System Library Supplement

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For Base Publication GC20-1809-7, *IBM Virtual Machine Facility/370: OLTSEP and Error Recording Guide,* Release 6 PLC 1

Prerequisites None

IBM Virtual Machine Facility/370
System Extensions
Program No. 5748-XE1

This supplement contains replacement pages for VM/370 OLTSEP and Error Recording Guide to support VM/370 System Extensions.

Before inserting any of the attached pages into VM/370 OLTSEP and Error Recording Guide, read carefully the instructions on this cover. They indicate when and how you should insert pages.

Do not insert the attached pages unless you install the program product.

Pages to be Removed	Attached Pages to be Inserted*
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*If you are inserting pages from different Newsletters/Supplements and identical page numbers are involved, always use the pages with the latest date (shown in the slug at the top of the page). The page with the latest date contains the most complete information.

Changes or additions to the text or illustrations are indicated by a vertical line to the left of the change.

Summary of Amendments

This supplement contains, in addition to functions available in the initial release of VM/370 System Extensions, the following:

- Support for the IBM 3310 and 3370 Direct Access Devices

For a complete list of publications that support VM/370 System Extensions, see IBM Virtual Machine Facility/370 System Extensions General Information Manual, GC20-1827.

Note: Please file this cover letter at the back of the base publication to provide a record of changes.

Preface

This publication is intended for the IBM customer engineer (CE), and assumes that the CE is familiar with OLTS testing procedures. This publication also assumes that the CE is knowledgeable about VM/370 and virtual machine concepts as outlined in the VM/370 Introduction. The CE must also be familiar with the VM/370 logon process as described in the VM/370 Terminal User's Guide.

This publication is divided into four sections.

Section 1 compares the environments available to the CE for testing and repairing I/O devices. The advantages of using the virtual machine as a tool for fault analysis is also described. A comparison of OLTS (online test system) results from both the real and the virtual system/370 is also discussed.

Section 2 discusses the requirements for testing I/O devices from a virtual machine environment which includes the following:

- The CE virtual machine
- How to log onto a virtual machine
- How to run the online tests
- Samples of test runs

This section provides information to permit the CE to run diagnostic tests in a virtual machine environment from a virtual machine console (terminal).

Section 3 describes the VM/370 system error recovery, error recording, and system console error messages, and the control blocks used in the error recovery/ recording process.

Section 4 describes VM/370 facilities that allows more detailed information to be obtained for problem analysis and repair. These include:

- CPEREP and OS/VS EREP
- Intensive Recording Mode
- Trace Option
- VMFDUMP

PREREQUISITE PUBLICATIONS

IBM Virtual Machine Facility/370:

Introduction, Order No. GC20-1800

Terminal User's Guide, Order No. GC20-1810

If the IBM 3767 Terminal is used, IBM 3767 Terminal Operator's Guide, Order No. GA18-2000, is also prerequisite.

If the system being serviced makes use of the IPCS (Interactive Problem Control System) component of VM/370, then the VM/370 Interactive Problem Control System (IPCS) User's Guide, Order No. GC20-1823 is also a prerequisite.

COREQUISITE PUBLICATIONS

IBM Virtual Machine Facility/370:

CP Command Reference for General Users, Order No. GC20-1820

System Messages, Order No. GC08-1808

OS/VS, DOS/VSE, VM/370 Envionmental Recording, Editing and Printing (EREP) Program, Order No. GC28-0772

OS/VS, DOS/VSE, VM/370 Environmental Recording, Editing and Printing (EREP) Program Logic, Order No. SY28-0773

OS/VS, DOS/VSE, VM/370 EREP Messages, Order No. GC38-1045

Figure 1, which follows the Preface, shows the relationship of VM/370 publications to one another within the VM/370 Library.

RELATED PUBLICATIONS

The following texts, although not required, will broaden the CE's knowledge of VM/370 and virtual machines.

IBM Virtual Machine Facility/370:

Planning and System Generation Guide, Order No. GC20-1801

CMS User's Guide, Order No. GC20-1819

Operator's Guide, Order No. GC20-1806

Remote Spooling Communications Subsystem User's Guide, Order No. GC20-1816.

IBM 3704 and 3705 Communications Controllers Network Control Program/VS, Program Logic Manual, Order No. SY30-3007.

In this publication, the term "3330 series" is ued in reference to the IBM 3330 Disk Storage, Models 1, 2, and 11 and the IBM 3333 Disk Storage and Control, Model 1 and 11.

In this publication, the term "2741" is applicable and equivalent to the IBM 3767 Terminal unless otherwise specified.

The term "3270" is used in this publication to refer to a series of display devices, namely, the IBM 3275, 3276, 3277 and 3278 display stations. A specific device type is used only when a distinction is required between the device types.

The term "FB-512" is used in this publication to refer to those IBM DASD devices that implement fixed block (512 byte blocks) mode. Specifically, these devices are the 3310 and 3370.

Information about display terminal usage also applies to the IBM 3138, 3148 and the 3158 display consoles, when used in display mode unless otherwise noted.

Any information pertaining to the IBM 3284 or 3286 printer also pertains to the IBM 3287, 3288 and 3289 printers unless otherwise noted.

Notes:

1. External interrupt reflection may cause OLTSEP Release 4.0, 4.1, or 5.0 execution problems; refer to the topic: "Invoking OLTS" for circumvention.

2. VM/370 provides limited 3704/3705 RAS support. Although VM/370 has enough function to effectively utilize the 3704 and 3705, provisions are not available with Release 3 to use the OLTTEP/OLLT/OLTT diagnostic package. If these test facilities are to be invoked then they must be used with VS with TCAM in a standalone System/370.

Contents

The entries in this Table of Contents are accumulative. They list additions to this publication by the following VM/370 System Control Program Products:

- VM/370 Basic System Extensions, Program Number 5748-XX8
- VM/370 System Extensions, Program Number 5748-XE1

However, the text within the publication is not accumulative; it only relates to the one SCP program product that is installed on your system. Therefore, there may be topics and references listed in this Table of Contents that are not contained in the body of this publication.

FIGURES

- In attempts to service components of a 3850 Mass Storage System, the CE should be aware that the virtual machine is interfacing with virtual 3330 volumes (3330V) and not with a real 3330 device; thus, the misapplication of diagnostics could lead to erroneous interpretations.

- In testing components of the 3850 Mass Storage System (MSS), most functions provided by the online test system (OLTS) require that MSS activity be quiesced. To insure a quiesced mass storage system, it is recommended that the CE's virtual machine be run in a standalone environment.

- The CPUID found in the error recording records is the CPUID associated with the real machine and not the one associated with a virtual processor.

- If the facilities of an IBM 3850 Mass Storage System (MSS) are used with VM/370 virtual machine operations and MSS errors are reflected to VM/370's error recording area, CPEREP must be invoked so that MSS-related errors recorded in the error area can be directed to an accumulation (ACC=Y) tape for further processing by the VS1/VS2 Subsystem Data Analyzer (SDA) Program. Because MSS logged out data is voluminous and the interrelationship of MSS components is complex, it is imperative that this service program be used to effectively diagnose and isolate mass storage problems.

