on disk or rebuilding the file with only those lessons selected.

One or more lessons can be added to a previous file without the need to reconstruct the entire lesson file. However, each tape processed will require a separate program run.

Each lesson will require a single control card. The format will be as follows:

Col. 1   =   T or N
T indicates the lesson loaded from tape is to be added to the existing disk file of lessons.

N indicates a new file is to be constructed starting with this lesson.

Col. 2-7   A 1 to 6 alphanumeric lesson name which corresponds to a lesson name on the tape. The first character must be a letter.

Col. 8   =   L or Blank
L instructs the program to output a listing of this lesson with associated error messages. If not used, a listing of the lesson is not produced.

No capability will be provided for lesson building from card decks and loading from tape within the same run. It will be the responsibility of a designated authority to maintain records of the sequence of lessons on each tape. Control card inputs must match the tape sequence, as the program will not rewind the tape if a requested lesson cannot be found.

3.1.2.5/2 Destination and Types of Outputs - Disk Output Records. The Lesson File records containing the course material as defined by the course designer are randomly written, based on the relative frame number and a constant obtained from the table of contents associated with that lesson. The Lesson File is described in section 3.1.2.1/1.3.3.

A pseudo User Swap File is created so that the file exists when the on-line functions of CDTS are initially executed. For the sake of brevity, the User Swap File will be defined under the Lesson Building Function (3.1.2.2/1.2.2).

3.1.2.5/3 Information Processing

3.1.2.5/3.1 Ø12 OPEN

"Frame listing and associated error messages" heading is output to the printer and control is passed to Ø20 READ-CARD.

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3.1.2.5/3.2   ∅2∅ READ-CARD

If tape processing is in effect, control is passed to ∅3∅ READ-CARD.
Otherwise, the next card is read and control passed to ∅21 READ-CARD.

3.1.2.5/3.3   ∅21 READ-CARD

A check is made to determine the end of a tape input has been reached.
If so, control is passed to 22∅ CLOSE routine. If not, Col. 1 is
examined for a "T," "N," "L," or the group parameter being searched
for. ∅2∅ READ-CARD is returned to for further card reads until the
condition is satisfied.

3.1.2.5/3.4   ∅3∅ READ-TAPE

This routine reads the input lesson tape until data is encountered
for a lesson requested by control card input. Each tape record is
moved to the card input data area and the same card processing
routines used.

3.1.2.5/3.5   ∅35 CARD-READ

If this is the end of a lesson from tape, control is passed to the
22∅ CLOSE routine. Otherwise, Col. 1 is checked for a "T" or "N."
If a "T" or "N" is encountered, the tape file (AEEC9C) is opened
(if not already open), the tape is searched until a match occurs with
the tape lesson name. Otherwise, control is passed to ∅38 PROCESS.

3.1.2.5/3.6   ∅38 PROCESS

If the card currently being read is a lesson control card, control
is passed to ∅4∅ PROCESS. Otherwise, control is passed to ∅36 READ-
CARD.

3.1.2.5/3.7   ∅36 READ-CARD

If the card currently being read is blank control is passed to
∅5∅ PROCESS. If it is a group 1 card control is passed to ∅7∅
PROCESS. If the card is within the existing group, control is
passed to 1∅∅ PROCESS. Otherwise, control is passed to ∅9∅ PROCESS.

3.1.2.5/3.8   ∅4∅ PROCESS

The lesson header record is written, lesson directory sorted, and
written to disk for an existing lesson.

3.1.2.5/3.9   Ø42 PROCESS

If a new lesson file is to be built from tape, the number of
entries in the lesson file is set to zero, and file searched for
the next available slot. If none can be found, the program runs
to end-of-job. Otherwise, a new entry is constructed and control
is passed to Ø45 PROCESS.

3.1.2.5/3.10   Ø45 PROCESS

The lesson file is closed and opened to update the end-of-file
pointer and the next lesson input read at Ø2Ø READ-CARD, with
control being passed to Ø35 READ-CARD.

3.1.2.5/3.11   Ø5Ø PROCESS

The end of frame indicator ("$") is set in the TTY table and switch
set to return control to Ø6Ø PROCESS, before transferring to 31ØØ
LBSW.

3.1.2.5/3.12   Ø6Ø PROCESS

Lesson inputs are repetitively searched for a frame header card at
Ø2Ø READ-CARD and control is passed to Ø35 READ-CARD.

3.1.2.5/3.13   Ø7Ø PROCESS

The frame header is parsed until the entire card has been read and
control is passed to 5ØØ FRM-NUM.

3.1.2.5/3.14   Ø9Ø PROCESS

Determines if the previously processed card was a frame header. If
not, the end of group processing is envoked. Control is passed to
1ØØ PROCESS.

3.1.2.5/3.15   1ØØ PROCESS

The group 2, 3, or 4 input is set up for normal lesson building
functions, return switch set to 1ØØ PROCESS, and control passed to
31ØØ LBSW.

3.1.2.5/3.16   218 CLOSE - 22Ø CLOSE

Lesson directory is sorted and written to the disk lesson file. If
tape processing is occurring and is not completed, control is passed

-79-

to Ø12 OPEN. Otherwise, all files are closed and the program runs
to end-of-job.

3.1.2.5/3.17   430 SORT - 3354 LBPGR

These routines function identically to the same numbered routines
within the On-Line Lesson Building Function with the exception
that error indications are sent to the line printer rather than the
course designer's remote terminal.

3.1.2.5/3.18   3358 LBPGR - 3366 LBPGR

These routines make the following BCD to EBCDIC character conversions:

"/" or " "	to carriage return
"%"	to "("
" "	to "0"
"#"	to "="
"&"	to "+"
"12-2-8"	to "?"
"@"	to "'"
"C:"	to "%:"

Control is passed to 3370 LBPGR when all characters have been examined.

3.1.2.5/3.19   3370 - 3580 LBPGR

These routines function identically to the same numbered routines
within the On-Line Lesson Building Function, with control ultimately
being passed to 3Ø89 LBEX.

3.1.2.5/3.20   359Ø LBPGR

Sets up to examine card input for a Group 1 input and reads suc-
ceeding cards via Ø2Ø READ-CARD, with control being passed to
Ø35 READ-CARD.

3.1.2.5/3.21   3363 LBED - 3675 LBED

Processes an input frame label for legality and existence within
the label table for the lesson. An illegal label transfers control
to 3515 LBPGR. A legal label results in a transfer to 335Ø LBPGR.

3.1.2.5/3.22   37ØØ LBPRT - 37Ø8 LBPRT

Frame header line is loaded into output format, with a full or new
page being written at 37Ø5 LBPRT.

3.1.2.5/3.23   3710 LBPRT - 3740 LBPRT

The appropriate group 2, 3, or 4 header lines are set up for
printing and control is passed to 3750 LBPRT.

3.1.2.5/3.24   3750 LBPRT - 3780 LBPRT

Successive lines of output data are moved to the print image until
a full page is reached. The full page is printed at 3780 LBPRT and
the routine is exited at 3780 LBPRT.

3.1.2.5/3.25   3800 CHECK - 3810 CHECK

This routine checks for duplicate frame numbers within the card/
type input and sets an error indicator before exiting at 3810
CHECK.

3.1.3 Data Base Requirements. (There are no parameters required for adapting
the CDTS to its operational environment nor any other constants or parameters
which affect the design. Therefore, this paragraph is not applicable to this
CPCEI.)

3.1.4 Human Performance. The following paragraphs establish the human per-
formance/human engineering requirements for this CPCEI.

3.1.4.1 Requirements of CDTS. The following capabilities are required of the
program system to maximize the efficiency of program/user interaction.

1. Error Detection. Course designer and trainees are immediately
    informed when system limits are exceeded or illegal actions taken.

2. Data Protection. The program has built-in safeguards to prevent
    access by unauthorized personnel to certain program functions
    and trainee records.

3. Lesson Presentation. As far as possible, the program completes
    the presentation of multiline textual material to a terminal
    prior to servicing another terminal.

