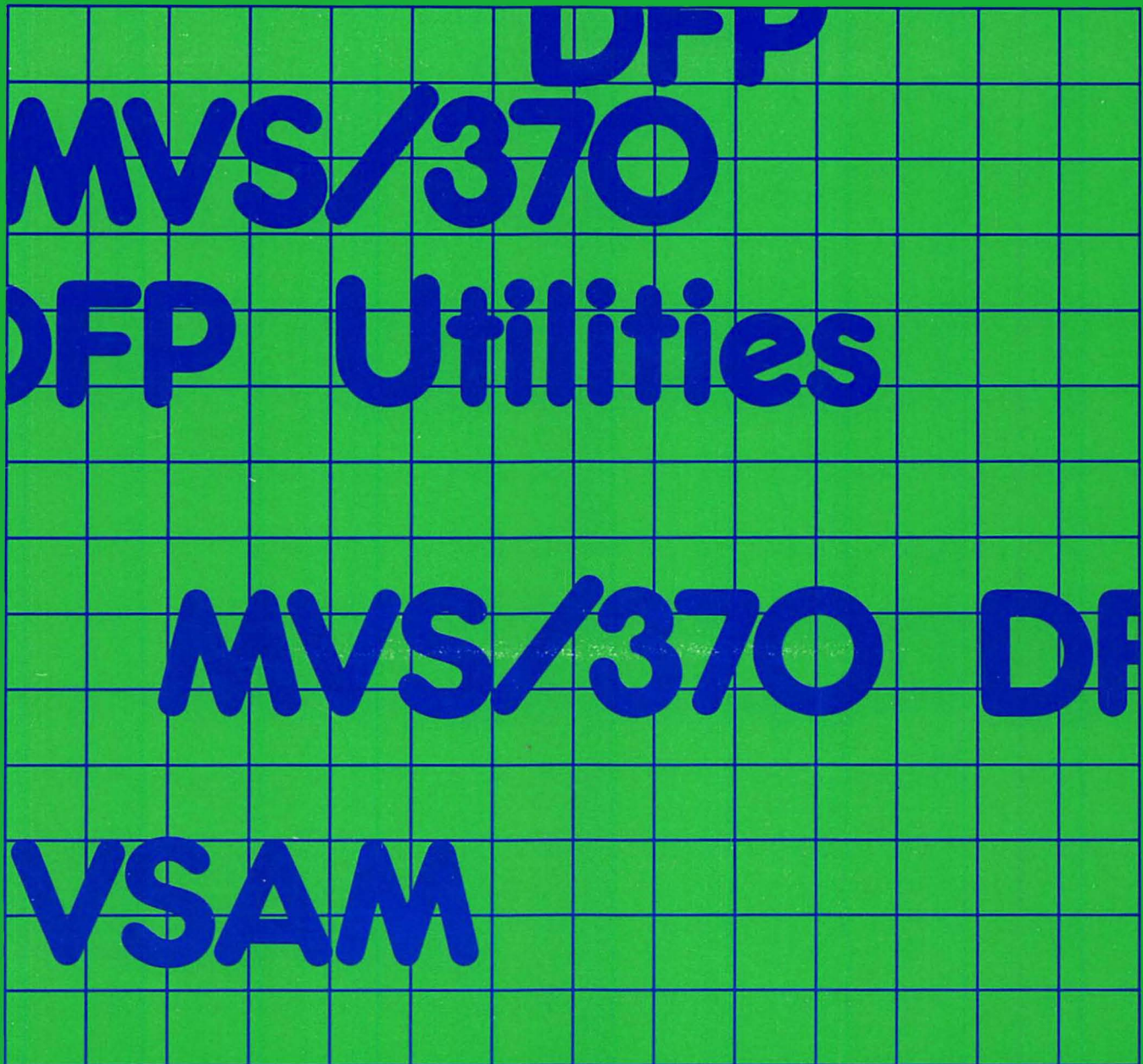




**MVS/370  
Checkpoint/Restart  
Supervisor Call Logic**

Program  
Product



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**MVS/370**  
**Checkpoint/Restart**  
**Supervisor Call Logic**

Data Facility Product 5665-295  
Release 1.1

LY26-3916-1

**Second Edition (December 1985)**

This is a major revision of, and makes obsolete, LY26-3916-0 and its technical newsletter, LN26-8087.

This edition applies to Release 1.1 of MVS/370 Data Facility Product, Program Product 5665-295, and to any subsequent releases until otherwise indicated in new editions or technical newsletters.

The changes for this edition are summarized under "Summary of Amendments" following the preface. Specific changes are indicated by a vertical bar to the left of the change. These bars will be deleted at any subsequent republication of the page affected. Editorial changes that have no technical significance are not noted.

Changes are made periodically to this publication; before using this publication in connection with the operation of IBM systems, consult the latest IBM System/370 and 4300 Processors Bibliography, GC20-0001, for the editions that are applicable and current.

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PREFACE

This book describes the logic of the MVS/370 Data Facility Product Supervisor Call (MVS/370 DFP SVC) routines that take a checkpoint, and restart a job at a checkpoint. The routines that restart a job at a step are documented in OS/VS2 System Logic Library, Volumes 1 through 7, SY28-0713 through SY28-0719.

This book is intended for use by programming systems representatives and system programmers maintaining checkpoint/restart routines.

ORGANIZATION

This publication contains the following major sections:

- "Introduction" describes the checkpoint/restart routines in general terms and briefly tells what they do.
- "Method of Operation" describes the operations performed by checkpoint/restart routines and the input to and output from those operations.
- "Program Organization" gives the flow of control between the modules of checkpoint/restart and describes the major operations performed by each module.
- "Module Directory" lists each checkpoint/restart module and refers to a diagram in "Program Organization" or "Method of Operation" that describes each module.
- "Data Areas" shows the data areas used by checkpoint/restart routines.
- "Diagnostic Aids" lists the messages, message codes, and return codes generated by checkpoint/restart modules.
- "Abbreviations" lists the acronyms and abbreviations used in this book and their meanings.

PREREQUISITE KNOWLEDGE

A general understanding of how a user requests that a checkpoint be taken and restarts a job is prerequisite knowledge for understanding the information in this book. For this type of information, see MVS/370 Checkpoint/Restart, GC26-4054.

Additional prerequisite knowledge is contained in MVS/370 VSAM Logic, LY26-3928.

**RELATED PUBLICATIONS**

Within the text, references are made to the publications listed in the table below.

Short Title	Publication Title	Order Number
ACF/TCAM Logic	<u>Advanced Communication Function for TCAM Logic</u>	LY30-3036
Data Areas	<u>MVS/370 Data Facility Product Data Areas</u>	LJB6-0096
Data Areas - OS/VS2	<u>OS/VS2 Data Areas</u>	SYB8-0606
Symbol Cross Reference	<u>MVS/370 Data Facility Product Symbol Cross Reference Listings</u>	LJB6-0095
TCAM Logic	<u>TCAM Logic</u>	SY30-2059
VIO Logic	<u>MVS/370 VIO Logic</u>	LY26-3927

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**SUMMARY OF AMENDMENTS**

**| RELEASE 1.1 LIBRARY UPDATE, DECEMBER 1985**

**| SERVICE CHANGES**

All MVS/370 titles referred to in this publication have been changed to their corresponding MVS/XA titles.

Information has been added to reflect technical service changes.

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## INTRODUCTION

Checkpoint/restart is a technique for recording information about a job at programmer-designated checkpoints so that the job can be restarted at one of these checkpoints or at the beginning of a job step. This book documents the logic of those routines. Restart of a job at a step is performed by scheduler termination routines, which are documented in System Logic Library.

When the system is loaded, checkpoint/restart modules are taken from SYS1.LPALIB and loaded into the link pack area. These modules are paged into real storage for execution as they are needed.

## OVERVIEW OF CHECKPOINT PROCESSING

The user takes a checkpoint by coding the CHKPT macro in the program. (Checkpoint/Restart shows how to code the CHKPT macro.) Execution of the CHKPT macro causes the checkpoint routines to save the contents of the user's region and all the information necessary to restart the user's program. This information is saved in a data set (called the checkpoint data set) that resides on one or more tape or direct access volumes. The user must provide a DD statement and a DCB macro for the checkpoint data set.

## OVERVIEW OF RESTART PROCESSING

The user can request that a job be restarted without being resubmitted (called automatic restart), or the user can resubmit the job for restart (called deferred restart). Automatic restarts must be authorized by the operator; deferred restarts take place without operator authorization when a job is resubmitted.

Automatic and deferred restart can take place from a checkpoint or from the beginning of a job step. They are requested in the following manner:

Type of Restart	How Requested
Automatic checkpoint restart	CHKPT macro (RD=NC or RNC must not be specified in the RD parameter)
Automatic step restart	RD parameter in the JOB or EXEC statement (RD=R or RNC must be specified)
Deferred checkpoint restart	RESTART parameter in the JOB statement and a SYSCHK DD statement in the resubmitted deck
Deferred step restart	RESTART parameter in the JOB statement in the resubmitted deck

(Checkpoint/Restart shows how to code these parameters and statements.)

Restart routines re-create the environment that existed when a checkpoint was taken. They open the checkpoint data set and, using the information that was saved in it when the checkpoint was taken, restore the user's region and task control information. They then position any user data sets open when the checkpoint was taken.



**METHOD OF OPERATION**

This section consists of method of operation diagrams. These diagrams describe the major operations performed by checkpoint and restart modules and the data that is input to, and output from, those operations.

The operations described in each diagram are further amplified in the adjoining "Notes to Diagram..." These notes tie the operations to a specific module and, where possible, to a label in that module.

Diagram 1 is a table of contents for the method of operation diagrams. It shows, at the highest level, each operation performed by checkpoint/restart and directs you to the specific diagram documenting the operation. Diagrams 2 and 8 show the major operations performed by checkpoint (Diagram 2) and restart (Diagram 8), respectively, and the data that is input to, and output from, those operations. Following is an explanation of the graphic symbols used in the method of operation diagrams.

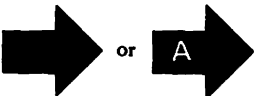
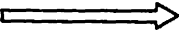



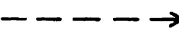

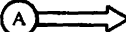
Control flow	Data flow
 <p>Entry point to diagram. The second type of arrow is used when a diagram has more than one entry point.</p>	 <p>Input to or output from a processing step</p>
 <p>Flow of control</p>	 <p>Modification of data</p>
 <p>On-page connector; number represents number of processing step receiving control</p>	 <p>Testing of, or reference to, data</p>
 <p>Off-page connector; number is number of diagram where processing resumes</p>	 <p>On-page connector; used to indicate input to or output from a processing step</p>

DIAGRAM 1. CHECKPOINT/RESTART TABLE OF CONTENTS

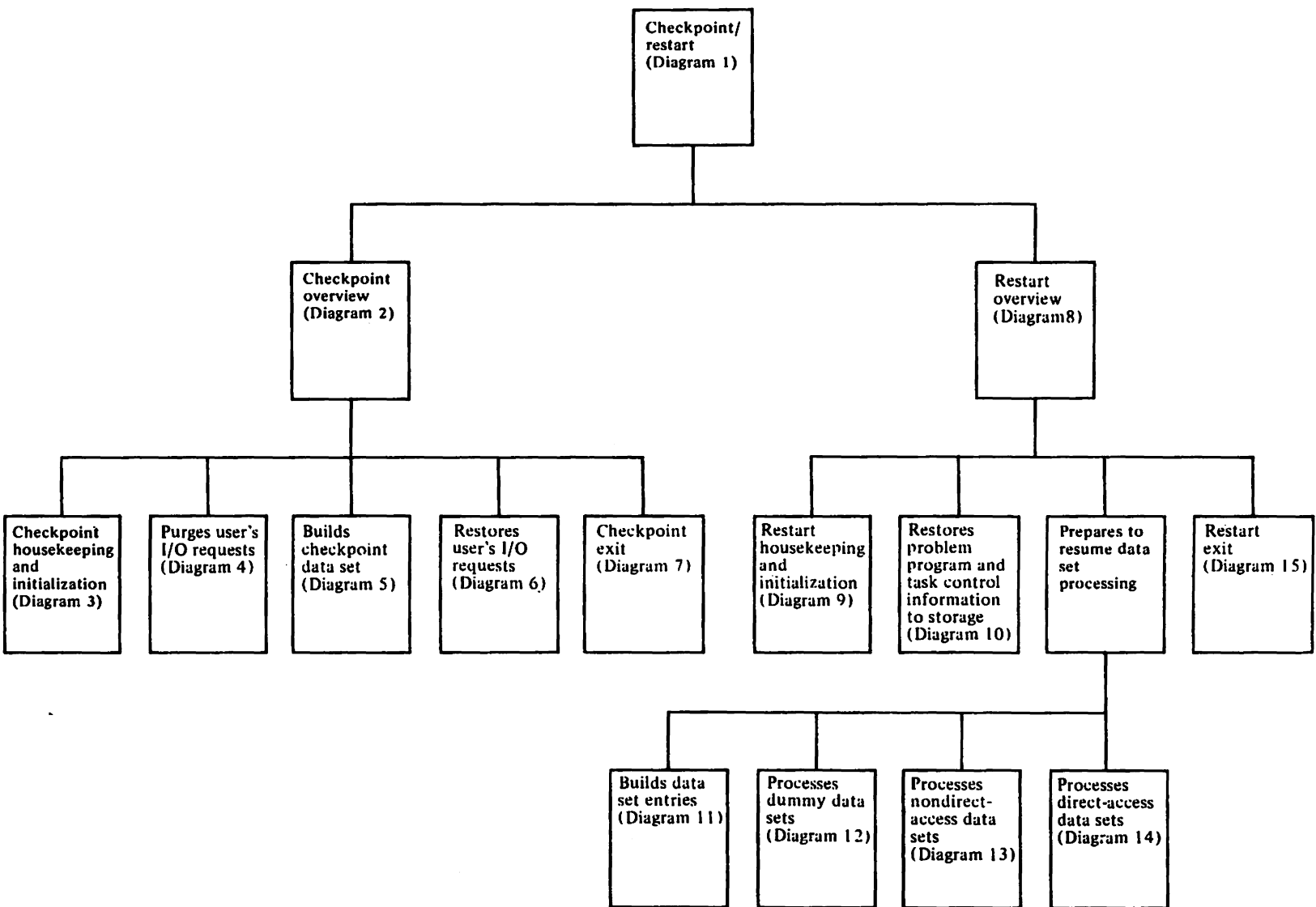
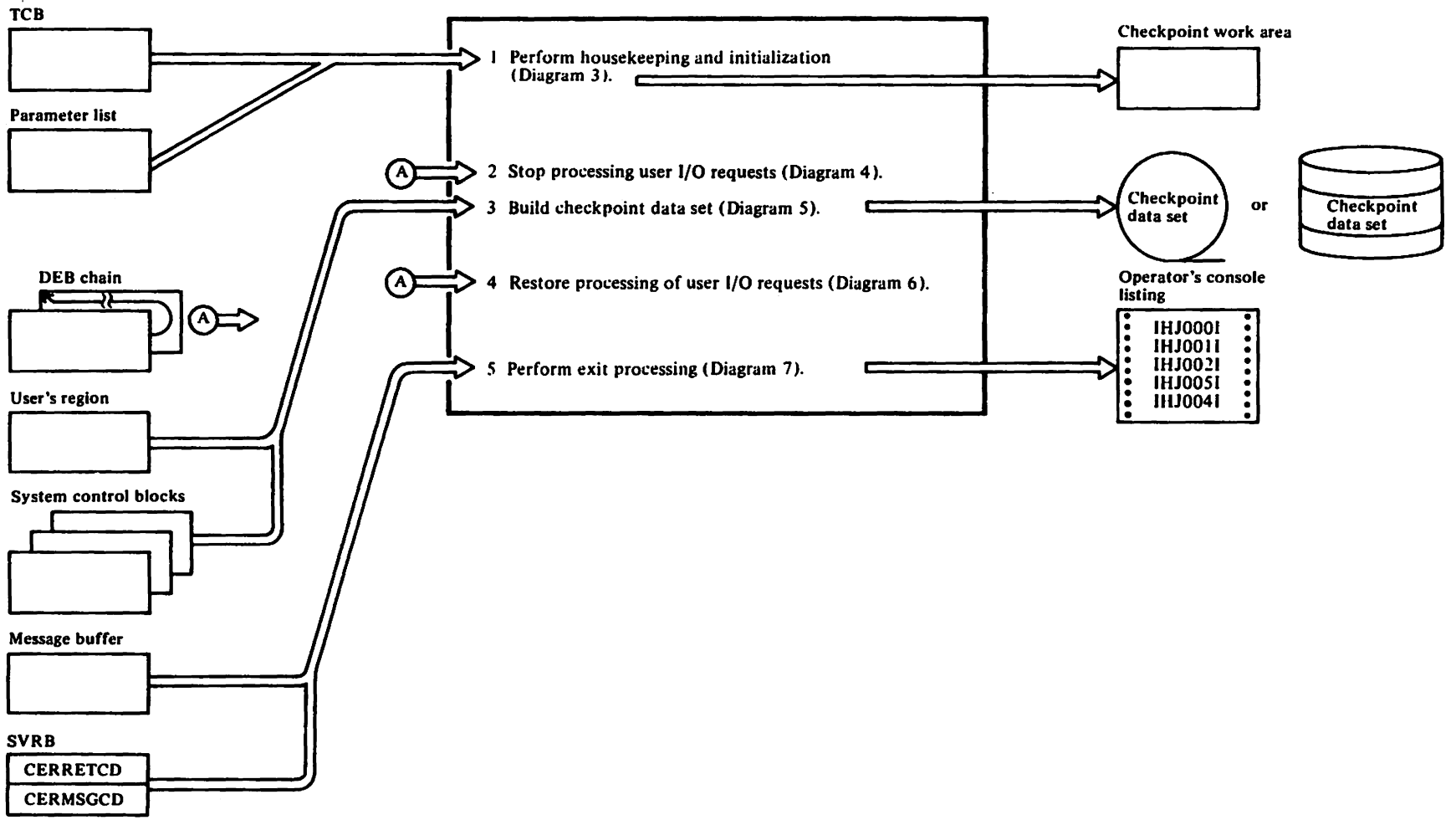


DIAGRAM 2. OVERVIEW OF CHECKPOINT PROCESSING



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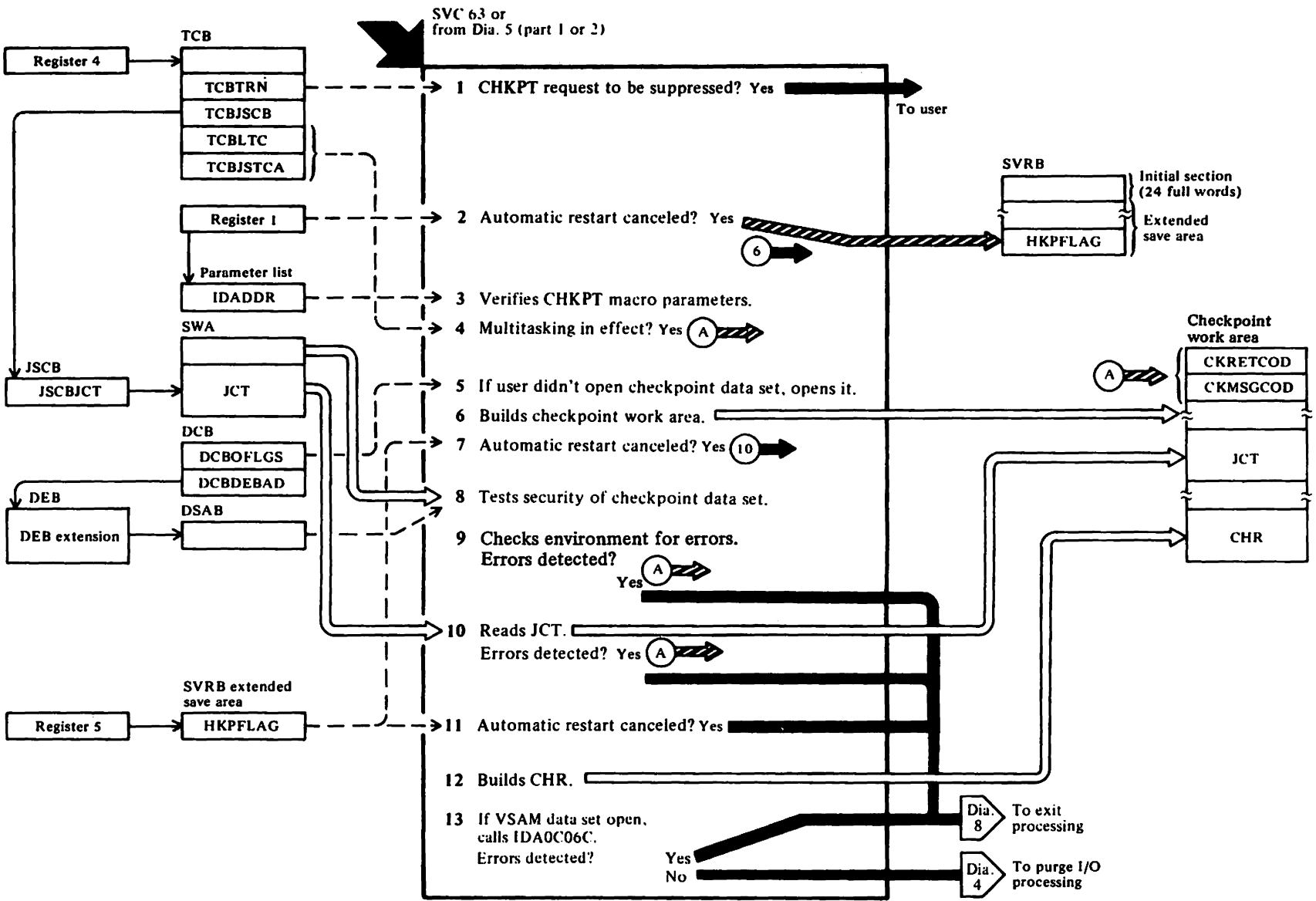


DIAGRAM 3. CHECKPOINT HOUSEKEEPING AND INITIALIZATION

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Notes to Diagram 3

IHJACP00 (IGC0006C)

- 1 Determines whether the user requested that checkpoints be suppressed (RD=NC or RNC coded on user's JOB or EXEC statement). If so, returns to user.
- 2 Clears the SVRB extended save area, which is subsequently used as a message parameter list in checkpoint exit processing.

Determines whether the user requested cancellation of automatic restart. (This request made via CANCEL parameter in CHKPT macro.)

If so, sets a flag (HKPFLAG) to indicate cancellation. Then obtains a 640-byte checkpoint work area and continues processing at step 6c.

- 3 Issues the SETLOCK macro to get the local lock and then checks whether the parameters specified in the CHKPT macro are valid. If not, releases the local lock and continues processing at step 9.
- 4 Releases the local lock. Determines whether the current task is a subtask or has subtasks. If so, continues processing at step 9.
- 5 Determines whether the user has already opened the checkpoint data set. If not, opens it. If the checkpoint data set is not successfully opened, continues processing at step 9.
- 6
  - a) Using the following formula, determines the number of bytes needed to build the checkpoint work area:  
$$\text{work area} = \text{TIOT length} + 1220 + 4096 + 48(\text{no. DEBs} - 2)$$
  - b) Issues a conditional GETMAIN macro to obtain space for the checkpoint work area. If not enough storage is available, continues processing at step 9.
  - c) Clears the first 256 bytes of the work area and initializes various fields in it.
- 7 If the user canceled automatic restart, continues processing at step 9.
- 8 The following security tests are made:

- a) If the checkpoint data set is known to be secure (DSABCKDS and DSABCKVL bits are on) but one of the following conditions exists, clears the checkpoint data set bit in the data set label (indicating that the data set has failed the security test). Then continues processing at step 9.
    - The checkpoint data set is on a shared device.
    - Another DCB is open to a data set with the same DSN as the checkpoint data set.
    - The checkpoint data set is not under exclusive control (DISP=SHR coded on the DD card).
  - b) If the checkpoint data set is not known to be secure (DSABCKDS and DSABCKVL bits are off), does the following:
    - If the device the checkpoint data set is on is neither tape nor direct access, or the device is tape but the block count for the tape is not zero, continues processing at step 9
    - Creates a label for the data set, indicating it is a checkpoint data set. The Open and Close routines of O/C/E0V are entered during this process. If the Open routine concludes that the checkpoint data set is not a secure one, continues processing at step 9.
  - c) If a direct access checkpoint data set is not empty or is not a BPAM or BSAM data set, clears the checkpoint data set bit in the data set label (indicating that the data set has failed the security test). Then continues processing at step 9.
  - d) If the Open routine of O/C/E0V established a security interface (the user of the checkpoint data set was unauthorized so a security interface was established to prevent reading from or writing to the checkpoint data set), gets the address of the DCB for the checkpoint data set, and stores it in the checkpoint work area.
- 9 If any of the errors listed in "Diagnostic Aids" were detected, sets a message code and gives control to IGC0006C.

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**IHJACP01 (IGC0106C)**

If any of the errors listed in "Diagnostic Aids" were detected, sets a message code and gives control to IGC0Q06C.

If any resources (requests made via ENQ macro) haven't been released, sets X'0100' in the CKMSGCOD field in the checkpoint work area to indicate a warning message should be printed in IGC0Q06C.

**IHJACP02 (IGC0206C)**

10 Prepares to read the job control table (JCT) by getting space for a QMNGRIO parameter list and work area. Sets user authorization (whether authorized to issue MODESET macro) in CHR.