- The virtual machine used by the CE normally does not have a dedicated high speed printer. Therefore, long listings (such as console spooling records, dumps, error recording records, and diagnostic output tabulations) are queued to a common spool output device along with the files generated by users of other virtual machines. These files are queued by class as well as by the time at which the files are closed. If the queue for output is long or contains files that are sequentially ahead of the CE's output records, the wait for output could be quite lengthy. However, the system operator can alter the order (sequence) of output files, if the need is urgent.

- The I/O configuration of the virtual machine should be such that each virtual channel maps to real channels of a single type and model. This requirement is explained in detail in "Appendix E. VM/370 Restrictions" in VM/370 System Messages. If this requirement is not met, the STIDC instruction may return inconsistent results, and any data from a channel extended logout may be misinterpreted since it depends on the channel model. Also note that there is a restriction against using control register 14 to mask out channel extended logouts; if this is done in a virtual machine, the logout does not remain pending and instead is lost.

- Hardware and software problems in VM/370 can cause the abrupt termination of a virtual machine. Such terminations (such as forced logoff) cause the register and storage contents of the virtual machine to be lost, thus rendering problem analysis ineffective. Facilities exist within VM/370 to preserve the register and storage contents of prespecified virtual machines on prespecified DASD locations so that, when system termination occurs, system analysis and system recovery can be accomplished. For details, refer to "Virtual Storage Preservation," described in VM/370 System Programmer's Guide. The saving of virtual machines on a VMSAVE area can be adversely affected by malfunctions of the checkpoint, spooling and abend dump modules as well as channel check handler and machine check handler modules.

- The third, fourth, and fifth lines represent the virtual unit record spool devices and addresses that are mapped by the system to equivalent real devices. The letter B located on line four and the letter A located on line five represent the assigned spool class for that device.

- The sixth line is an entry describing a 2314 minidisk with an address of 190 that contains the CMS system residence files on cylinders 000 to 050. This disk is labeled CMS190 and this user has read-only (R/O) access to this disk, since it is the CMS system disk.

- The seventh line is interpreted the same as the sixth line with the following exceptions: only five cylinders are allocated to the user of the 2314 volume labeled CMS001. However, the write (W) access privilege allows the CE to write routines or modify existing routines and store them permanently on this disk.

For further details on VM/370 user directory entries, see the VM/370 Planning and System Generation Guide.

Command Privilege Class for the CE

The CE's virtual machine is similar to other virtual machines running under VM/370. The CE's virtual machine reacts to the System/370 machine instruction set in much the same manner as on a dedicated System/370. Control of the virtual machine is through a terminal and CP commands. These commands are grouped into eight privilege classes. Each class relates to specific system functions. The privilege class or classes of commands assigned to a particular virtual machine are stored in the VM/370 directory along with the user's virtual machine identification code and password.

As a user of a virtual machine, it is assumed that the CE has the class G and F commands and CMS allocated for his use. CMS is discussed briefly in the VM/370 Introduction. CMS is important to the CE because this environment must be entered to execute the CPEREP command. CPEREP, when invoked, calls EREP modules that format and print error recording data; optionally, CPEREP may be used to create an accumulation tape (ACC=option) or edit an existing accumulation tape (HIST option); even SYS1.LOGREC data sets on tape or disks compiled from other systems may be used. If the CE in a remote location has access to any of the remote terminals supported by the RSCS component of VM/370, he may utilize the facilities of RSCS to transfer bulk data, such as trace output and error recording printouts, to a remote printer. Remote spooling procedures are described in the VM/370 RSCS User's Guide.

The use of CPEREP is also important in relation to its use with the 3850 Mass Storage System. Errors accumulated on the VM/370 error recording area must be placed in the CPEREP accumulator output tape for additional processing and analysis by the VS1/VS2 subsystem data analyzer (SDA) program. For details on how this is accomplished, refer to CPEREP and OS/VS EREP in Section 4 (for a description on how to create an output tape) and then refer to either OS/VS1 SYS1. LOGREC Error Recording, Order No. GC28-0668 or OS/VS2 System ProgrammingLibrary SYS1. LOGREC Error Recording, Order No. GC28-0677 for details.

The class F commands include the SET RECORD and SET MODE commands. With these commands, the CE can set requirements for intensive or soft error recording. Refer to "Section 3. Additional CE Aids." Class F allows the CE to void error recording that occurs as a result of the CE's virtual machine activity except for the device and condition specifically named in the SET RECORD command.

Class F also allows the CE to generate trace data for a specified 3704 or 3705 BTU (basic transmission unit) or resource by means of the NETWORK TRACE command. The produced trace data is then spooled to the CE's virtual printer. Class F is also necessary for access to the 'CE area' on FB-512 devices. The size and location of this area is described in the particular device reference publication. Class G commands comprise a complete set of commands for virtual machine use.

In addition to the Class F and G commands, there are commands that are not confined to any assigned command category. These commands, referred to as the class "Any" commands, can be invoked regardless of logon status. Examples of these commands are MESSAGE and LOGON.

This book illustrates the use of only those VM/370 commands necessary for CE applications. However, if additional help is necessary, the CE can solicit help from the system operator via MESSAGE OPERATOR command, or use the VM/370 CP Command Reference for General Users, the VM/370 Operator's Guide, and VM/370 CMS Command and Macro Reference.

If the CE receives "virtual machine already in use," or "...exceeds system parameters" in addition to "vm/370 online" and possibly RESTART, use the MESSAGE command and contact the system operator for assistance.

To invoke the MESSAGE command for communication to the system operator any of the following forms may be used:

```
message operator message-text
msg op message-text
m op message-text
```

If a message response from the system operator is not forthcoming or the message cannot be entered via terminal equipment, then other media must be used to establish communication with the system operator.

If an acknowledgement of the message is received by the CE, then line and terminal communication have been successfully established.

USING THE LOGON COMMAND

If line and terminal performance is satisfied, failure to log on can be the result of improper use of the LOGON command and its associated operands. The correct procedure involves knowing the correct password and CE userid.

Assume that the LOGON was invoked correctly but the response was a facsimile of one of the following:

```
MAXIMUM USERS EXCEEDED
INVALID USERID
USERID NOT IN CP DIRECTORY
PASSWORD INCORRECT
ALREADY LOGGED ON LINE raddr
```

CE action should be to relay this data via the MESSAGE command back to the system operator. The system operator can then defer maintenance to a later time period, or can arrange an environment so that CE LOGON is successful. Once logon is successful, the CE can use OLTSEP and the online test sections (OLTS). Samples of invoking OLTSEP are shown later in the text.

To assist in the process of entering the tests or other data, the CE can use VM/370's four input line edit functions; they are described in the VM/370 Terminal User's Guide. Briefly, an @ symbol when entered deletes the previously entered character on the logical input line. The ¢ symbol deletes the previously entered input line. The # symbol is used to signal the end of a logical input line so that multiple logical input lines can be entered on the same terminal input line. The " symbol is issued as an escape character, that is, it cancels the line edit function of a following @, #, ¢, or " character and allows that line edit function character to be accepted as data.

