

DBARS

DB2 Access Recording Services

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1 Product Description

Many corporations maintain sensitive or confidential data that are vital to corporate operations. In today's distributed IT environments, these data need special protection. As the initial security measure, DB2 privileges are granted to authorized users who are allowed to access these data. As a further measure, all access to sensitive data should be recorded, to verify that accesses are made for legitimate reasons and not for fun, curiosity or dishonest motives.

Today, there is a growing concern (and legislation) about data privacy. Databases often contain confidential information about individuals. This information has been entrusted by the individual to the corporation, in the expectation that the information will be handled with respect to personal privacy. Legislations may state that companies owning personal information, implement procedures to ensure that personal data are accessed by legitimate sources only. Legislation may also impose that accesses to confidential information can be retraced whenever needed.

Once DB2 privileges have been granted to a user, the user has access to the entire table. For reasons of security and privacy, it is necessary to control data access at the table-row level. It is therefore advisable to maintain an access log, either by application programming or by means of a system tool. The access log should record which data have been accessed, by whom and when. The log will be a valuable source of information for auditors or security officers.

1.1 DB2 Auditing Facilities

Sensitive data are normally stored in DB2 tables created with the AUDIT clause of the CREATE TABLE statement. A DB2 audit trace can be activated to verify that only authorized users access auditable tables and to record the SQL statements that access these tables. Finally, DB2 log analysis can be used to view the actual modifications to the data.

However, these DB2 facilities are not sufficient to fully record all access to sensitive data, for the following reasons:

- The audit trace records only the first read or write SQL statement in a logical unit of work.
- The trace records do not provide the contents of the input variables submitted with the SQL statement. Without this information, access recording is incomplete.
- DB2 auditing requires that an auditing trace be enabled. If many tables are audited or intensely used, the operating cost of tracing may be excessive.

1.2 Facilities provided by DBARS

DB2 Access Recording Services - "**DBARS**" - is a product developed by Software Product Research.

- DBARS records all accesses to sensitive data in auditable DB2 tables, by recording the SQL statements that perform the access. Depending on the degree of auditing defined, read (SELECT) and write (DELETE, INSERT and UPDATE) access will be recorded.
- DBARS will record access to:
 - the DB2 tables created with the AUDIT CHANGE or AUDIT ALL attribute
 - the DB2 tables specified in the AUDITNAMES section of the DBARS startup parameters
 - **all** DB2 tables when the ALLTABLES option is specified at DBARS startup
- DBARS records all input variables ("hostvariables") associated with the SQL statement.
- DBARS stores the intercepted SQL statement into the DBARS **Recorder**.
- DBARS provides a powerful utility to scan the Recorder for recorded events.
- DBARS has its own interface to DB2 and does not depend on DB2 tracing. As a result, recording overhead will be acceptable.

1.3 The Recorder

For each access to an audited table, DBARS inserts following data into the DBARS **Recorder**:

- The **context** of statement execution:
 - the date and time of access
 - the name of the DB2 application server accessed
 - the name of the DB2 application requester (identical to the application server for local access)
 - the DB2 and z/OS userid
 - the correlation ID (e.g. the z/OS job name for batch access)
 - the type of connection (e.g. batch, CICS)
 - the type of access (dynamic or static)
 - the LUW_id
 - the external application name for distributed access
 - the workstation name for distributed access
 - the name of the program used for access
 - the number of rows modified by the statement
 - the statement's SQLCODE (indicating successful or failing access)
- The **text of the SQL statement** executed, with all input variables ("host variables") in the statement replaced by their contents.¹

At the choice of the user, the Recorder is a DB2 table or a sequential file (a VSAM ESDS cluster).

VSAM Recorder Considerations

- When defining a VSAM ESDS Recorder during product installation, the supplied jobstream will also define Recorder Index clusters. These KSDS clusters are provided to allow faster scan of the Recorder. The Recorder Indexes are on date and time. A Recorder Index record is written when a predefined number of records have been written on the Recorder.
- A VSAM Recorder can be "exported" to a DB2 Recorder using the archive program. If exporting occurs frequently, the advantages of both Recorder options can be combined. For more details, read section 8.7.
- The sequential file option should be chosen when intensive access recording is performed.

¹ When VARCHAR variables are replaced, the length of the replacement is limited to 128 characters. Should the application specify an invalid length for the VARCHAR, the variable will be displayed as ???.

1.4 Inspecting the Recorder

The **Recorder Scan** utility searches the Recorder for specific access events. The user may supply following search criteria:

- One or more columns of the Recorder.
- Table column names used in the recorded SQL statement. This will report all SQL statements that reference the named table column.
- Table column names with a specified value. This will report all statements that reference the table column with the specified value. This option will report all recorded access for a given table "key".

The Recorder Scan program includes following additional facilities:

- The search values specified for the recorder table columns may contain DB2 expressions. For example: **Program Name LIKE DSQ%**
- The program can be used to scan the archive result table, described in the paragraph "Archiving the Recorder".
- The search arguments supplied by the user are saved in a DB2 table and may be recalled in a later scan session. The USERPARMS table saves up to 32 sets of search arguments.

1.5 Access Summary Report

The Access Summary program accepts the same search criteria as the Recorder scan. The program provides an hierarchical view of recorded access events.

- Typically, access summary is requested to display, for a given table, the **list of all users** that have accessed the table in a defined period of time.
- For a designated user in the user list, a **program list** may be requested, to list all programs by which that user has accessed the table.
- In the program list, a **statement list** may be requested for a selected program. The list will show the program's SQL statements, executed by the user against the DB2 table.

1.6 Archiving the Recorder

The DBARS archiving function transfers the Recorder to a sequential disk or tape dataset, so that recorded information can be kept for a longer period of time.

DBARS supplies a utility to scan an archived Recorder using the search criteria, described above. At the choice of the user, the archive scan produces a printed report or a result DB2 table. The latter table can be used as input for an interactive Recorder scan.

1.7 Customizing DBARS

- When the Recorder has been defined as a DB2 table, it can be processed as such by customer procedures. When the Recorder is a VSAM cluster, the Recorder scan can be used to transfer the Recorder entries to a DB2 table.
- An installation may provide a user exit that will be invoked whenever an access is stored in the Recorder. The exit is written in REXX and receives all the Recorder columns as its input arguments.

1.8 Access Exception Reporting

The Access Exception Reporting facility is designed for implementation within a DBARS User Exit, in order to detect and report unusual data access events. For more details see [Reporting Access Exceptions](#)).

1.9 The DBARSGUI Facility

The facility allows a Windows workstation to scan the DBARS Recorder. DBARSGUI is a client-server application, where the server is implemented by the DBARSGUI program executing in a z/OS address space. The client application consists of a number of Java classes.