Sets up the QMNGRIO parameter list with TTR of JCT (gotten from JSCB). Reads the JCT (using QMNGRIO macro) into the checkpoint work area.

If an I/O error was detected when the JCT was read, sets message code 025 in CKMSGCD2 and gives control to IGC0Q06C.

11 If the user canceled automatic restart (this request made via CANCEL parameter in CHKPT macro), gives control to IGC0Q06C.

12 Updates the JCTNRCKP field in the JCT, which indicates the number of checkpoints taken.

If the user didn't supply a checkid, generates one.

Moves the checkid into the checkpoint header record (CHR) build area and builds remainder of CHR.

13 If any VSAM data sets are open, loads and branches to the VSAM checkpoint routine, IDA0C06C. (See VSAM Logic.) If the CKRETCOD routine indicates an error, gives control to IGC0Q06C. Otherwise, gives control to IGC0506C.

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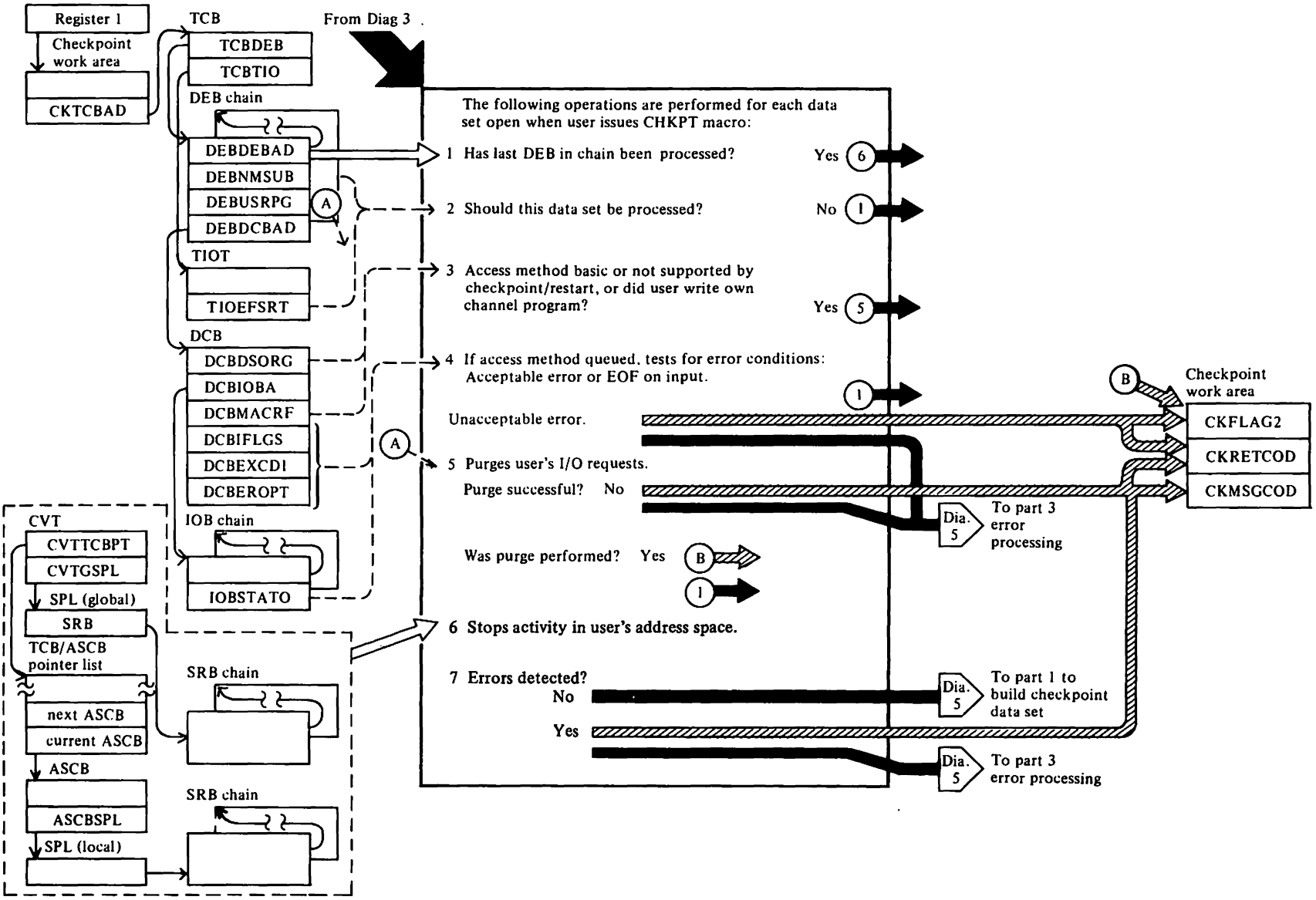


DIAGRAM 4. PURGING USER'S I/O REQUESTS

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Notes to Diagram 4

IGC0506C

1 Tests whether the DEB just processed is the last DEB in the chain (DEBDEBAD contains 0). If so, continues processing at step 6.

2 Examines the DEB and its associated DSAB and TIOT DD entry to determine whether the DEB is for any of the following types of data sets: TCAM, VSAM, subsystem, dummy, ISAM (using the compatibility interface). If so, skips processing of this data set, gets the address of the next DEB in the chain, and continues processing at step 1.

3 Checks DCBDSORG field to determine whether the access method being used is supported by checkpoint/restart. If not supported, continues processing at step 5.

Checks DCBMACRF field to determine whether the user wrote own channel program or is using the basic access method. If so, continues processing at step 5.

4 For queued access methods, checks DCBIFLGS and DCBEXCD1 for errors.

If errors are posted, determines (from DCBEROPT field) if the errors are acceptable.

If the errors are acceptable, skips processing of this data set, gets the address of the next DEB, and continues processing at step 1.

If the errors are not acceptable, tests the IOB for EOF on input. If EOF was reached, skips processing of this data set and continues processing at step 1.

If EOF was not reached, sets the appropriate codes in checkpoint's work area and gives control to IGC0N06C.

5 Sets up a purge parameter list containing the addresses of the DEB and the DEBUSRPG field. Sets the

option field in the parameter list to quiesce active I/O and post the results of the purge operation.

Issues the PURGE macro (SVC 16). Checks register 15 and the PPLCC field in the parameter list to determine whether the purge was successful. If not, sets the appropriate codes in checkpoint's work area and gives control to IGC0N06C.

Checks the DEBUSRPG field to determine whether the purge took place. If so, sets the result I/O flag.

If the access method was basic, gets the address of the next DEB and continues processing at step 1. If the access method was queued, rechecks for errors (as in step 4). If processing can continue, gets the address of the next DEB and continues processing at step 1.

6 Issues the STATUS macro to stop dispatching of routines for which an SRB exists. Gets the dispatcher lock.

Searches the SRB chains for SRBs associated with the user's address space. If any are found, releases the dispatcher lock and issues the STATUS macro to start dispatching of routines associated with these SRBs. Continues processing at the beginning of this step to repeat this process. (Additional SRBs may have been added to the SRB chain after the dispatcher lock was released.) When all global SRBs associated with the user's address space have been processed, releases the dispatcher lock.

Then, after all SRBs have been processed, issues the STATUS macro so the routines associated with any future SRBs for the user's address space can be dispatched.

7 If no errors were detected, exits to IHJACP20 (IGC0A06C). Else, exits to IGC0N06C.

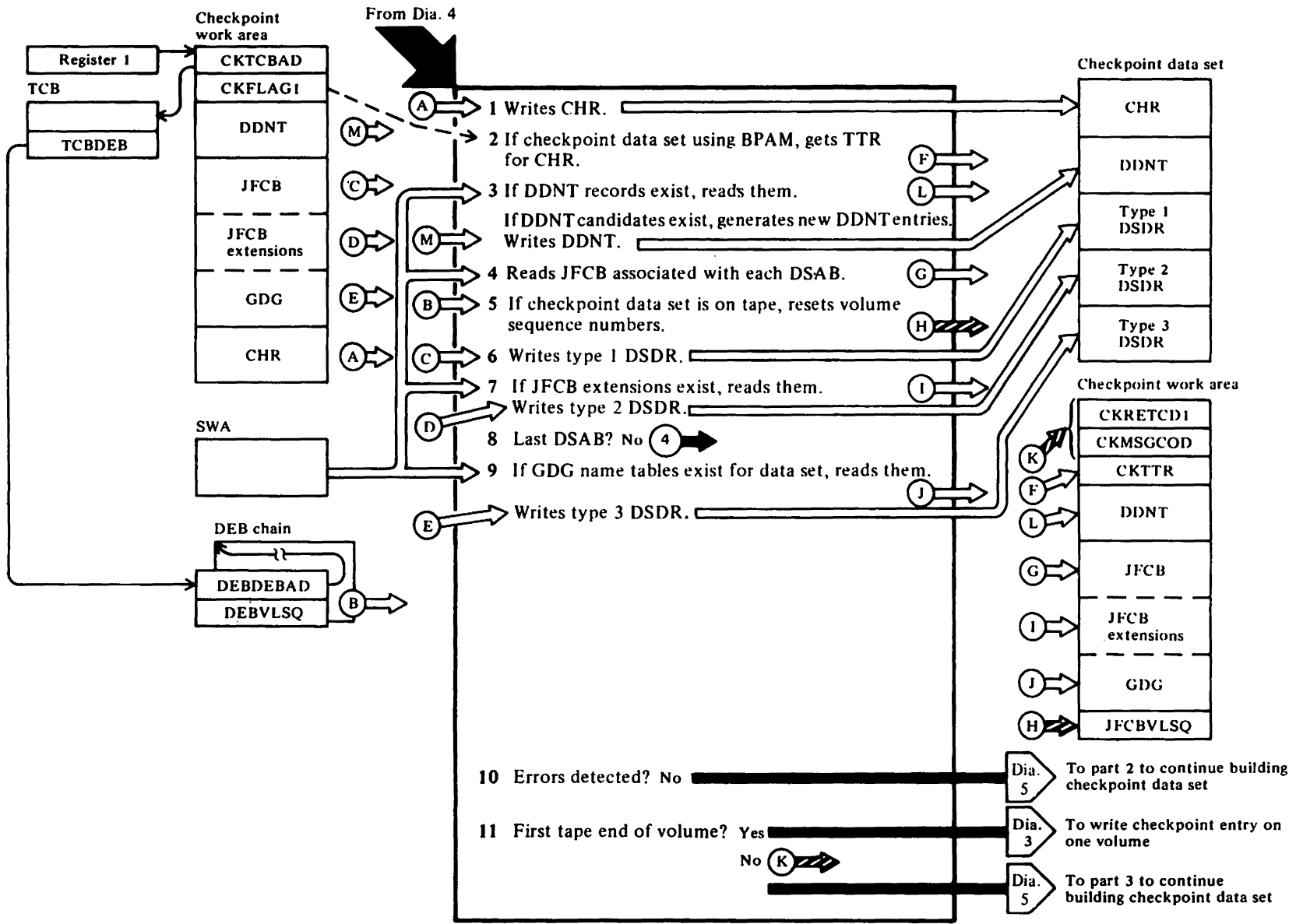


DIAGRAM 5 (PART 1 OF 3). BUILDING CHECKPOINT DATA SET

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**Notes to Diagram 5 (Part 1 of 3)**

**IHJACP20 (IGC0A06C)**

- 1 If the checkpoint data set is on tape, saves the volume sequence number (VOLSEQNO in DEB) in the checkpoint work area. If the checkpoint data set is on a direct access device, saves the number of extents (DEBNMEXT in DEB) in the checkpoint work area. This information is used later to test for EOVS.

Initializes the DECB (used in writing the CHR).

Writes the CHR.

- 2 If the checkpoint data set is using BPAM, issues the NOTE macro to get the CHR's TTR.

**IHJACP25 (IGC0D06C)**

- 3 Determines whether the SWA contains any DDNT records. (A DDNT record consists of a series of entries—up to 21—each entry identifying a data set that's been dynamically deallocated since the beginning of the job step.) If so, reads the DDNT records into the checkpoint work area and then writes them to the checkpoint data set (except the last DDNT record).

Examines the JSCBOPTS field to determine whether any DDNT candidates exist. (A DDNT candidate is an entry waiting to be put in the DDNT record. This condition arises because the scheduler only updates DDNT records at intervals.) If DDNT candidates exist, issues the QMNGRIO macro to read each SIOT on the SIOT chain. Examines the SIOTBYT1 field in each SIOT to determine whether it represents a DDNT candidate. If so, the candidate is made an entry in the current DDNT record in the checkpoint work area. When the record is filled, it gets written to the checkpoint data set and a new record is established in the checkpoint work area. When all SIOTs have been examined, writes the last DDNT record to the checkpoint data set.

- 4 Prepares to read in the JFCB(s) for each data set on the user's DSAB chain when the CHKPT macro was issued.

For each DSAB, accesses the DD entry in the user's TIOT (pointed to by the DSABTIOT field) to get the TTR of the JFCB associated with the DSAB. Stores the TTR in the SMNGRIO

parameter list. Then issues the QMNGRIO macro to read in the JFCB.

- 5 If the checkpoint data set is on tape, determines whether the JFCBVLSQ field in the JFCB equals 0. If so, sets the JFCBVLSQ field equal to the volume sequence number in the DEBVLSQ field of the DEB. If JFCBVLSQ is not equal to 0, sets JFCBVLSQ equal to DEBVLSQ - 1 + JFCBVLSQ. This information is used at restart time to position the checkpoint data set.

- 6 For each data set on the DSAB chain when the user issued the CHKPT macro, moves the data set's JFCB and UCBTYP field to the buffer in the checkpoint work area. Issues the QMNGRIO macro to read each SIOT (pointed to by the DSABSIOT field) on the SIOT chain. Moves the ddname and other selected fields from the SIOT into the buffer in the checkpoint work area. Moves the DEBVLSQ field into the DSDR buffer. When the buffer is full, writes this information to the checkpoint data set as a type 1 data set descriptor record (DSDR).

- 7 If the JFCB associated with the data set being processed has extensions, reads the JFCB extensions into the buffer in the checkpoint work area. Each time the buffer is full, writes its contents to the checkpoint data set as a type 2 DSDR.

- 8 When the last JFCB has been processed, determines whether processing associated with the last DSAB has been completed. If not, continues processing at step 6.

- 9 When the last DSAB has been processed, determines whether generation data group (GDG) name tables exist for any of the user's data sets. If so, reads them into the buffer in the checkpoint work area. Each time the buffer is full, writes its contents to the checkpoint data set as a type 3 DSDR.

- 10 If no errors have been detected, gives control to IHJQCP30.

- 11 If errors were detected, sets the appropriate error codes (see "Diagnostic Aids") and gives control to IGC0N06C.

If EOVS occurred for the first time on tape, gives control to IHJACP02 (IGC0206C) to attempt to write a complete checkpoint entry on one volume. (A tape checkpoint entry must be contained on one tape volume.)

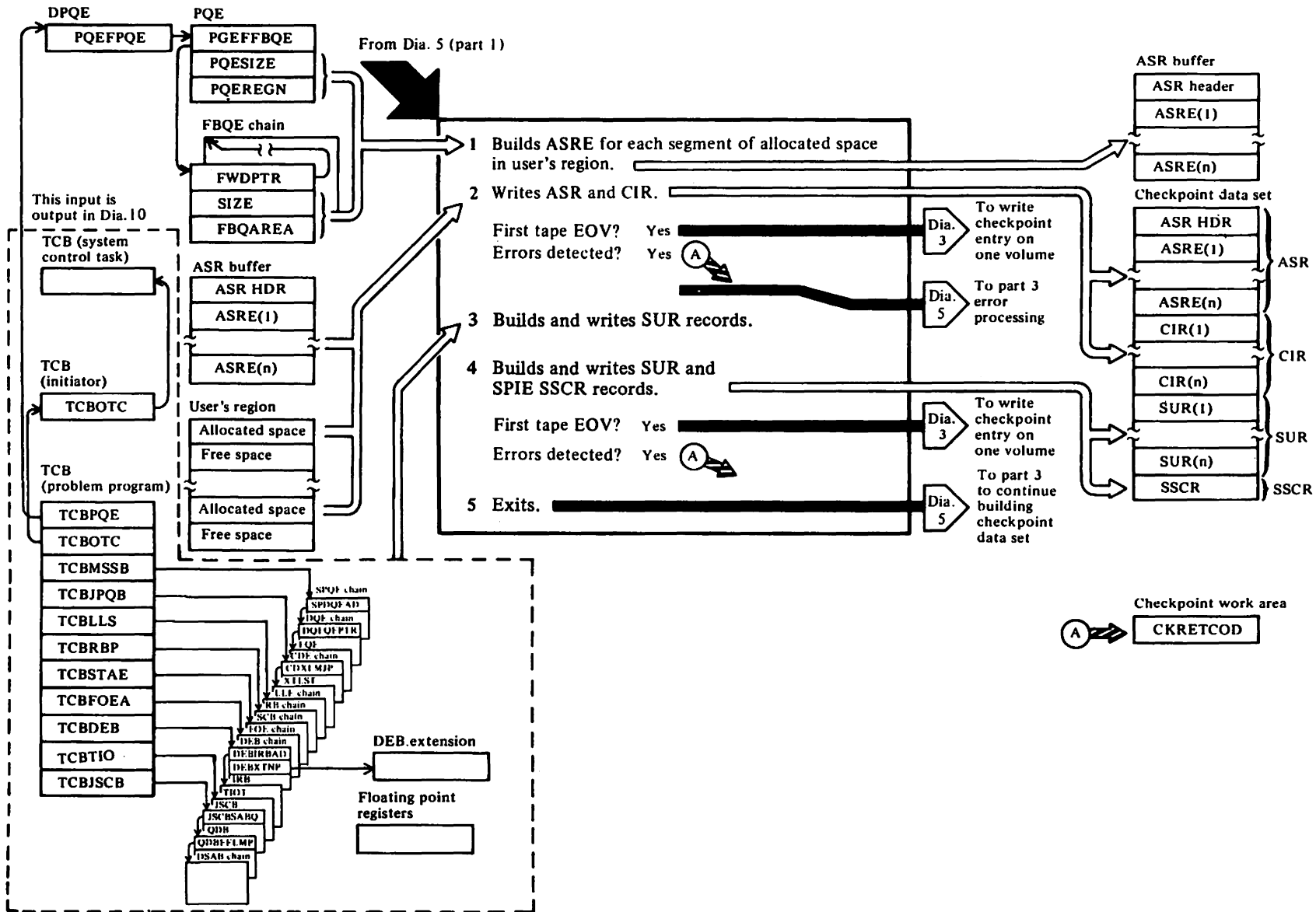


DIAGRAM 5 (PART 2 OF 3). BUILDING CHECKPOINT DATA SET

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**Notes to Diagram 5 (Part 2 of 3)**

**IHQCP30 (IGC0F06C)**

1 Determines from the partition queue element (PQE) the starting (CMCESA) and ending (CMRGEND) address of the user's region. Establishes a buffer for building allocated storage record elements (ASREs).

Determines from the free block queue element (FBQE) the boundaries of each segment of allocated space within the user's region.

For each continuous segment of allocated space, builds an ASRE. (If 255 ASREs are built, writes the ASRE, followed by its CIRs, in the checkpoint data set, resets the ASRE count in the ASR header field to 0, and then continues building ASREs.)

2 Sets a flag in the ASR header field indicating that the last ASRE has been built. Calls subroutine WRITERTN to write the ASR in the checkpoint data set.

Calls subroutine WRITERTN to write the CIRs in the checkpoint data set. (One CIR is written for each ASRE.)

If any of the errors listed in "Diagnostic Aids" were detected, sets a message code and gives control to IGC0N06C.

If EOV occurred for the first time on tape, gives control to IGC0206C to attempt to write a complete checkpoint entry on one volume. (A tape checkpoint entry must be contained on one tape volume.)

**IHQCP31 (IGC0G06C)**

3 Builds the following SUR records in the checkpoint data set buffers and writes the buffers to the data set as each buffer is filled.

- SPQE, DQEs, and FQEs. These control blocks are checkpointed. The order is as follows:

```

SPQE
  DQE
    all FQEs for this DQE,
    if any
  DQE (if more)
    all FQEs for this DQE,
    if any
  etc.
SPQE
  etc.
```

- The JOB pack area CDE queue.

The CDEs and their associated extend lists are checkpointed. The order is as follows:

```

Major CDE
  Extent list (if any)
  Minor CDE (if any)
Major CDE
  Extent list (if any)
  Minor CDE (if any)
Major CDE
  etc.
```

- The problem program load list element (LLE) queue.
- The TCB and its extension.
- The request block (RB) queue, which include XSBs.
- SCB control blocks.
- FOE control blocks.

If an EOV occurred for the first time on tape, gives control to IGC0206C to attempt to write a complete checkpoint entry on one volume. (A tape checkpoint entry must be contained on one tape volume.)

**IHQCP32 (IGC0H06C)**

4 Builds the following SUR records in the checkpoint buffers and calls IHJCLU00 to write the buffers to the checkpoint data set as each buffer is filled.

- Certain fields from the user's checkpoint DCB.
- User's general purpose registers.
- DEBs and their associated control blocks as follows:
  - IRBs (if present).
  - DEB extension (if present).
  - SAMB (if present).
  - Purge I/O restore list (PIRL) (if present).
  - EPCBs (if present).
  - User's floating point registers.
- TIOT.
- Selected DSAB information.
- SPIE SSCRs. If IEAVSPIE provides SPIE/ESPIE data, it will be checkpointed.

If an EOV occurred for the first time on tape, gives control to IGC0206C to attempt to write a complete checkpoint entry on one volume. (A tape checkpoint entry must be contained on one tape volume.)

5 Exits to IGC0N05B.

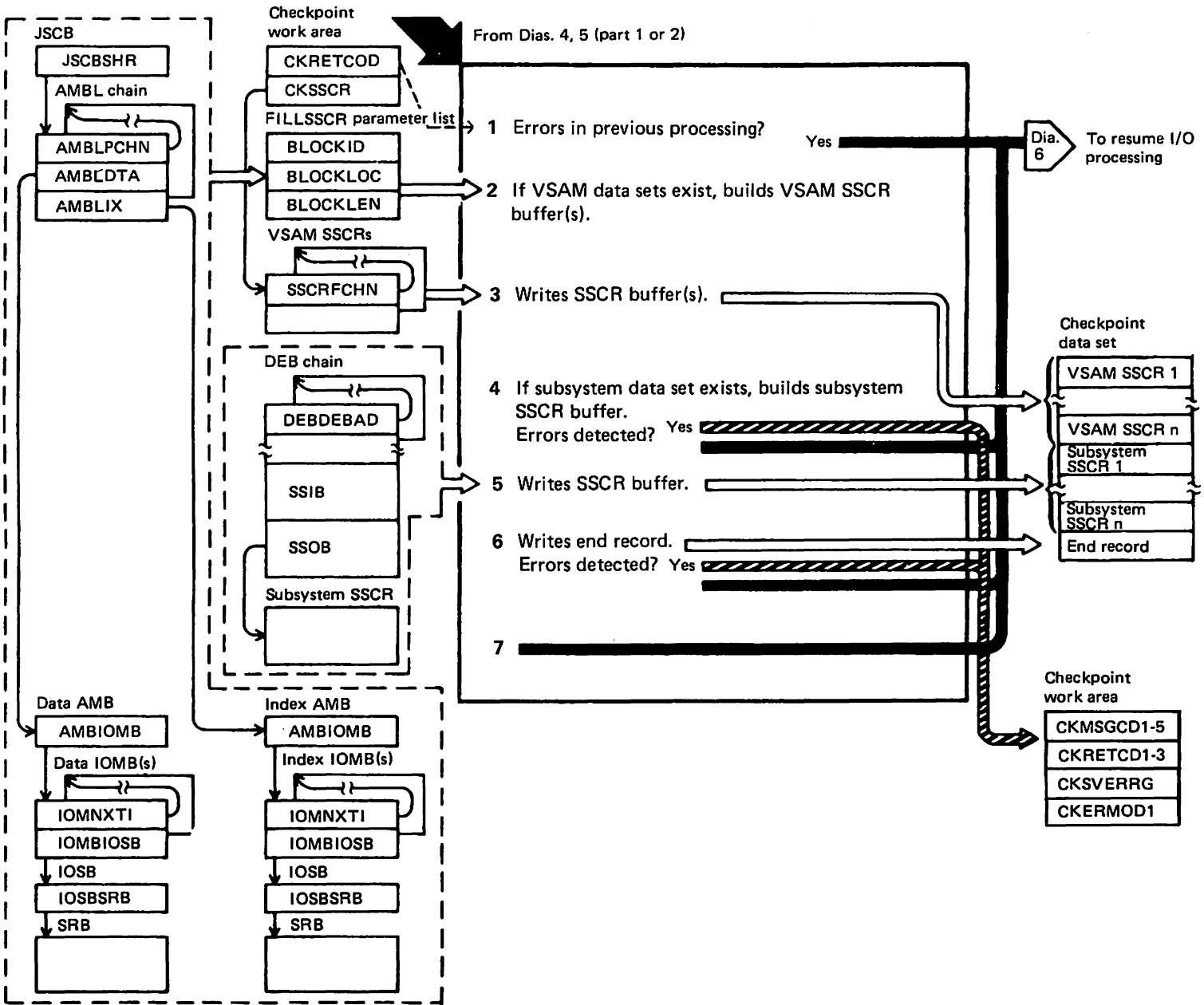


DIAGRAM 5 (PART 3 OF 3). BUILDING CHECKPOINT DATA SET

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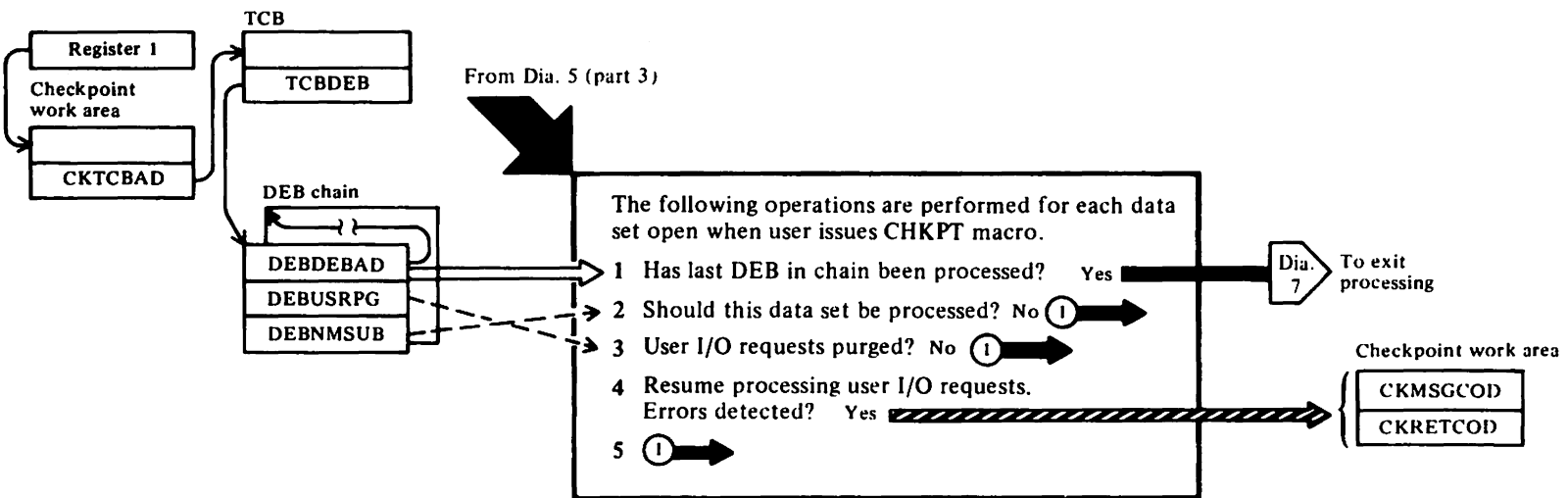
**Notes to Diagram 5 (Part 3 of 3)**

**IGC0N06C**

- 1** Determines whether an error occurred in previously executed processing. If so, continues processing at step 1 in diagram 6.
- 2** If any VSAM data sets exist, load and branch to VSAM module IDA0I96C. See VSAM Logic.
- 3** If VSAM SSCR records were generated by IDA0I96C, writes each VSAM SSCR on the SSCR chain to the checkpoint data set. Then frees the storage allocated to all SSCRs on the chain.
- 4** Searches the DEB chain for subsystem data sets. For each one found, gets a 4096-byte SSCR. Then initializes the SSOB associated with the subsystem data set and puts header information in the SSCR. Issues the IEFSSREQ macro, which will cause the SSCR for the subsystem data set to be completed.
- 5** Determines whether an error occurred generating the SSCR. If so, sets error and message codes and then continues processing at step 1 in diagram 6. If no errors occurred, determines whether any data was put in the SSCR buffer (there may have been no positioning information to save). If not, the next subsystem data set is processed (if there is one).
- 5** If there is data in the subsystem SSCR, writes the SSCR in the checkpoint data set. Frees the SSCR buffer before processing the next subsystem data set (if there is one).
- 6** Writes a 4096-byte end record in the checkpoint data set. The end record, which contains X'FFFF', marks the end of the checkpoint entry.  
  