After successful logon, the CE must enter the environment needed to perform the function he desires. To store or display storage or registers in the virtual machine, the environment to use is CP; to invoke CPEREP to edit error recording, the CE must first perform an IPL and enter the CMS environment. To use the online test sections, the OLTSEP program must be loaded into the virtual machine. Details on logon, the initial program load (IPL) operation, and the virtual logoff process (ending the terminal session) are described in VM/370 Terminal User's Guide.

Invoking OLTS

To load the OLTSEP and OLTS programs from a tape or a disk, the CE must have the operator attach the IPL device containing the tests to his virtual machine. This can be accomplished by asking the operator, or, if the CE is at a remote location, the CE can communicate by sending him messages on a terminal such as the following:

```
msg operator mount my diagnostic pack on 181 - ce

msg operator put scratch tape on 583 - test device
```

The operator will then mount and make ready the devices desired for testing by the CE. The operator then issues the ATTACH command; the CE's terminal then indicates:

```
DEV 181 ATTACHED
DEV 583 ATTACHED
```

In the case of system-owned volumes (DASD devices) that cannot be directly attached to the CE's virtual machine, testing is facilitated by defining the device as a full extent minidisk with a relocation factor of 0 (that is, the DASD device is described in the system with its minimum and maximum cylinder or block values). The CE can then use the LINK command to link to the device (via password identification) in write mode to execute the prescribed tests.

Under these conditions, the diagnostic used must confine its write operation to the CE cylinders only. Use of system owned disks by the CE can be achieved by directory entry in the CE's virtual machine or by the use of the LINK command.

The CE is now ready to load his virtual machine with OLTSEP. This is done by issuing the IPL command to the addressed device. Upon completion of the operation, OLTSEP responds to the CE's terminal as though he were using the real system console (3215, etc.). Figure 5 shows a sample of the complete logon operation, OLTS testing, and logoff operation as initiated from a 2741 console. The 2741 sample session shown in Figure 5 would suffice for diagnostics run from a display terminal. The major difference is that the exclamation point is not indicated on the screen's output area; instead, a change in screen status information is indicative of attention signaling.

Notes:

1. While the execution of OLTS in a virtual machine is usually identical to execution on a real machine, differences exist for specific types of test devices. Terminal control devices (2701, 2702, 2703, 3704, and 3705) often appears to respond differently to tests executed in a virtual machine. A control run should be executed against a device that is known to be operating correctly, and the error shown should be considered the normal results when the OLTS are run in virtual machine.

2. If the OLT section selection (DEV/TEST/OPT) defines the same terminal that is serving as the virtual system console, refer to the topic, "Invoking OLTS to Virtual Machine Console Terminals."

SVC 76 Handling of Channel Errors

Channel errors are handled differently from device errors. CP records a channel check in the VM/370 error recording area immediately and informs the VM/370 system operator of the channel check via a console message (but for a channel data check, no message is issued). Then CP reflects the channel check to the virtual machine. After seeing the error, the operating system in the virtual machine issues SVC 76. Since CP has already recorded the error, CP ignores the SVC 76 and reflects it to the virtual machine (without translating virtual channel and device addresses in the error record to real addresses). The reflected SVC 76 then causes the operating system in the virtual machine to record the channel error in its own LOGREC data set.

SVC 76--Parameter Passing

VM/370 examines the contents of general registers 0 and 1 to determine if valid conditions exist for handling the error recording data.

If the system is OS (Release 21 or above), VS/1, VS/2, or VM/370 (in a virtual environment) then:

```
General register 0 = two's complement of the error record length
General register 1 = address of the record
```

If the system is DOS (Release 27) or DOS/VS then:

```
General register 0 = address of the error record minus 8
General register 1 = Byte 0, Bit 0 must be a 1,
                     Bytes 1, 2, and 3 contain the CCB address
                     (DOS control block for I/O)
```

VM/370 then locates the formatted error record and examines the record header for a valid operating system identity (ID). The record type then examined to determine if it is one of the supported recording types.

Record Modification for VM/370 Error Recording

The error record is modified, changing virtual information to real. The fields modified vary with the type of record.

- Type 30, OBR (Outboard Recorder)

Common Fields:

Primary and Alternate CUA are replaced with the real device address corresponding to the virtual device address.

CPUID (CPU model number) is replaced with the real machine model number.

JOBID is replaced with the virtual user ID.

Device Dependent Fields:

For dedicated DASD devices no modification is required. For nondedicated DASD devices, the following modifications are required:

Seek Address, the relocation factor, found in the VDEVBLOK, adjusts the seek address field of the record in order to reflect the true real seek address if the DASD device is count-key-data device; or adjusts the physical block number if the device is a fixed block device.

Home Address Read, the relocation factor, found in the VDEVBLOK, adjusts the home address read field in order to reflect the true real home address.

Volume ID, the volume label in the RDEVBLOK, replaces the volume ID in the record.

3330, 3340, 3350, and 2305, the relocation factor in the VDEVBLOK, adjusts the cylinder address portion of the sense data (sense bytes 5 and 6).

Virtual 2311 on 2314, the device type is changed to 2314 and sense byte 3 is altered to reflect 2314 information. For this situation, the 2314 module ID usually found in the sense byte is not available.

Note: The failing CCW and CSW fields are not altered. This results in the CCW address in the CSW and data address in the CCW being virtual, not real.

- Type 40, 41, 42, 44, 48, and 4F programming abend records:

Common Fields:

CPUID (CPU model number) is replaced with the real machine model number.

JOBID is replaced with the virtual user's ID.

RDEVBLOK to determine if intensive recording mode is in effect for this device. If the conditions are met, an I/O error record is created. This record is constructed and recorded as described previously. Control is returned to the I/O supervisor, which reflects the error to the user of the I/O operation.