DBARSGUI is self-contained: it has no special software prerequisites. For full details, please read the [DBARSGUI](#) chapter.

2 Installation

2.1 Software Prerequisites

DBARS requires:

- z/OS version 1.4 or later.
- DB2 Server for z/OS version 7 or later. DB2 Version 9 is supported.

2.2 Define the DBARS userid's

The userid performing DBARS installation should have the necessary DB2 privileges:

- to create the DBARS database
- to create the DBARS tablespaces and tables
- to bind the DBARS plans

The userid that will execute the DBARS access recording function should have the DB2 privileges:

- to access the system catalogs
- to write to the DBARS tables
- to execute the DBARS plans

The userid that executes the DBARS recorder scan functions should have the privilege to dynamically access the DBARS tables.

The DBARS runtime requirements are met when the userid running the DBARS plans has SYSADM authority. If it is impossible to grant SYSADM, explicit grants should be issued, as explained later in this section.

2.3 Define the DBARS Libraries

Before starting the installation process, four DBARS libraries should be created, with the characteristics listed in the table below.

Please note that DBARS.LOADLIB **MUST** be defined in the active PARMLIB PROGxx as an **authorized library**.

Library Name	Record Format and Length	Block Size ²	Primary Extent (3390 tracks)	Secondary Extent (3390 tracks)	Directory Blocks
DBARS.OBJLIB	FB 80	8000	1200	200	10
DBARS.DBRMLIB	FB 80	8000	250	20	4
DBARS.JCLLIB	FB 80	8000	10	2	2
DBARS.LOADLIB	FB 80	8000	5000	500	10

² Any blocksize that is a multiple of the record length is acceptable.

2.4 Uploading DBARS using FTP

The DBARS product is electronically delivered as a ZIP file, which should be processed as follows:

- Unzip the file to a PC directory, for example C:\DBARS.
- Go to the newly created DBARS directory.
- Execute the DBARSFTP.EXE program.
- DBARSFTP will prompt you for:
 - the name of the z/OS FTP server
 - your FTP userid
 - your FTP password
- DBARSFTP will then transfer the DBARS software from the PC directory to following z/OS libraries:
 - DBARS.OBJLIB
 - DBARS.DBRMLIB
 - DBARS.JCLLIB
- When errors have occurred during the FTP session, you will get an error message. Examine the file DBARSFTP.LOG in the DBARS directory to determine the nature of the error.

2.5 Uploading DBARS using TRANSMIT

The DBARS product is electronically delivered as a ZIP file, which should be processed as follows:

- Unzip the file to a PC directory, for example C:\DBARS.
- Go to the DBARS\XMIT_Install directory.
- Transfer all 3 files in that directory to the mainframe in binary mode, RECFM FB, LRECL 80, BLKSIZE=3120.
- Issue a TSO RECEIVE for these 3 files. This will create the following z/OS libraries:
 - DBARS.OBJLIB
 - DBARS.DBRMLIB
 - DBARS.JCLLIB

2.6 Installing DBARS

Following jobstreams should be submitted from the DBARS JCLLIB to z/OS **in the specified order**:

- DBARSLNK links the DBARS modules into the DBARS.LOADLIB
- DBARSTAB creates the DBARS tables
- DBARSBND binds the DBARS plans
- DBARSGRN grant execution authorities
- DBARSXT1 creates the DBARS EXCEPTIONS table
- DBARSREC defines the Recorder as a VSAM cluster

When the recorder will be a DB2 table:

- Submit the DBARSTAB job.
- Submit the DBARSXT1 job.
- Do not submit DBARSREC.

When the recorder will be a VSAM cluster:

- Submit the DBARSREC job.
(The DBARSREC job will also define the Recorder Index clusters. These KSDS clusters are provided to allow faster scan of the Recorder.)
- Submit DBARSTAB (perhaps with minimal space definitions) if you wish to export the VSAM Recorder to the Recorder DB2 table.
- Submit the DBARSXT1 job.

The DBARSLNK, DBARSBND and DBARSXT1 jobs must be submitted in both cases. If the Access Exception facility will not be used, DBARSXT1 may be submitted with minimal space allocations.

If the userid running DBARS components does not have SYSADM authority, the DBARSGRN job should be submitted as well.

Before submitting, edit and verify each jobstream as follows:

DBARSLNK

Must be executed in each z/OS system that will run DBARS.

- Complete the JOB statement.
- Define the DB2 load library on the SET DB2LIB statement that appears at the beginning of DBARSLNK.

DBARSTAB

Must be executed in each DB2 system that will hold a DBARS Recorder table.

- Complete the JOB statement.
- Specify the target DB2 system in the DSNUTILB PARM operand.
- Complete the SDSNEXIT and SDSNLOAD DD's for the STEPLIBs.
- Verify the following DB2 statements and modify them to meet your installation requirements and standards:
 - CREATE DATABASE DBARS
 - CREATE TABLESPACE DBARS
 - CREATE TABLESPACE DBARSAUX
- The BUFFERPOOL BP32K implicitly defines the maximum length of the SQL statement stored in the DBARS RECORDER table. If the DBARS and DBARSAUX tablespaces are created in other bufferpools, DBARS will automatically adapt the maximum SQL statement length. It is recommended that a 32K buffer pool be used.
- The DBARS AUX_RECORDER is used for recovery purposes only. When errors (such as no available space) prevent DBARS from writing to the RECORDER table, the AUX_RECORDER table will be used automatically.

DBARSBND

Must be executed in each z/OS system that will run DBARS.

- Complete the JOB statement.
- Define the DB2 load libraries on the SET DB2EXIT and DB2LOAD statements that appear at the beginning of DBARSBND.
- Update the DSN SYSTEM(yyyy) statement that follows the SYSTSIN DD.

DBARSGRN

Must be executed in each z/OS system that will run DBARS, when the DBARS userid has no SYSADM authority.

- Complete the JOB statement.
- Specify the DB2 subsystem on the DSNUTILB PARM operand.
- Specify the DB2 load libraries on the STEPLIB DD statement.
- Change the grantee name on the GRANT statements.

DBARSXT1

Must be executed in each DB2 system that will hold the DBARS EXCEPTIONS table.

- Complete the JOB statement.
- Specify the target DB2 system in the DSNUTILB PARM operand.
- Complete the SDSNEXIT and SDSNLOAD DD's for the STEPLIBs.
- Verify the following DB2 statement and modify them to meet your installation requirements and standards:
CREATE TABLESPACE EXCEPT
- The BUFFERPOOL BP32K implicitly defines the maximum length of the SQL statement stored in the DBARS EXCEPTION table. If the tablespace is created in other bufferpools, DBARS will automatically adapt the maximum SQL statement length. It is recommended that a 32K buffer pool be used.