If an error is detected, sets the appropriate error and message codes.
- 7** Continues processing at step 1 in diagram 6.



DIAGRAM 6. RESTORING USER'S I/O REQUESTS



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**Notes to Diagram 6**

**IGC0N06C**

- 1A** Determines whether the DEB just processed is the last DEB in the chain (DEBDEBAD contains 0 if last).
- 1B** If so, or if errors were detected, deletes VSAM module IDA0I96C (if it was loaded) and then gives control to IHJACP50 (IGC0Q06C).
- 2** Examines the DEB to determine whether it is for a TCAM, VSAM, subsystem, or ISAM/VSAM compatibility interface data set. If so, skips processing of this data set, gets the address of the next DEB in the chain, and continues processing at step 1.
- 3** Determines whether the user's I/O requests were purged by checking the DEBUSRPG field in the DEB. If I/O was not purged, gets the address of the next DEB in the chain and continues processing at step 1.
- 4** Resumes processing of the user's I/O requests by issuing the RESTORE macro (with register 1 pointing to the address that points to the PURGE I/O request list). If any errors occur during the RESTORE operation, sets appropriate message and return codes and issues abend S53F.
- 5** Gets the address of the next DEB and continues processing at step 1A if no errors were detected; at step 1B if errors were detected.

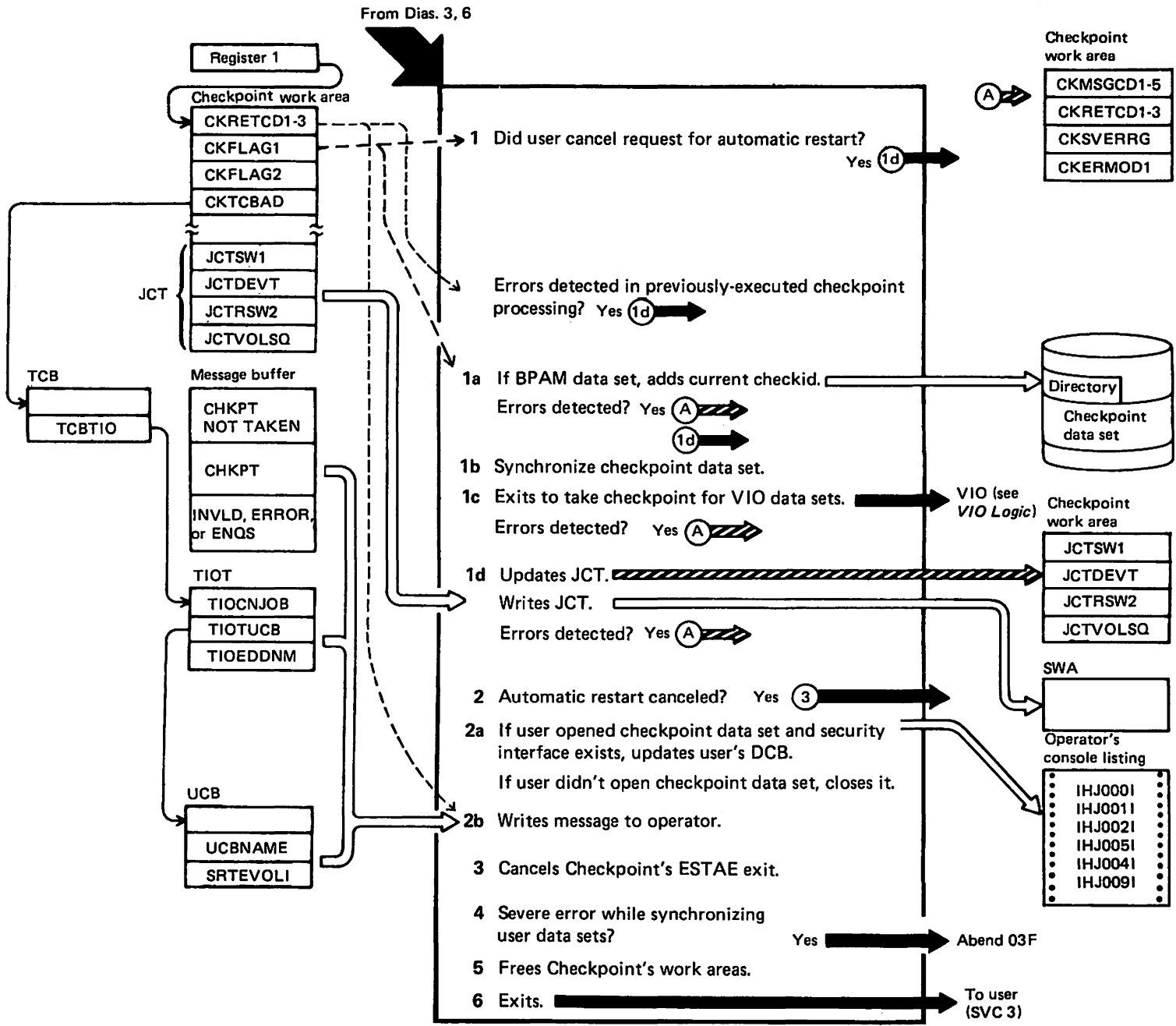


DIAGRAM 7. CHECKPOINT EXIT

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**Notes to Diagram 7**

**IHJACP50 (IGC0Q06C)**

1 If the checkpoint work area wasn't built (register I=0), sets up a message parameter list containing the checkpoint data set's DCB address, jobname, and ddname. This list is used by IGC0S06C in building messages. Then gives control to IGC0S06C.

If the checkpoint work area was built, moves CKRETCO, CKMSGCO, and CKFLAG1 into the message parameter list.

2 If the user canceled the request for an automatic restart or if an error was previously detected on return from VIO (CKMSGCO=205), zeros checkpoint JCT fields (JCTDEVT, JCTCKITR, and JCTCKIDL), blanks out JCTCKID1, and turns off the checkpoint-taken bit (JCTRSW1) to make it appear a checkpoint wasn't taken (so automatic restart won't take place). Continues processing at step 9.

3 If the CHR wasn't written in the checkpoint data set, moves the data normally obtained from the CHR into the message parameter list for use by IGC0S06C in building messages. (The data saved is the jobname and checkpoint ddname.) Continues processing at step 9.

4 Moves the checkid into the CERCHKID field of the SVRB so module IGC0S06C can get, from the CHR, the other information it needs to build a message.

5 If any errors (other than warning messages) were detected in previously executed checkpoint modules, goes to CERSKP2 to prepare to write the JCT, and then continues processing at step 8.

6 If the checkpoint data set was using BPAM, issues the STOW macro to add the current checkid to the partitioned data set directory. If any errors were detected during the STOW operation, sets message code 026 in the message parameter list. Then continues processing at step 8.

7 Issues the WIJOURN macro, which gives control to VIO to save checkpoint information in the job journal for any VIO data sets open when the CHKPT macro was issued. (For details of the operation, see VIO Logic.)

8 Updates the following JCT fields: JCTRSW1 (indicates checkpoint was taken), JCTRSW2 (turns off SYSCHK

bit in this field, if it is on), JCTDEVT (indicates type of device checkpoint data set is on), JCTVOLSQ (indicates volume sequence number of checkpoint data set), JCTCKIDT (checkpoint entry identifier), and JCTSMRBA (relative block address of system message data set).

9 Branches to CERQW to write the JCT to the scheduler work area. If errors were detected while writing the JCT, sets message code 025 and return code X'0C' in the message parameter list.

10 Restores the user's block size and SYNAD address in the DCB (if the user canceled the request for automatic restart).

Issues the FREEMAIN macro to free space used by the checkpoint work area. If the user did not open the checkpoint data set, turns the close bit on to indicate that checkpoint module IGC0S06C should close the data set.

11 If the user canceled the request for automatic restart, returns to the user via SVC3.

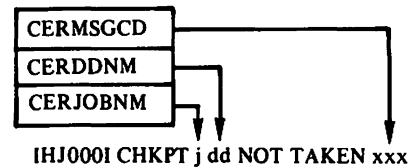
**IHJACP70 (IGC0S06C)**

12

a) Issues the GETMAIN macro to obtain a 160-byte buffer for messages.

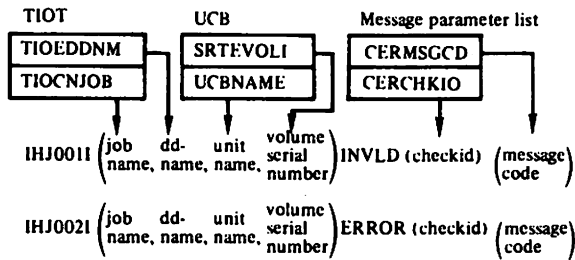
If the return code (CERRETC1) is 0 or the first byte of the message code (CERMSGCD) is not 0, branches to step 12b to format the appropriate message. If not, moves a message with the following format into the message buffer:

Message parameter list



Continues processing at CMWTO.

b) If the message code (CERMSGCD) indicates the checkpoint entry is invalid or an error occurred after the checkpoint entry was successfully written, moves the appropriate message (IHJ001I or IHJ002I) into the message buffer as follows:



If the return code (CERRETC1) is not 0, continues processing at step 12c. Otherwise, moves message IHJ004I into the message buffer. If the CERMSGCD field indicates a probable error, moves message IHJ005I into the message buffer as well.

IHJ004I (jobname, ddname, unit name, volume serial number)  
CHKPT (checkid) (message code)

IHJ005I (jobname, ddname, unit name, volume serial number) ENQS (checkid)

c) Issues WTO to write the message at the operator's console.

- 13 If the first byte of the return code (CERRETC1) is X'8', an I/O error occurred during processing associated with the RESTORE macro (in addition to some other error not associated with RESTORE macro). In this case, sets up CERRETC1 and CERMSGCD (with message code 215) to print another message. Then continues processing at step 12a.
- 14 If the user opened the checkpoint data set, examines the DSAB to determine whether the security interface exists. If so, updates certain fields in the user's DCB with fields from the protected DCB.
- 15 Closes the checkpoint data set (if it was opened by the checkpoint routine) and frees the space used by the message buffer.
- 16 Exits to user.

DIAGRAM 8. OVERVIEW OF RESTART PROCESSING

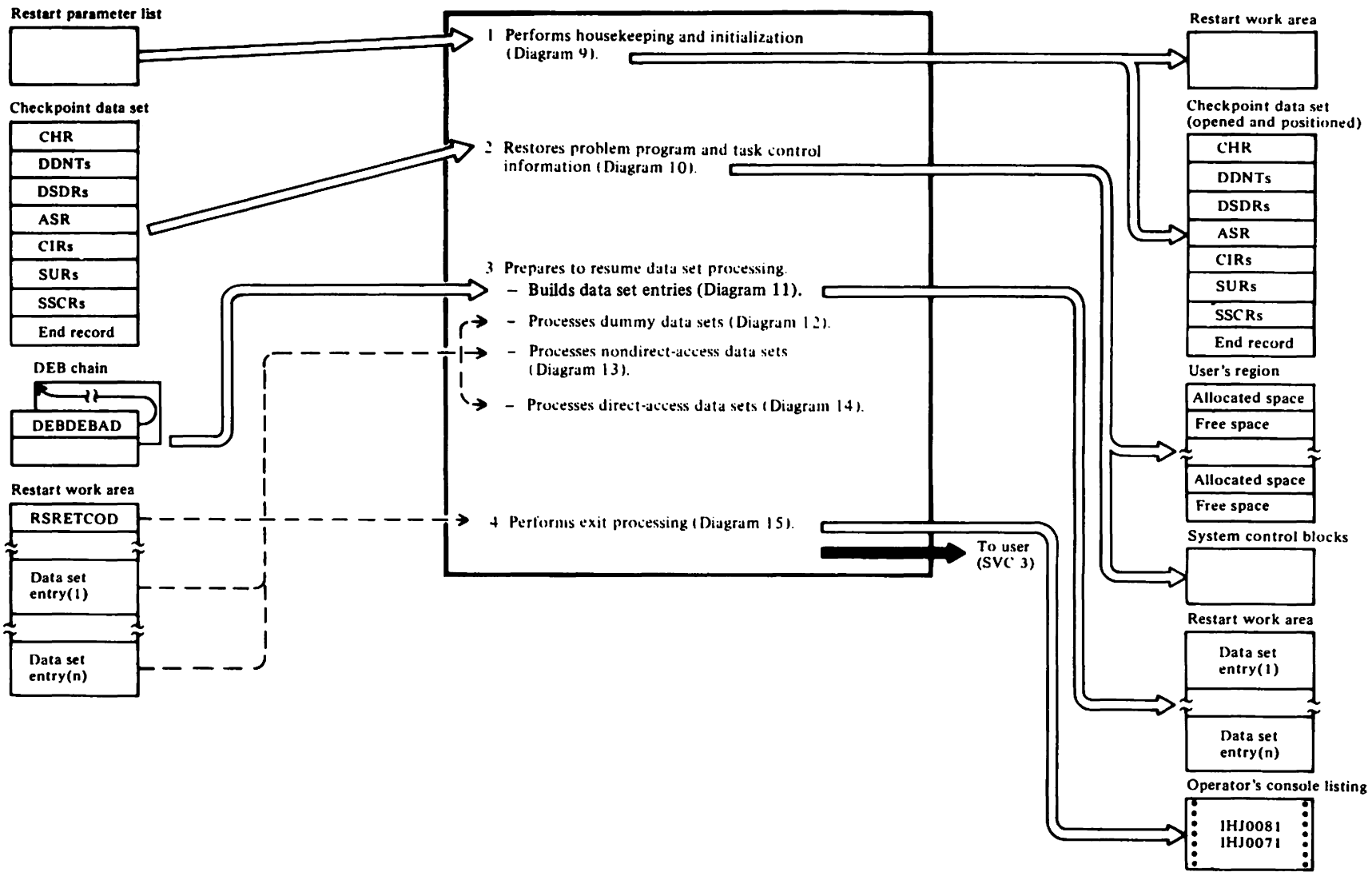
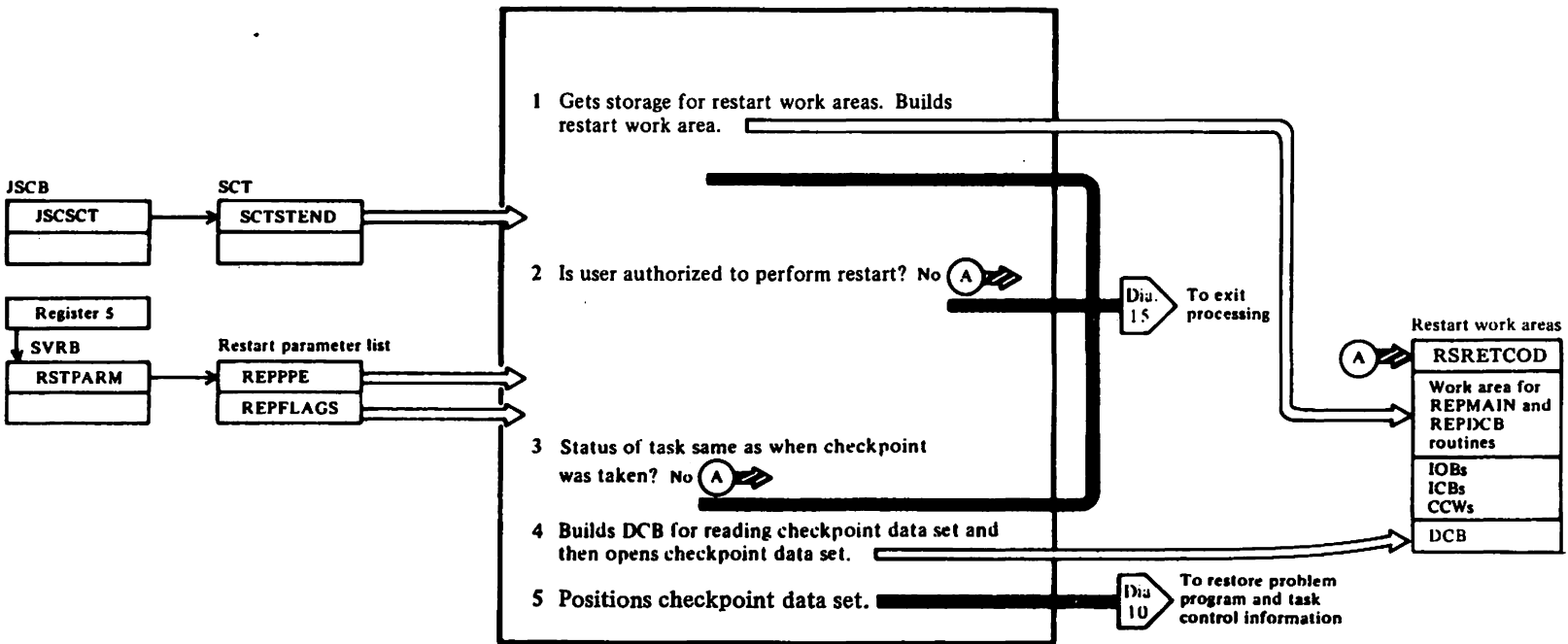


DIAGRAM 9. RESTART HOUSEKEEPING AND INITIALIZATION



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**Notes to Diagram 9**

**IHJARS00 (IGC0005B)**

- 1** Acquires and initializes the work areas needed by restart.
- 2** Checks that the caller of restart is scheduler restart. If not, sets error and reason codes and goes to IHJARS60 (IGC0V05B) via abend S53F.
- 3** Compares the current environment with that recorded in the checkpoint header record (passed by scheduler restart) to see if the environments are compatible. If not, sets error and reason codes and goes to IHJARS60 (IGC0V05B) via abend S53F.
- 4** Constructs and opens a DCB for reading the checkpoint entry.

If no errors were detected, goes to IHJARS01 (IGC0205B). Else, sets error and return codes and goes to IHJARS60 (IGC0V05B).

**IHJARS01 (IGC0205B)**

- Moves the IOB, ICBs, SAMBs, and channel programs to a restart work area that is in a subpool owned by restart (subpools 250, 251, and 252 are released by IHJQRS20).
- 5** Positions the checkpoint data set to the first ASR in the checkpoint entry to be restored.
- Goes to IHJQRS20 if no errors were detected. Else, sets appropriate error and reason codes and goes to IHJARS60 (IGC0V05B).



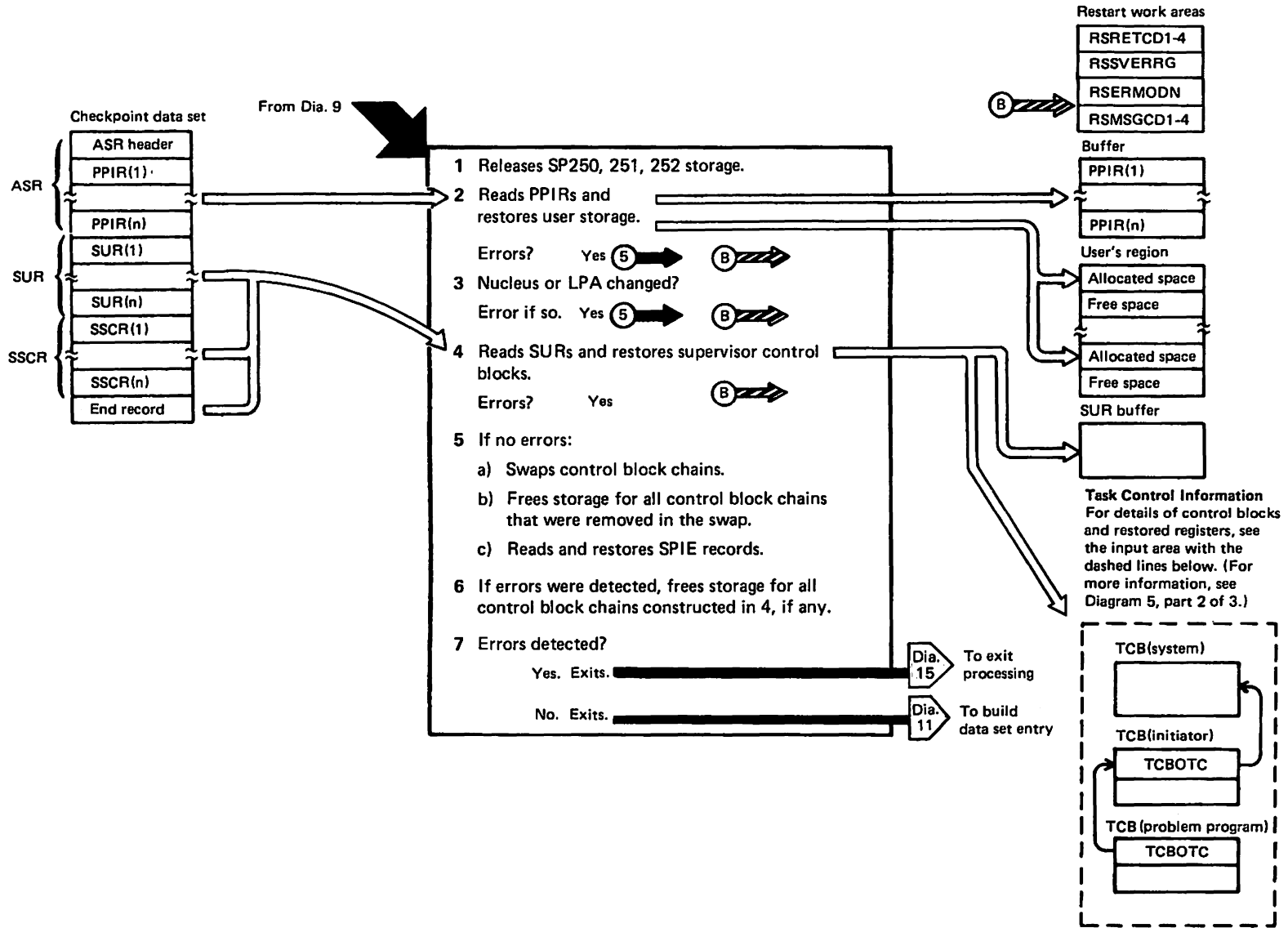


DIAGRAM 10. RESTORING PROBLEM PROGRAM AND TASK CONTROL INFORMATION TO STORAGE

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**Notes to Diagram 10**

**IHJQRS20 (IGC0505B)**

- 1 Determines from the PQE the starting address and size of the user's region.