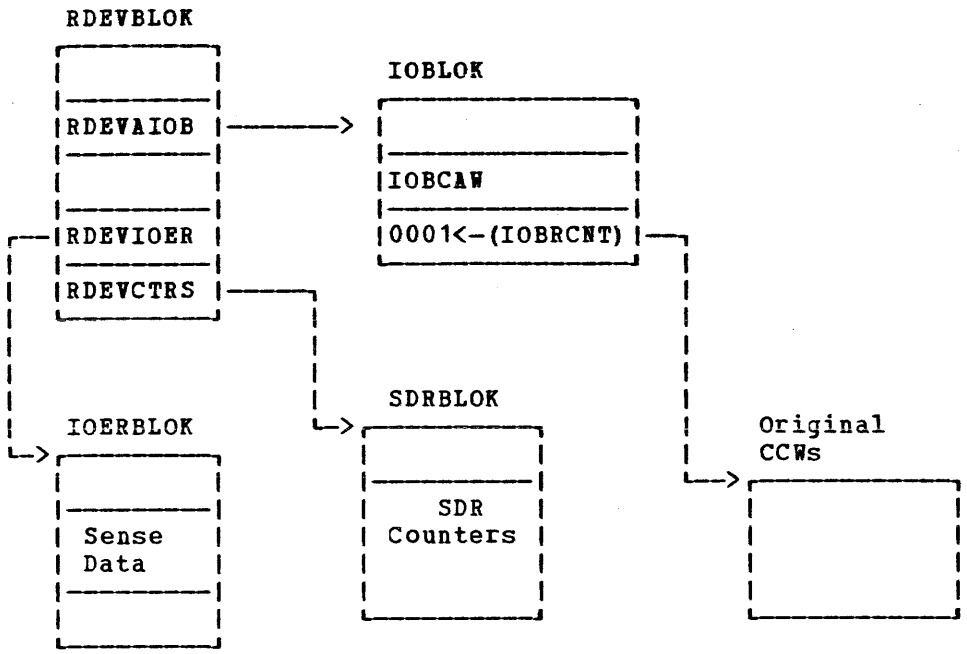

Figure 12. Control Block Relationship for SDR Counter Update

I/O Error Recording and Error Recording Area

The error recording facilities of VM/370 format and record outboard error records, and record formatted machine check and channel check records created by the RMS routines of VM/370.

The error recording routines of VM/370 do not actually perform I/O operations. Instead, the I/O error routines treat the error recording area allocated on the VM/370 system residence pack as a logical extension of VM/370 storage. These extensions of VM/370 storage are in the form of logical pages that can be read and written out of by the paging supervisor of VM/370. The error recording routines place multiple error records within a page; when an error record is assembled within a page, a pointer is updated to indicate the beginning of any unused area. The next error record is checked to see if it can be contained in the remainder of this page. If it can, the error record is read into the page and the pointer is updated to again reflect any residual storage available for the next error record. This process continues until an error record is encountered that cannot be contained within the page. When this happens, the page is scheduled to be read out to the next available slot in the error recording area and a new page in storage is assigned to accept and retain the error record. The process continues in like manner.

On count-key-data devices, the error recording area is from two to nine adjacent cylinders assigned on the system residence volume. The starting cylinder number and number of cylinders are specified in VM/370 generation procedures. On FB-512 devices the error recording area is any number of adjacent pages assigned on the system residence volume. The starting page number and the number of pages are specified in the VM/370 generation procedures. In any case when the error recording area is 90% full, and again when 100% full, the I/O error routines instruct the VM/370 system operator to invoke the CPEREP command to print (or create a tape of) the error data and erase the recording area. Errors are recorded in the order of occurrence until the allotted space is exhausted.

With the support provided for the 3031, 3032, and 3033 processors, CPEREP need not be aware of the content or the EC level of the processor logouts in order to format machine check and channel check records. Format and content information is provided via the SRF (Service Record File) device. Frames (records containing text and scan buffer codes) are maintained on the SRF device by customer engineering, and software makes use of these frames to interpret and format inboard errors. Whenever the VM/370 error recording cylinders are formatted on a 3031, 3032 or 3033 processor, the SRF is accessed and the frames are retrieved, formatted as frame records, and recorded at the beginning of the VM/370 error recording area by the process described above. When CPEREP is invoked, these frame records are used to format MCH and CCH records for the printed report.

The SRF device is accessed by VM/370 to read frame data (a) during VM/370 system initialization if the error recording cylinders have not been previously formatted; and (b) as a result of running CPEREP with the CLEARF operand. To ensure that the VM/370 control program has access to the SRF device, the following steps should be followed to activate the SRF:

1. Check that the I/O interface for the service support console is enabled.

2. Obtain the configuration frame on the service support console.

3. The SRF appears disabled until accessed on the 3032. Activate the SRF on the 3031 and 3033 by selecting SRF mode A2.

4. VARY ON cuu (SRF address) on the operator's console.

5. ATTACH cuu * cuu to attach the SRF device to the operator's console; or ATTACH cuu userid cuu to attach the SRF device to the console of the class F user who runs CPEREP.

In a 303x environment, access to the SRF device by an SCP in a virtual machine must be considered when planning to run EREP to print the error log belonging to that virtual machine. The SRF device must be accessible to the operating system in a virtual machine when it initializes its error log in order that frame data may be read from the SRF. The VM/370 system operator should attach the SRF device to the virtual machine before that SCP initializes its error log (for example, in the case of OS/VS2, before running IFCDIP00); the virtual machine operator should then vary the SRF online. In single processor mode, the SRF device of the VM/370 processor must be attached to the MVS V=R virtual machine before MVS runs IFCDIP00 to initialize SYS1.LOGREC.

The error recording facilities of VM/370 are of the following types:

OUTBOARD RECORDING:

- Statistical data recording
- Permanent I/O errors
- Environmental data records
- Intensive mode recordings
- Specific DASD recording requirements
- Specific tape recording requirements
- Software abend records

INBOARD RECORDING:

- Machine checks
- Channel checks

I/O Statistical Data Recording (SDR)

Statistical data recording is the accumulation and the recording of I/O error statistics that relate to specific devices. VM/370 supports SDR recording for CP-initiated I/O events by building and maintaining device statistics tables (counters) in the SDRBLOK associated with the I/O device. These counters are updated when a device-dependent error recovery procedure (ERP) determines that the error has either been corrected successfully or is a permanent error. SDR counters are updated based on the sense information in the original IOERBLOK. The updating of the counters is done asynchronously. If the update function causes a counter overflow, a short OBR record is built. The OBR record is then placed on the asynchronous output queue. This causes the OBR record to be written on the error recording area asynchronously.

When the SHUTDOWN command or NETWORK SHUTDOWN command is issued by the system operator, any devices that have SDR counters associated with them cause control to be passed to the I/O error recording routine to format a short OBR record. (A long OBR is formatted for 3400 tapes.)

The VARY OFFLINE command or NETWORK VARY OFFLINE command of a device that has associated SDR counters also causes control to be passed to the I/O error recording routine to format a short OBR record (a long OBR is formatted for 3400 tapes).

The VARY OFFLINE, SHUTDOWN, NETWORK VARY OFFLINE, and NETWORK SHUTDOWN commands result in an OBR record being written to the error recording area synchronously.

Permanent I/O Error Recording

Permanent I/O errors related to VM/370-initiated I/O events are recorded by the I/O error recording routines of VM/370. When a device-dependent error recovery procedure determines that an I/O event cannot be successfully recovered, the fatal flag is turned on in the IOBLOK and control is returned to the I/O supervisor. The I/O supervisor invokes the I/O error recording routines with the control block structure as shown in Figure 13. The I/O error recording routines format the error and record it on the error recording area.