Note:

The DBARSXT1 job assumes that the DBARS database has been created by a previous DBARSTAB execution. If this is not the case, you should submit the CREATE DATABASE statement manually.

DBARSREC

Do not run the DBARSREC job when the Recorder will be a DB2 table. When you plan to use a VSAM Recorder, you should submit DBARSREC.

- Complete the JOB statement.
- Specify the volume operand in the DEFINE CLUSTER statements.

2.7 DBARS Post-installation steps

Some DBARS programs should be defined to TSO as authorized programs, by including them in the SYS1.PARMLIB IKJTSOxx member, under the AUTHPGM statement. The updated IKJTSOxx is activated by an IPL or using the PARMLIB command. Failure to insert these DBARS programs in IKJTSOxx will result in a 047 system abend when using them.

Following programs should be defined as authorized:

- **DBARSIR** (only when the SSID argument is used during its invocation)
- **DBARRRI** because it submits a CLOSE_REC command to the DBARS address space
- **DBARSRXI** when the DBARS Access Exception facility is used

2.8 DB2 version or release migration

When a new DB2 version or release has been installed, the DBARS software should be rebound. The bind of the DBARS plans is achieved by submitting the DBARSBND JCL job, which is part of the DBARS distribution material.

3 Operating DBARS

3.1 Specifying the tables to be recorded

The names of the tables to be recorded are specified to DBARS as follows:

- By creating or altering a table with the **AUDIT ALL** or **AUDIT CHANGE** clause. This method creates plan-to-table dependencies and may cause rebind when the audit table column is altered.
- By coding **ALLTABLES** in the startup parameters. This will record accesses to all DB2 tables. The **ALLTABLES** option should be used with caution, due to the possible processing overhead.
- By coding the names of the tables following the **AUDITNAMES** statement in the startup parameter dataset. This is the preferred method for designating recordable tables.

3.2 Recording a newly created table

When a new table should be recorded after creation, following rules apply:

- When the **CREATE TABLE** statement specifies the **AUDIT** clause, the new table is automatically inserted in the DBARS table list.
- When the **ALLTABLES** option is in effect, the new table is automatically inserted in the DBARS table list.
- When **AUDITNAMES** is in effect, the new table is automatically inserted in the DBARS table list, if the new tablename meets a [generic] name specification in the **AUDITNAMES** table list.

The table list is automatically rebuilt at the start of a DBARS session.

3.3 Coding DBARS Startup Parameters

By default, DBARS startup parameters are specified in the **EXEC Parm** member of the **DBARS.JCLLIB** library.

If the startup parameters are stored elsewhere, specify the membername and eventually the libraryname on the PARM operand of the EXEC DBARS statement, as follows:

PARM='membername'

or:

PARM='libraryname(membername)'

In the PARM='membername' case, the libraryname defaults to DBARS.JCLLIB.

Most startup parameters have default values. If all defaults are acceptable, there is no need to specify startup parameters at all.

ALLTABLES [CHANGE]

Requests that DBARS records the accesses to all DB2 tables. When ALLTABLES CHANGE is specified, only update accesses will be recorded. Otherwise, all access, including SELECT, is recorded.

When ALLTABLES is not specified, recording will be done only for the DB2 tables defined with the AUDIT CHANGE or AUDIT ALL attribute or for the tables specified after **AUDITNAMES**.

ARCHIVE_PROC procedurename

When a SWITCH_REC command is supplied or when a no-more-space condition is detected for the Recorder table or for the Recorder VSAM cluster, DBARS automatically switches to the Auxiliary Recorder table or to the alternate VSAM cluster.

If the ARCHIVE_PROC statement has been provided, the named procedure will be started before switching to the alternate recorder.

For more information, refer to [Automated Recorder Archiving](#).

AUDITNAMES

This optional statement starts the list of tablenamees to be recorded. It should be the last statement in the parameter dataset and be followed by a tablename list. See also [Specifying the tables to be recorded](#).

Each line in the tablename list has the format:

owner.tablename [CHANGE]

A generic tablename can be specified by appending a % sign to the end of the generic name. A generic owner specification is not allowed.

If the **CHANGE** keyword is specified, only write access will be recorded for the designated tables: SELECT statements will not be recorded. If CHANGE is omitted, all access, including SELECT, will be recorded.

For example:

```
AUDITNAMES
DSN8810.EMP
CUSTOMER.STATS CHANGE
ACCOUNT.ACT%
```

DB2_ADDRSPACE nnnnnnnnn

Specify **nnnnnnnnn** as the name of the DB2 Database Address Space.

Default: <DB2_subsystemname>DBM1

DB2_SUBSYS nnnn

Specify **nnnn** as the name of the DB2 subsystem where DBARS should be installed.

Default: the subsystem name found in DSNHDECP.

DYNOONLY

When this option is specified, only dynamic SQL is recorded.

Warning

This option should be specified only on systems where DBARS runs as an SQL recorder. If DBARS is used as a security product, the DYNOONLY option should not be specified.

EXIT DATASETNAME(MEMBERNAME)

If DBARS should invoke a user exit for every recorded access, specify the library and membername of the REXX program.

For details about writing DBARS user exits, see section [Writing a DBARS User Exit](#).

Default: No exit is invoked.

IGNORE

The IGNORE statement allows to bypass access recording for defined DB2 users, programs or jobs.

The syntax of the IGNORE statement is as follows:

IGNORE [JOB nnn] [USER nnn] [PROGRAM nnn]

IGNORE JOB	ignore all accesses from the named z/OS job
IGNORE USER	ignore all accesses by the named DB2 user
IGNORE PROGRAM	ignore all accesses from the named DB2 program

Notes:

Names appearing on the IGNORE can be generic by providing a trailing %.
For example: IGNORE JOB REORG%.

If multiple ignore criteria appear on the same IGNORE statement, access will be ignored only when all the criteria are true.

For example: IGNORE PROGRAM ADBMAIN USER DBADM will ignore accesses by the ADBMAIN program, only when that program is executed by DB2 userid DBADM.

INCLUDE

The INCLUDE statement defines the DB2 users, subject to access auditing. If no INCLUDE statements are specified, all DB2 users will be audited.

The syntax of the statement is as follows:
INCLUDE USER nnnnnnnn

Notes:

Names appearing on the INCLUDE statement can be generic by providing a trailing %. For example: INCLUDE USER ACCT%.

An unlimited number of INCLUDE statements can be supplied.

OPT [NODDF] [NOTRACE]

OPT NODDF

Inhibits recording of SQL accesses from the DDF environment.

OPT NOTRACE

Turns the internal trace facility off. Specify only when requested by SPR product support.

PROGCACHE n

For static SQL statements longer than 4K, DBARS must retrieve the statement text from SYSIBM.SYSSTMT. To avoid repetitive catalogue access for the same statement, a program cache is maintained for the most recently retrieved statements.