4. User Language. As far as possible, program interaction with course
    designers is in a natural language. However, certain abbreviations
    and symbols must be interpreted by both the user and the program
    to expedite the process.

3.1.4.2 <u>Requirements of the Course Designer</u>. Performance requirements for maximizing the efficiency of program/user are:

1. <u>Length of Text</u>. The length of messages to and from the remote devices shall be as short and concise as possible without sacrificing clarity. Simplicity and clarity are the major requirements for remote terminal operations.

2. <u>Trainee Response Requirements</u>. Responses to questions are designed so that the trainee is not penalized by a lack of typing proficiency. The KEYWORD, PHONETIC, and ORDER service function are used to minimize the effect of typing deficiencies.

3. <u>Remedial Material</u>. Training should not be restricted to repetitive viewing of the same course material. New remedial material should be given to trainees experiencing continued difficulty with the original material.

4. <u>Course Material Preparation</u>. Course material is carefully prepared in advance by the course designer. The avoidance of large quantities of inserted frames within a lesson improves the efficiency with which the material is presented to the trainee.

3.2 CEI DEFINITION

The relation of CDTS to the Phase II programs and computer is defined in the following subparagraphs.

3.2.1 <u>Interface Requirements</u>

Interface Functional Block Diagrams and detailed interface definitions define the requirements imposed upon CDTS because of its relationship with the Phase II Base Level Master Control Program and Data Communications Handler, The Burroughs B3500 Computer System, and other Phase II program systems.

3.2.1.1 <u>Interface Block Diagrams</u>

3.2.1.1-1 <u>B3500 System</u>

3.2.1.1-2 <u>COBOL Compiler and Program Test System</u>

3.2.1.1-3 <u>Master Control Program/Data Communications Handler</u>

3.2.1.1-4 <u>Phase II System – On-Line Processing</u>

3.2.1.1-5 <u>Phase II System – Off-Line (Batch) Processing</u>

3.2.1.2 Detailed Interface Definition

3.2.1.2/1 B3500 System. The Phase II Base Level System will use the Burroughs Corporation B3500 computer system. Figure 3.2.1.1-1 contains a system diagram of the configuration to be installed at Development Centers. All configurations will not necessarily be identical to the one depicted by figure 3.2.1.1-1, but it is the one to be used as a guide to system planning.

3.2.1.2/1.1 System Configuration

DEVICE	MODEL	ADDITIONAL FEATURES	CHARACTERISTICS
CPU	3501, 3015	Floating point 3 Type "A" I/O channels 3 Type "B" I/O channels (minimum)	150,000 bytes of Core memory
Disk File Control	3373	3474-Exchange 3674-Adapters (2)	
Console Control	3340		
Card Reader Control	3110		
Card Punch Control	3210		
Line Printer Control	3240		
Magnetic Tape Control	3391-1	3490-Exchange	9-track tape control
Multiline Control	3353	3354-8 Channel adapter 3651-1 Adapters	Line Adapters for Keyboard Printer Remotes and Remote Card Reader
Console Printer and Keyboard	9340		
Card Reader	9111		800 CPM Reader
Card Punch	9211		300 CPM Punch

DEVICE	MODEL	ADDITIONAL FEATURES	CHARACTERISTICS
Line Printer	9245	9941 - which adds 12 additional print positions	1100 LPM Printer 132 Print positions
Magnetic Tape Units	9392		9-tracks, 1/2"-wide, 200, 556, or 800 BPI density, 72000 BPS at 90 IPS
Electronic Unit	9371-1		Disk File Electronics Units
Disk File	9372-5		Five modules of 10,000,000 bytes each with an average access time of 20 milliseconds
Remote Keyboard Printer	9350-2		Buffered Remote Keyboard Printers, ASCII
Remote Card Reader	9350-3		Buffered Remote Card Reader-ASCII

3.2.1.2/1.2 System Characteristics. The B3500 system is a modular system, incorporating monolithic circuitry, high-speed core storage, massive immediate access (disk storage, and remote communications terminals. Its Master Control Program (operating system) is designed to facilitate on-line user interaction with programs from the remote terminals. The following paragraphs briefly describe the major components of the system.

1. Central Control. All peripheral unit operations are independent of each other and of the processor; therefore, any combination of simultaneous input-output and compute operations are possible. When a particular device wants a memory access, it makes an access request to central control, which grants the request as soon as all requests from high priority devices have been satisfied.

2. Core Memory. Core memory requires a memory cycle time of one microsecond for every two bytes accessed.

3. Address Memory. Address memory is an array or table of 24 words (two bytes to the word), expandable in increments of 12 words. Eight words are assigned to each I/O channel in the system. During

execution, the processor addresses core memory with words from address memory so that memory accesses are not required for information relative to the command itself during execution; that is, accesses during the execution phase are for data only. A word from address memory requires an access time of only 100 nanoseconds.

4. Input/Output System. The input/output system consists of the peripheral control units and their related input/output channels and operates independently of the processor. The processor issues a command to the I/O system and then proceeds independently until the I/O system completes the operation and interrupts the processor. I/O operations are independent of each other and any or all I/O channels may operate simultaneously. The I/O system time shares core memory and address memory with the processor, under control of the central control unit. There is an I/O channel and a peripheral control for each peripheral unit, or group of units of the same type.

5. The Processor. The processor contains the arithmetic units and the logical controls of the system. Object programs are floated in memory through the use of a base register thus allowing several programs to be resident in memory at one time. The Master Control Program (MCP) will set the base register for one program, retrieve it, and turn control over to that program. After handling an interrupt, the MCP may reset the base register and turn control over to another program.

6. Operational States. The central processor always operates in one of two states: The Normal State, in which user programs are executed, or the Control State, in which the functions of the MCP operating system are performed. A powerful interrupt system causes the processor to enter the Control State and branch to the MCP whenever conditions such as completion of an I/O operation, memory parity error, memory address error, and clock interrupt occur. I/O operations can be initiated only when the central processor is in the Control State, and their execution is directed by the MCP.

7. Memory Protection. Base and limit registers are used to provide memory protection--an essential feature for multiprocessing. An attempt to go out of memory allocated will result in the suspension of the offending program.

8. Disk Files. The modular random storage disk modules provided the capacity of 10 million bytes each. The average access time for a module is 20 milliseconds, and the peak transfer rate is 218,000 bytes per second. Disk File Exchange units permit multichannel access of disk units.