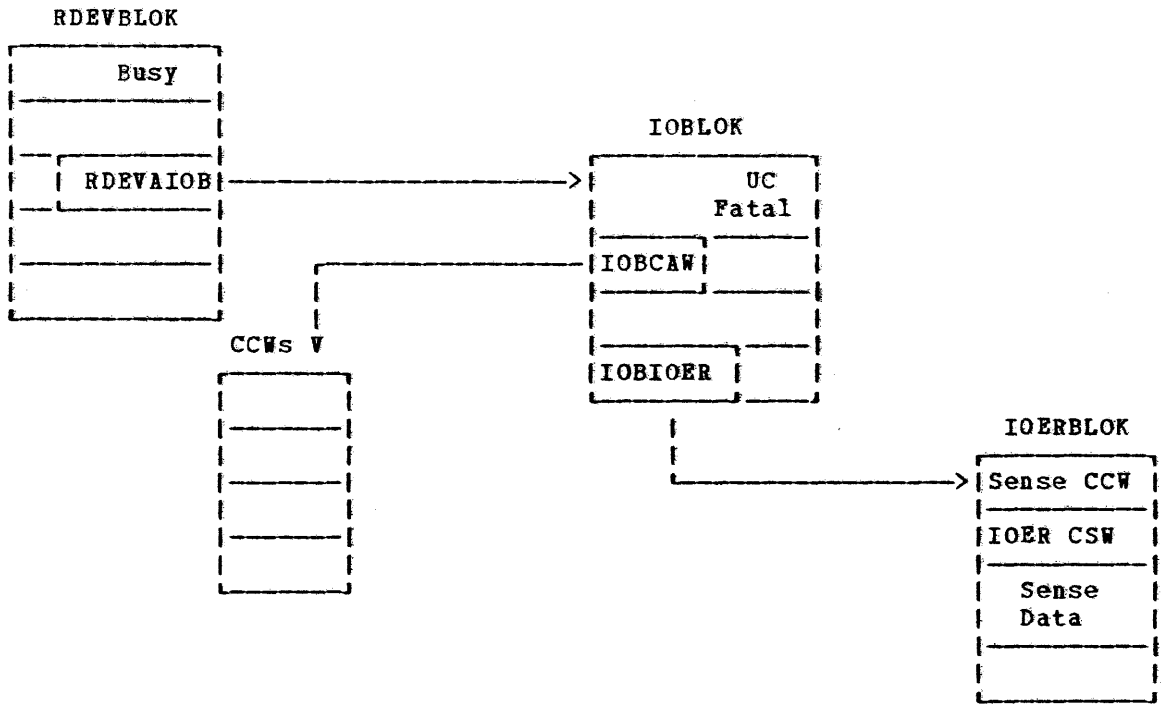

Figure 13. Control Block Linkage--Fatal Error Condition

Environmental Data Recording

When the I/O supervisor receives a unit check interruption from a 3330, 3340, 3350, or 2305, the count-key-data error recovery procedure is invoked. If the unit check is from an FB-512 device, that error recovery procedure is used. In any case, if the sense information indicates that an environmental data recording is required, the error recovery procedure builds the necessary channel program to retrieve the error log data from the file control unit.

The sense data that indicates this condition is as follows:

Machine	Sense Byte	Bit	Condition
2305	2	0	Buffer Log Full
3330,3340,3350,FB-512	2	3	Environmental Data

The manner in which the error recovery procedure passes the data to the I/O error recording routine differs between the 2305 and the 3330/3340/3350/FB-512 as shown in Figures 14 and 15, respectively.

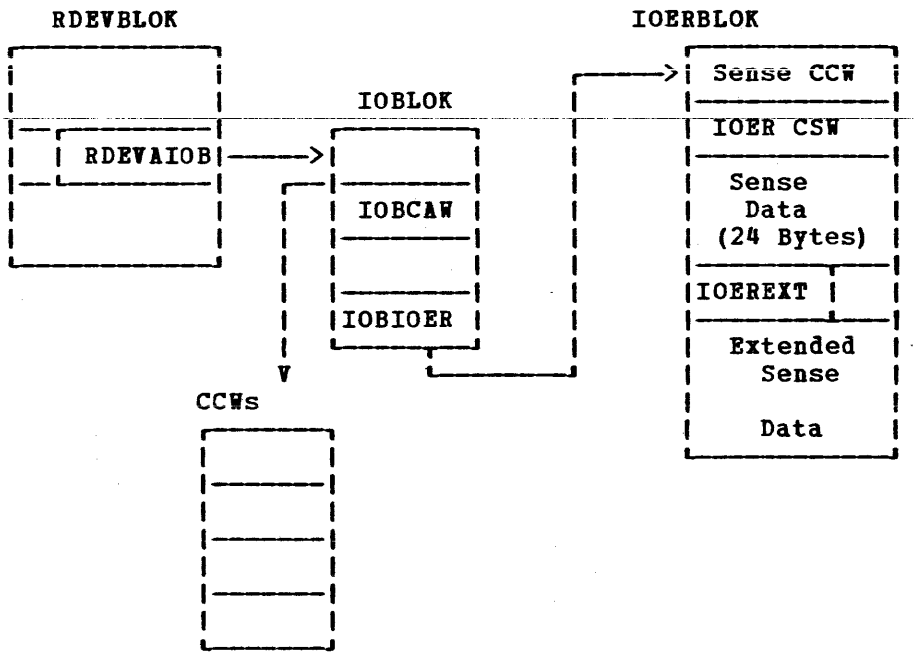

Figure 14. 2305 Control Block Structure--Environmental Data Recording

The IOEREXT field in the IOERBLOK contains the length in doublewords of the extended data area. The I/O error recording routine builds an environmental data record in the proper format, queues the request for recording, and returns to the I/O supervisor. The DASD error recovery procedure retries the operation and normal processing continues.

A different control block linkage exists on 3330/3340/3350 environmental data recordings due to the amount of data. The DASD error recovery procedure builds multiple IOERBLOKS and chains them together to pass the data to the I/O error recording routines.