The PROGCACHE parameter specifies the maximum number of entries in the cache. If that value is exceeded, the oldest cache entries are removed. The PROGCACHE value specified should be a power of 2. If necessary, DBARS will round the specification to the next power of 2.

Default size of the program cache: 4096

Q2_MSG DBARS | USER | NONE

Specify the destination of the Q2 extension messages DBARSM02 and DBARSM12.

Q2_MSG DBARS

The messages are displayed on the console by the DBARS Writer in the DBARS address space. This is the default value.

Q2_MSG USER

The messages are displayed by the DBARSI component in the DB2 DBM1 address space. Because DBARSI executes under the TCB of the DB2 client, the Q2 extension messages will also appear in the user application log.

Q2_MSG NONE

Q2 extension messages are not displayed. The DBARS STATS command can be used to display the actual number of Q2 extensions.

Q2_SIZE n

Before being inserted into the Recorder table, intercepted SQL statements are inserted into a queue residing in the DBARS address space (Q2).

Specify the initial size of Q2 in kilobytes.

When Q2 is full, Q2 extensions will occur by allocating (Q2_SIZE) additional space.

During DBARS startup, the message DBARSM13I will show the maximum number of queue extensions that will be performed. The extended size of Q2 will never exceed 1 Gigabyte or the size of the DBARS region, whichever value is smaller.

Default: 8192 (which results in an 8 MB queue)

Minimum value: 1024

Please note that the Q2 is not a contiguous area of main storage. Q2 consists of a number of chained pages whose total size equals Q2_SIZE.

RECORDER_LOC nnnn

If DBARS is active in multiple DB2 systems, the DBARS Writer can be requested to store the intercepted SQL statements into a centralized Recorder, if the latter is a DB2 table.

The RECORDER_LOC statement provides the name of the DB2 system that holds the centralized Recorder.

Default: current DB2 system

For more information about Recorder sharing (DB2 and VSAM), please refer to [Shared Recorder Considerations](#)

SCAN n

The DBARS main task polls Q2 for new recordings at a defined time interval. The SCAN parameter specifies this interval in 1/100 seconds.

Default = 100 (1 second)

SEQREC

Specify SEQREC only when access recording should be done to a VSAM Recorder, which should have been defined previously using the DBARSREC job.

3.4 Initiating DBARS as a started task

- The source JCL (member DBARS.JCLLIB.DBARS) can be a JOB (located in a member of a data set defined in the IEFJOBS or IEFPSI concatenation of master JCL) or a procedure (located in a subsystem procedure library, for example, SYS1.PROCLIB).
- The REGION parameter on the JOB or EXEC statement should be coded as REGION=0M or a value that allows for Q2 extensions up to 1 Gigabyte, for example REGION=1400M.
- Please note that the RECORDA, RECORDAX,RECORDB and RECORDBX DD statements present in member DBARS.JCLLIB.DBARS are not needed when the Recorder has been defined as a DB2 table.
- Issue the RACF commands to assign privileges to the started task:

```
RDEFINE STARTED DBARS.DBARS STDATA(USER(yyyy) GROUP(yyy))  
SETROPTS RACLIST(STARTED) REFRESH
```

- Issue a START DBARS or insert the START command into the z/OS startup procedure.

3.5 Initiating DBARS using JCL

Submit the source JCL (member DBARSJ in DBARS.JCLLIB) to JES. Please note that the RECORDA, RECORDAX,RECORDB and RECORDBX DD statements are not needed when the Recorder has been defined as a DB2 table.

The REGION parameter on the JOB or EXEC statement should be coded as REGION=0M or a value that allows for Q2 extensions up to 1 Gigabyte, for example REGION=1400M.

3.6 Implicit connection considerations

DBARS does not issue explicit connect but assumes that its first SQL statement will implicitly connect to the intended DB2 subsystem. Implicit connections use the default subsystem name specified in the module DSNHDECP. If the default DSNHDECP is not pointing to the desired DB2 subsystem, specify the correct library in a STEPLIB or JOBLIB concatenation.

3.7 Sample DBARS start JCL

```
//MAIN      EXEC PGM=DBARS
//STEPLIB   DD DSN=DBARS.LOADLIB,DISP=SHR
//RECORDA   DD DSN=DBARS.RECORDER.A,DISP=SHR
//RECORDAX  DD DSN=DBARS.RECORDER.A.INDEX,DISP=SHR
//RECORDB   DD DSN=DBARS.RECORDER.B,DISP=SHR
//RECORDBX  DD DSN=DBARS.RECORDER.B.INDEX,DISP=SHR
//SYSPRINT  DD SYSOUT=A,SPIN=UNALLOC,FREE=CLOSE
//SYSUDUMP  DD SYSOUT=A
//SYSTSPRT  DD SYSOUT=A
```

Please note that the RECORDA, RECORDAX,RECORDB and RECORDBX DD statements are not needed when the Recorder has been defined as a DB2 table.

3.8 Terminating DBARS

On the z/OS console enter the command **MODIFY DBARS,STOP**. This command can also be inserted in the z/OS shutdown procedure to stop the DBARS address space.

3.9 Operational Considerations

- The DBARS components:
 - The **master task** (DBARS): conducts the DBARS initiation and termination processes and provides an operator command interface.
 - The **DB2 interface task** (DBARSI): intercepts and queues all SQL statements executed into main storage.
 - The **writer task** (DBARSW): inserts the SQL statements queued from main storage into the Recorder table or cluster.

The intercepted SQL statements are transmitted through the different layers of the DBARS software using a queue (Q2):

- The DBARSI component stores the intercepted SQL statements into Q2, which resides in the DBARS address space. DBARSI executes in the DB2 DBM1 address space.
 - The DBARS Writer stores the Q2 records into the Recorder. The Writer executes in the DBARS address space.
- The execution priority assigned to the DBARS address space should allow fast retrieval of the buffers built by DBARSI in Q2. This is especially true when a large number of SQL requests will be recorded.
 - Buffers acquired by DBARS have storage key 7. This protects DBARS data from access by application processes, which execute in key 8.
 - Initiating DBARS as a started task during z/OS IPL is the recommended method for starting DBARS, as it ensures that all accesses to audited tables will be recorded. When started before DB2 is active, DBARS will wait until DB2 is up.
 - DBARS must be initiated in all DB2 subsystems where access to audited tables should be recorded.
 - DBARS records all SELECT INTO, INSERT, UPDATE and DELETE statements. For cursor-based SELECT, only the OPEN of the cursor is recorded.
 - SQL statements issued by the DB2 utilities are not recorded. However, SQL statements executed by means of the DSNUTIL EXEC SQL facility are recorded.