Calls subroutine READRTN, which reads the ASR from the checkpoint data set. If I/O errors were detected, continues processing at IHJQRS24.

Compares the address of the first (or next) area to be restored in the user's region with the starting address of the ASRE in the ASR buffer. If they are equal, calls subroutine READRTN to read the CIR associated with the ASRE into the user's region. If the addresses are not equal (which means the next segment of storage in the user's region is unallocated), determines the size of the unallocated area and issues a FREEMAIN macro to free that area and create an FBQE describing it. This process continues until all the ASREs in the ASR buffer have been processed and the user's region has been restored.

If I/O errors were detected when the CIRs were read, continues processing at IHJQRS24.

- 2 Calculates the address of the SUR buffer. Calls subroutine RPM500 to read the first SUR into the SUR buffer. If I/O errors were detected when the SUR was read, continues processing at IHJQRS24.
- 3 (The following discusses the restoration to storage of the information in one SUR buffer. After each control block in the SUR buffer is processed, the subroutine doing the processing positions to the next control block in the buffer. When all information in the SUR buffer has been processed, another SUR is read into the buffer and the process is repeated. When all SURs have been read, an SSCR (if one exists) or an end record is read into the SUR buffer.)

**SPQE, DQE, FQE processing:** Calls subroutine RSGET to get space for SPQEs for the system, initiator, and problem program TCB. Moves SPQEs from the SUR buffer into that space. Puts the address of each SPQE chain into the REPMAIN work area.

Calls subroutine RPM500 to move DQEs from the SUR buffer into storage. Puts the address of each DQE chain in the appropriate SPQE.

Calls subroutine RPM500 to move FQEs from the SUR buffer into storage. Puts

the address of each FQE chain in the appropriate DQE.

If an I/O error was detected in any of the processing in this module, sets message code 038 in the RSRETCOD field in the restart work area and continues processing in IHJQRS24.

**IHJQRS21 (IGC0605B)**

Changes the user's SYNAD address so, if an I/O error occurs during restart processing, control will return to this module.

**CDE processing:** Calls subroutine RSGET to get storage for CDEs and then move them from the SUR buffer into acquired storage. Puts the address of the CDE chain into the REPMAIN work area. If bytes 21-23 in the CDE being processed contain the address of an extent list, moves the extent list into storage and puts its new address into the CDE associated with it.

**LLE processing:** Before processing each LLE, determines whether it is associated with a CDE for module in the job pack queue or link pack area queue. If neither (which indicates the end of the LLE chain has been reached), continues processing at TCB processing.

Calls subroutine RSGET to move LLEs from the SUR buffer into storage. Puts the address of the LLE chain into the REPMAIN work area.

If the LLE is associated with a CDE for a module on the link pack area queue, calls subroutine RPMCDLDR to create a CDE for that module. If the entry point address for the module has changed since the checkpoint was taken, sets message code 052 in the RSRETCOD field in the restart work area and continues processing at IHJQRS24. Otherwise, puts the new CDE address in the LLE.

If the LLE is associated with a CDE for a module on the job pack queue, calls subroutine RPMJPOS to find the CDE and put its address in the LLE.

**TCB processing:** Calls subroutine RSGET to get storage for the checkpoint TCB and its extension and moves them from the SUR buffer into the acquired storage. Puts the address of the acquired storage in the REPMAIN work area.

**RB Processing:** Calls subroutine RSGET to get storage for RBs and their XSBs, and then move them from the SUR buffer into acquired storage. Puts the address of the RB chain in the REPMAIN work area. Updates the key mask in the XSBs when appropriate.

For SVRBs and PRBs (except those created when the SYNCH macro was issued),

determines whether the entry point address to the module they're associated with has changed since the checkpoint was taken. If so, sets message code 052 in the RSRETCOD field in the restart work area and continues processing at IHJQRS24.

**SCB processing:** If the SCB is for a STAI control block, rather than a STAE control block, bypasses processing. Otherwise, calls subroutine RSGET to get storage for SCBs and then move them from the SUR buffer into the acquired storage. Puts the address of the SCB chain into the REPMAN work area.

**FOE processing:** Calls subroutine RSGET to get storage for FOEs and then move them from the SUR buffer into the acquired storage. Puts the address of the FOE chain into the REPMAN work area.

Sets up a parameter list for the PGFIX macro. Each entry in this list contains the beginning and ending address of a page described by an FOE. Issues the PGFIX macro to fix these pages in storage.

If an I/O error was detected in any of the processing in this module or if the page-fixing operation was unsuccessful, sets message code 038 or 039, respectively, in the RSRETCOD field in the restart work area and continues processing at IHJQRS24.

**IHJQRS22 (IGC0705B)**

Changes the user's SYNAD address so, if an I/O error occurs during restart processing, control will return to this module.

Calls subroutine RSBFSTAB to move the following information from the SUR buffer into the indicated area of storage:

Information Moved	Where Stored
TCBUSER, TCBPIE, and TCBFSA fields	Problem program TCB
Save area address of problem program	TQESADDR field of initiator TQE
DCB address and block size of checkpoint data set	Restart work area
User's SYNAD	DCB
User's general purpose registers	SVRB register save area

**DEB processing:** Adjust the length of each DEB. If the DEB is for an ISAM data set, converts the address of each ISAM extent to an absolute address. Moves DEBs from the SUR buffer into storage. Puts the address of the DEB chain into the REPMAN work area.

If the next block in the SUR buffer is an IRB (any IRB whose address was in the user's DEB when the CHKPT macro was issued was put in the checkpoint data set), moves the IRB into storage and puts its address in the DEB it's associated with.

If the IRB contained the address of an IQE, converts the address of the first available IQE to an absolute address and puts the absolute address in the IRB.

If the next block in the SUR buffer is a DEB extension, gets storage and moves the DEB extension into that storage.

Next resets DEBXDSSI in DEBXFLG1 (the RACF-protected data set indicator). IGC0N05B will set this flag if necessary.

Then updates the DEB with the DEB extension address and the DEB extension with the DEB address.

If the next block in the SUR buffer is a purge I/O restore list (PIRL), gets the length of the PIRL from the DEBUSRPG field, issues GETMAIN for storage from subpool 254, then moves the PIRL into that storage. Updates the DEBUSRPG field of the associated DEB with the address of the PIRL.

Moves the contents of the user's floating point registers from the SUR buffer into the restart work area. Then loads the floating point registers.

**TIOT processing:** Moves the TIOT in use when the checkpoint was taken from the SUR buffer into storage.

If the next block in the SUR buffer is a DSAB with a ddname matching the one saved in the DSAB record. If no match is found, sets message code 034 (except in the case of an implied VSAM catalog data set (code X'24') which does not require DSAB updating) in the RSRETCOD field in the restart work area and continues processing at IHJQRS24. Otherwise, updates the DSAB on the chain with information saved in the DSAB record at checkpoint time.

Reads into the SUR buffer the next record in the checkpoint data set (an SSCR record, if there are any, or the end record).

If an I/O error was detected in any of the processing in this module, sets message code 038 in the RSRETCOD field

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in the restart work area and continues processing at IHJQRS24.

**IHJQRS23 (IGC0805B)**

If OS/VS2 MVS/System Product is installed, move the following fields from the checkpoint TCB to the problem program TCB: TCBUSER, TCBRTMCT, TCBCAUF, TCBFSA.

Puts the addresses of the SPQE, DQE, and FQE chains for the problem program, initiator, and system tasks in the appropriate TCBS.

Calls subroutine RPMSWAP to put the address of the RB chain for the restored problem program in the SVRB used by restart.

Deletes all LLEs associated with CDEs for modules on the link pack area queue.

Calls subroutine RPMSWAP to put the addresses of the LLE, CDE, and SCB chains in the problem program TCB.

Puts the address of the DEB chain in the restart work area.

For each CDE, determines whether it's associated with an overlay program. If so, stores the address of the note list (obtained from the CDE extent list) in the segment table (whose address is in the extent list).

Updates the SEGTAB field in the extent list with a pointer to either the DCB for SYS1.JOBLIB or SYS1.LINKLIB, depending on which DCB the SEGTAB field was pointing to at checkpoint time.

Puts in each CDE in the CDE chain the address of the RB it's associated with. Also, updates the SCB key mask when appropriate.

Puts in each SCB in the SCB chain the address of the RB it's associated with.

Increments the use count (CDUSE field) of each CDE for a module on the link pack area queue.

**IHJQRS24 (IGC0905B)**

If no errors were detected in previously executed restart modules, continues processing at step 5b.

4 Sets the error pass switch (SWITCH field in restart work area) to 1 to indicate error processing is to take place. The control block chains constructed from the checkpoint data set and anchored to the REPMAN work area have not been attached to the problem program TCB (because the restart was found to be unsuccessful before swapping took place in

IGC0805b) and therefore must be freed.

Calls subroutine FREEM to free SPQEs, DQEs, and FQEs (whose addresses are in the REPMAN work area) for the system, problem program, and initiator tasks (only DQEs and FQEs for owned subpools are freed).

Calls subroutine FREEM to free the CDE, LLE, RB, SCB, and FQE chains whose addresses are in the REPMAN work area.

If the error pass switch is 0 (indicating no errors were detected in previous modules) and a SPIE SSCR is in the SUR buffer, calls the SPIE routine to reestablish the SPIE environment. Continues processing at XCTLA.

**5**

a) When the last SPQE has been processed, continues processing at R8B0 to free up control block chains anchored to the REPMAN work area. These represent the restart task's control blocks because the problem program's control block chains (obtained from the checkpoint data set) were successfully attached to the TCB via swapping in IGC0805b.

b) If the SPQE for the problem program (address in TCBMSS field of TCB) is not for subpool 0 and is a shared SPQE, continues processing at step 5e.

c) If the task is in real storage, continues processing at step 5d. Otherwise, calls subroutine FINDPAGE to get an external page table entry (XPTE). Sets the storage protect key in the XPTE.

d) If the page is in storage, sets the storage protect key in both parts of the page described by the DQE associated with the SPQE and turns on the fetch protect bit for all subpools except 252.

If the storage described by the DQE is made up of multiple pages, continues processing at step 5c.

e) Continues processing at step 5c for all DQEs on the chain. Then accesses the next SPQE and continues processing at step 5a.

If any errors were detected, gives control to IGC0V05b. Otherwise, gives control to IGC0G05B.

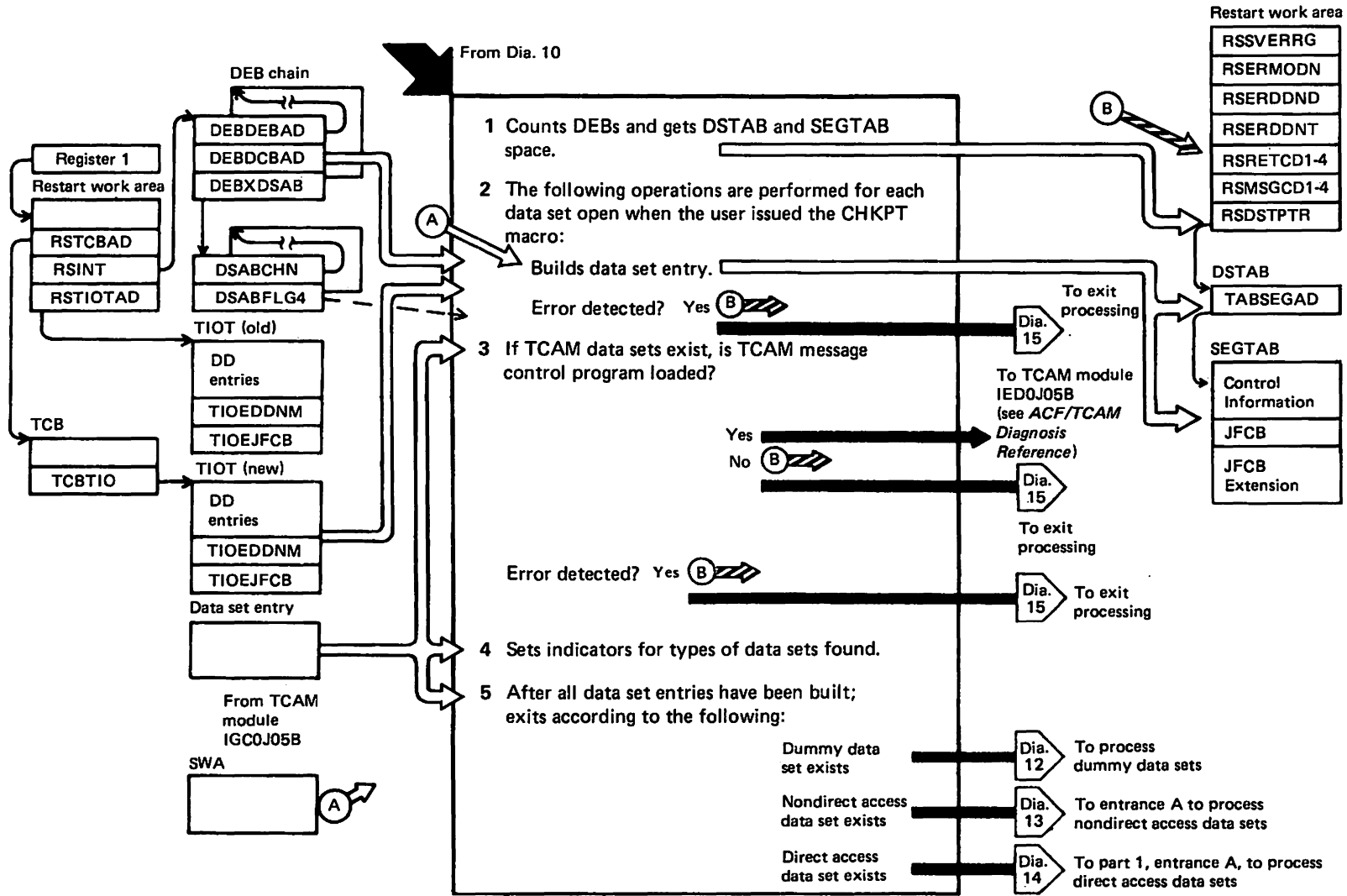


DIAGRAM 11. BUILDING DATA SET ENTRIES

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**Notes to Diagram 11**

**IGC0G05B**

- 1 Determines the number of data sets open when the checkpoint was taken by counting the number of DEBs in the DEB chain. Gets work space in which to build a 48-byte data set entry for each of these data sets.

Moves the DCB address for each of these open data sets from the DEBDCBAD field of the DEB to the TABDCBAD field of the data set entry.

Tests the DEBNMSUB field of each DEB for a TCAM data set. If one is found, sets RSFLAG2 in the restart work area and TABFLG1 in the data set entry (special processing is subsequently done on TCAM data sets).

- 2 Compares ddnames in the new (restart time) and old (checkpoint time) TIOT. If a match is found, stores the offset (in new TIOT) in the DCBTIOT field of the DCB. Then moves the TTR of the JFCB from the new TIOT to the TABJFCB field in the data set entry.

If no match is found, sets message code 020 in the restart work area and gives control to IGC0V05B.

- 3 For each data set open when the checkpoint was taken, searches the DSAB chain for a match on the DSABTIOT field. When a match is found, puts a pointer to the matching DSAB in the data set's DEB extension.

For each subsystem data set open when the checkpoint was taken, updates the name of the subsystem data set in the SSIB and puts the address of the DEB in the SSOB and the address of the SSOB in the DEB.

- 4 Before verifying security, examines the DSABFLG4 field in each DSAB on the DSAB chain to determine whether the DSAB represents a checkpoint data set. If so, determines whether it is the checkpoint data set being used for restart; if it is, sets TABFLG3 field in the data set entry.

Determines from the DSABFLG4 field whether the security interface has been invoked for the checkpoint data set to be used for restart. If so, stores the DEB address in the user's DCB.

Determines from the DSABFLG4 field whether the checkpoint data set to be used for restart is on a secure volume. If not, sets message code

218 in the restart work area and gives control to IGC0V05B.

- 5 Divides the remainder of the restart work area into a series of 304-byte buffers. Puts the address of one of the buffers in the TABSEGAD field of each data set entry (multiple buffers allow I/O to be overlapped).

**IGC0G95B**

Sets up a QMNGRIO parameter list and then issues the QMNGRIO macro to read the JFCB into the buffer.

If I/O errors were detected when the JFCB was read, sets message code 024 in the restart work area and gives control to IGC0V05B.

Makes device type and data set organization tests to determine the specific JFCB data to be put in the data set entry. Puts this information, and the volume identification of the specific volume to be positioned, in the data set entry. (At this point, each data set entry for a sequential data set residing on five or fewer volumes will contain the information necessary for positioning the data set prior to restart. Otherwise, TABFLG2 is set with X'80' indicating that there are more than five volumes and further processing will be done in IGC0I05B.)

- 6 Searches the DEBAMTYP field of each DEB in the chain to determine whether the data set is a dummy ISAM/VSAM compatibility interface data set. If so, sets an indicator in the TABFLG2 field in the data set entry.

- 7 Calls IGC0J05B if there are any TCAM data sets to restart.

- 8 Searches the DSABFLG3 field of each DSAB in the chain to determine whether the data set is a VIO data set. If so, sets an indicator in the RSDCBFLG field in the restart work area and in the TABFLG2 field in the data set entry.

**IGC0I05B**

- 9 Examines the TABFLG2 field in each data set entry to determine if the data set is on six or more volumes.

If so, uses the volume sequence number in the TABVLID5 field of the data set entry to determine the number of JFCB extensions to be accessed on SWA to get the correct volume serial number for positioning.

When the correct JFCB extension is in storage, gets the appropriate

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volume identification from it and stores it in the TABVLIDI field of the data set entry.

If errors were detected when the FJCB extension was accessed, sets

message code 024 in the restart work area and gives control to IGC0V05B.

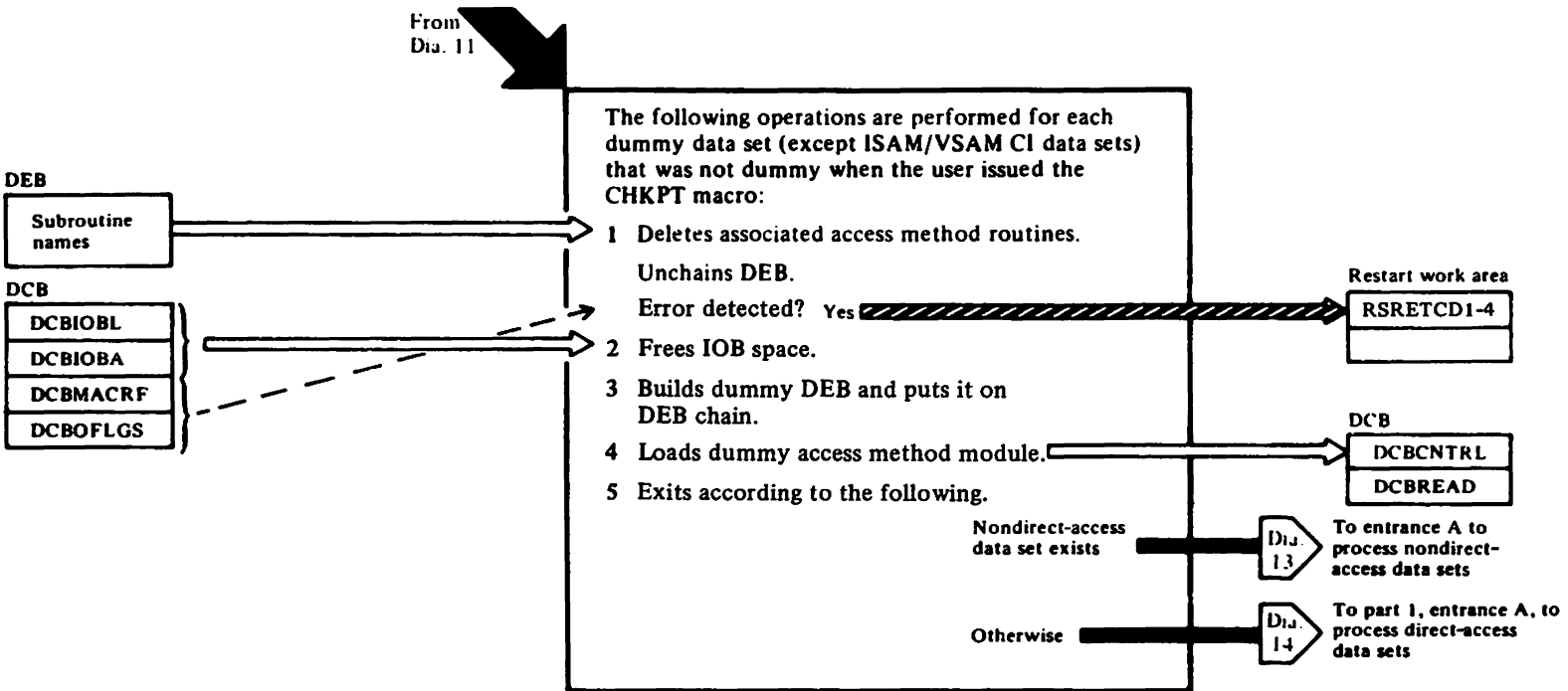
- 10** When the last data set entry has been processed, determines which module to transfer to for positioning of data sets.

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DIAGRAM 12. PROCESSING DUMMY DATA SETS



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**Notes to Diagram 12**

**IGC0H05B**

For each dummy data set found, determines (from DEBXSCL field in DEB) if it was a dummy data set when the checkpoint was taken. If it was, bypasses the data set entry and processes the next one.

- 1 If the dummy data set was not a dummy data set when the checkpoint was taken, gets the names of the access method routines associated with it and deletes these routines, unless the data set was a SYSIN or SYSOUT data set.

Takes the DEB off the DEB chain.

- 2 Frees the IOB space created when the data set was originally opened.

- 3 Gets storage and builds a dummy DEB. Stores the DEB address in the DCB and puts the dummy DEB on the DEB chain.

- 4 Loads the dummy access method module (IGC019AV) and puts a pointer to it in the DCB.

If no errors were found, processes the next data set.

- 5 If no errors were encountered, goes to the next module as follows:

- a) IGC0K05B, if any nondirect access data sets to restart.
- b) IGC0M05B, if no nondirect access data sets.

If any errors were detected, sets the appropriate error and reason codes and goes to IHJARS60.

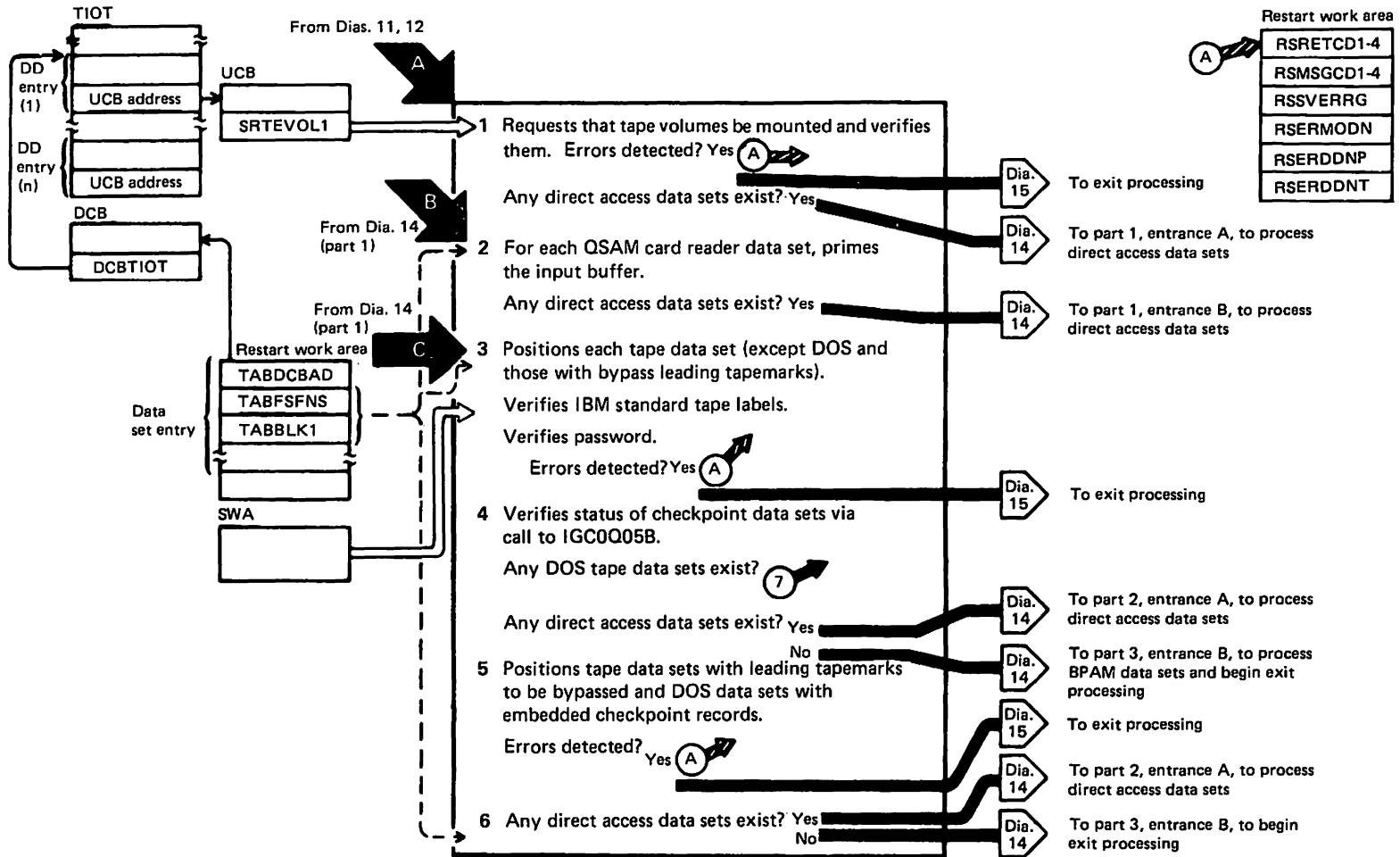


DIAGRAM 13. PROCESSING NONDIRECT ACCESS DATA SETS

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**Notes to Diagram 13**

**IGC0K05B**

- 1 Searches the data set entries for SYSIN, SYSOUT, unit record, and graphic data sets. For each one found, updates the UCB address in the DEB.