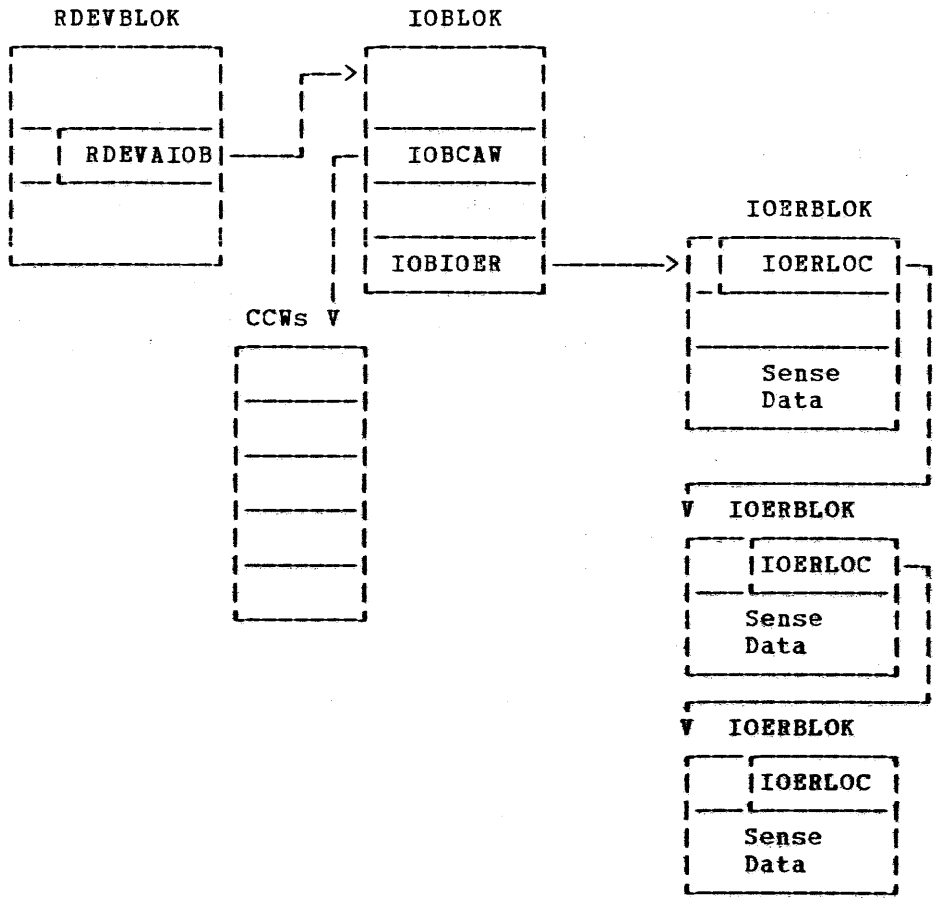

Figure 15. 3330/3340/3350/FB-512 Control Block Structure--Environmental Data Recording

The IOERLOC pointer in the IOERBLOK points to the next IOERBLOK on the string. The error recovery procedures obtain free storage and construct IOERBLOKs to be placed on the string until the buffer on the control unit is completely unloaded. The I/O error recording routine builds an environmental data record in the proper format, queues the request for recording, and returns to the I/O supervisor. The error recovery procedure retries the operation and normal processing continues.

Intensive Mode Recordings

On any unit check occurrence the I/O supervisor invokes the I/O error recording routines to determine if the conditions for intensive mode recording are satisfied. Intensive mode is an error recording mode whereby errors are recorded for a specific device that achieves a unit check condition and sense data that matches previously defined sense data values. The SET RECORD command starts intensive mode. If intensive mode recording conditions are satisfied, an I/O error record is constructed, formatted, and recorded in the I/O error area of the VM/370 system residence device, and a flag is set in the IOERBLOK to indicate that the error has been recorded (IOERFLG2 = IOERCEMD). This recording is done for CP-owned devices as well as dedicated devices attached to virtual machines. The user who initiated the intensive mode operation must run the CPEREP program to retrieve the records created

while this option was active. No messages occur to inform either the VM/370 system operator, or the virtual machine user when a recording is made or when intensive mode is disabled by the I/O error recording routines after the tenth recording. Intensive mode (SET RECORD option) can be invoked only on one real hardware device at any time and only by a user with the privilege class F command usage.

Note: For the privilege class F virtual machine all normal error recording is suspended except for the 'intensive mode' selected device. If however, the F class user invokes SVC 76 to pass a record to CP to record, CP will honor such a request.

VM/370 I/O Error Recordings

OBR records are written if any of the following conditions exist for all but the privilege class F user (unless intensive mode is specified for a particular device).

- An unrecoverable (permanent) I/O error which was initiated as a VM/370 I/O task (CP request).
- Counter overflow statistics (SDR count).
- SHUTDOWN and NETWORK SHUTDOWN commands (devices with SDR counters).
- VARY OFFLINE (devices with SDR counters).
- 2305/3330/3340/3350/FB-512--Equipment Check.
- 2305/3330/3340/3350/FB-512--Busout Check.
- 2305/3330/3340/3350--MDR record on BUFFER UNLOAD command (X'A4' or X'24') to a nondedicated DASD storage device by a virtual machine.
- 3340--Seek Check.
- 2305/3340/3350--Data Check.
- 2305/3330/3340/3350--Overrun.
- FB-512--Data Check.

Error Recording Record Layout

Error recordings vary in length and format depending on the malfunction or the device encountered. Data that relates to channel check, machine check, or unit check conditions is arranged in byte-formatted records in the error recording area. Figures 16, 17, 18, 19, and 20 describe the layout and data length of the fields within defined record types. Use Figure 21 with these charts to ascertain the origin of particular fields of data.

The paired alphabetical characters shown in the fields of Figures 16, 17, 18, 19, and 20 correspond to the location codes in Figure 21. The location code in conjunction with the type of error (MC, UC, CC) indicates the availability of that data and what data block or function contains or generates this data.

Figures 22 and 23, using the same paired alphabetical character scheme, describe the 24-byte header that precedes the error record. Figure 23 describes the contents and source of the fields indicated in Figure 22.

For additional information on error record layout as used by the CP component of VM/370 refer to VM/370 Data Areas and Control Block Logic. For information on the printout format of supported error record types, refer to the OS/VS, DOS/VSE, VM/370 Environmental Recording Editing and Printing (EREP) Program. Support logic for this program is contained in the OS/VS, DOS/VSE, VM/370 Environmental Recording Editing and Printing (EREP) Program Logic.

Record Header Field	Source of Data	Location
Record Type	From calling routines or type of entry	CA
Operating System	System description module	CB
Switches (dependent/independent)		CC
Byte 0		
Bit 0 Multiple Record Recording	NA	
1 NS Machine	Always 0 (using NS Clock Binary)	
2 EC Mode	PSW	
3 Reserved for IBM Use	-	
4 Time Macro Used (HHMMSS)	Always 1	
Byte 1 MACHINE CHECK		
Bit 0 Short Form	NA	
1 Record Incomplete	NA	
2 System Terminated	MCH	
3 First Record of two	NA	
4 Channel Record Included	NA	
5 Data Overlaid	NA	
6 External Machine Check	NA	
Byte 1 CHANNEL CHECK		
Bit 0 Operator Message	NA	
1 Record Incomplete	NA	
2 System Terminated	CCH	
3 Channel unsupported or failed to log.	CCH	
4 Invalid CUA	CCH	
5 Data Overlaid	CCH	
6 ERP in Progress	NA	
Byte 1 UNIT CHECK		
Bit 0 SDR dump (EOD)	RECORDER	
1 Temporary error	IOBLOK	
2 Short record	RECORDER	
3 MP system	NA	
4 CPU B	NA	
5 Volume dismount	NA	
6 SVC requested	NA	

Figure 23. Header Record Table (Part 1 of 2)

Record Header Field	Source of Data	Location
Byte 2 MISCELLANEOUS DATA		
Recorder (Nonstandard)		
Record ID Code		
01 = 3330		
02 = 2305-2		
03 = 3270		
04 = 3211		
05 = 3705		
08 = 2715		
09 = 3340		
0A = 3330-11		
11 = 3350		
12 = 2305-1		
16 = 3370		
17 = 3310		
FF = Reserved for IBM Use		
Record Count	Always 01	CD
Date & Time	RECORDER	CE
CPU ID and Serial	Store CPU ID	DF
Max MCEL Length	Store CPU ID	CG
Version Number	Store CPU ID	CF
NA = Not Available		

Figure 23. Header Record Table (Part 2 of 2)

VM/370 Recovery Features -- Introduction

The primary objectives of VM/370's recovery management support are:

- To reduce the number of system terminations that result from machine malfunctions.
- To minimize the impact of such incidents.