9. Remote Terminal Communications. A multiprocessing environment
    is provided, under which up to ten users of the system may simul-
    taneously interact with their programs from remote keyboard/printer
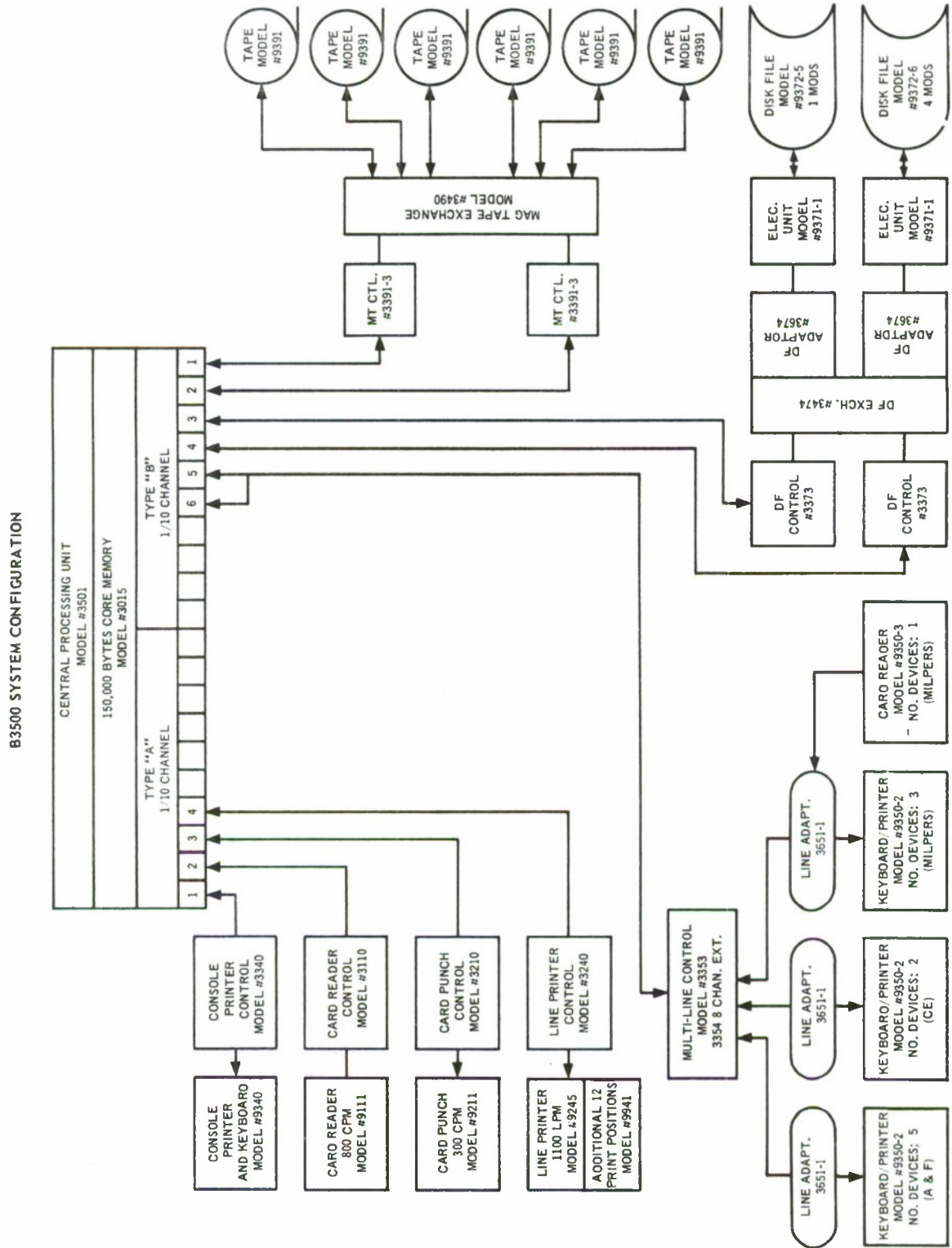   terminals.

FIGURE 3.2.1.1-1   B3500 SYSTEM CONFIGURATION

3.2.1.2/2 COBOL Compiler and Program Test System

3.2.1.2/2.1 COBOL Compiler. The Common Business Oriented Language (COBOL) is
the standard Phase II programming language for all Air Force standard command
unique data system and for nonrecurring base level unique reporting requirements.
The COBOL elements implemented in the B3500 are as defined by the USASI COBOL 65
proposed except as noted in the Burroughs B3500 Systems COBOL Reference Manual
(1033099). Extensions to the language have been made to support program over-
lays, disk processing, data communications, and interprogram communications.
Certain elements which are contained in the B3500 version of COBOL have been
restricted from use or modified in some manner. The basic reason for any
restriction is to insure conformity to the proposed United States of America
Standards (pUSAS) COBOL specifications as documented in updated COBOL Information
Bulletin number 9 (CIB#9). Coding conventions, legal characters, language
elements, and other limitations upon Phase II COBOL programs are specified in
AFM 171-100, B3500 Automated Management Supporting Data Systems (AMSDS) Development,
Maintenance, and Documentation Standards.

3.2.1.2/2.2 Program Test System. The Phase II Program Test System will operate
in a batch processing environment, for use in verifying changes to established
systems. The specific requirements imposed upon interfacing systems will be pub-
lished at a later date as AFM 171-104. The test system is designed to provide:

1. A Source Language Tape (SOLT) which contains, in card image format,
    the program source language statements. CDTS will be compiled as
    three programs, one for on-line processing functions, and the
    other two designed to operate in a batch mode. The on-line pro-
    gram will contain the Control, Lesson Building, and Lesson Execu-
    tion functions. The batch-processing programs will provide the
    Off-Line Lesson Building and Trainee Record Processing functions.

2. A Test Data Library Tape which contains the test data for the
    programs.

3. A means to maintain the SOLT and the Test Data Library Tapes.

4. A test data generator which creates the various data files
    necessary to test the object programs.

5. A test system dump program which creates printouts of tapes
    specified by the programmer.

6. An analyzer program which analyzes the input data and creates the
    various execute, change cards, etc., thereby reducing the amount
    of manual manipulation required. Also, it analyzes the program for
    Phase II standards and rejects those programs that do not conform.

Figure 3.2.1.1.-2 shows a general flow of the program test system.

3.2.1.2/2 COBOL Compiler and Program Test System

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6. An analyzer program which analyzes the input data and creates the
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   Phase II standards and rejects those programs that do not conform.

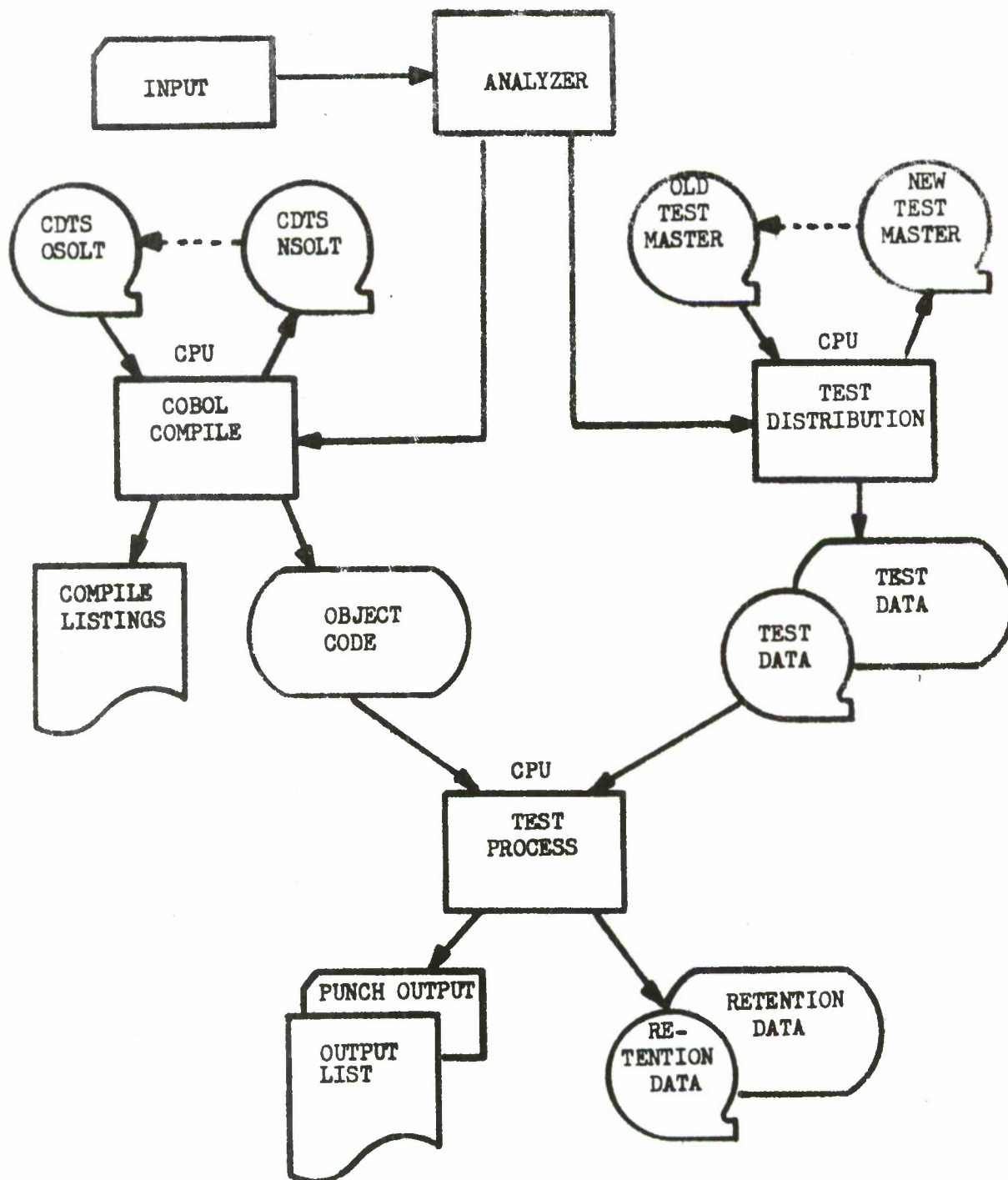Figure 3.2.1.1.-2 shows a general flow of the program test system.