For tape data sets, ensures that:

- a) The correct volumes are mounted.
- b) The correct label information is in the UCB.
- c) User is authorized to use the tape volumes.
- d) Nonstandard label processing is done for nonstandard labels.

For the tape data sets, DEQ at demount is indicated in the JFCB and the user is APF authorized, sets the corresponding indicator in the UCB and DEQs all the volumes in the JFCB up to, but not including, the current volume.

If any errors are found, sets the appropriate error and reason codes and goes to IHJARS60.

If any direct access data sets exist, goes to IGC0M05B, else goes to IGC0L05B.

**IGC0L05B**

- 2 Searches through the data set entries for QSAM card reader data sets.

For each one found, calls the EOB subroutine to prime the input buffers.

Exits to IGC0N05B.

**IGC0S05B**

- 3 Ensures all tapes are correctly positioned except for DOS tapes and those with bypass leading tapemarks.

Calls IGC0Q05B to verify checkpoint data sets.

If password protection is specified and the volume was not found to be RACF protected, requests that the operator enter the correct password before processing continues.

Exits to IGC0005B.

**IGC0Q05B**

- 4 The status of the data set is verified by asking the operator, and if the checkpoint and restart security status of the data set are not the same, sets the appropriate error and reason codes and goes to IHJARS60.

If the checkpoint and restart status are the same, control is returned to the caller.

If any errors were detected, sets the appropriate error and reason codes and goes to IHJARS60.

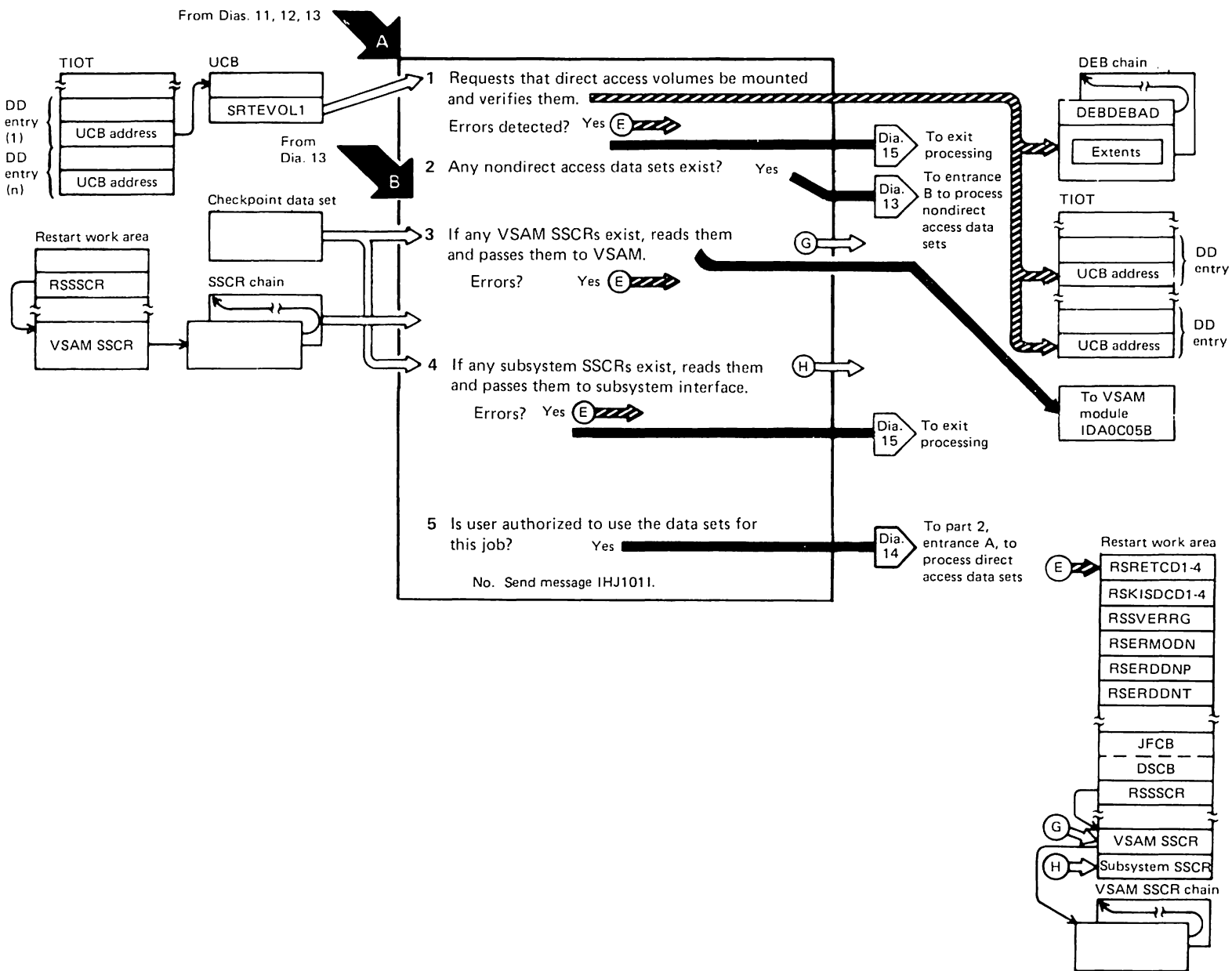
**IGC0U05B**

- 5 Searches through the data set entries. For each tape data set indicating leading tapemark or embedded DOS checkpoint records, repositions the data sets to the correct file and record.

- 6 If any direct access data sets exist, exits to IGC0R05B. Else, exits to IGC0T05B.

If any errors were detected, sets the appropriate error and reason codes and goes to IHJARS60.

DIAGRAM 14 (PART 1 OF 3). PROCESSING DIRECT ACCESS DATA SETS



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**Notes to Diagram 14 (Part 1 of 3)**

**IGC0M05B**

- 1 Searches through the data set entries for data sets on direct access and ensures that the correct volume or volumes for the data set are mounted.

If any error was detected, sets the appropriate error message codes and goes to IHJARS60.

- 2 If any nondirect access data sets exist, gives control to IGC0L05B. Else, exit to IGC0N05B.

**IGC0N05B**

- 3 If VSAM SSCRs exist, reads them from the checkpoint data set into the restart work area.

If a VSAM SSCR exists, VSAM restart module IDA0C05B is loaded and branched to for SSCR and initial VSAM DEB processing (see VSAM Logic).

- 4 If subsystem SSCRs exist, reads them from the checkpoint data set into the restart work area. Sets the

restart flags in the subsystem's SSOB block. Then issues the IEFSSREQ macro, which gives control to JESSSREQ (subsystem request routine) to process the subsystem SSCRs.

- 5 Searches through the data set entries for data sets that are password or RACF protected and verifies the user's authority to use the data set.

If the user isn't authorized, links to IGCMSG6C to write message IHJ101I, sets error and message codes, and passes control to IHJARS60 (IGC0V05B).

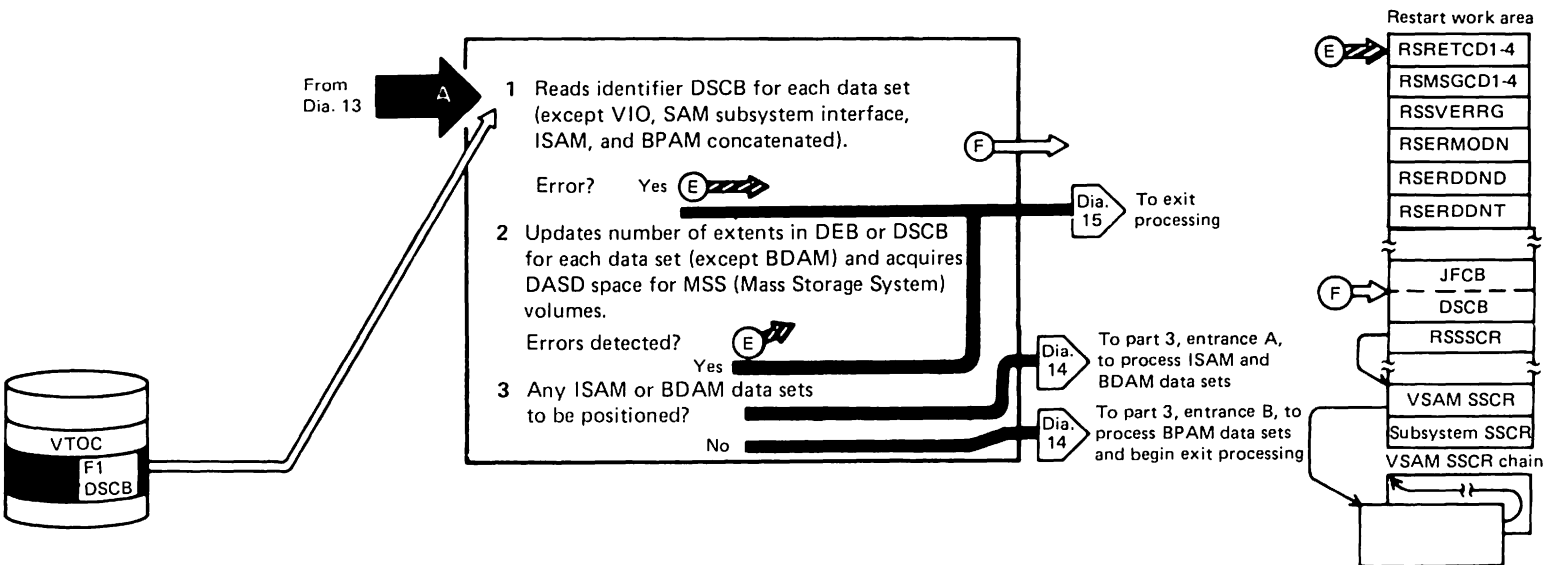
If JSCBPASS is set, the RACF security checks are bypassed.

If any errors are detected, sets the appropriate error codes and goes to IHJARS60.

Exits to IGC0S05B if any tape data sets exist, or to IGC0R05B if any direct access data sets exist.

Else, exits to IGC0T05B.

**DIAGRAM 14 (PART 2 OF 3). PROCESSING DIRECT ACCESS DATA SETS**



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**Notes to Diagram 14 (Part 2 of 3)**

**IGC0R05B**

- 1** Searches through the data set entries for data sets on direct access devices (except for noncheckpoint VIO data sets, SAM, subsystem interface (SYSIN/SYSOUT), ISAM, and BPAM data sets that are concatenated).

If the data set being processed is a checkpoint data set, updates those fields in the DCB containing the MBBCCHHR and the number of bytes remaining on the track.

- 2** Compares the number of extents recorded in the DEB and DSCB. If they're equal, updates the DEB.

If the DSCB indicates more extents than the DEB and the data set is an output data set, gives control to the DADSM partial release routines to release all tracks after the last track for the last extent recorded in the DEB.

If the DEB indicates more extents than the DSCB and the data set is an output data set, moves the ending track address from the last extent in the DSCB to the last extent in the DEB.

If any errors were detected, sets the appropriate error codes and goes to IHJARS60.

- 3** Exits to IGC0W05B if any ISAM or BDAM data sets exist. Else, exits to IGC0T05B.



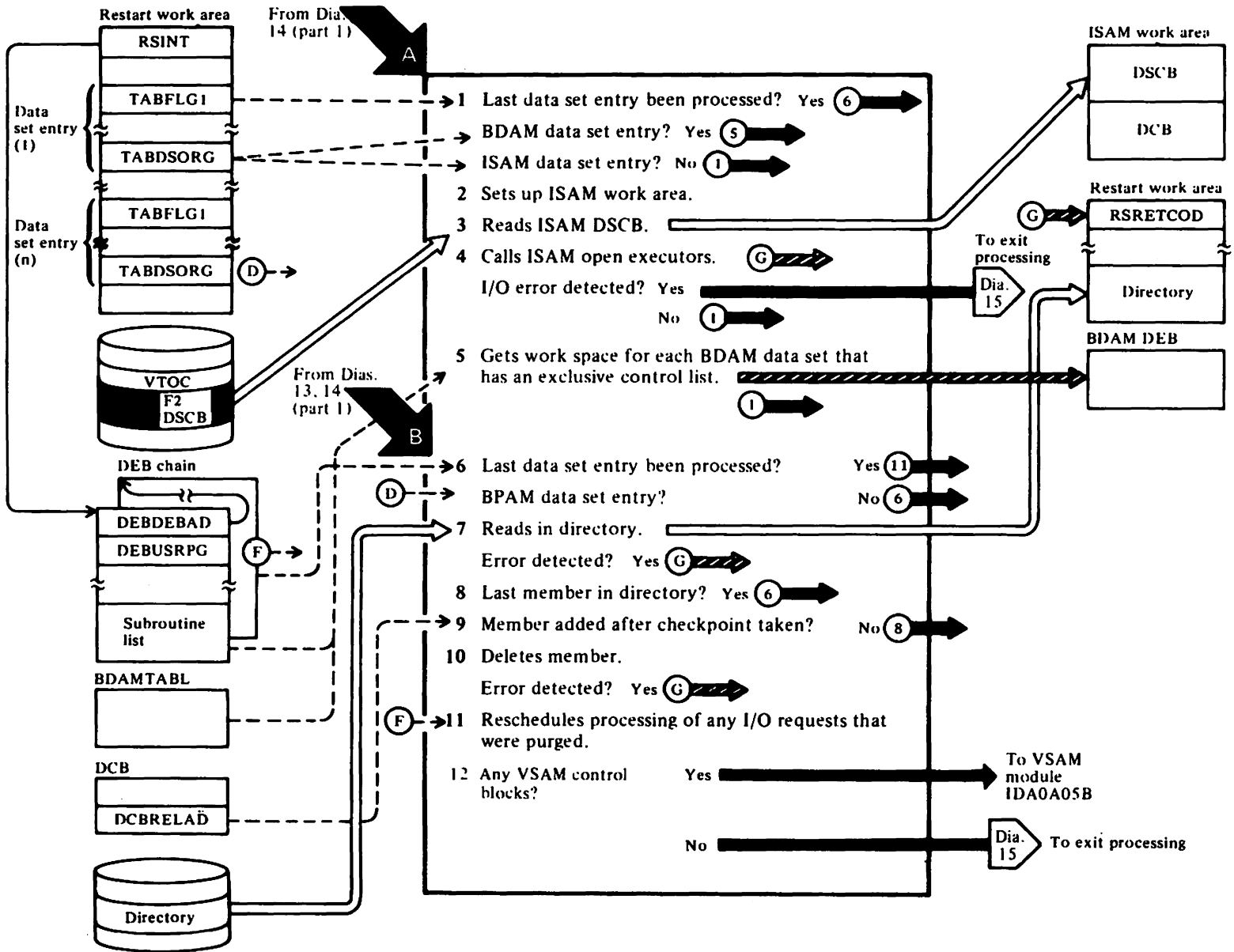


DIAGRAM 14 (PART 3 OF 3). PROCESSING DIRECT ACCESS DATA SETS

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**Notes to Diagram 14 (Part 3 of 3)**

**IGC0W05B**

- 1 Searches for ISAM and BDAM data set entries.
- 2 For each ISAM data set found, gets an ISAM work area (key 5) and prepares it for use by the ISAM open executors. Gets the UCB and disk address of the data set's ISAM (format 2) DSCB. Builds the IOB and channel program used to read the DSCB.
- 3 Reads the ISAM (format 2) DSCB into the ISAM work area. Then copies the ISAM DCB into the ISAM work area.
- 4 Loads and goes to the ISAM open executors IGG01920 (for fixed-length records) or IGG01950 (for variable-length records) to open the ISAM data set.
- 5 For each BDAM data set that has an exclusive control list, gets space in subpool 230 (key 5). Then stores the address of this space in the BDAM DEB extension.

If any errors were detected, sets the appropriate error codes and goes to IHJARS60.

Exits to IGC0T05B.

**IGC0T05B**

- 6 Issues the DEBCHK macro for each data set open when the CHKPT macro was issued. This causes the DEB address for each of these data sets

to be added to the DEB table. If a DEB is found to be invalid, an abend 16E will be issued by DEBCHK.

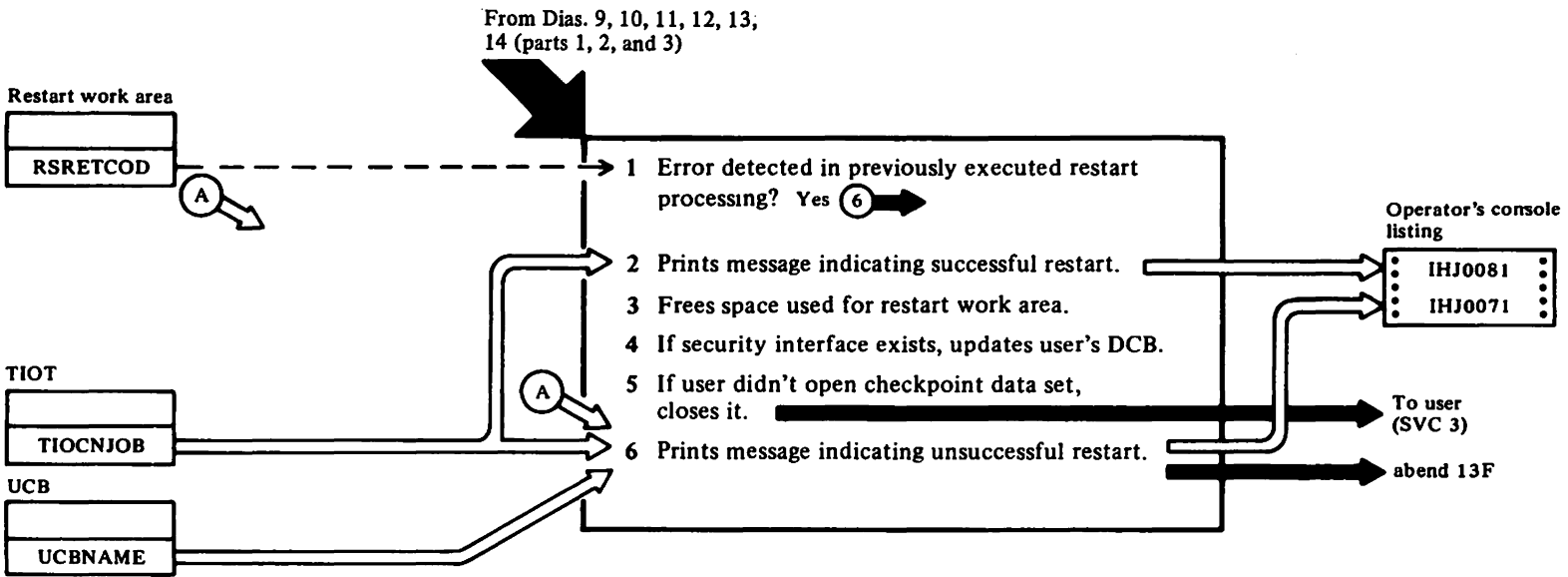
Searches through the data set entries for BPAM data sets that were open for output when the checkpoint was taken.

- 7 Builds the control blocks (DEB, ECB, IOB) and channel program necessary for reading the BPAM directory. Reads each block of the directory into the restart work area.
- 9 Determines whether any of the members of the directory were added after the checkpoint was taken.
- 10 Issues the STOW macro to delete any members in the directory that were added after the checkpoint was taken.
- 11 Examines each DEB (except those for TCAM, subsystem, or compatibility interface data sets) to determine whether the user I/O requests associated with the data set were purged. If so, issues the RESTORE macro to reschedule I/O processing.
- 12 If a VSAM SSCR was read from the checkpoint data set, module IDA0A05B is loaded and branched to (see VSAM Logic).

If any errors were detected, sets the appropriate error codes and goes to IHJARS60.

Else, control is passed directly to IHJARS60 (IGC0V05B).

DIAGRAM 15. RESTART EXIT



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Notes to Diagram 15

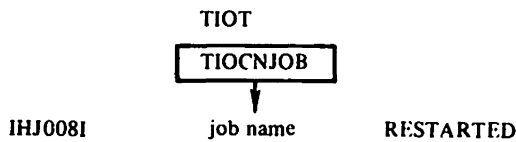
IHJARS60 (IGC0V05B)

- 1 If any errors were detected in previously executed restart modules, continues processing at RERABEND.

Restores the user's checkpoint data set block size in the DCB.

- 2 Issues the FREEMAIN macro to free all but the message portion of the restart work area.

Calls subroutine RERWTO, which moves the message for successful restart into the message buffer and prints a message of the following format:



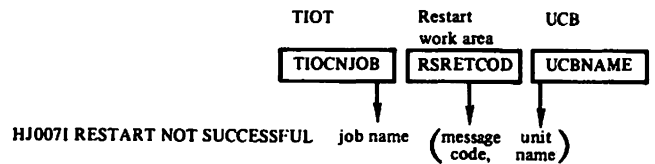
- 3 Frees the remainder (message portion) of the restart work area.

If the checkpoint data set is on tape, sets the volume sequence number in the VOLSEQNO field in the DEB to 1 for automatic restarts.

- 4 If the security interface exists (an unauthorized user was taking checkpoints), updates the user's DCB from the protected DCB.

- 5 Closes the checkpoint data set and returns control to the problem program with a return code of 4 (indicating successful restart) in register 15.

- 6 Calls subroutine RERWTO, which moves the message for an unsuccessful restart into the message buffer and prints a message of the following format:



and issues abend code S13F.

PROGRAM ORGANIZATION

This section shows the flow of control between checkpoint/restart modules and the major operations performed by each module.

The on- and off-page connectors from one flow diagram to the next contain an alphabetic character and a number, thus:



The alphabetic character corresponds to the alphabetic character assigned to each diagram (Diagram A, Diagram B, and so forth). The number refers to an entry point on the page for that diagram.

Diagrams A and B show the checkpoint modules. These modules are executed after an SVC 63 instruction (CHKPT macro) is issued. When the SVC 63 instruction is executed, an SVC interruption occurs and control passes to the SVC FLIH, the SVC SLIH, and then to the first checkpoint load module.

Diagrams D through G show the restart modules. These modules are executed after an SVC 52 instruction is issued. Before this instruction is issued, the job management routine, IEFXB609, processes the job's SWA entries to ensure that the job's device allocation environment is the same as it was at checkpoint time. Before exiting, IEFXB609 changes the name of the program to be executed to IEFRSTRT.

IEFRSTRT consists only of an SVC 52 instruction. When this instruction is executed, an SVC interruption occurs and control passes to the SVC FLIH, the SVC SLIH, and then to the first restart load module.