Recorder Considerations

When the Recorder has been defined as a DB2 table, the following applies:

The DBARS Writer inserts recorded SQL statements into the primary RECORDER table. When a recoverable error, such as insufficient space, is detected, diagnostic information is written to the console and an automatic switch to the auxiliary recorder table AUX_RECORDER, is performed. This allows to clear the error situation on the primary recorder, at which time the primary recorder should be re-activated using the SWITCH_REC command, described in the [DBARS Commands](#) section of this manual.

When the Recorder has been defined as a VSAM, the following applies:

Two VSAM clusters have been defined at product installation (DBARS.RECORDER.A and DBARS.RECORDER.B). When one of the clusters has no more space, an automatic switch is done to the alternate cluster. The Recorder clusters are defined with the REUSE attribute: switching to another recorder for writing will automatically delete its previous contents.

The Recorder switching described above can also be forced using the SWITCH_REC command. In any case, after Recorder switching has been performed, the inactive Recorder should be archived. Automated archiving may be used for this purpose. (See [Automated Recorder Archiving](#)) If the inactive Recorder is not archived, its contents will be lost when performing the next switch.

3.10 Recorder Archiving Considerations

When a non-automatic archive is initiated, access recording switches to the alternate Recorder cluster, while the primary cluster is being archived. Archiving will not interrupt the access recording process and accesses continue to be inserted while archiving progresses.

3.10.1 Automated Recorder Archiving

When Recorder switching occurs, a user provided archiving procedure will be invoked, if this procedure has been defined on the **ARCHIVE_PROC** startup statement. DBARS invokes the procedure using the following z/OS command: **START *procedurename*,RECID='x'**

The RECID argument indicates to the called procedure which Recorder must be archived. RECID='A' indicates the primary Recorder, RECID='B' indicates the auxiliary Recorder. The called procedure should use the RECID argument on the DBARSA statement, followed by the procedure variable &RECID, as shown in the example below.

3.10.2 Automated Recorder Archiving Sample

```
//DBARSA JOB (xxxx),'.....  
//DBARSA EXEC PGM=DBARSA,PARM='SEQREC RECID &RECID'  
//ARCHIVE DD DSN=DBARS.ARCHIVE,DISP=(MOD),UNIT=SYSDA  
//RECORDA DD DSN=DBARS.RECORDER.A,DISP=SHR  
//RECORDB DD DSN=DBARS.RECORDER.B,DISP=SHR  
//STEPLIB DD DSN=DBARS.LOADLIB,DISP=SHARE  
//SYSPRINT DD SYSOUT=A  
//SYSUDUMP DD SYSOUT=A
```

3.11 Shared Recorder Considerations

If DBARS is initiated in multiple DB2 systems, the DBARS Writers can be requested to store the intercepted SQL statements into a centralized Recorder, that is, into the RECORDER of a named DB2 system. This is achieved by specifying the RECORDER_LOC startup parameter.

Sharing of the Recorder (either DB2 table or VSAM cluster) occurs in the DBARS Writer, at the time of writing to the Recorder.

If several DB2 systems must be recorded, each DB2 system must be equipped with a corresponding DBARS address space. The name of the target DB2 subsystem should be specified in the startup parameter DB2_ADDRSPACE of each DBARS. Each of these DBARS address spaces has its own Q2. Each DBARS also has its own writer task to store Q2 into the Recorder.

The Recorder should be setup by the customer as a shared DB2 table or VSAM cluster.

Scenario 1: Recorder as a DB2 table

Two DB2 systems DB2A and DB2B are recorded. The Recorder table is held in DB2B. Two DBARS address spaces are required: DBARS1 to record DB2A and DBARS2 for DB2B.

DB2A is captured by the DBARS1 address space with the following startup parms:

DB2_SUBSYS	DB2A
DB2_ADDRSPACE	DB2ADBM1
RECORDER_LOC	DB2B

DB2B is captured by the DBARS2 address space with the following startup parms:

DB2_SUBSYS	DB2B
DB2_ADDRSPACE	DB2BDBM1

In such a setup, there are 2 recorder writer tasks: one in DBARS1 and one in DBARS2. However, due to the RECORDER_LOC DB2B statement, the DBARS1 writer will connect to DB2B before performing the insert into the Recorder table. The DBARS2 writer will simply insert using its default connection.

The customer should ensure that a DRDA connection is available to DBARS1 for connecting and inserting into the recorder table maintained in DB2B.

Scenario 2: Recorder as a VSAM cluster

Two DB2 systems DB2A and DB2B are recorded. Two DBARS address spaces are required: DBARS1 to record DB2A and DBARS2 for DB2B.

DB2A is captured by the DBARS1 address space with the following startup parms:

DB2_SUBSYS	DB2A
DB2_ADDRSPACE	DB2ADBM1

DB2B is captured by the DBARS2 address space with the following startup parms:

DB2_SUBSYS	DB2B
DB2_ADDRSPACE	DB2BDBM1

The recorder is defined using the VSAM share options. This will allow to insert into the VSAM cluster from 2 different DBARS address spaces.

3.12 DBARS Storage requirements

3.12.1 CSA storage requirements

Following DBARS control blocks reside in the CSA:

Buffer	Size
DBARSCA	4 K
Active user list	64 K
Audited table list	Number of tables * 4 bytes
Ignore list	Number of ignore items * 24 bytes

3.12.2 Storage requirements in the DB2 address space

- In DB2 versions 8 and 9, the DBARS Initiator requires 1MB of working storage in the DB2 address space. In other DB2 versions, 512KB is sufficient.
- A 512K storage block is acquired for trace buffers.

3.12.3 Storage requirements in the DBARS address space

- The DBARS logic modules require less than 1 MB in the address space.
- The DBARS Q2 is maintained in the DBARS address space. Its size in kilobytes, is specified by the Q2_SIZE startup parameter. The parameter defaults to 8 MB.
- When Q2 is 75 percent full, a Q2 extension will occur by allocating (Q2_SIZE) additional space. During DBARS startup, the message DBARSM13I will show the maximum number of queue extensions that will be performed. The extended size of Q2 will never exceed 1 Gigabyte or the size of the DBARS region, whichever value is smaller.
- The suggested DBARS region size is 0M.

3.13 DBARS Commands

DBARS commands are entered on the z/OS console using the **MODIFY** command (which can be abbreviated to **F**), for example:

```
MODIFY DBARS,STOP
```

```
F DBARS,STATS
```

Following commands are available:

AUDITTAB

Displays the list of DB2 tables that are currently recorded by DBARS.

EXECPARMS

Shows the contents of the active startup parameter dataset.

LICENSE

Displays information from the DBARS license key on the console.

RECSTATS

Shows statistical information about the DBARS Recorder table or cluster using messages DBARSM14I through DBARSM18I. See [Messages issued by the DBARS Queue Manager](#) for details.