FIGURE 3.2.1.1-2   COBOL COMPILER AND PROGRAM TEST SYSTEM

3.2.1.2/3 Master Control Program/Data Communications Handler

3.2.1.2/3.1 Master Control Program. The B3500 Master Control Program (MCP) is a modular operating system consisting of a set of routines to provide automatic control over program loading, scheduling allocation of memory, input/output operations, assignment of hardware componenets, multiprocessing, and hardware interrupt resolution.

3.2.1.2/3.1.1 Program Organization Requirements for Execution under the MCP. Typically, all information pertaining to a program cannot be in core at the same time. CDTS will therefore be divided into non-overlayable and overlayable seqments. The non-overlayable segment contains data used most frequently by the program and the program routines required to interface with the MCP (and DCH – see Section 3.2.1.2/3.2). The overlayable segments are brought into core as they are needed. If the program segment is to be overlaid, the code must be re-entrant.

3.2.1.2/3.1.2 MCP-CDTS Disk Storage Interface. Disk storage is divided into two categories by the MCP: (1) System Disk; and (2) Users Disk. The System Disk is reserved for the use of MCP and its associated tables and directories. The Users Disk is used to store data files and program files (as well as the system compilers). The Users Disk is also divided into two categories: (1) Permanent Files; and (2) Temporary Files. A temporary file is one that is declared by the program using it, and it not maintained in the MCP's Disk Directory. A program can cause its temporary file to be made permanent by performing a "Close with Lock" or a "Close with Release" on it.

3.2.1.2/3.1.2.1 Disk File Organization. Every program must specify the maximum amount of disk required for a particular file. The MCP allows a single file to occupy from one to twenty separate areas on disk. The program that establishes a file specifies the number of areas in the file and the size of the area by defining the number of logical records per area, and the number of areas required. The size of the disk file is broken into two dimensions so that the MCP will allocate disk space only as required during the creation of a file or the lengthening of an existing file.

3.2.1.2/3.1.2.2 Disk File Access. The disk file is addressed by 100 byte segments. With the disk file being addressed in 100 byte increments, all disk file physical records should be a multiple of 100 bytes or 200 digits. If the disk file physical records are not in increments of 100 bytes, disk space will be wasted. When a logical record is requested in a random mode, it is addressed by the logical number it has with respect to the first logical record. In this scheme the first logical record is addressed by using ACTUAL KEY of "1." This method of organization allows the file to be built in a sequential mode and later accessed in a random mode.

3.2.1.2/3.1.3 MCP-CDTS Tape Storage Interface. The basic tape configuration at all Phase II sites will be six nine channel tapes. All nine-track tape is written in binary (core image) therefore, no conversion is necessary. The tape is always written in odd parity with no translation taking place. This makes it possible to include COMPUTATIONAL data in tape files without having to consider conversion.

An additional seven-track tape will be installed at certain sites. However, interface problems exist in reading tapes produced by other systems. Although the B3500 system has a "Non-Standard Recording-Mode" to provide IBM compatibility, all BCD tape characters cannot be translated to EBCDIC.

CDTS has no requirement for outputting data to seven-track tape. Its only input external to the B3500 system is to the Off-Line Lesson Building Function. Since this function is designed to accept either card or nine-track tape input, no compatibility with seven-track tape input will be provided within the program.

3.2.1.2/3.2 Data Communications Handler. On-Line systems communicate with the Master Control Program for interaction with the remote terminals through the Data Communications Handler (DCH). Detailed interface requirements imposed upon Phase II systems by the DCH are documented in AFM 171-103, Vol. III (TEST), Data Communications Control System Users Information. The following paragraphs contain those DCH/subsystem interface requirements of primary concern to CDTS. It is understood that these requirements may be modified by subsequent AFM 171 publication.

3.2.1.2/3.2.1 On-Line Program System Structure. Each on-line functional system will be written as a single COBOL program with a Functional System Analyzer (FSA) as the non-overlayable program segment and each unique processing routine as an overlayable segment. The Control Function of CDTS will be the single analyzer that communicates with the DCH. The FSA performs an analysis of input messages to determine which processing overlay is needed to react to the message. When processing is completed and a response prepared, the response is passed back to the DCH for output to the remote device.

3.2.1.2/3.2.2 Input/Output Communications. The DCH performs all direct communications with the remote devices, handles line discipline and error situations, relieving CDTS from consideration of hardware pecularities of the remote devices, timing considerations, etc.

3.2.1.2/3.2.2.1 COBOL Restriction-Data Communications. The only data communication COBOL constructs that may be used by CDTS are the "FILL FORM" and the "FILL INTO" statements to exchange data with the DCH. The FSA receives remote input messages from the DCH via the "FILL data-name-1 FROM NACE 20" construct, a Burroughs extension to COBOL for interprogram communications. Likewise, responses are returned to the DCH using the "FILL data-name-INTO NACE 20" construct.

3.2.1.2/3.2.2.2 Input-Output Timing. The DCH will not deliver the next remote input message to CDTS until the FSA notifies the DCH that it has completed processing of a previous message. The FSA may produce a response that requires multiple "FILL INTOs." In this case, the FSA must return to the "FILL FROM" only when the "FILL INTOs" have been completed. This allows the FSA to process remote messages in a serial mode one at a time. Whenever the FSA requests a message and there is none, the FSA is "stalled." This stall point indicates that the CDTS has no work to perform and may be rolled-out to make core available for other processing. When a message arrives for processing the DCH will bring the FSA back into core and pass it the message.

3.2.1.2/3.2.2.3 Remote Terminal Message Processing. Internally, data is passed between DCH and FSA as core buffer images. Each core buffer contains 160 data-character positions preceded by eight characters of control information. The Buffer Information Characters (BIC) are outlined below. Different characters may be referenced as BIC3 meaning the third buffer information character, BIC4-6 meaning the fourth, fifth, and sixth buffer information characters, etc.

1. Buffer Format

   a. BIC1-2. To and from FSA. Device Identification-a two character code assigned to uniquely identify each remote.

Code	Meaning
$\emptyset$A - $\emptyset$Z	Host base remote keyboard devices
1A - 1Z	First satellite remote keyboard devices
2A - 2Z	Second satellite remote keyboard devices

   b. BIC3. To FSA. Card Reader Control--used to pass card reader status information to the FSA(s) for devices having remote card readers.

      This input character is not applicable to CDTS.

   c. BIC3. To DCH. Write Directive--informs the DCH what disposition is to be made of the original input message and the message now being passed to the DCH. The code is Boolean as follows:

Code	Meaning
4-bit on	Write original input message to tape with code 'R'.
2-bit on	Write this message to tape with code 'D'.
1-bit on	Write this message to remote.

      The valid range of values is 0 through 7. Code 0 indicates a null message. The code is resolved in 4-2-1 sequence. The original input message is lost once a message is written back to the remote device. Therefore, no write directive with a

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4-bit should be sent subsequent to processing a write directive containing a 1-bit. This is an FSA responsibility.

d. <u>BIC4</u>. To FSA. Special Input Code--used by the DCH to signal the FSA of some special action.

Code	Meaning
C	After completing all writing to the remote, the FSA has indicated it is processing input data from the disk, instead of reading from that remote. This signals the FSA to process one more message from disk and deliver its output to the remote identified.
S	Notifies the FSA that it must shut down. This is the only message to an FSA that requires no response, as it disconnects the functional system from the DCH and on-line processing.

e. <u>BIC4</u>. To DCH. Write Terminator--indicates the DCH what action is to be taken after resolving the Write Directive.