**DIAGRAM A**

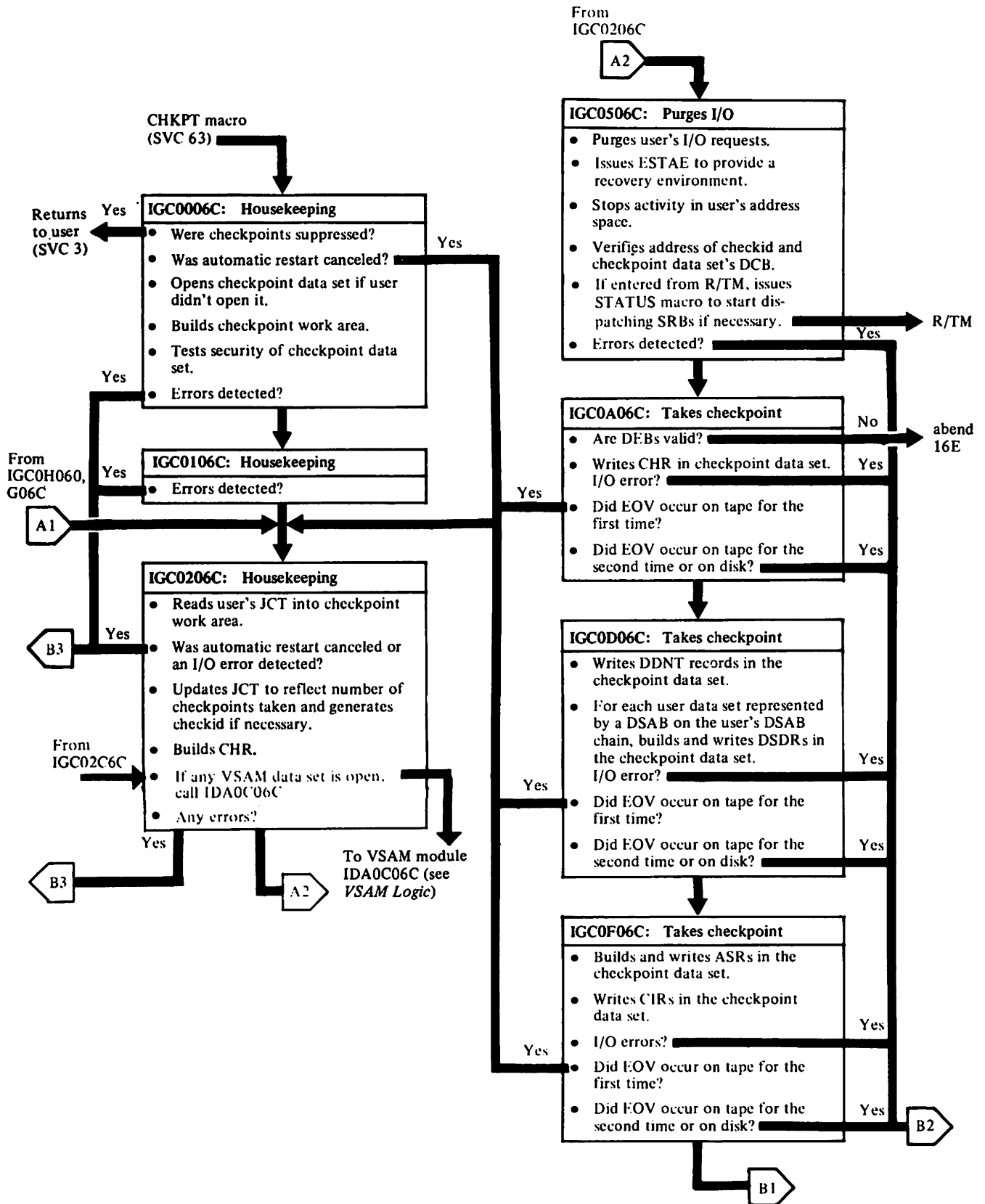


DIAGRAM B

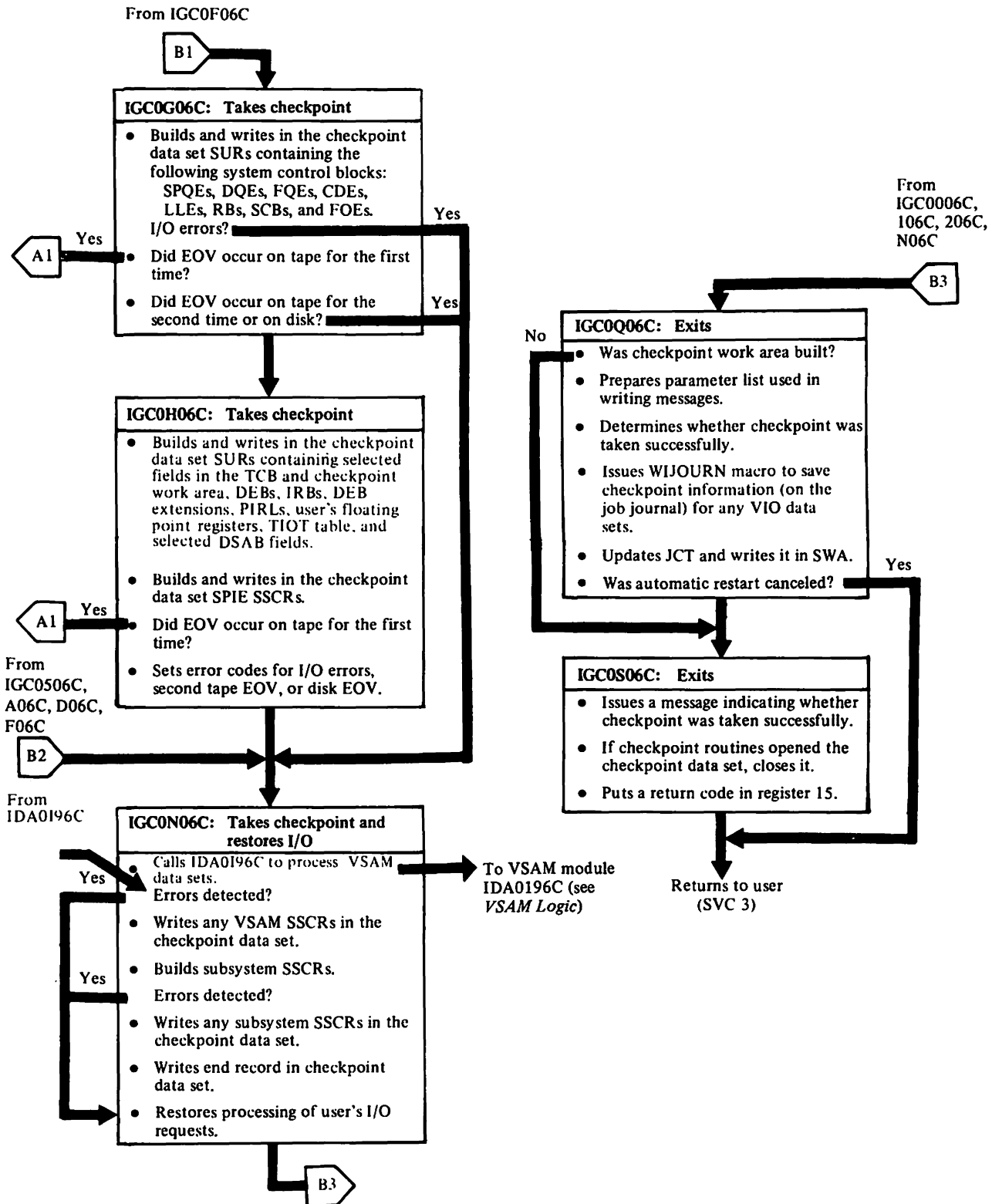


DIAGRAM C

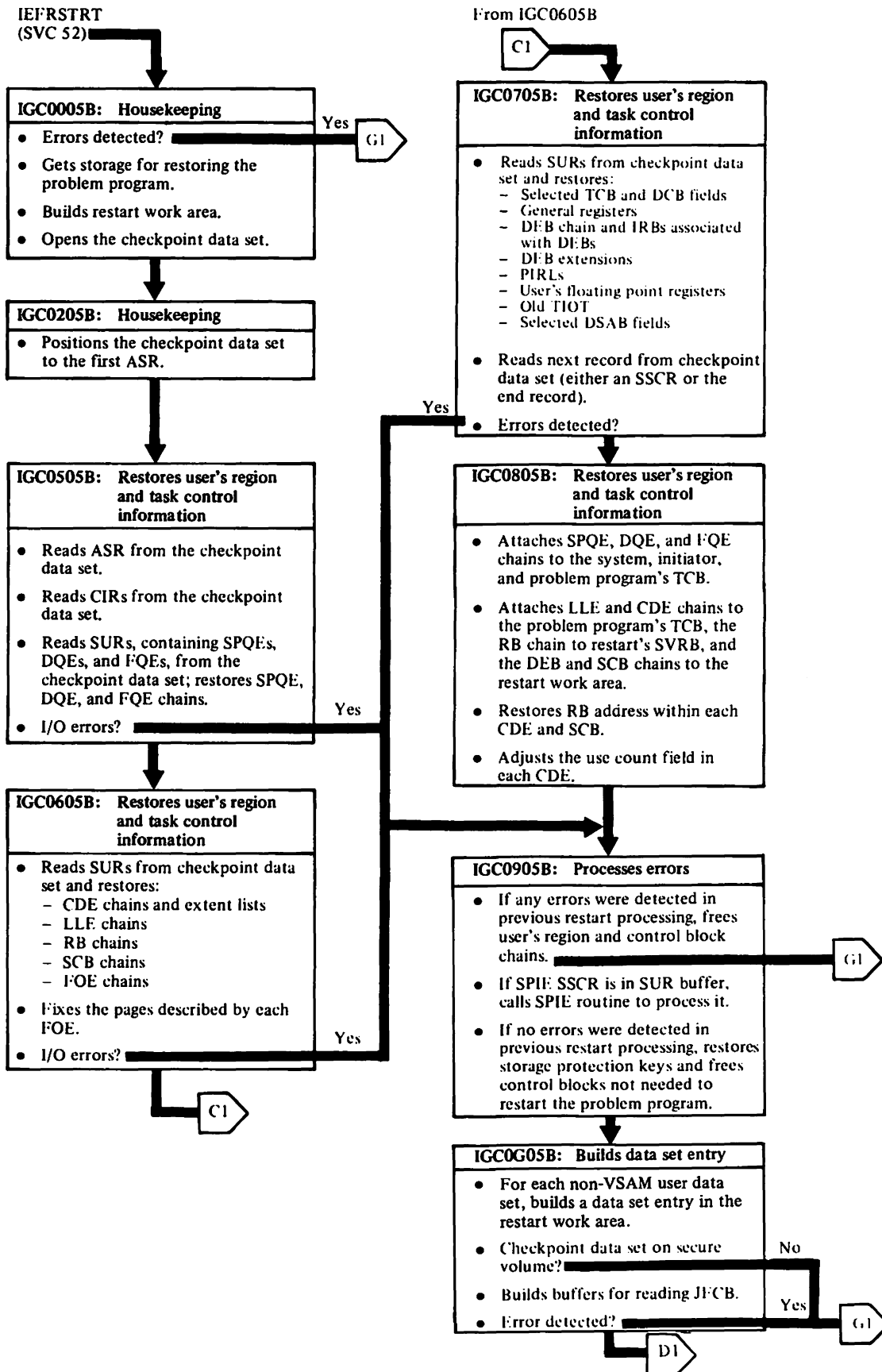




DIAGRAM D

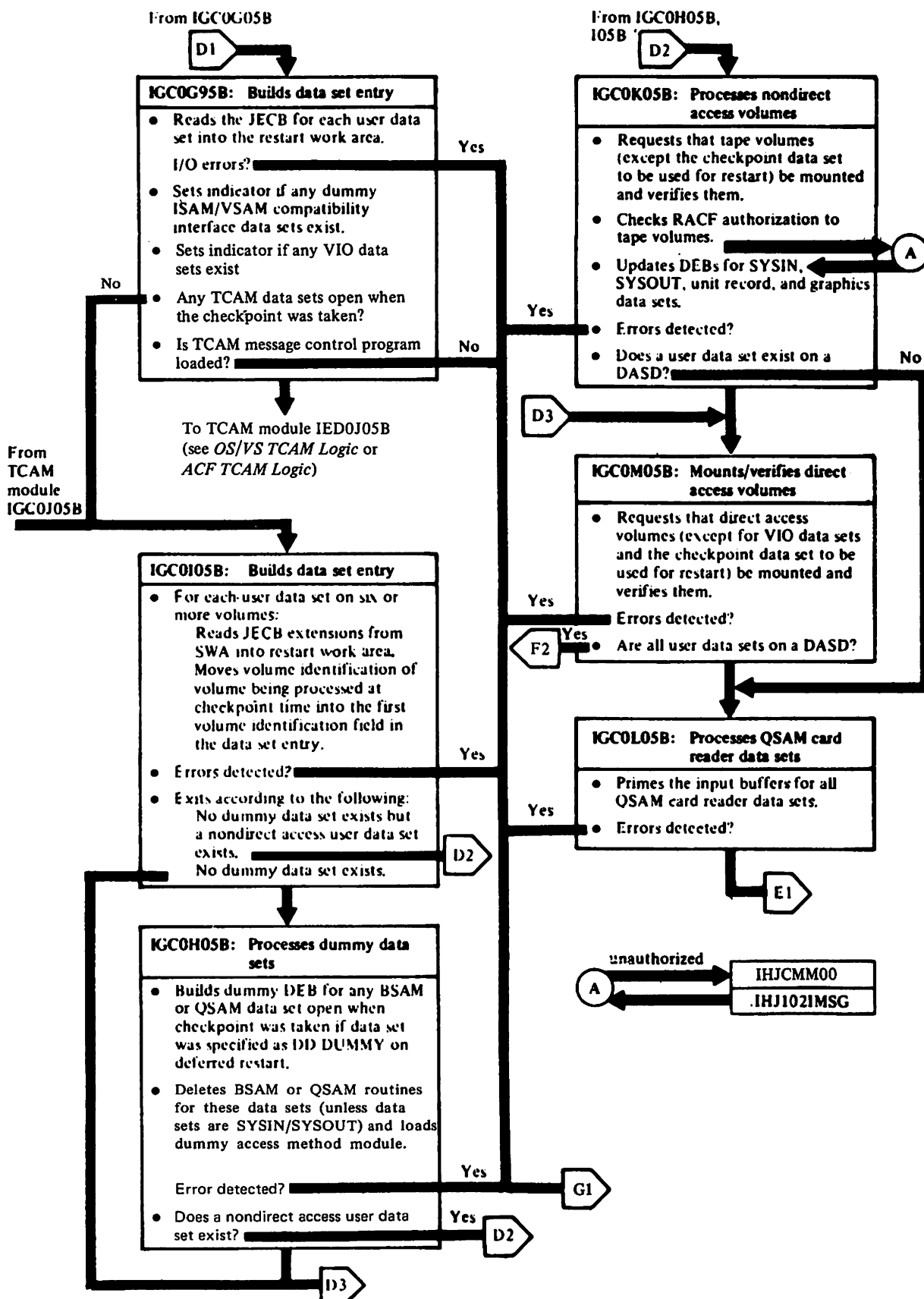


DIAGRAM E

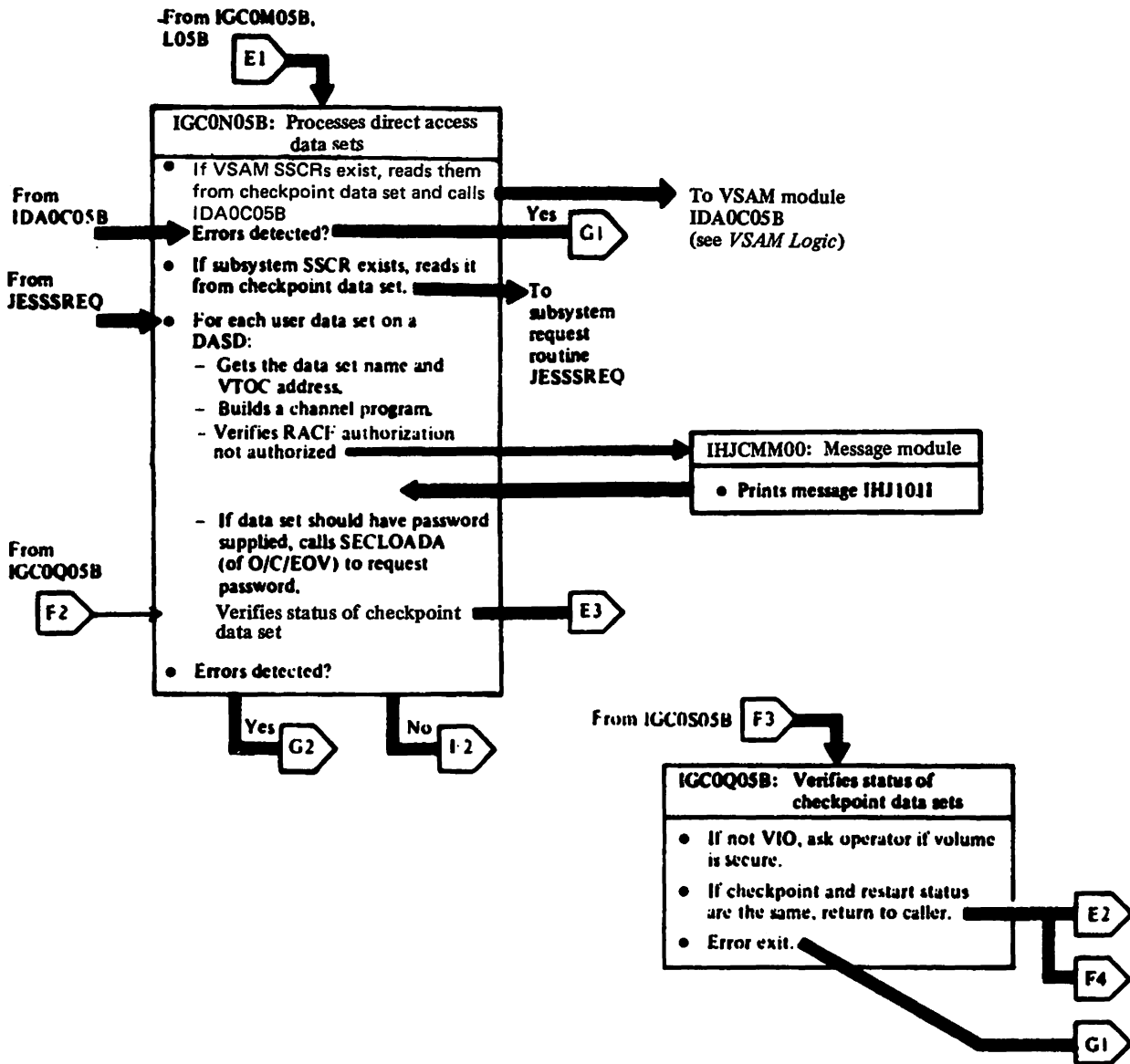


DIAGRAM F

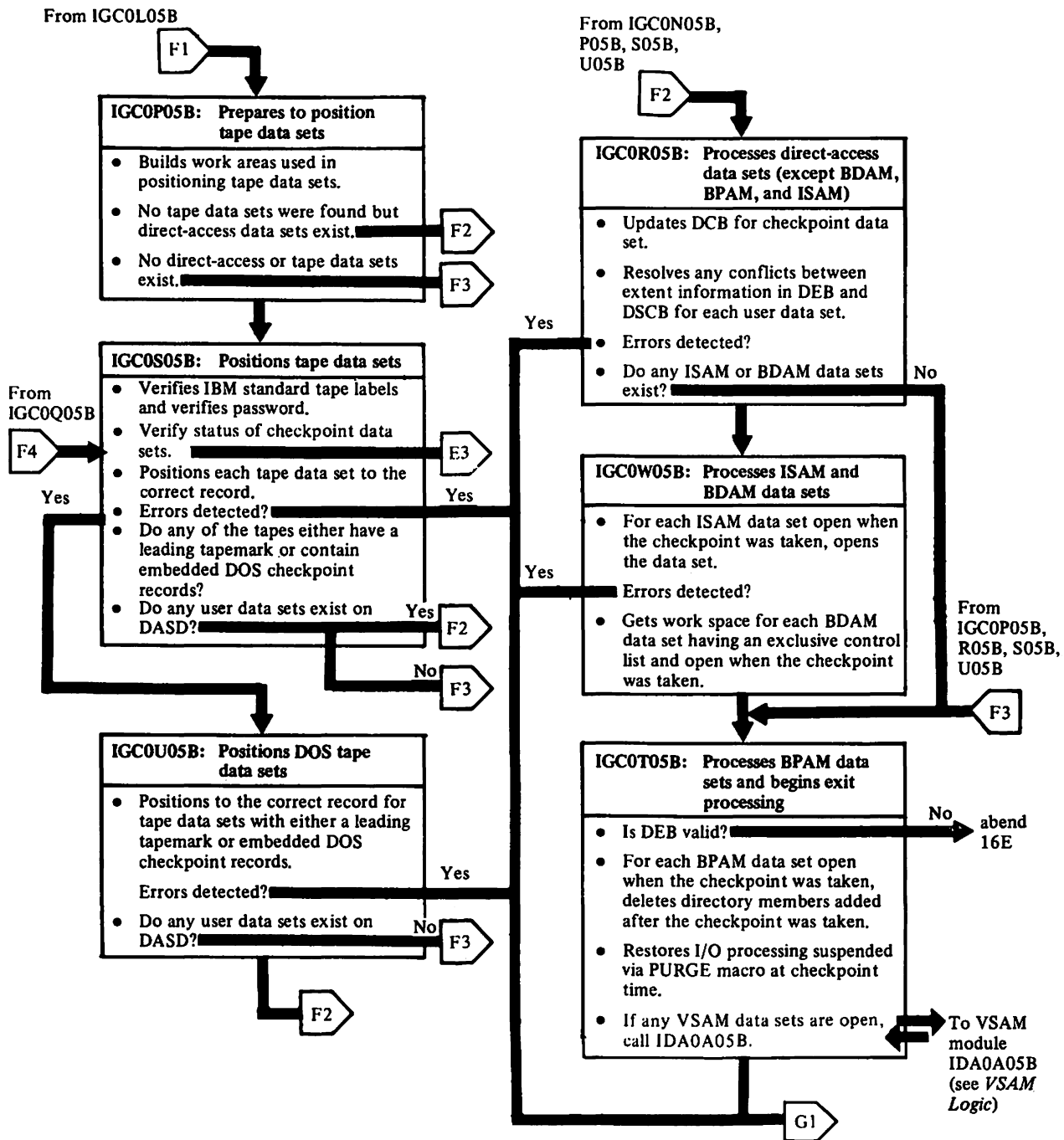
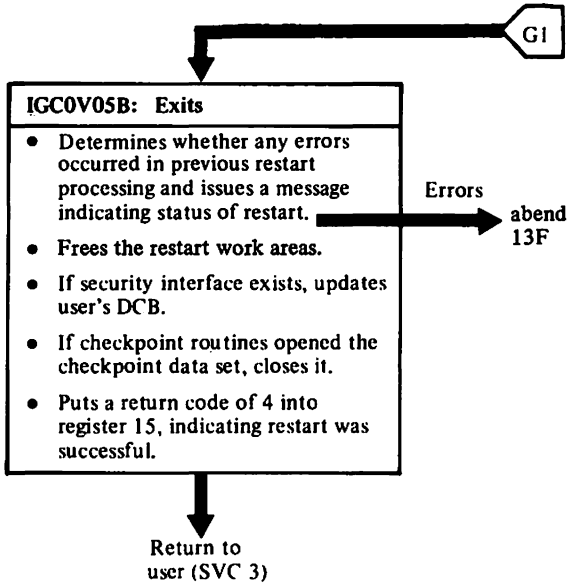


DIAGRAM G

From IGC0005B,  
905B, G05B,  
G95B, H05B,  
I05B, K05B,  
L05B, M05B,  
N05B, Q05B, R05B,  
S05B, T05B,  
U05B, W05B



MODULE DIRECTORY

The cross reference table that follows is ordered by CSECT name.

Microfiche Name	CSECT Name	Program Organization Diagram	Method of Operation Diagram	Operation Performed
IGCMSG6C	IGCMSG6C	D,E	13, 14 (Part 1)	Prints RACF message
IHJACP20	IGC0A06C	A	5 (Part 1)	Builds checkpoint data set
IHJACP25	IGC0D06C	A	5 (Part 1)	Builds checkpoint data set
IHJQCP30	IGC0F06C	A	5 (Part 2)	Builds checkpoint data set
IGC0G05B	IGC0G05B	C	11	Builds data set entry
IHJQCP31	IGC0G06C	B	5 (Part 2)	Builds checkpoint data set
IGC0G95B	IGC0G95B	D	11	Builds data set entry
IGC0H05B	IGC0H05B	D	12	Processes dummy data sets
IHJQCP32	IGC0H06C	B	5 (Part 2)	Builds checkpoint data set
IGC0I05B	IGC0I05B	D	11	Builds data set entry
IGC0K05B	IGC0K05B	D	13	Mounts and verifies tape volumes
IGC0L05B	IGC0L05B	D	13	Processes QSAM card reader data sets
IGC0M05B	IGC0M05B	D	14 (Part 1)	Mounts and verifies direct access volumes
IGC0N05B	IGC0N05B	E	14 (Part 1)	Processes direct access data sets
IGC0N06C	IGC0N06C	B	5 (Part 3)	Builds checkpoint data set
			6	Takes checkpoint and restores user's I/O requests
IGC0Q05B	IGC0Q05B	E	13, 14 (Part 1)	Verifies status of checkpoint data sets
IHJACP50	IGC0Q06C	B	7	Checkpoint exit
IGC0R05B	IGC0R05B	F	14 (Part 2)	Positions direct access data sets
IGC0S05B	IGC0S05B	F	13	Positions tape data sets
IHJACP70	IGC0S06C	B	7	Checkpoint exit
IGC0T05B	IGC0T05B	F	14 (Part 3)	Processes BPAM data sets
IGC0U05B	IGC0U05B	F	13	Positions DOS tape data sets
IHJARS60	IGC0V05B	G	15	Restart exit
IGC0W05B	IGC0W05B	F	14 (Part 3)	Processes ISAM and BDAM data sets
IHJARS00	IGC0005B	C	9	Restart housekeeping

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<b>Microfiche Name</b>	<b>CSECT Name</b>	<b>Program Organi- zation Diagram</b>	<b>Method of Operation Diagram</b>	<b>Operation Performed</b>
IHJACP00	IGC0006C	A	3	Checkpoint housekeeping
IHJACP01	IGC0106C	A	3	Checkpoint housekeeping
IHJARS01	IGC0205B	C	9	Restart housekeeping
IHJACP02	IGC0206C	A	3	Checkpoint housekeeping
IHJQRS20	IGC0505B	C	10	Restores user's region and task control information
IGC0506C	IGC0506C	A	4	Purges user's I/O requests
IHJQRS21	IGC0605B	C	10	Restores user's region and task control information
IHJQRS22	IGC0705B	C	10	Restores user's region and task control information
IHJQRS23	IGC0805B	C	10	Restores user's region and task control information

DATA AREAS

This section shows the work areas, records, and SVRB extended save area used by checkpoint/restart. For information about other data areas and control blocks used by checkpoint/restart, see Data Areas.