REFRESH

Rebuilds the list of tables to be recorded by DBARS. Please note that this command may take a considerable time to complete. It may also cause contention on the DB2 catalogs.

Since the creation of DB2 objects is automatically intercepted by DBARS, use of this command should be exceptional. See [Recording a newly created table](#).

STATS

Shows the DBARS queuing statistics, using messages DBARSM03I through DBARSM10I. See [Messages issued by the DBARS Queue Manager](#).

STOP

Terminates DBARS when all recorded access events have been written to the Recorder table.

SWITCH_REC

When the Recorder is a VSAM cluster, the command switches between the Recorder clusters A and B in a flip-flop manner. If cluster A is active, switching will be to cluster B and vice-versa.

When the Recorder is a DB2 table, the command switches between the DBARS.RECORDER and the DBARS.AUX_RECORDER tables.

Note that a Recorder full condition automatically switches Recorders.

When switching has occurred, the inactive Recorder should be archived. Automated archiving may be used for this purpose. See [Automated Recorder Archiving](#).

The following commands are used for problem determination and should be entered only when requested by SPR software support.

- TRACE
- ITRACE
- PTRACE

4 Interactive Access Reporting

The online Access Reporting program DBARSIR is used to scan a Recorder that has been defined as a DB2 table. Alternatively, DBARSIR can be used to scan a result DB2 table produced by the other DBARS reporting programs.

DBARSIR is called from a TSO session using the TSO command

```
CALL 'DBARS.LOADLIB(DBARSIR)' ['SSID=xxxx']
```

or using an installation defined ISPF shortcut.

The SSID parameter on the above CALL statement can be used if the TSO session is not implicitly connected to the DB2 subsystem where the DBARS tables reside, that is, if the TSO login procedure does not contain a DD statement for the corresponding SDSNEXIT dataset.

DBARSIR can be invoked only if the TSO terminal has at least 32 lines.

4.1 Entering Report Criteria

At entry into the DBARSIR program, the report selection criteria are requested. Report criteria can be entered for the columns of the Recorder table and for expressions in the recorded SQL statement text.

4.1.1 Recorder Table Column Criteria

Enter selection values for one or more of the following table columns:

Recording date	Date of the recorded access (as a valid DB2 date expression)
Recording time	Time of the access (as a valid DB2 time expression)
Table creator	Creator of the table accessed
Table name	Name of the table accessed
Appl server	Name of the DB2 system where the SQL statement was executed
DB2 authid	DB2 userid issuing the recorded SQL statement
z/OS userid	z/OS userid issuing the recorded SQL statement
Correlation name	Name of the process issuing the recorded SQL statement (for example the z/OS job name)
Connection type	Type of the users DB2 connection ('batch', 'tso', ...)
Appl requester	Name of the DB2 system sending the SQL statement
Ext_application	Name of the external application issuing the SQL statement (distributed data access only)

Ext_workstation	Name of the workstation issuing the SQL statement (distributed data access only)
Program name	Name of the program containing the recorded SQL statement
Statement type	Type of the recorded SQL statement as SELECT, INSERT, DELETE or UPDATE
SQLCODE	SQLCODE resulting from statement execution
SQLROWS	Number of rows modified by the statement
Location	Name of the DB2 subsystem where the recorded statement was executed
Dynamic SQL	<ul style="list-style-type: none"> • Y will report SQL statements executed in dynamic mode • N will report SQL statements executed in static mode • blank will report both static and dynamic statements
Order by	<p>Insert the column-names or column-numbers for sorting the report. If multiple columns are specified, they should be separated by a comma. The keywords ASC and DESC request an ascending or descending order.</p> <p>For example:</p> <p>ORDER BY DB2_ID, ACCESS_STAMP DESC</p> <p><i>or</i></p> <p>ORDER BY 5, 1 DESC</p> <p>For a list of the report column-names and numbers, refer to at the end of this section</p>

Criteria syntax rules:

- Criteria can be entered as a simple value, for example:
TABLE NAME : **CUSTOMER**
- A generic value may be supplied using a trailing % sign, for example:
PROGRAM NAME : **DSQ%**
- Selection criteria may be entered as a DB2 expression, for example:
STATEMENT TYPE : **<> 'SELECT'**
or
RECORDING DATE : **> CURRENT DATE - 2 MONTHS**
- DB2 expressions on recorder table columns are executed using DB2 calls. Therefore, these expressions must obey DB2 syntax rules. All columns of the Recorder table, except SQLCODE and SQLROWS, have the CHARACTER format. Search values entered for CHARACTER columns must be enclosed in quotes.
- When multiple selection values are entered, the Recorder table rows must satisfy all criteria before being selected.

ORDER BY column-names and column-numbers

<u>Column-nr</u>	<u>Column-name</u>
1	ACCESS_STAMP
2	DATE(ACCESS_STAMP)
3	TIME(ACCESS_STAMP)
4	LOCATION
5	DB2_ID
6	MVS_ID
7	CORRELATION
10	TCREATOR
11	TNAME
12	PROGRAM
13	STMNTNR
14	SQLCODE
15	SQLROWS
16	OPCODE
17	DYNAMIC
18	CONNECT_ID
19	LUWID
20	EXT_SERVER
21	EXT_APPL
22	EXT_STATION

4.1.2 SQL text expressions

Recorded accesses may be selected by examining the text of the recorded SQL statement.

An SQL text expression consists of a **column_name** with an optional **column_value**. When a column_value is supplied, it is connected to the column_name by an **operator**.

When a column_name is specified alone, recorded statements will be reported as soon as they contain a reference to the column_name.

When a column_name with an operator and a column_value are specified, recorded statements are reported when they reference the column_name with the specified value.

The supplied expression is checked against:

- the INSERT VALUES clause
- the UPDATE SET clause
- the WHERE clause when present

Expression Syntax Rules

- The column expression has the format:

column_name operator column_value

- The operator should be entered as:

=	to test equal
<	to test lower than
>	to test higher than
<=	to test lower or equal than
>=	to test higher or equal than
<>	to test not equal
LIKE	to perform a generic test using a trailing % sign

- Column_values may, but need not, be enclosed in quotes.
- Leading zeroes need not be supplied for a column that is logically numerical, even if it has been defined as character to DB2.
- The elements of the expression may, but need not, be separated by one or more blanks.
- Up to 3 column expressions can be specified on the criteria panel.
- When multiple column expressions are specified, a recorded statement will be reported only when it satisfies all the expressions.

Examples

(1) Table-Name EMP_MED_HIST
Statement-Type SELECT
Text-expression-1 EMPNO = 100

Reports all recorded SELECT's on the medical history of employee 100.

(2) Table-Name EMPLOYEE
Statement-Type UPDATE
Text-expression-1 EMPNO = 100
Text-expression-2 SALARY

Reports all recorded UPDATE's on the SALARY of employee number 100.