Code	Meaning
blank	The processing of the message is complete; allows remote to input next message.
1	The processing of this message is not complete. Another "FILL FROM" the FSA is issued.
2	The processing of this message is complete. Also notifies the DCH that the input data is being read from the remote. The remote is receiving the results of that processing. The FSA requests a BIC4=C be issued as soon as the typing to this remote is finished.
3.	The processing of this message is complete. Indicates that the FSA has rejected an "OPEN" request or accepted a "CLOSE" request. It causes the DCH to disconnect this remote from the functional system.

f. <u>BIC5</u>. Not used.

g. <u>BIC6-8</u>. To and from FSA. Number of data characters--contains the number of characters in the data portion of the buffer. This field must be numeric, right justified with zero fill on left. For input messages the range of values is 1 to 150; for output, 1 to 160.

h. Summary of Control Characters

BIC	DCH TO FSA	FSA TO DCH
1-2	Device ID	Device ID
3	Card Reader Control	Write Directive
4	Special Input Code	Write Terminator
5	Not Used	Not Used
6-8	Character Count	Character Count

The data portion of the message buffer could contain:
(1) CDTS Message data; (2) Control Message "*OPEN";
(3) Control Message "*CLOSE"; (4) Control Message "*FORCE";
(5) Control Message "*DOWN."

2. Control Messages. Certain messages are required to furnish the DCH
with controlling information. All control messages begin with an
asterisk (*) in position 1.

   a. The Open Statement

      Format: *OPEN FOR E (education) Social Security Number

      This message must be first message input from a remote device.
      Its purpose is to associate the device with a functional system.
      The "E" defines the functional system as CDTS. The remainder
      of the message has been defined by CDTS, and is used to identify
      the system user. After establishing the device with CDTS, the
      DCH will pass the message to the FSA. The FSA may then accept
      the device and complete the message cycle with a normal message
      response or deny access by returning the appropriate response
      to the device and setting BIC="3."

   b. The Close Statement

      Format: *CLOSE

      This statement is normally the last message from a remote device
      to a functional system, and requests the device to be disconnected
      from the FSA. After the FSA has accepted the response (Write
      Terminator=3) and delivered its response, the DCH will disconnect
      the remote and issue instructions for the remote to log in.

   c. The Force Statement

      Format: *FORCE

      This message is an undeniable CLOSE of the remote device. The
      device will be disconnected following the FSA's response regardless

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of the setting of the Write Terminator

d.   <u>The Down Statement</u>

Format: *DOWN

This message is originated only by the DCH. It notifies the
FSA that the remote has been lost temporarily for some reason.
The FSA will first be aware that a remote is active again when
it receives the next input message from that remote.

3.   <u>Input Data Messages</u>. An ETB or ETX control character terminates a
buffer fill from the remote. The DCH examines each input message and:

   a.   Eliminates control characters preceding the data.

   b.   Detects backspace characters embedded in the data and eliminates
the backspace and the preceding data character.

   c.   Determines the actual number of data characters (delineated by
an EXT or ETB) and sets the character count.

The DCH will acknowledge receipt of an input message by a carriage
return to the remote. The data message is passed to the FSA in
its final edited form. The ETX (or ETB) character is passed but not
included in the character count.

4.   <u>Output Data Messages</u>. The FSA is responsible for placing carriage
return characters in all output messages to insure the carriage is
not overrun. The last data character in the last message should be
a carriage return. The contents of an output data message are not
examined but are transmitted as received from the FSA.

The DCH maintains two message stacks for each remote. Each stack
can hold 98 output messages. When the FSA produces a multiple
message response, the DCH places all but the first in the "normal"
stack. Switched messages for a remote are placed in its "alternate"
stack. The alternate stack is emptied after the normal stack
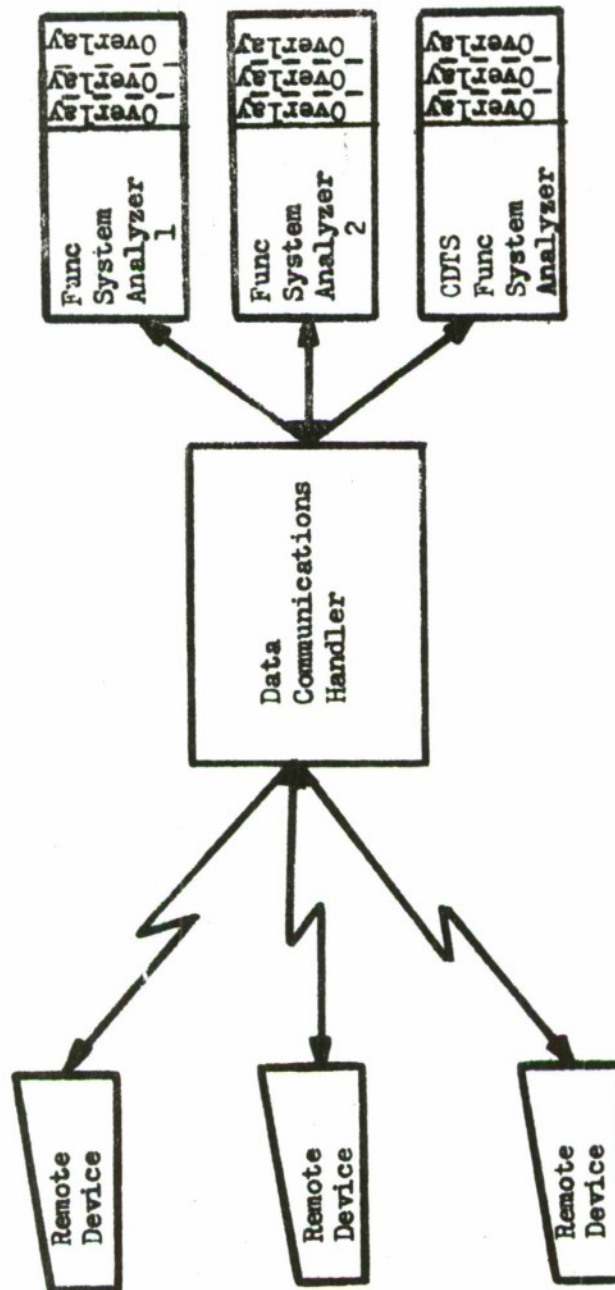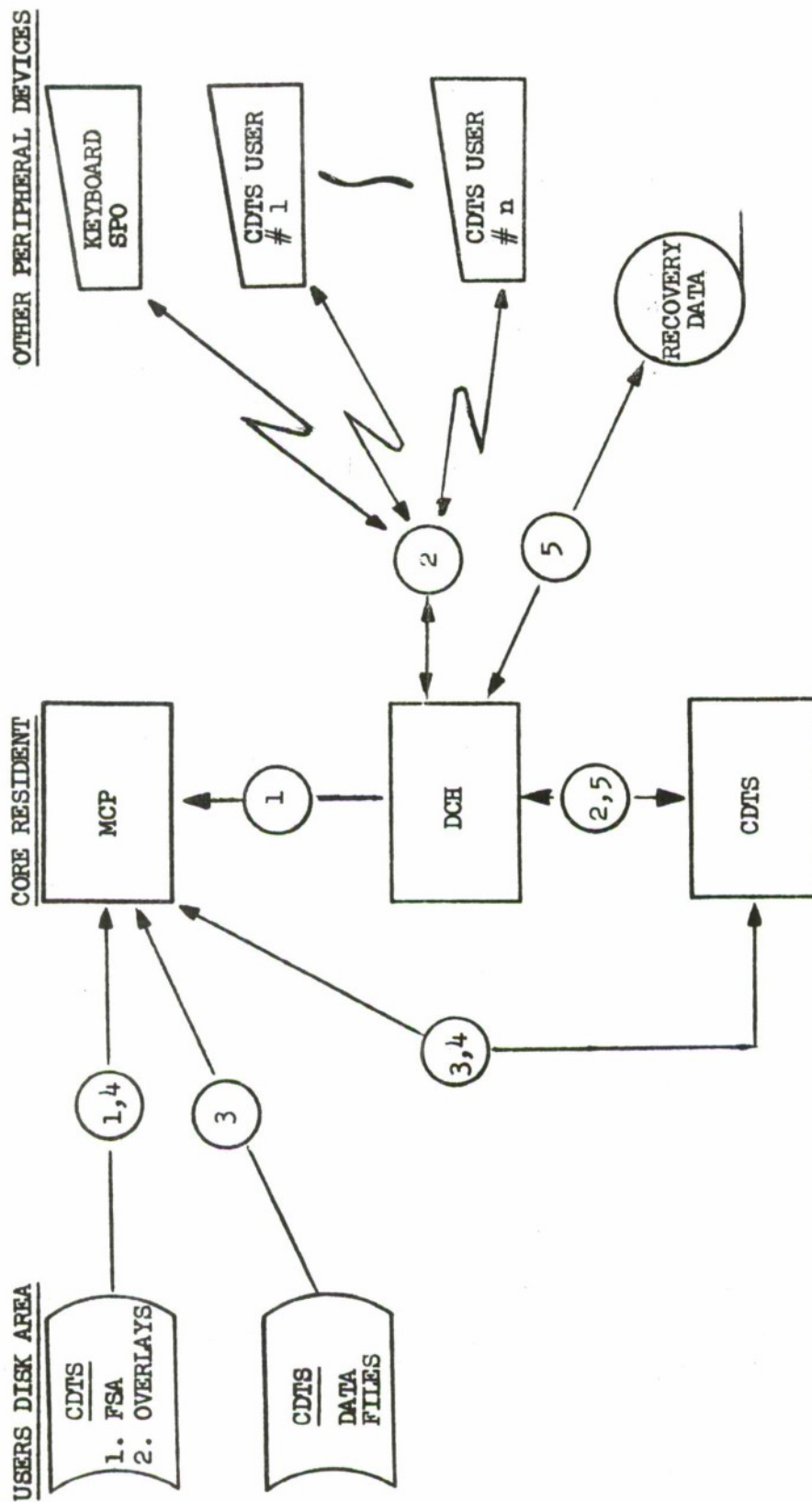becomes empty or when the remote is found to be idle.