ASR (ALLOCATED STORAGE RECORD)

An ASR is a 1024-byte record containing allocated storage record elements (ASREs). Each ASRE contains the starting and ending address of a continuous segment of allocated storage in the user's region. If more than 2 ASREs are needed to describe the user's region, the ASR is written in the checkpoint data set, followed by 1024 bytes of unused information, followed by the CIRs associated with each ASRE. Then another ASR is built.

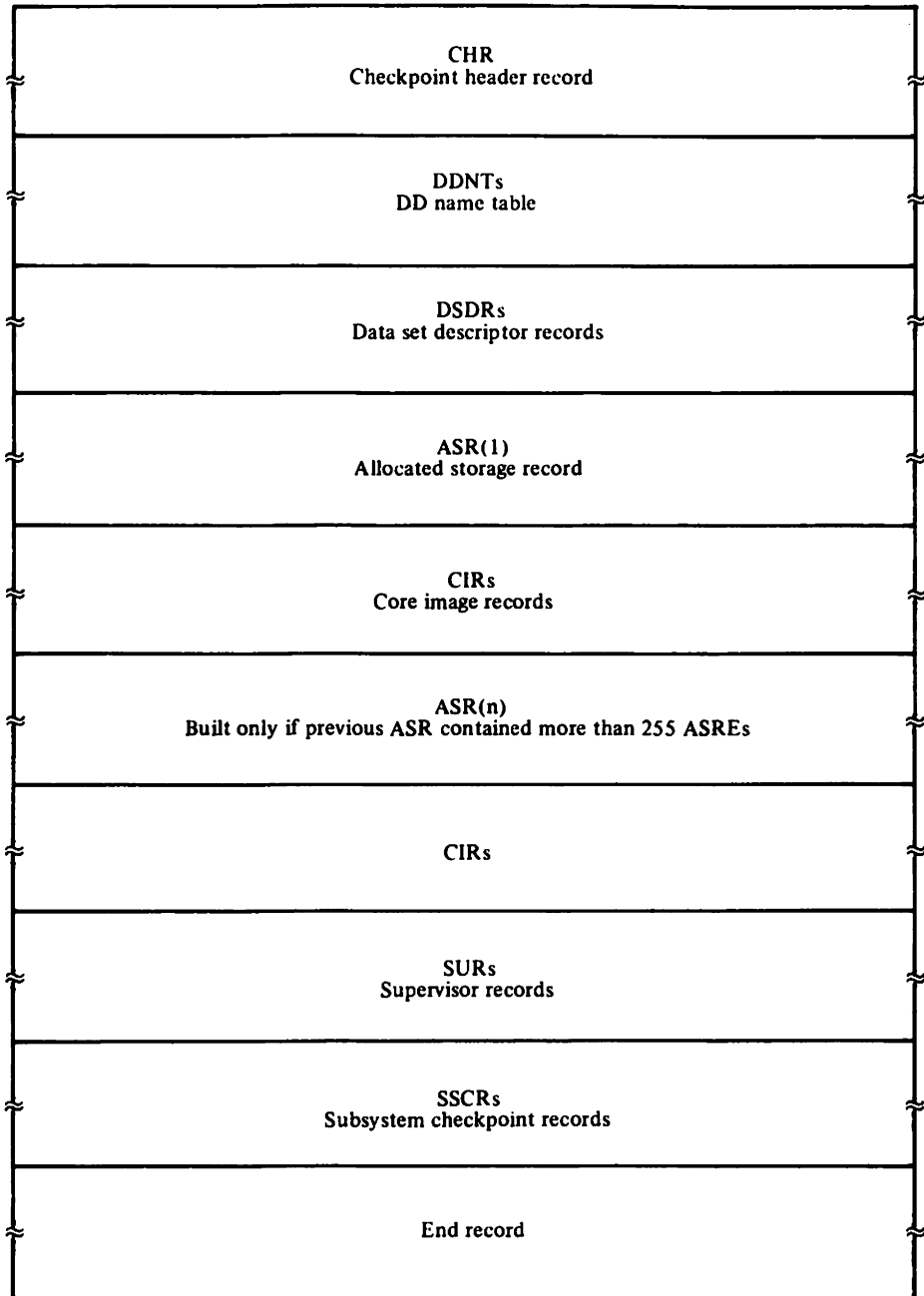
Module IGC0F06C builds the ASR and writes it in the checkpoint data set.

0(0)	ASRCOUNT Number of ASREs in the ASR record	2(2) ASRE.LG1 Contains X'80' if it is the last ASR record	3(3) Unused	} ASR header
4(4)	Unused			
8(8)	Starting address of first segment of storage in user's region			} ASRE(1)
12(C)	Ending address of first segment of storage in user's region			
~				
	Starting address of last segment of storage in user's region			} ASRE(n)
	Ending address of last segment of storage in user's region			

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**CHECKPOINT DATA SET ENTRY**

A checkpoint data set entry is built whenever a checkpoint is taken. The records that comprise a checkpoint data set entry contain all the information necessary to restart a job.





**CHECKPOINT WORK AREA**

The checkpoint work area is built by module IGC0006C.

0(0)	CKWAOFST Offset from beginning of checkpoint work area to work area used by CHECKMAIN and CHKDCB	
4(4)	CKBFOFST Offset from beginning of checkpoint work area to checkpoint buffer	
8(8)	CKWACL Length of checkpoint work area	
12(C)	CKBUFLL Length of checkpoint buffer	
16(10)	CKTCBAD Address of TCB for problem program	
20(14)	CKPPM Beginning address of problem program's storage	
24(18)	CKPPE Ending address of problem program's storage	
28(1C)	Unused	
32(20)	Unused	
36(24)	CKTIOLN Length of TIOT	
40(28)	CKFLAG1 <sup>1</sup>	41(29) CKFLAG2 <sup>2</sup>
		42(2A) CKDCBSI Block size user specified for checkpoint data set
44(2C)	CKRETCOD Return code	46(2E) CKMSGCOD Message code
48(30)	CKSSCR Address of first VSAM SSCR	
52(34)	CKDECB1 First DECB	
72(48)	CKDECB2 Second DECB	
92(5C)	CKINT Unused	
96(60)	CKSYNAD Save area for SYNAD address in user's DCB	
100(64)	CKPARMAD Address of PARMLST, a parameter list containing information the user specified in the CHKPT macro	
104(68)	CHUNIT Unit checkpoint data set is on	107(6B)
	CKDDNAME ddname for checkpoint data set	115(73)
	CKVOLSER Volume serial number for checkpoint data set	

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124(7C)	CKCHEKID System-generated checkid
132(84)	CKTTR TTR for BPAM checkpoint data set
136(88)	CKJCTMB MBBCCHHR of JCT
144(90)	CKERAS00-09 Work area
184(B8)	CKREGSAV Register save area
256(100)	JCT Job control table
432(1B0)	ECB, IOB, CCWs Control blocks and channel program for reading JCT
504(11'B)	Variable-length scratch area Size of area depends on number of user data sets open when the CHKPT macro was issued
	Checkpoint buffer The CHR, SURs, and SSCRs are built in this buffer. The CHR buffer is 400 bytes long. The SUR buffer, which is 200 bytes long, overlays the first 200 bytes of the CHR buffer. The SSCRs are 4096 bytes long.

- <sup>1</sup> X'01' - checkpoint data set is using BPAM  
X'02' - checkpoint modules opened checkpoint data set  
X'04' - user requested cancellation of automatic restart (via CANCEL parameter in CHKPT macro)  
X'20' - checkpoint data set is on tape  
X'40' - track overflow was specified  
X'80' - task is in real storage (V=R)

- <sup>2</sup> X'01' - I/O has been purged  
X'02' - checkpoint work area should be freed  
X'04' - user supplied a checkid  
X'20' - EOV occurred  
X'80' - CHR was written

**CHR (CHECKPOINT HEADER RECORD)**

The CHR is a 400-byte record built by module IGC0206C and written in the checkpoint data set by module IGC0A06C. One CHR is built in each checkpoint entry.

0(0) <b>CHRCOUNT</b> Number of checkpoints taken, including this one	2(2) <b>CHRCKIDL</b> Length of checkid
4(4) <b>CHECKID</b> Name of checkpoint data set entry	
20(14) <b>CHRDDNM</b> ddname of checkpoint data set	
28(1C) <b>CHRPPM</b> Size of region	
32(20) <b>CHRPEI</b> Size, in bytes, of problem program's storage	
36(24) <b>CHRBLKSI</b> Block size of checkpoint data set	38(26) <b>CHRTIOTL</b> Length of TIOT
40(28) <b>CHRFLAGS</b> Checkpoint flag byte 1 <sup>1</sup>	41(29) <b>CHRWALL</b> Size of checkpoint work area
44(2C) <b>CHRFLAG2</b> Checkpoint flag byte 2 <sup>2</sup>	45(2D) <b>CHRWAAD</b> Address of checkpoint work area
48(30) <b>CHRSVRB</b> Address of SVRB used by checkpoint routines	
52(34) <b>CHRPPML</b> Unused	
56(38) <b>CHRPEL</b> Unused	
60(3C) <b>CHRSYD</b> <b>CVTDCB</b> field	61(3D)  <b>CHRID</b> C'\$\$%@/\$ CHR %@/\$!/%' (19 bytes)

<sup>1</sup> X'01' - BPAM checkpoint data set  
X'02' - a checkpoint routine opened the data set  
X'40' - track overflow specified  
X'10' - user authorized to issue MODESET macro  
X'04' - automatic restart canceled  
X'08' - real storage specified for the task  
X'20' - tape checkpoint data set

<sup>2</sup> X'04' - user supplied checkid

CIR (CORE IMAGE RECORD)

A CIR is a 2048-byte record that contains a copy of one continuous segment of allocated storage in the user's region. The boundaries of a continuous segment of storage are described by an ASRE in the ASR. One CIR is built for each ASRE unless a continuous segment of storage is larger than 2048 bytes; in that case, as many CIRs as are needed to copy it will be built.

CIRs are written in the checkpoint data set by module IGC0F06C.

**DATA SET ENTRY**

The data set entry, which is embedded in the restart work area, is used for restoring and positioning user data sets. One data set entry is built for each user data set open when the CHKPT macro was issued.

0(0) TABDSORG <sup>1</sup>	1(1) TABDCBAD Address of DCB for this data set		
4(4) TABFLG1 <sup>2</sup>	5(5) TABSEGAD Address of buffer into which the JFCB is read for this data set		
8(8) TABNVOLS	9(9) TABJFCB TTR address of JFCB for this data set		
12(C) TABTIOT (DASD) or TABTPLBL and TABSQNO (tape) <sup>3</sup>	14(E) TABFLG2 <sup>4</sup>	15(F) TABFLG3 <sup>5</sup>	
16(10) TABFLG4 <sup>6</sup>	17(11) TABFLG5 <sup>7</sup>	18(12)	
TABVLID1 through TABVLID5 Five 6-byte fields for the volume identification numbers for this data set. One field is used for the volume identification number of each volume containing the data set.			

<sup>1</sup> TABDSORG contains one of the following codes indicating what was specified in the DSORG parameter in the DCB:

X'80'-IS  
X'40'-PS  
X'20'-DA  
X'02'-PO  
X'01'-U

<sup>2</sup> TABFLG1 contains one of the following codes:

X'80'-NULLFILE or SYSCHECK DD (subsystem data set) statement submitted  
X'40'-SYSIN or SYSOUT data set  
X'20'-data set on DASD  
X'10'-data set on tape device  
X'08'-last data set entry  
X'04'-unit record or other (not DA or tape)  
X'02'-TCAM data set  
X'01'-DOS tape with embedded DOS checkpoint records

<sup>3</sup> If the data set is on a DASD, the 2-byte TABTIOT field contains the offset from the beginning of the old TIOT to the ddname in that TIOT.

If the data set is on tape, the 2-byte TABSQNO field (X'0D') contains the file sequence number and the 2-byte TABTPLBL field (X'0C') contains one of the following codes describing tape label status:

X'80'-error detected during execution of NSL routine  
X'40'-nonstandard label mount switch  
X'20'-nonstandard label communication bit  
X'10'-bypass label processing  
X'08'-ASCII label  
X'04'-nonstandard label  
X'02'-standard label  
X'01'-no label

<sup>4</sup> TABFLG2 contains one of the following codes:

X'80'-data set on more than 5 volumes  
X'40'-BPAM data set is concatenated  
X'20'-process control switch (password, partial release, ISAM open, DOS tape processing)  
X'10'-checkpoint data set being used for restart  
X'08'-ISAM/VSAM (compatibility interface) data set  
X'04'-VIO data set  
X'02'-old data set was a subsystem data set

<sup>5</sup> TABFLG3 contains one of the following codes:

X'80'-checkpoint data set at checkpoint time  
X'40'-checkpoint data set at restart time

<sup>6</sup> TABFLG4 contains one of the following codes:

X'80'-Bypass password checking because of RACF authorization  
X'40'-RACF authorized for input  
X'20'-RACF authorized for output

<sup>7</sup> TABFLG5 may contain one of the following:

For tape data sets, logical file sequence number.  
For DASD: X'01'-DA label (DSCB) checking completed  
X'02'-DA multivolume switch for DSCB extent checking

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**DDNT (DD NAME TABLE)**

0(0) DDNTIDNT Contains X'0001', the DDNT identification	2(2) DDNTUSCT Relative address of next available entry (see DDNTDDNM) in this table
4(4) DDNTLINK SWA address of next DDNT	
8(8) DDNTDDNM Eight-byte ddname of each data set that has been dynamically deallocated since the beginning of the job step. Up to 21 of these entries may exist.	

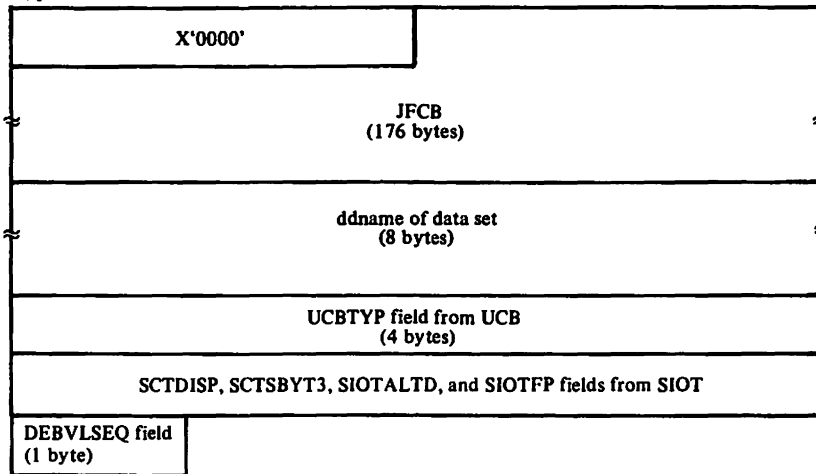
**DSDR (DATA SET DESCRIPTOR RECORD)**

A DSDR is a record in the checkpoint data set containing one of the following types of information:

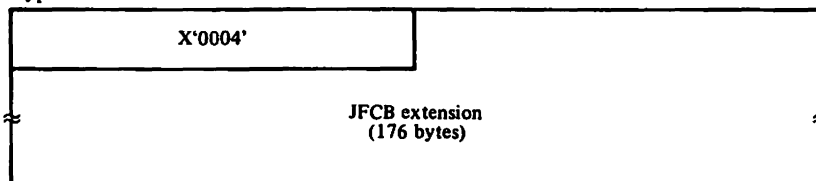
- Type 1 DSDR—contains the JFCB for each data set open when the CHKPT macro was issued.
- Type 2 DSDR—contains the JFCB extension, if one exists, for each user data set open when the CHKPT macro was issued.
- Type 3 DSDR—contains the GDG bias-count table, if one exists, for each user data set open when the CHKPT macro was issued.
- Type 4 DSDR—contains the SIOT for each dynamically allocated data sets.

The physical size of the DSDR record in the checkpoint data set is 400 bytes (2 DSDRs are written as one physical record). DSDRs are built and written in the checkpoint data set by module IGC0D06C.

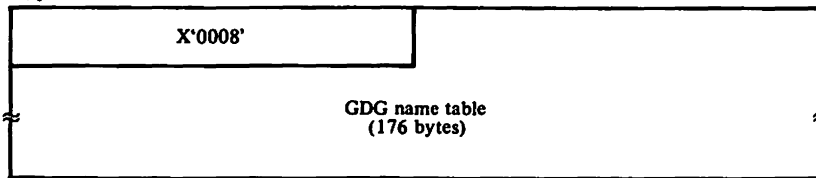
Type 1 DSDR



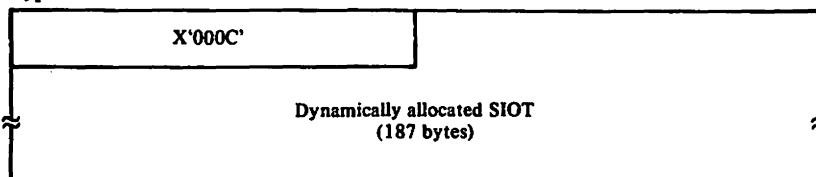
Type 2 DSDR



Type 3 DSDR



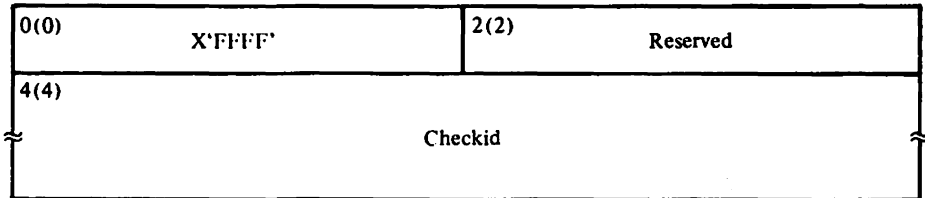
Type 4 DSDR



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END RECORD

The end record (4096 bytes) is the last record written in a checkpoint entry. It is formatted and written by IGC0N06C.





**REPMAN WORK AREA**

The REPMAN work area is embedded in the restart work area. It is used by restart modules IGC0505B, IGC0605B, IGC0805B, and IGC0905B.

0(0)	ERAS1 Temporary save area
4(4)	Unused
8(8)	RSBFSTAD Address of block being processed in SUR buffer
12(C)	RSBFLWA Used to calculate number of bytes remaining in SUR buffer
16(10)	RPMSS1 Address of first SPQE in restored SPQE chain for system task
20(14)	RPMSS2 Address of first SPQE in restored SPQE chain for initiator task
24(18)	RPMSS3 Address of first SPQE in restored SPQE chain for problem program task
28(1C)	RPMRB Address of first RB in RB chain
32(20)	RPMLLE Address of first LLE in LLE chain
36(24)	RPMCDE Address of first CDE in CDE chain
40(28)	RPMDEB Address of first DEB in DEB chain
44(2C)	RPMFOE Address of first FOE in FOE chain
48(30)	RSCORE Beginning address of storage acquired when last GETMAIN macro was issued
52(34)	Module-dependent
56(38)	Module-dependent
60(3C)	RPLNT Length of the block
64(40)	Unused
68(44)	Unused
72(48)	CKSAVAR Register save area

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136(88)	RPMN40 Module Name for XCTL
144(90)	RP40XCTL Pointer to XCTL parameter list
148(94)	RSSWIT1 Big block switch
152(98)	RSTCBSAV Address of checkpointed TCB
156(9C)	RSAPPLNT Length of SUR appendage
160(A0)	RMCD SAV Save cell for LPA CDE search

**RESTART WORK AREA**

The restart work area is built by module IGC0005B. Following is the format of the part of the restart work area used to restore the user's region and system control information and the format of the part of the restart work area used to restore and position the user's data sets.

**FOR RESTORING USER'S REGION AND SYSTEM CONTROL INFORMATION**

0(0)	RSWAOFS Offset from beginning of restart work area to REPDCB work area	
4(4)	RSMWOFST Offset from beginning of restart work area to REPMAIN work area	
8(8)	RSBF OFST Offset from beginning of restart work area to SUR buffer	
12(C)	RSCKDCB Address of DCB for checkpoint data set	
16(10)	RSWACL Length of restart work area	
20(14)	RSBUFL Length of SUR buffer	
24(18)	RSDCBFLG or RSDCBL Length of REPDCB work area	
28(1C)	RSINT Address of DEB chain	
32(20)	RSTCBAD Address of restart's TCB	
36(24)	RSPPM Beginning address of problem program's storage	
40(28)	RSPPE Ending address of problem program's storage	
44(2C)	Unused	
48(30)	Unused	
52(34)	RSTIOTO Length of TIOT used when checkpoint was taken	
56(38)	RSTIOTAD Address of TIOT used when checkpoint was taken	
60(3C)	RSCIRTTR TTR of first CIR in checkpoint data set	
64(40)	RSSVRBN Address of SVRB used by restart routines	
68(44)	RSFLAG1 <sup>1</sup>	70(46) RSDCBSI Block size user specified for checkpoint data set
	69(45) RSFLAG2 <sup>2</sup>	
72(48)	RSRETCOD Return code	74(4A) Unused
76(4C)	RSSVRB Address of CHKPT SVRB	
80(50)	RSNSTAE Address of first SCB in user's SCB chain	
84(54)	RSPIE Address of first PIE in user's PIE chain	
88(58)	RSSSCR Address of first VSAM SSCR	

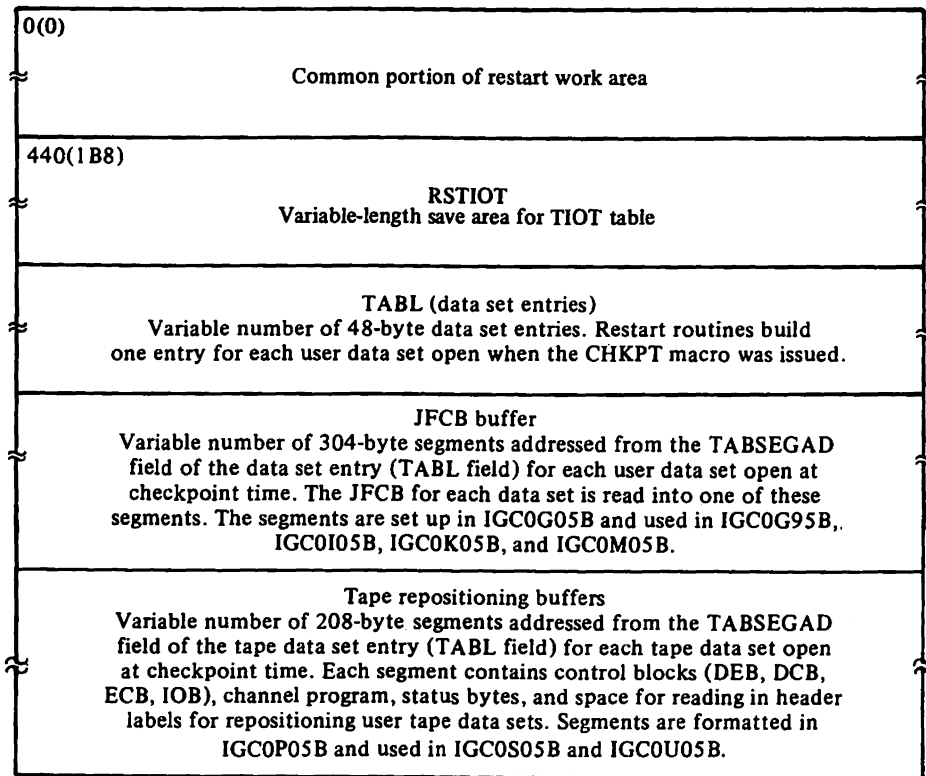
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92(5C)	RSBDCB DCB for checkpoint data set
180(B4)	RSDECB1 First DECB
200(C8)	RSIOBCP Storage area for IOB and channel program
320(140)	RSERAS00-09 Work area
360(168)	RSREGSAV Register save area
432(1B0)	RSTIOTL Length of TIOT save area
440(1B8)	RSTIOT TIOT save area
	REPMAIN work area
	SUR and SSCR buffer (4096 bytes)

<sup>1</sup> X'01'—checkpoint data set is using BPAM  
X'02'—checkpoint modules opened checkpoint data set  
X'20'—checkpoint data set is on tape

<sup>2</sup> X'04'—a TCAM DEB exists for this job  
X'08'—user didn't specify block size for checkpoint data set

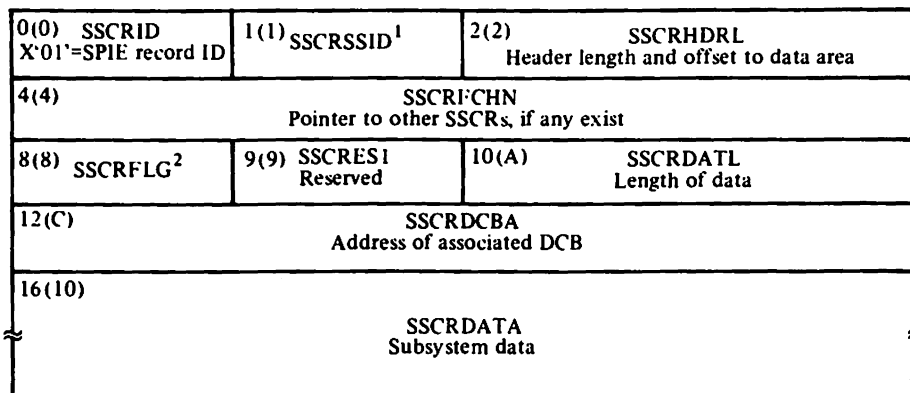
**FOR RESTORING AND POSITIONING USER'S DATA SETS**



**SSCR (SUBSYSTEM CHECKPOINT RECORD)**

SSCRs are 4096-byte records written in the checkpoint data set if VSAM, SPIE, or subsystem data sets are open when the checkpoint is taken.