(3) Table-Name CUSTOMERS
Text expression-1 CUSTNAME LIKE FREI%

Reports all recorded accesses to customer names matching the generic specification.

4.2 PFkey Assignments on the Report Criteria Screen

PF1	Displays a help file.
PF2	Calls the User Access Summary Report using the specified report criteria.
PF3	Terminates the report program.
PF4	Allows to specify the name of a DB2 table into which DBARS recorder data have been stored ³ . By default, the DBARS RECORDER table is used for reporting. The DB2 tablename selected here will be remembered across DBARSIR sessions.
PF5	Recalls the previous report selection parameters ⁴
PF6	Recalls the next report selection parameters

³ For example:

- an archive table created using the TABLE keyword of the DBARSA program
- a report output table created using the OUTTABLE keyword of the DBARSRR program

⁴ All report selection parameters are saved into a DB2 table, for the active TSO userid. Up to 32 sets of selection parameters are retained. Using the PF5 and PF6 keys, the user can browse these saved parameter sets.

4.3 Processing the Access Report

When the report criteria have been entered, DBARSIR selects the requested rows from the Recorder table into a list and displays the first page of that list on the terminal.

Program Function keys (PFkeys) are used to process the report list. Some of the PFkeys operate on the "current row", that is the row on the line pointed to by the cursor. To execute these functions, move the cursor to the line showing the object and press the corresponding PF key.

Only the PF keys labelled with a function name on the bottom of the screen are enabled.

- PF1 Requests help.
- PF2 Shows the SQL statement text in formatted mode.
- PF3 Terminates list display.
- PF4 If in list mode, takes a hardcopy of the entire list.
If in page mode, takes a hardcopy of the current screen.
- PF5 Invokes the "format" function.

The format function displays all column names in the list, preceded by a + sign if the column is displayed or by a - sign if the column has been hidden previously. You may override the + or - sign in the following manner:

- + Unhides a previously hidden column, i.e. the column will be displayed again.
 - Hides a column so that it is no longer displayed, although it remains in the list.
 - < Sorts the list on this column in ascending sequence (low to high). Only one ordering column can be designated.
 - > Sorts the list on this column in descending sequence (high to low). Only one ordering column can be designated.
 - 2-9 Entering a number from 2 to 9 will move the column to the corresponding position in the list. The column previously on that position will take the position of the column moved.
- PF6 Places the current line on the first line of the list.
 - PF7 Displays the previous page in the list.
 - PF8 Displays the next page in the list.
 - PF9 Makes the first line of the last page in the list current.

PF10 When displaying the list in pagemode, calls the "Search" function which allows to search list columns on their value. Search can be done using the logical operators = ^= > >. Functions are also provided to locate the highest and lowest column value in the list.

When in listmode, moves the display window to the left.

PF11 Moves the display window to the right if the screen capacity does not allow to display the entire list line.

PF12 Swaps the listformat between column and page mode.

In column mode, several table rows are displayed on one screen.
In page mode, only one row is displayed.

ENTER Will make the object on the line pointed to by the cursor to the current object and highlight it. Other functions may operate on the "current object". Pressing ENTER is not required : it is sufficient to place the cursor on the required line and press the function PFkey. On return from the function, the object will be shown as current automatically.

4.4 User Access Summary Report

The User Access Summary reports accesses to audited DB2 tables in an hierarchical manner.

Before entering the Access Summary program, the user has specified search criteria that create a subset of the Recorder table rows.

On entry, the Access Summary displays the **User List** containing all distinct DB2 userids that appear in the selected Recorder table rows.

From the **User List**, the Detail function (PF4) displays the **Program List** for the selected user.

From the **Program List**, the Detail function displays the **Statement List** for the selected user and program.

Following PF keys are used to execute a particular function on a summary list. Some of the functions operate on the "current row", that is the row on the line pointed to by the cursor. When executing these functions, move the cursor to the line showing the object and press the corresponding PF key.

Only the PF keys labelled with a function name on the bottom of the screen are enabled.

PF1 Requests help.

PF3 Terminates list display or returns to a previous list, if any.

PF4 When in the User List, the Detail function produces a list of all programs by which the current userid has accessed DB2.

When in the Program List, the Detail function produces a list of all program statements by which the current userid has accessed DB2.

PF6 Places the current line on the first line of the list.

PF7 Displays the previous page in the list.

PF8 Displays the next page in the list.

PF9 Makes the first line of the last page in the list current.

ENTER Will make the object on the line pointed to by the cursor to the current object and highlight it. Other functions may operate on the "current object". Pressing ENTER is not required : it is sufficient to place the cursor on the required line and press the function PFkey. On return from the function, the object will be shown as current automatically.

5 Interactive Reporting from a VSAM Recorder

The online Access Reporting program DBARSRRI is used to scan a Recorder that has been defined as a VSAM cluster.

DBARSRRI is called from a TSO session using the TSO command

EXEC 'DBARS.JCLLIB(DBARSRRX)' 'SSID=xxxx'

or using an installation defined ISPF shortcut.

The SSID parameter on the above EXEC statement can be used if the TSO session is not implicitly connected to the DB2 subsystem where the DBARS tables reside, that is, if the TSO login procedure does not contain a DD statement for the corresponding SDSNEXIT dataset.

DBARSRRI can be invoked only if the TSO terminal has at least 32 lines.

5.1 Entering Report Criteria

At entry into the DBARSRRI program, the report selection criteria are requested. Report criteria can be entered for the columns of the Recorder and for expressions in the recorded SQL statement text.

5.1.1 Recorder Column Criteria

Enter selection values for one or more of the following Recorder columns:

Recording date	Date of the recorded access ⁵
Recording time	Time of the access ⁶
Table creator	Creator of the table accessed
Table name	Name of the table accessed
Appl server	Name of the DB2 system where the SQL statement was executed
DB2 authid	DB2 userid issuing the recorded SQL statement
z/OS userid	z/OS userid issuing the recorded SQL statement
Correlation name	Name of the process issuing the recorded SQL statement (for example the z/OS job name)

⁵ Recording date can be entered as a valid DB2 date expression, with the following restrictions:

- The IN operator should not be used
- If the BETWEEN operator is used, the arguments should be absolute date/time values, for example 2008-10-02 or 10.20.22. Special registers are not allowed as BETWEEN arguments.

⁶ Recording time can be entered as a valid DB2 time expression, with the same restrictions mentioned above for date expressions.