FIGURE 3.2.1.1-3   MASTER CONTROL PROGRAM/DATA COMMUNICATIONS HANDLER

FIGURE 3.2.1.1-4   PHASE II SYSTEM – ON-LINE PROCESSING

LEGEND

1. ZIP GO
2. Remote Device and SPO Keyboard I/O
3. Disk I/O
4. Switching in of Overlays
5. Tape I/O

3.2.1.2/4 Phase II System On-Line Processing. The Computer-Directed Training Subsystem performs its functions of lesson building and lesson execution in an on-line environment and conforms to the limitations and restrictions applying to all Phase II on-line systems.

3.2.1.2/4.1 Core Memory. CDTS must be designed to operate within 32,000 bytes of core memory. This allocation of memory includes the core-resident portions (i.e., input/output buffer, data areas, constant areas, FSA, etc.) and the largest overlayable segment required by the system. The estimate of CDTS core memory requirements is as follows:

Program Function/Data Area	Core Required (Bytes)
Functional System Analyzer	3,000 (Resident Portion)
User Control Table	3,000
User Swap Data & Working Storage	3,200
Lesson Data (frame table)	400
Cue-Feedback Message Table	550
*Trainee Record Table	20
Remote Terminal Table	168
Input/Output Buffers	7,000
Overlay Area	15,000

3.2.1.2/4.2 Disk Storage. The use of disk during the time the data communications systems are running will be restricted to program libraries, nonfunctional software and master files used by the approved data communications systems. The planned maintenance of any file on disk must be approved as prescribed in AFR 300-3. It may be desirable to maintain master files on disk and have them processed as batch processing systems. This may be feasible when the application involves the processing of a limited number of input transactions against a large master file. It is tentatively planned that the User Control Table (see 3.1.2.1/1.3.1) and the User Swap Data File (see 3.1.2.1/1.3.2) be recommended for permanent storage on disk.

The following disk files are required for use by the Computer-Directed Training Subsystem:

3.2.1.2/4.2.1 Lesson File. The Lesson File contains the lesson table, frame directory, and label table, for each lesson constructed. Storage allocation for the table is:

1. Lesson Table - 300 frames x 400 bytes per frame = 120,000 bytes

2. Frame Directory - 300 frames x 4 bytes per frame = 1200 bytes

3. Label Table - 50 labels x 8 bytes per label = 400 bytes

---

*Minimum allocation for trainee records. If overlay memory requirements permit, these data will be output in blocked format.

Total disk allocation per lesson = 121,600 bytes.

No maximum disk allocation is intended for the Lesson File. A lesson loading
program will be developed to run in a batch processing environment and load
lessons selected from a library tape of course material. This program will
reconstruct, on a run-specific basis, the Lesson File Table of Contents and
load the requested lessons onto immediate access storage. The amount of disk
allocated to lesson material storage would then be influenced by the training
requirements of a given Phase II installation.

3.2.1.2/4.2.2 <u>User Swap Data File</u>. The User Swap Data File contains the Master
Swap Data and the User Swap Data. Storage allocation for the table is:

    1.   Master Swap Data - 100 users x 23 bytes = 2300 bytes for all users.

    2.   User Swap Data - 3000 bytes per user/lesson combination.

The User Swap Data contains an entry (3000 bytes) for each user/trainee who is
in the process of building or taking a lesson. User/lesson entries are cleared
from the file when the lesson is completed. With other system restrictions set
at 100 active users, it is estimated that 300 User Swap Data records will handle
the storage requirements for the file (300 x 300 = 900,000 bytes of disk storage.)
It is recommended that no fixed limit be placed on the number of lessons with
which a user/trainee may be interacting, unless experience indicates that an
exorbitant amount of disk storage is being required during on-line sessions to
maintain CDTS data. The Swap Data file will be updated onto tape storage fol-   '
lowing the close of on-line processing by a batch processing program. This
process will be followed even if permission is granted to maintain the file
permanently on disk, in order to provide tape back-up. It is recommended that
this batch program eventually have a capability to delete, at training super-
visor's option, Swap Data records for user/lesson entries which are no longer
meaningful (i.e., a trainee starts a lesson and soon discovers that he is not
qualified to continue to completion).

3.2.1.2/4.2.3 <u>Trainee Display Record File</u>. The Trainee Display Record file is
used by the Lesson Execution Function to output records of trainee performance,
and is input to the batch mode Trainee Record Processing Function for pro-
duction of formal reports. Storage allocation for the file is not fixed. Fixing
the allocation would require the imposition of a limit upon the number of "frame
executions" for a trainee/lesson combination. That is to say, an assumption
would have to be made as to what would be a reasonable limit upon the number of
times a trainee would repeat through frames of a lesson, and thus create trainee
records.

To cope with the problems of excessive disk storage requirements, excessive
input/output operations, and maintenance/control functions, CDTS has been
designed to maintain, as a part of the User Swap Data, limited trainee performance
records for use by decision frames.

3.2.1.2/4.3 Opening On-Line Sessions

1. An on-line session begins when the computer operator issues an EXECUTE of the DCH program. The DCH will perform its initialization processing, open its files, etc. The DCH then allows the operator to identify the on-line systems that are to be opened at this time. As a system is identified to the DCH,   DCH will issue an EXECUTE of the functional on-line program using the ZIP function. DCH waits for a "GO AHEAD" signal to be returned from the FSA indicating its initialization is complete and the system is ready to accept remote traffic. When the DCH broadcasts to all remote devices that the system is ready for log in, the session then assumes a normal mode of operation. At any time during a session, the computer operator may request attention from DCH and indicate another on-line system is to be opened.

2. The DCH will require the first message from a remote device be an OPEN request. Otherwise, the message will be ignored. A remote may request an OPEN at any time during a session. If the FSA requested by the OPEN statement is not currently open, the computer operations facility will be notified.