The programmed recovery, which accomplishes these objectives, allows system operations to continue whenever possible, and records the system status for all errors. The MCH (Machine Check Handler) and CCH (Channel Check Handler) provide the recovery management functions of VM/370.

MACHINE CHECK HANDLER

A machine malfunction can originate from a processor, processor storage, control storage, or a channel group. When any one of these fails to work properly, the hardware tries to correct the malfunction. If the machine recovers from the error through its own recovery facilities, a machine check interruption notifies the appropriate machine check handler routine. The machine check handler records the fact that the machine operated improperly. Concurrently with the machine check interruption, the processor logs out fields of information in processor storage. This information describes the cause and nature of the error. MCH analyzes this information and builds the machine check record.

If the machine fails to recover from the error through its own recovery facilities, a machine check interruption occurs, and an interruption code indicates that the recovery attempt failed. The machine check handler then analyzes the data and tries to keep the system as fully operational as possible. The cause of the malfunction determines what action the machine check handler takes:

- Resume operations, leaving no adverse effects on the system.
- Resume system operations by terminating the virtual machine that was interrupted.
- Isolate the failure to a page and flag the page as invalid or unavailable for use by the paging supervisor.
- Place the system in a disabled wait state.
- If the 158 AP or 168 AP operating in attached processor mode had an unrecoverable malfunction occur on the attached processor in problem program state, resume operations in uniprocessor mode.

Virtual machines for which VMSAVE (Directory option or SET command operand) is enabled normally have their register and storage contents saved in the event of certain abend situations. However, the following machine errors cause a disabled wait PSW to be loaded and may prevent saving the contents of a virtual machine.

- MCIC invalid
- PSW masks, key, program mask or CC invalid
- Floating-point, control, or general registers invalid when CP was in control
- System damage
- Timer damage
- CPU clock damage
- Instruction processing damage when CP was in control
- Machine check recursion

CHANNEL CHECK HANDLER (CCH)

The channel check handler is a resident program that receives control from the I/O supervisor when a real channel error occurs. CCH records the error. CCH reflects channel control checks, channel data checks, interface control checks, and channel interface inoperative (for a dedicated channel) to the virtual machine to allow the SCP in that virtual machine to attempt recovery, and/or initiate appropriate termination procedures. If CCH determines that system integrity has not been damaged, channel errors associated with an input/output operation initiated by CP (for example, paging or spooling) are retried by the appropriate device-dependent error recovery procedure.

If CCH determines that system integrity has been damaged (for example, if the channel has been reset, or if the device address stored is invalid), CCH places the system in a disabled wait state and sends a message to the VM/370 primary system operator. For the 4331 and 4341 processors, limited channel logout is still available, but no fixed or I/O extended logout area exists.

Virtual machines for which VMSAVE (Directory option or SET command operand) is enabled normally have their register and storage contents saved in the event of certain abend situations. However, catastrophic channel errors cause a disabled wait PSW to be loaded and may prevent saving the contents of a virtual machine.

HANDLING OF HARD MACHINE CHECKS

If a permanent error (hard machine check) occurs on the main processor (or attached processor), the error is analyzed to determine whether or not it is correctable by programming. Time-of-day clock and timer errors that result in a machine check interruption that are not correctable and cannot be circumvented place the real computing system in a disabled wait state.

Uncorrectable or unretryable processor errors, storage errors, and storage protect key failures are handled as discussed in the following paragraphs.

Processor Errors

When a machine check interruption indicates that a processor error associated with VM/370 cannot be corrected or retried the system operator is informed of the error and the system is put in a disabled wait state. All virtual machine users must log on again. If the error is associated with a virtual machine, the user is informed of the error and the virtual machine is reset, unless it is using the virtual=real option. In that case, the virtual machine is terminated, and the user must then log on and reinitialize (via IPL) his machine.

If VM/370 is being run in attached processor mode and an uncorrectable error is encountered on the attached processor while executing in problem program state, system operation continues in uniprocessor mode on the main processor.

Storage Errors in a Virtual Machine Page

When the control program (CP) detects a permanent storage error (hard machine check) in a real storage page frame that is being used by a virtual machine, the frame is marked invalid if the error is intermittent, or unavailable if the error is solid. If the page frame has not been altered by the virtual machine, a new page frame is assigned to the virtual machine and a backup copy of the page is brought in the next time the page is referenced. All storage errors are transparent to the virtual machine user.

If the page frame has been altered, VM/370 resets the virtual machine, clears its virtual storage to zeros, and sends an appropriate message to the user. If the virtual machine is using the virtual=real option, it is terminated. In either case, normal system operation continues for all other users.

Storage Errors in the CP Nucleus

Multiple-bit storage errors in the CP nucleus cannot be corrected; they cause VM/370 to terminate. (Single-bit storage errors are corrected by ECC, as noted above.)

Storage Protect Key Failures

When intermittent storage protect key failures occur, whether associated with VM/370 or a virtual machine, the key is corrected and operation continues.

If the storage protect key error is uncorrectable (solid) and is associated with a virtual machine, the user is notified and the virtual machine is terminated. The page frame is marked unavailable. Uncorrectable storage protect key failures associated with VM/370 cause the VM/370 system to be terminated. An automatic restart reinitializes VM/370.

HANDLING OF SOFT MACHINE CHECKS

Although hard machine checks always cause a machine check interruption to occur and logouts to be written, soft machine checks are handled in one of two operating modes -- recording mode or quiet mode.

- In recording mode, soft machine checks cause machine check interruptions and write logouts.
- In quiet mode, only hard machine checks cause machine check interruptions and write logouts.

The normal operating state of VM/370 for CPU retry reporting is recording mode. For ECC (error checking and correction) reporting, the initialized (normal) state of VM/370 is model-dependent: quiet mode for all VM/370-supported processors except Models 155II and the 165II. The initial state for the 155II and 165II is record mode.

A change from recording mode to quiet mode can occur in one of two ways: when 12 soft machine checks have occurred, or when the SET MODE RETRY/MAIN QUIET command is executed by maintenance personnel.

To revert to record mode again, the command SET MODE RETRY/MAIN RECORD must be issued.

In attached processor applications, soft error recording can be set or reset for the selected processor if so desired.

If a soft machine check (a transient error) occurs while the system is in recording mode, a machine check record containing information about the error is written on the error recording cylinders. This record includes the data in the fixed logout area, the date, the time of day, and other pertinent data. The operator is not informed that a soft machine check has occurred.

If a transient error occurs while the system is in quiet mode, no machine check interruption occurs, and no logouts are written. The hardware, which had gained control when the soft machine check occurred, returns control to either VM/370 or the problem program, depending on which had control at the time the machine check occurred.

3. This step applies to attached processor operations only: Next the PSA (prefix storage area) of the main processor is printed followed by the PSA values for the attached processor if the system was in attached processor mode when the abend occurred.