SSCRs contain information used at restart time to restore control blocks to storage and to reposition data sets. VSAM and subsystem SSCRs are formatted and written in IGC0N06C; SPIE SSCRs are formatted and written in IGC0H06C.



<sup>1</sup> X'00'—subsystem interface data set  
 X'01'—VSAM data set  
 X'02'—SPIE data set

<sup>2</sup> 1 . . . . . —checkpoint time  
 0 . . . . . —restart time  
 . xxx . . . . . —reserved

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**SUR (SUPERVISOR RECORD)**

A SUR is a 400-byte record containing the information outside the user's region that is necessary to restart a job. Control blocks and other pieces of control information are stored sequentially in the SUR with a code that identifies the type of information preceding each. A complete control block or piece of control information is stored within one SUR record; it never overlaps the next SUR record.

SURs are built and written in the checkpoint data set by modules IGC0G06C and IGC0H06C. The codes that precede and identify each type of information in a SUR follow:

<b>Code (in hex)</b>	<b>Control Block or Other Piece of Control Information That Identification Code Precedes</b>
02	FQE
04	DSAB fields (44 - last DSAB, 24 - DSAB for VSAM private catalog data sets)
05	PRB that was created when SYNCH macro was issued
06	SPQE
07	DQE
08	FOE
09	CDE
0A	LLE with CDE on job pack queue
0B	PRB with CDE on job pack queue
0C	PRB with CDE on link pack area queue
0D	TCBNSTAE field in TCB
0E	LLE with CDE on link pack area queue
0F	TCBUSER field in TCB
0F	TCBCAUF field in TCB
0F	TCBFSA field in TCB
0F	CKDCBAD field in DCB
0F	CKSYNAD field in DCB
0F	CKDCBSI field in DCB
10	General registers 0-15
11	SCB
12	IRB
13	Floating point registers
14	TIOT
15	CKTCBAD field in checkpoint work area
15	TCBPIE field in TCB
16	TCB
17	Extent list
18	TCB extension

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1D	SVRB created when the SVC for EOY was issued
1E	Type 4 (not first load) SVRB
1F	Type 2, 3, or 4 (first load) SVRB
20	DEB extension
21	PIRL (purge I/O restore list)
22	EPCB (first)
23	EPCB (subsequent)
30	PSA
31	CVT - Part 1
32	CVT - Part 2
33	CVT - Part 3
34	CVT Extension 2
35	PVT - Part 1
36	PVT - Part 2
37	PVT - Part 3
38	PVT - Part 4
39	PVT - Part 5
3A	SCVT
3B	SVC table - Part 1
3C	SVC table - Part 2
3D	SVC table - Part 3
80	Non-ISAM DEB
81	ISAM DEB
82	Dummy DEB
83	Subsystem DEB

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**SVRB EXTENDED SAVE AREAS**

**SVRB EXTENDED SAVE AREA USED BY MODULE IGC0006C**

0(0)		HKPSVRB Fixed area in SVRB	
96(60)	Unused	97(61) HKPRETCD Return code	98(62) HKPMSGCD Message code
100(64)		HKPGML Parameter list for GETMAIN macro	
104(68)		HKPGMLAD Length and address of space obtained by GETMAIN macro for checkpoint work area	
112(70)		HKPGLIST Parameter list for OPEN, GETMAIN, and XCTL macros	
116(74)		HKPWD2 Character to alter module name to name of next module to get control	
120(78)		HKPNTLST Address of the area that contains the address of a parameter list	
124(7C)	HKPTIOTL Length of TIOT	126(7E)	Unused
128(80)	HKPFLAG <sup>1</sup> Flag byte	129(81)	HKPTIOAD Address of TIOT
132(84)	HKPSP Used to check boundary alignment of addresses	133(85)	HKPDCBAD Address of DCB for checkpoint data set
136(88)		Unused	

<sup>1</sup> X'01'-error has occurred; give control to IGC0006C  
X'02'-checkpoint data set is open  
X'04'-user requested cancellation of automatic restart (via CANCEL parameter in CHKPT macro)  
X'10'-checkpoint routines should close checkpoint data set  
X'20'-environmental error detected



SVRB EXTENDED SAVE AREA USED BY MODULE IGC0Q06C

0(0)	CERSVRB Fixed area in SVRB	
96(60)	CERRETCB Return code	98(62) CERMSGCD Message code
100(64)	CERMSGMD Name of next module to get control	
108(6C)	CERXCTL Address of next module to get control	
112(70)	CERJOBNM (or CERCHKID) Job name (or checkid)	
120(78)	CERDDNM ddname for checkpoint data set	
128(80)	CERTIOAD Address of TIOT	
132(84)	CERDCBAD Address of DCB for checkpoint data set	

DIAGNOSTIC AIDS

MESSAGES ISSUED BY CHECKPOINT/RESTART

Checkpoint/restart modules issue the following messages:

- IHJ000I CHKPT jjj [(ddn)] NOT TAKEN (xxx)
- IHJ001I jjj (ddn,utn,ser) INVLD checkid (xxx)
- IHJ002I jjj (ddn,utn,ser) ERROR checkid (xxx)
- IHJ004I jjj (ddn,utn,ser) CHCKPT checkid
- IHJ005I jjj (ddn,utn,ser) ENQS checkid (xxx)
- IHJ007I RESTART NOT SUCCESSFUL FOR jjj (xxx [,utn])
- IHJ008I jjj RESTARTED
- IHJ009I ERROR ON ddname
- IHJ101I USER NOT AUTHORIZED TO DASD DATA SET = dsname, ser
- IHJ102I ENVIRONMENT NOT RACF AUTHORIZED TO TAPE VOL = ser

where:

checkid  
is the identification assigned to a checkpoint entry.

ddn  
is the ddname of the checkpoint data set.

jjj  
is the job name.

ser  
is the volume serial number of the checkpoint data set volume.

utn  
is the unit number.

xxx  
is the message code as described below.

ddname  
is the ddname of the data set that caused the error.

sss  
is the step name.

Following is a list of these messages, the message and return codes associated with them, and the module detecting each error. All messages resulting from errors detected during checkpoint processing are issued by IGC0506C. Messages resulting from errors detected during restart processing are issued by IGC0505B. For a description of modules IDA0A05B, IDA0C05B, IDA0C06C, and IDA0I96C, see VSAM Logic.

Message Number	Reason Code	Return Code (in hex)	Module Detecting Error	Meaning of Message Code
IHJ000I	001	08	IGC0006C	Error in parameters of CHKPT macro.
	001	08	IGC0506C	Error in parameters of CHKPT macro.
	002	0C	IGC0006C	Error opening DCB for checkpoint data set.
	003	08	IGC0006C	GETMAIN for checkpoint work area failed.
	003	08	IDA0C06C	GETMAIN for checkpoint work area failed.
	005	08	IGC0106C	KEYLEN for checkpoint data set not 0.
	006	08	IGC0106C	RECFM for checkpoint data set not U.
	007	08	IGC0006C	DSORG for checkpoint data set not P0 or PS.
	007	08	IGC0106C	DSORG for checkpoint data set not P0 or PS.
	008	08	IGC0106C	Time interval specified in STIMER macro hasn't elapsed.
	009	08	IGC0106C	Checkpoint macro issued in exit routine other than EOVS or an RB of an unacceptable type was found on the RB chain.
	010	08	IGC0106C	Graphics data set open when CHKPT macro issued.
	011	08	IGC0006C	Current task is a subtask.
	012	08	IGC0006C	Current task has subtasks.
	013	08	IGC0106C	Checkpoint issued with an outstanding PCLINK.
	014	08	IGC0106C	No reply received for an outstanding WTOR.
	015	08	IGC0106C	Checkid provided by caller was invalid.
	016	08	IGC0006C	Checkpoint data set not on DASD or tape.
	016	08	IGC0106C	Checkpoint data set not on DASD or tape.
	019	08	IGC0106C	Checkpoint data set not opened for output.
	021	08	IGC0106C	Label for checkpoint data set specified as AL or AUL.
	025	0C	IGC0206C	Error when JCT read.
	027	08	IGC0A06C	EOVS (second time on tape, first on DASD) when writing checkpoint entry.
	029	08	IGC0106C	American National Standards Institute (ANSI) translation for tape specified (OPTCD=Q in DCB).
	030	0C	IGC0506C	I/O error during PURGE operation.

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Message Number	Reason Code	Return Code (in hex)	Module Detecting Error	Meaning of Message Code
	032	0C	IHJACP01	ISAM data set is open with DISP=SHR.
	041	08	IDA0C06C	The checkpoint was issued with (1) VSAM key sequenced data set open for create mode processing, (2) VSAM entry sequenced data set open for create mode processing with no repositioning (AMP=CROPS=NRE) specified, or (3) VSAM entry sequenced data set open for noncreate mode processing with active requests outstanding.
	042	0C	IDA0C06C	VSAM checkpoint repositioning error.
	043	08	IDA0C06C	Repositioning specified for ESDS with a path open for immediate upgrade.
	044	08	IDA0C06C	Direct processing performed against an RRDS in create mode.
	045	08	IDA0C06C	Global shared resources specified.
	102	08	IGC0106C	A checkpoint was requested when a DCB was open for a data set in support of Version 3 ISO/ANSI (International Organization for Standardization/American National Standards Institute) tape labels.
	134	08	IDA0C06C	No storage available for VSAM open or close.
	121	0C	IGC0506C	SYNCDEV error has been detected.
	146	0C	IDA0C06C	I/O error completing I/O request.
	147	08	IDA0C06C	ACB is not for a valid data set.
	200	0C	IGC0506C	Uncorrectable error during PURGE operation.
	202	0C	IGC0006C	Uncorrectable error during SETLOCK operation.
	202	0C	IGC0506C	Uncorrectable error during SETLOCK operation.
	206	08	IGC0106C	VTAM data set open when CHKPT macro issued.
	208	08	IGC0006C	New checkpoint data set is not empty.
	209	08	IGC0006C	More than one DCB specifying the checkpoint data set open.
	210	08	IGC0006C	DISP=SHR coded for checkpoint data set.
	211	08	IGC0006C	Volume specified for creation of new checkpoint data set not secure.
	212	08	IGC0006C	Tape checkpoint data set didn't have standard labels.
	213	08	IGC0006C	Checkpoint data set was subsystem data set.

Message Number	Reason Code	Return Code (in hex)	Module Detecting Error	Meaning of Message Code
	214	08	IGC0006C	New checkpoint data set on a shared direct access device.
	224	08	IGC0106C	SAM subsystem interface data set (not using the compatibility interface) open when CHKPT macro issued.
	240	0C	IDA0C06C	ESTAE macro failed. Recovery environment could not be established.
	241	0C	IDA0C06C	Uncorrectable error occurred.
	242	0C	IDA0C06C	Machine check occurred.
	250	08	IGC0106C	IMAGELIB DCB open.
IHJ001I	003	08	IDA0I96C	No storage available for VSAM checkpoint.
	017	08	IGC0Q06C	No directory space for BPAM checkpoint data set.
	022	0C	IGC0D06C	Error reading control blocks from SWA.
	023	0C	IGC0A06C	I/O error writing checkpoint data set.
	023	0C	IGC0D06C	I/O error writing checkpoint data set.
	023	0C	IGC0F06C	I/O error writing checkpoint data set.
	023	0C	IGC0G06C	I/O error writing checkpoint data set.
	023	0C	IGC0H06C	I/O error writing checkpoint data set.
	023	0C	IGC0N06C	I/O error writing checkpoint data set.
	026	0C	IGC0Q06C	I/O error during STOW operation.
	027	08	IGC0A06C	EOV (second time on tape, first on DASD) when writing checkpoint entry.
	027	08	IGC0D06C	EOV (second time on tape, first on DASD) when writing checkpoint entry.
	027	08	IGC0F06C	EOV (second time on tape, first on DASD) when writing checkpoint entry.
	027	08	IGC0G06C	EOV (second time on tape, first on DASD) when writing checkpoint entry.
	027	08	IGC0H06C	EOV (second time on tape, first on DASD) when writing checkpoint entry.
	027	08	IGC0N06C	EOV (second time on tape, first on DASD) when writing checkpoint entry.
	207	0C	IGC0N06C	Subsystem interface failed.
	240	0C	IDA0I96C	Recovery environment could not be established during a checkpoint of VSAM data sets.
	241	0C	IDA0I96C	Indeterminate error occurred during a checkpoint of VSAM data sets.

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Message Number	Reason Code	Return Code (in hex)	Module Detecting Error	Meaning of Message Code
	242	0C	IDA0I96C	A machine check occurred during a checkpoint or restart of VSAM data sets.
IHJ002I	025	0C	IGC0Q06C	Error when JCT written to SWA.
	204	0C	IGC0Q06C	WIJOURN macro issued for VIO data set unsuccessful; current checkpoint unavailable for automatic restart.
	205	0C	IGC0Q06C	WIJOURN macro issued for VIO data set unsuccessful; all checkpoints for step unavailable for automatic restart.
	215	18	IGC0N06C	Uncorrectable error during RESTORE operation.
IHJ004I	None	None	Not applicable	Checkpoint taken successfully.
IHJ005I	000	10	IGC0I06C	Resources had been enqueued when checkpoint was taken (probable error).
	017	08	IGC0I06C	Insufficient storage to check for ENQs.
	018	08	IGC0I06C	GQSCAN macro discovered an abnormal condition.
IHJ007I	002	None	IGC0005B	Status (virtual or real storage) of checkpoint and restart tasks differs.
	004	None	IGC0005B	Environment of checkpoint and restart tasks differs.
	023	None	IGC0005B	Error when reading control blocks from SWA.
	024	None	IGC0G95B	Error when reading control blocks from SWA.
	025	None	IGC0I05B	Error when reading control blocks from SWA.
	026	None	IGC0K05B	Error when reading control blocks from SWA.
	027	None	IGC0N05B	Error when reading control blocks from SWA.
	030	None	IGC0K05B	Error during execution of user's NSL routine.
	031	None	DSDRP	A DD statement was DUMMY in the original run and is not DUMMY in the restart run.
	032	None	IGC0705B	DD statement missing for restarted step.
	033	None	IGC0G05B	DD statement missing for restarted step.
	034	None	DSDRP	DD statement missing for restarted step.
	035	None	IGC0505B	I/O error when reading checkpoint data set.
	036	None	IGC0605B	I/O error when reading checkpoint data set.

Message Number	Reason Code	Return Code (in hex)	Module Detecting Error	Meaning of Message Code
037		None	IGC0705B	I/O error when reading checkpoint data set.
038		None	DSDRP	I/O error when reading checkpoint data set.
039		None	IGC0N05B	I/O error when reading checkpoint data set.
040		None	IGC0K05B	I/O error when reading standard volume label.
041		None	IGC0505B	Wrong length record detected when reading checkpoint data set.
042		None	IGC0605B	Wrong length record detected when reading checkpoint data set.
043		None	IGC0705B	Wrong length record detected when reading checkpoint data set.
044		None	IGC0K05B	UCB not available.
045		None	IGC0M05B	UCB not available.
046		None	IGC0K05B	No secondary control unit for 1275/1419.
048		None	IGC0M05B	I/O error when reading volume label in direct access device.
049		None	IGC0M05B	MSS failure. See message IEC4661 for explanation and reason code.
050		None	IGC0M05B	Volume serial at restart not equal to volume serial at checkpoint.
052		None	IGC0605B	Module in LPA at checkpoint time either not there now or its location has changed.
053		None	IGC0605B	Module in LPA at checkpoint time has different entry point address for restart.
060		None	IGC0S05B	Error in repositioning tape data sets.
063		None	IGC0S05B	Error when positioning tape data set.
064		None	IGC0U05B	Error when positioning tape data set.
065		None	IGC0U05B	Error positioning tape to correct data set.
072		None	IGC0R05B	I/O error when reading DSCB or the data set was scratched or deleted.
073		None	IGC0N05B	I/O error when reading DSCB or the data set was scratched or deleted.
074		None	IGC0W05B	I/O error when reading DSCB or the data set was scratched or deleted.
076		None	IGC0R05B	Number of extents in DEB and DSCB for input data set not equal.

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Message Number	Reason Code	Return Code (in hex)	Module Detecting Error	Meaning of Message Code
	077	None	IGC0W05B	Error during ISAM open.
	079	None	IGC0H05B	Non-BSAM or -QSAM data set made dummy at restart time.
	080	None	IGC0H05B	CI DEB made dummy at restart time.
	082	None	IGC0G95B	TCAM control program not active at restart time.
	083	None	IGC0J05B	QNAME parameter process entry not in terminal table.
	084	None	IGC0J05B	QNAME parameter process entry being used by another user.
	085	None	IGC0J05B	GETMAIN for TCAM control blocks failed.
	092	None	IGC0T05B	I/O error when processing BPAM directory.
	095	None	IGC0G06C	A control block chaining error occurred.
	096	None	IGC0T05B	Error during STOW operation.
	099	None	IGC0G05B	Missing DSAB at restart.
	132	None	IDA0A05B	ddname not found in TIOT.
	133	None	IDA0A05B	Error reading or writing JFCB.
	134	None	IDA0A05B	No storage available.
	136	None	IDA0A05B	I/O error reading or writing catalog entry.
	137	None	IDA0A05B	Catalog entry not found.
	138	None	IDA0A05B	Password was invalid.
	140	None	IDA0A05B	Conflicting parameters.
	141	None	IDA0A05B	I/O error reading volume label.
	142	None	IDA0A05B	Data set not available.
	144	None	IDA0A05B	PGFIX failure.
	145	None	IDA0A05B	Catalog does not exist or is not open.
	146	None	IDA0A05B	I/O error completing I/O request.
	147	None	IDA0A05B	ACB is not for a valid data set.
	148	None	IDA0A05B	Unusable data set open for output.
	149	None	IDA0A05B	Access to data set via empty path AIX.
	150	None	IDA0A05B	Format-4 DSCB indicates volume is unusable.
	153	None	IDA0A05B	ACB indicates LSR and data set is empty.



Message Number	Reason Code	Return Code (in hex)	Module Detecting Error	Meaning of Message Code
	154	None	IDA0A05B	ACB indicates LSR and key of data set exceeded maximum key length in BLDVRP macro.
	155	None	IDA0A05B	Shared resources—BSPH too small.
	157	None	IDA0A05B	Shared resources VSRT does not exist.
	158	None	IDA0A05B	Reset specified for nonreusable data set.
	159	None	IDA0A05B	An MSS acquire/relinquish error occurred.
	160	None	IDA0A05B	Volume time stamp discrepancy for output ACB.
	161	None	IDA0A05B	CRA volume not mounted.
	174	None	IDA0A05B	ACB is not for a valid data set.
	181	None	IDA0A05B	VSAM restart preformat error.
	182	None	IDA0A05B	VSAM restart verify error.
	183	None	IDA0A05B	VSAM restart put error.
	184	None	IDA0A05B	VSAM restart index put error.
	190	None	IDA0A05B	Error from catalog interface routine.
	191	None	IDA0A05B	Error from volume mount routine.
	193	None	IDA0A05B	Data set was in create mode during checkpoint but not during restart.
	194	None	IDA0A05B	Immediate upgrade AIX added or deleted since checkpoint.
	195	None	IDA0A05B	No storage available for VSAM restart.
		None	IDA0C05B	No storage available for VSAM restart.
	196	None	IDA0A05B	The catalog for the cluster has been updated after the checkpoint was taken.
	198	None	IDA0A05B	The cluster has extended to a new volume after the checkpoint was taken.
	199	None	IDA0A05B	An error occurred during BLDVRP processing.
	201	None	IGC0605B	Uncorrectable error during PGFIX operation.
	202	None	IGC0505B IGC0605B	Uncorrectable error during SETLOCK operation.
	202	None	IGC0805B	Uncorrectable error during SETLOCK operation.
	202	None	IGC0905B	Uncorrectable error during SETLOCK operation.
	203	None	IGC0005B	User attempted to invoke IEFRSTRT.

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<b>Message Number</b>	<b>Reason Code</b>	<b>Return Code (in hex)</b>	<b>Module Detecting Error</b>	<b>Meaning of Message Code</b>
207	None	None	IGC0N05B	Table for subsystem data set not found.
208	None	None	IGC0N05B	Bad return code from subsystem.
216	None	None	IGC0005B	Reallocation of user's region unsuccessful.
217	None	None	IGC0905B	Error during FINDPAGE operation.
218	None	None	IGC0Q05B	In a situation in which more than one data set was being used to take checkpoints, one of the data sets (not the one used for restart) was deemed insecure.
219	None	None	IGC0S05B	Password failed for tape data set.
220	None	None	IGC0N05B	Address of data set label changed since checkpoint time.
221	None	None	IGC0N05B	Wrong password given for a password protected data set.
222	None	None	IGC0S05B	Tape data set name changed since checkpoint was taken.
230	None	None	DSDRP	Checkpoint data set not secure.
231	None	None	DSDRP	Error occurred during dynamic allocation of checkpoint data set.
232	None	None	DSDRP	Checkpoint data set could not be successfully opened.
233	None	None	DSDRP	Entry in directory for BPAM checkpoint data set not found.
235	None	None	DSDRP	A checkpoint entry record of undetermined type encountered in checkpoint data set.
236	None	None	IGC0N05B	A checkpoint entry record of undetermined type encountered in checkpoint data set.
237	None	None	DSDRP	Specified checkpoint entry not found.
238	None	None	DSDRP	SYSCHK DD did not specify explicit VOLUME and UNIT information.
239	None	None	DSDRP	Nondummy VIO data set found at deferred checkpoint restart time.
240	None	None	IDA0A05B	Recovery environment could not be established during VSAM restart.
240	None	None	IDA0C05B	Recovery environment could not be established during VSAM restart.
241	None	None	IDA0A05B	An indeterminate error occurred during VSAM restart.
241	None	None	IDA0C05B	An indeterminate error occurred during VSAM restart.

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<b>Message Number</b>	<b>Reason Code</b>	<b>Return Code (in hex)</b>	<b>Module Detecting Error</b>	<b>Meaning of Message Code</b>
	242	None	IDA0A05B	A machine check occurred during VSAM restart.
	242	None	IDA0C05B	A machine check occurred during VSAM restart.
	243	None	IDA0C05B	An invalid SSCR record was encountered in the checkpoint data set during VSAM restart.
	251	None	IGC0Q05B	A data set that was not a checkpoint data set at the time a checkpoint was taken was found to be open to a secure checkpoint data set at restart time.
	254	None	IGC0N05B	User not authorized to access RACF-protected data set.
	255	None	IGC0K05B	User not authorized to access RACF-protected data set or tape volume.
IHJ008I	None	None	Not applicable	Restart at a checkpoint was successful.
IHJ009I	None	None	IDA0A05B	VSAM detected an error while attempting to reposition a data set described by <u>ddname</u> . This message is followed by message IHJ007I.

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**ABBREVIATIONS**

ACB	access method control block	EOF	end of file
ANSI	American National Standards Institute	EOV	end of volume
ASCB	address space control block	FBQE	free block queue element
ASCII	American National Standard Code for Information Interchange	FLIH	first level interruption handler
ASR	allocated storage record	FOE	fixed ownership element
ASRE	allocated storage record element	FQE	free queue element
BDAM	basic direct access method	GDG	generation data group
BPAM	basic partitioned access method	ICB	interruption control block
BSAM	basic sequential access method	I/O	input/output
CCW	channel command word	IOB	input/output block
CDE	contents directory element	IQE	interruption queue element
CHR	checkpoint header record	IRB	interruption request block
CI	compatibility interface	ISAM	indexed sequential access method
CIR	core image record	ISO	International Organization for Standardization
CSA	common service area	JCT	job control table
CVT	communications vector table	JFCB	job file control block
DADSM	direct access device space management	JSCB	job step control block
DASD	direct access storage device	LLE	load list element
DCB	data control block	LPA	link pack area
DDNT	ddname table	LSQA	local storage queue area
DEB	data extent block	MBBCHHR	absolute disk address
DOS	disk operating system	MSS	mass storage system
DPQE	dummy partition queue element	NCP	number of channel programs
DQE	descriptor queue element	NSL	nonstandard label
DSAB	data set association block	O/C/EOV	open/close/end of volume
DSCB	data set control block	PCB	page control block
DSDR	data set descriptor record	PIRL	purge I/O restore list
EBCDIC	extended binary-coded-decimal interchange code	PO	partitioned organization
ECB	event control block	PQE	partition queue element
EOB	end of block	PRB	program request block
		PS	physical sequential
		QCB	queue control block

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QDB	queue descriptor block	STCB	subtask control block
QSAM	queued sequential access method	SUR	supervisor record
RACF	Resource Access Control Facility	SVC	supervisor call
RB	request block	SVRB	supervisor request block
R/TM	recovery/termination manager	SWA	scheduler work area
SAM	sequential access method	TCAM	telecommunications access method
SCB	STAE control block	TCB	task control block
SCT	step control table	TIOT	task input/output table
SDWA	STAE diagnostic work area	TQE	timer queue element
SIOT	step input/output table	TTR	track, track, record (relative track address)
SIRB	supervisor interruption request block	UCB	unit control block
SLIH	second level interruption handler	USASI	USA Standards Institute
SPL	service priority list	VAT	valid AMBL table
SPQE	subpool queue element	VIO	virtual input output
SSCR	subsystem checkpoint record	VSAM	virtual storage access method
SSIB	subsystem identification block	VTAM	virtual telecommunications access method
SSOB	subsystem option block	VTOC	volume table of contents
STAE	specify task asynchronous exit	WTO	write to operator
STAI	subtask ABEND interception	XDAP	execute direct access program
STC	system task control	XPTE	external page table entry

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