3.2.1.2/4.4 Closing On-Line Sessions

1. The computer operator notifies the DCH that a mandatory and permanent closing of the on-line session is requested. The DCH broadcasts a notification to all open remote devices that the system is closing down in 10 minutes. This will allow remote operators to finish their business and request a CLOSE of their device. At the end of the time limit, the DCH unconditionally cancels all traffic on the remote lines that are still open, sets the devices in a write only status, and then generates CLOSE messages for each open device.

2. When the last device associated with a functional on-line system closes, the DCH will issue a system close message to the FSA and disconnects itself from the functional system.
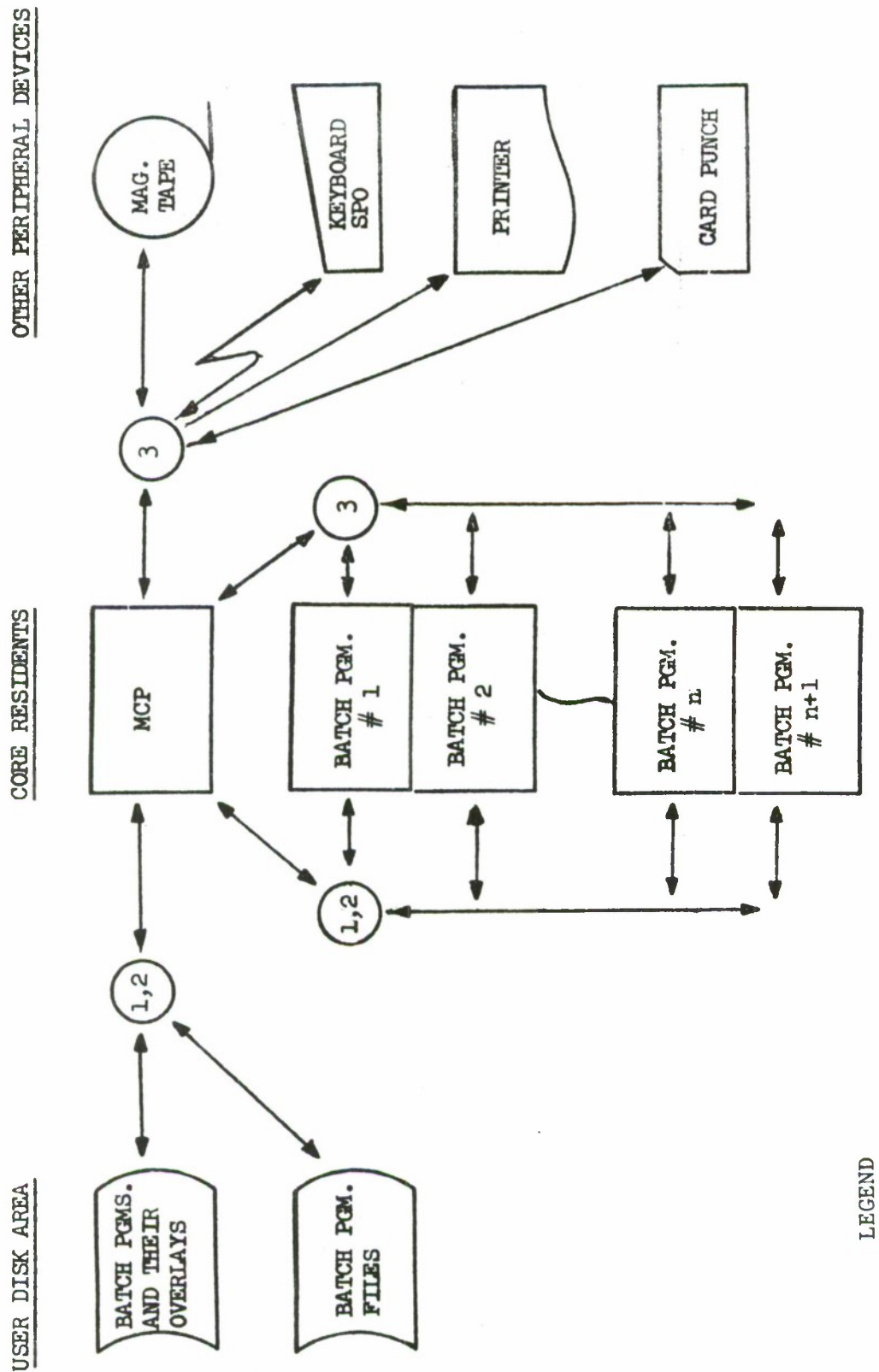
FIGURE 3.2.1.1-5   PHASE II SYSTEM - OFF-LINE (BATCH) PROCESSING

OTHER PERIPHERAL DEVICES

MAG. TAPE

KEYBOARD SPO

PRINTER

CARD PUNCH

CORE RESIDENTS

MCP

BATCH PGM. #1

BATCH PGM. #2

BATCH PGM. #n

BATCH PGM. #n+1

USER DISK AREA

BATCH PGMS. AND THEIR OVERLAYS

BATCH PGM. FILES

LEGEND

1.   Loading of Object Programs and Overlays
2.   Disk I/O
3.   Other than Disk I/O

3.2.1.2/5 Phase II System - Off-Line Processing. The Computer-Directed Training Subsystem performs its functions of trainee record processing and off-line lesson building in a batch processing mode. These functions:

     1. Initialize system disk files as required by a given installation.

     2. Produce reports from disk files and release files.

     3. Produce lesson files on disk from card and tape input.

In accomplishing these functions, the CDTS batch processing functions will conform to the limitations and restrictions of all Phase II off-line systems.

3.2.1.2/5.1 Core Memory. All batch processing applications will be designed to run in a maximum of 20,000 bytes of core memory. It is desirable to have each batch application designed to function in approximately 10,000 bytes. The off-line functions of CDTS operate independently of each other and are designed to operate within 20,000 bytes of memory.

3.2.1.2/5.2 Disk Storage. Batch processing programs are allowed to use a maximum of 14 million bytes of disk for temporary working storage. These files are not closed with lock or closed with release. This working storage is primarily allocated for sorting and must be shared by all batch processing programs. An example of the use of this working storage would be a large table that a program reads from tape to disk and accesses the table from disk randomly. If batch processing systems desire to maintain files on disk or to use disk for temporary storage of files between programs it must be approved as prescribed in AFR 300-3.

CDTS has, at this time, no requirement for permanent maintenance of disk files created by its batch processing functions.

3.2.1.2/5.3 Peripheral Devices. Four magnetic tape units, one card reader, one card punch, one on-line printer, and the supervisory printer are available to batch processing systems. However, the use of all devices by any one program is discouraged. Batch processing systems will be designed to run concurrently or non-concurrently with the on-line systems. Batch processing programs will be designed to have as a maximum three card files as inputs (one file behind the other, requiring no pseudo readers), one card file as output, and no more than three print files simultaneously (not to exceed four magnetic tape units including printer back-up). If a program is limited to three or four files, excluding disk files, it will allow the total system and each individual system to obtain optimum utilization of the equipment.

3.2.1.2/5.3.1 CDTS Tape Files. CDTS maintains two tape files, the Lesson File and the Trainee Record File, during its batch processing operations. Each file is used by a different off-line function, thus only one input file and one out-

put file will be open at any time.

3.2.1.2/5.3.2 Print Files. All programs that produce output files which are assigned to the printer must either utilize the standard print routine for page formatting or contain routines to handle line counting, page counting, and page ejection. CDTS specific routines for these functions will be used to create more economical code and more efficient operation.

Pertinent conventions for printer output are as follows:

1. The first report header line of each page will contain as the extreme left of the line the word "PREPARED" followed by the current date in the form of two or four digit year, three character month and two digit day. The title of the report will be entered on this line. Remaining header lines will describe all columns of data that are contained in the report. The descriptions will be short words and/or meaningful abbreviations.

2. The last line of each page will contain the word "PAGE" followed by the sequential page number centered in the line. The final page of the report will contain the word "END" preceding the last "PAGE."

3. The standard vertical spacing for all printed output will be six lines per inch and the standard carriage control tape will be used for all printing.

4. All files assigned to the printer must be labeled. When the file is opened the label is printed "BEFORE ADVANCING TO CHANNEL 1," and when the file is closed the label is printed "AFTER ADVANCING TO CHANNEL 1."