4. Following this is data extracted from CP's symbol table (DMKSYM), which contains the storage location of selected entry points for the CP system.

5. The tabulations that follow the symbol table printout are pages that are applicable to the real system hardware. These blocks represent every channel, every control unit, and every device that is represented as available to VM/370 operations. These blocks are designated as RCHBLOK, RCUBLOK, and RDEVBLOK, respectively. Those devices that are actively involved with system operations at the occurrence of system abnormal ending are indicated by an adjacent display of an active IOBLOK.

6. These blocks are followed by statistics applicable to the spool files that are applied to the spooling devices (system reader, printer, and punch). These blocks are designated as spooled file blocks (SFBLOK). If no spooling activity exists, then the VMFDUMP output indicates this (as indicated in the following VMFDUMP sample).

7. The spooled file data is followed by the CORTABLE. This table indicates the real address of the four doubleword entries that contain pointers to the SWPTABLE, the PAGTABLE, the previous entry in queue, and the next entry in queue. Also contained in this block are flags to indicate whether the page is on the flush list, the free list, or is shared or unavailable. The CORTABLE printout also indicates the user identity and the page assignment at the time of the abnormal ending.

8. After the CORTABLE, there is a progression of data blocks that are related to each logged on user. They are listed in the following order: the virtual machine blocks (VMBLOCK), virtual channel blocks (VCHBLOK), virtual control unit blocks (VCUBLOK), virtual device blocks (VDEVBLOK), and virtual console control blocks (VCONCTL). This is followed by Segment tables, Page tables and Swap tables (SEGTABLE, PAGTABLE, SWPTABLE), respectively that are applicable to the associated user's virtual machine activity.

Figure 36 illustrates the output of a formatted VMFDUMP operation (uniprocessor mode). Note that if RDEVBLOK 200 is for an FB-512 device, the RECBLOK would be in a different format. For the actual format of an FB-512 RECBLOK, see VM/370 Data Areas and Control Block Logic, Order No. SY20-0884.

```
VM/370 SYSTEM ABEND CODE PRG05: DATE  09/08/72    TIME  15:13:31

GREGS 0-7   00000034  00C5C1C4  00000048  0007BC10  00000000  000237F8  00000000  00000008
      8-15  000237DE  0007B668  00000000  00033448  00023480  00073A08  00012D22  00072390

GREGS 0-7   808008C0  00026F80  FFFFFFFF  FFFFFFFF  00000000  00000000  00000000  00000000
      8-15  00000000  00000000  00000000  00000000  00000000  00000000  EFC00000  00073930

FPRGS 0-4   00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000

TOD CLOCK   82636C06  455D6000       TOD CLOCK COMP  8263E1B3  57000000

CPU TIMER   FFFFFFFF  CA337000

CSW  00000000  00000000        CAW  000158D0        INT TIMER  00000E00

EXT OLD PSW  1004  070D0000  00015A56                      EXT NEW PSW 000C0000  000009C8

SVC OLD PSW  0008  000C0000  0000D23E                      SVC NEW PSW 000C0000  00000500

PGM OLD PSW  0005  000C0000  00023812                      PGM NEW PSW 000C0000  00011C58

MCK OLD PSW        00000000  00000000                      MCK NEW PSW 00080000  00011000

I/O OLD PSW  0046  070D0000  0001764A                      I/O NEW PSW 000C0000  00014080
```

```
DMKPSA   - 000000    DMKPSASV - 000500    DMKPSANS - 000B44    DMKPSADU - 00069C    DMKPSAEX - 0009C8
DMKFEIBM - 000560    DMKPSARX - 00081A    DMKPSAID - 000850    DMKPSARS - 000860    DMKPSARR - 000866
DMKMCH   - 011000    DMKPRG   - 011C58    DMKPRGCT - 011D30    DMKPRV   - 012120    DMKPRVCT - 012178
DMKPRVLG - 012120    DMKPRVKY - 0127A8    DMKHVC   - 012998    DMKHVCAL - 012998    DMKHVCYL - 012EA0
DMKHVCPC - 012EA8    DMKGEN   - 012F08    DMKDGD   - 0130E0    DMKVAT   - 013608    DMKTMR   - 013E10
DMKIOS   - 014020    DMKIOSOR - 014020    DMKIOSQV - 01402C    DMKIOSIN - 014080    DMKIOSRW - 0147AA
DMKIOSCT - 01421C    DMKRIO   - 019558    DMKRIODV - 019558    DMKRIOCU - 01BFD8    DMKRIOCH - 01C398
DMKRIOCT - 01C518    DMKRIOCC - 01C538    DMKRIOUC - 01C53A    DMKRIODC - 01C53C    DMKRIOCN - 01C540
DMKRIOPR - 01C548    DMKRIOPU - 01C554    DMKRIORD - 01C55C    DMKCNS   - 014A88    DMKCNSIN - 014A88
DMKCNSID - 014E2E    DMKCNSOF - 014FE8    DMKTBL   - 015C88    DMKRSP   - 016788    DMKRSPEX - 016788
DMKRSPHQ - 017920    DMKRSPID - 017950    DMKRSPDL - 017948    DMKRSPRD - 017940    DMKRSPPR - 017930
DMKRSPPU - 017938    DMKRSPAC - 017928    DMKRSPER - 017954    DMKDAS   - 017A00    DMKIOE   - 018AB8
DMKCCH   - 019098    DMKSTK   - 01C568    DMKSTKCP - 01C568    DMKSTKIO - 01C586    DMKDSP   - 01C5B0
DMKDSPCH - 01C5B0    DMKDSPQS - 01CF08    DMKDSPRQ - 01CF0C    DMKDSPA  - 01C5D4    DMKDSPB  - 01C5F8
DMKDSPNP - 01CF1C    DMKDSPCC - 01CF20    DMKDSPAC - 01CF24    DMKDSPBC - 01CF28    DMKSCH   - 01D008
DMKSCHN1 - 01D7D0    DMKSCHN2 - 01D7DC    DMKSCHCT - 01D0C0    DMKSCHPU - 01D7E0    DMKVIO   - 01D838
DMKVIOEX - 01D838    DMKVIOIN - 01DED2    DMKVIOMK - 01E2A4    DMKVIOCT - 01E29C    DMKVIOCW - 01E2A0
DMKCCW   - 01E488    DMKCCWTR - 01E488    DMKUNT   - 01F5A0    DMKUNTRN - 01F5A0    DMKUNTFR - 01F5F2
DMKUNTRS - 01F886    DMKVSP   - 01F9A8    DMKVSPEX - 01F9A8    DMKVSPCR - 01FDCA    DMKVSPCO - 02033C
```

Figure 36. Formatted VMFDUMP (Part 1 of 6)

Index

The entries in this Index are accumulative. They list additions to this publication by the following VM/370 System Control Program Products:

- VM/370 Basic System Extensions, Program Number 5748-XX8
- VM/370 System Extensions, Program Number 5748-XE1

However, the text within the publication is not accumulative; it only relates to the one SCP program product that is installed on your system. Therefore, there may be topics and references listed in this Index that are not contained in the body of this publication.