5. The "WRITE BEFORE ADVANCING" option of COBOL must be used for all line spacing. The "TO CHANNEL" option of COBOL should be used whenever the spacing exceeds 2.

3.2.2 Government-Furnished Property List

This paragraph is not applicable to the Computer-Directed Training Subsystem, as it has no requirement to incorporate government-furnished computer programs.

3.3 DESIGN REQUIREMENTS

The following subparagraphs specify requirements which affect the design of the CPCEI, and are distinguishable from the performance requirements of paragraph 3.1. These requirements result from general considerations of CPCEI usability.

3.3.1 System Design and Construction Standards

The coding of CDTS shall be restricted to that which produces a computer program that economically satisfies the requirements of this specification, both from a production and from a maintenance viewpoint. The program will be compiled from a source program coded in the B3500 COBOL language, and will conform to Air Force standards, as specified in AFM 171-100 (TEST). These standards restrict or modify the use of certain elements of the B3500 COBOL language. The basic reason for any restriction is to insure conformity to the proposed United States of America Standards (pUSAS) COBOL specifications as documented in COBOL Information Bulletin Number 9 (CIB #9).

3.3.1.1 On-Line System Organization. The B3500 multiprogramming environment allows several programs to reside in memory, providing core is available. To insure core for multiprogramming, the amount of core that can be used for the programs within each application system is restricted. A modular design which facilitates program overlaying is necessary for large programs. Since CDTS is primarily designed for on-line processing, special consideration must be given to efficiency and responsiveness because several users are being serviced during the real-time period. Consideration must be given to structure of a program – sequence and arrangement of data and procedures – to allow for easy and proper segmentation. Program segments must be designed to preclude unnecessary loading of non-resident routines. Files will be opened only as needed, and closed when they are no longer needed.

3.3.1.2 Off-Line Program Functions. Off-line systems are limited to the use of disk storage for input and output data files. Time consuming processes of file searching and printing of large amounts of data are restricted to off-line batch processing programs. Restrictions of this nature require the segmentation of CDTS into both on-line and batch processing programs. Processes such as lesson building via card input and processing of trainee records must be accomplished in a batch mode.

3.3.2 Processing Capability and Error Detection

CDTS will process inputs, construct outputs, and interact with the SPO, the Master Control Program and the Data Communications Handler, the B3500 hardware, and remote terminal users. This interaction will be in a manner compatible with the limits, needs and capacities of the interfacing elements, as stipulated or implied elsewhere in this document. CDTS shall also ensure that if anticipated limits are exceeded by users, the program shall not fail. All overload and error conditions plus equipment malfunctions, when detected, will be communicated as specified. Whenever possible, input/output errors effecting one remote terminal will not force other remote terminal users to be closed down.

3.3.3 Interrupt and Restart Capability

CDTS will provide an interrupt and restart capability that is compatible with the Phase II procedure for interrupting and restarting on-line systems.

3.3.4 Test and Simulation

CDTS will provide capabilities to facilitate the testing of the program and associated lesson material. It will accept card inputs of pre-established lesson material and simulate the production of course material input via remote communications terminals, in a manner which satisfies program or system test requirements. This will include the ability to establish disk files required to be considered as existing by normal operating functions of CDTS.

3.3.5 Maintainability

To provide maintainability, CDTS will be structured as a series of subfunctions containing individual areas of code that can be changed with little effect on the other subfunctions. Coding conventions established in AFM 171-100 will be rigidly adhered to in order to facilitate understanding of the program design logic.

3.3.6 Deviation from Accepted Programming Standards

When unusual or special problems are encountered which warrant a solution not in compliance with the standards outlined in AFM 171-100, a request to deviate ' from the standard will be documented and submitted to AFDSDC (DIBA).

4. QUALITY ASSURANCE PROVISIONS

The purposes of provisions contained in this section are (1) to define requirements for equipment and facilities to support contractor testing of the Computer-Directed Training Subsystem (CDTS) as part of the computer program design and development process and (2) to specify the Category I test methods to be employed for formally verifying that CDTS satisfies all performance and design requirements specified in Section 3. Qualification requirements associated with acceptance of the CDTS Contract End Item shall be satisfied by successful completion of the testing specified herein.

4.1 CATEGORY I TESTS

Detailed requirements pertaining to Computer Programming Test and Evaluation, Preliminary Qualification Tests (PQTs), and Formal Qualification Tests (FQTs) are contained in the following subparagraphs.

4.1.1 Computer Programming Test and Evaluation

Testing to support the design and development of CDTS shall be conducted prior to and parallel with preliminary and formal qualification tests. This testing shall be conducted by the contractor as an integral part of the CDTS design and development process, using government-furnished equipment and facilities as specified below.

4.1.1.1 Government-Furnished Equipment. The following items of government-furnished equipment will be installed and maintained at the Sheppard Technical Training Center (Sheppard AFB, Wichita Falls, Texas). This equipment will be available for use by the contractor, on a scheduled basis, throughout the period of CDTS design, development, and qualification testing.

ITEM	QUANTITY
3501 - 150,000-byte memory CPU	1
3373, 3374 - Disk File Control & Exchange	1
3340 - Console Control	1
3110 - Card Reader Control	1
3210 - Card Punch Control	1
3240 - Line Printer Control	1
3391, 3490 - Magnetic Tape Control and Exchange	1
9340 - Supervisory Printer and Keyboard	1
9111 - Card Reader	1
9211 - Card Punch	1
9245 - Line Printer	1
9392 - 9-Track Magnetic Tape Units	6
9371-1 - Disk File Electronics Unit	2
9372-5 - Disk File - 5 Modules	1
9350-2 - Remote Keyboard Printer	10
9353-3 - Remote Card Reader	1

4.1.1.2 Test Requirements. Computer program testing associated with interfacing equipment and computer programs will require the use of this equipment with the following allowable exceptions:

    1. Only one disk file is required.

    2. Only 3 remote keyboard printers are required.

    3. The remote card reader is not required.

An operational Master Control Program, Data Communications Handler and COBOL compiler are also required. Computer time to the extent of 4 hours per day for a period of 90 days must be available to the contractor at the Sheppard Technical Training Center, starting approximately 150 days after initiation of

the program development activity. Delays in the availability of the test equipment will result in a corresponding delay in the initiation of Preliminary and Final Qualification Tests.

4.1.2 Preliminary Qualification Tests

The scope of preliminary qualification testing of the CDTS CEI shall be limited to verifying that the Execution Function, using inputs from a subset of the computer operator's course, can function with a minimal number of Air Force subjects and properly interface with the B3500 hardware, the Master Control Program, Data Communications Handler, and any available Phase II systems. This level of testing shall not attempt to satisfy, in detail, the requirements of section 3 of this specification.

4.1.3 Formal Qualification Tests

Formal qualification testing of the CDTS CEI will consist of verifying that the integrated CEI satisfies all requirements of this specification, including those detailed by the Lesson Building/Editing Function. Initial inputs to the Formal Qualification Tests will result from the Off-Line Lesson Building Function having successfully formatted the entire Computer Operator's Course for execution. Successive inputs will result from On-Line generation of lesson material by the Lesson Building Function.

Formal qualification testing of the CDTS CEI will be conducted in a Phase II operational environment, using the full capabilities of the B3500 central computer and peripheral components, and interfacing with other available Phase II Base Level Systems.

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13. ABSTRACT

This document presents the performance/design requirements and detailed technical description for a Computer-Directed Training Subsystem to be integrated in the Air Force Phase II Base Level System. The subsystem is to be used to provide a computer-assisted lesson construction and presentation capability for on-the-job training for data automation, staff, and management personnel in the operation and use of the Air Force Phase II Base Level System. System, personnel, and operational requirements specified herein are to be fulfilled by program elements of control, lesson building, lesson execution, trainee record processing, and off-line lesson building. Inputs, outputs, and internal processing are specified for each element.

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Computer-Directed Training						
Phase II						
Base Level System						
On-Line interactive teaching						
Individualized training						
CDTS						