Connection type	Type of the users DB2 connection ('batch', 'tso', ...)
Appl requester	Name of the DB2 system sending the SQL statement
Ext_application	Name of the external application issuing the SQL statement (distributed data access only)
Ext_workstation	Name of the workstation issuing the SQL statement (distributed data access only)
Program name	Name of the program containing the recorded SQL statement
Statement type	Type of the recorded SQL statement as SELECT, INSERT, DELETE or UPDATE
SQLCODE	SQLCODE resulting from statement execution
SQLROWS	Number of rows modified by the statement
Location	Name of the DB2 subsystem where the recorded statement was executed

Dynamic SQL

- Y will report SQL statements executed in dynamic mode
- N will report SQL statements executed in static mode
- blank will report both static and dynamic statements

DBARS RegionName

If the jobname of the DBARS address space is different from "DBARS", specify the jobname.

If multiple DB2 systems are recorded, you should specify the name of the DBARS region that records the intended DB2 system.

Criteria syntax rules:

- Criteria can be entered as a simple value, for example:
TABLE NAME : **CUSTOMER**
- A generic value may be supplied using a trailing % sign, for example:
PROGRAM NAME : **DSQ%**
- Selection criteria may be entered as a DB2 expression, for example:
STATEMENT TYPE : **<> 'SELECT'**
or
RECORDING DATE : **> CURRENT DATE - 2 MONTHS**
- DB2 expressions must obey DB2 syntax rules.
- When multiple selection values are entered, the Recorder table rows must satisfy all criteria before being selected.

5.1.2 Accelerating the Recorder scan

Since the Recorder is a VSAM ESDS, scanning is essentially a sequential process. However, DBARS maintains an index on the ESDS to allow for faster scans. The Recorder index is on date and time.

To speed up a scan, specify the Recording date column as a non-generic value (for example CURRENT DATE or 2008-12-12). When a date is supplied, the scan may be further accelerated by supplying a time value (which may be generic).

5.1.3 SQL text expressions

Recorded accesses may be selected by examining the text of the recorded SQL statement.

An SQL text expression consists of a **column_name** with an optional **column_value**. When a column_value is supplied, it is connected to the column_name by an **operator**.

When a column_name is specified alone, recorded statements will be reported as soon as they contain a reference to the column_name.

When a column_name with an operator and a column_value are specified, recorded statements are reported when they reference the column_name with the specified value.

The supplied expression is checked against:

- the INSERT VALUES clause
- the UPDATE SET clause
- the WHERE clause when present

Expression Syntax Rules

- The column expression has the format:

column_name operator column_value

- The operator should be entered as:

=	to test equal
<	to test lower than
>	to test higher than
<=	to test lower or equal than
>=	to test higher or equal than
<>	to test not equal
LIKE	to perform a generic test using a trailing % sign

- Column_values may, but need not, be enclosed in quotes.
- Leading zeroes need not be supplied for a column that is logically numerical, even if it has been defined as character to DB2.
- The elements of the expression may, but need not, be separated by one or more blanks.
- Up to 3 column expressions can be specified on the criteria panel.
- When multiple column expressions are specified, a recorded statement will be reported only when it satisfies all the expressions.

Examples

(1) Table-Name EMP_MED_HIST
Statement-Type SELECT
Text-expression-1 EMPNO = 100

Reports all recorded SELECT's on the medical history of employee 100.

(2) Table-Name EMPLOYEE
Statement-Type UPDATE
Text-expression-1 EMPNO = 100
Text-expression-2 SALARY

Reports all recorded UPDATE's on the SALARY of employee number 100.

(3) Table-Name CUSTOMERS
Text expression-1 CUSTNAME LIKE FREI%

Reports all recorded accesses to customer names matching the generic specification.

5.2 **PFkey Assignments on the Report Criteria Screen**

- PF1 Displays a help file.
- PF3 Terminates the report program.
- PF5 Recalls the previous report selection parameters (*)
- PF6 Recalls the next report selection parameters (*)

(*) Note

All report selection parameters are saved into a DB2 table, for the active TSO userid. Up to 32 sets of selection parameters are retained. Using the PF5 and PF6 keys, the user can browse these saved parameter sets.

5.3 Processing the Access Report

When the report criteria have been entered, DBARSRI selects the requested rows from the Recorder table a list and displays the first page of that list on the terminal.

Program Function keys (PFkeys) are used to process the report list. Some of the PFkeys operate on the "current row", that is the row on the line pointed to by the cursor. To execute these functions, move the cursor to the line showing the object and press the corresponding PF key.

Only the PF keys labelled with a function name on the bottom of the screen are enabled.

- PF1 Requests help.
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- PF3 Terminates list display.
- PF4 If in list mode, takes a hardcopy of the entire list.
If in page mode, takes a hardcopy of the current screen.
- PF5 Invokes the "format" function.

The format function displays all column names in the list, preceded by a + sign if the column is displayed or by a - sign if the column has been hidden previously. You may override the + or - sign in the following manner:

- + Unhides a previously hidden column, i.e. the column will be displayed again.
 - Hides a column so that it is no longer displayed, although it remains in the list.
 - < Sorts the list on this column in ascending sequence (low to high). Only one ordering column can be designated.
 - > Sorts the list on this column in descending sequence (high to low). Only one ordering column can be designated.
 - 2-9 Entering a number from 2 to 9 will move the column to the corresponding position in the list. The column previously on that position will take the position of the column moved.
- PF6 Places the current line on the first line of the list.
 - PF7 Displays the previous page in the list.
 - PF8 Displays the next page in the list.
 - PF9 Makes the first line of the last page in the list current.

PF10 When displaying the list in pagemode, calls the "Search" function which allows to search list columns on their value. Search can be done using the logical operators = ^= > >. Functions are also provided to locate the highest and lowest column value in the list.

When in listmode, moves the display window to the left.

PF11 Moves the display window to the right if the screen capacity does not allow to display the entire list line.

PF12 Swaps the listformat between column and page mode.

In column mode, several table rows are displayed on one screen.
In page mode, only one row is displayed.

ENTER Will make the object on the line pointed to by the cursor to the current object and highlight it. Other functions may operate on the "current object". Pressing ENTER is not required : it is sufficient to place the cursor on the required line and press the function PFkey. On return from the function, the object will be shown as current automatically.

6 Batch Access Reporting from a VSAM Recorder

The current DBARS Recorder dataset is processed by the batch DBARSRR program, to generate a printed report or a result table. Using a result table allows to import from the VSAM Recorder into the Recorder table.

The result table can be:

- the DBARS.RECORDER table created using the DBARSTAB installation job
- a table created previously with a table structure identical to that of the DBARS Recorder (created "LIKE")

After the reporting run, the result table can be displayed using interactive DBARS reporting, as shown [above](#).

The DBARSRR program determines which of the Recorders (RECORDA or RECORDB) is the current one. Therefore, DD statements for both recorders must be supplied.

Report control and report selection statements are supplied after a DD SYSIN.

6.1 Report Control Statements

DBARS_JN *nnn*

If the jobname of the DBARS address space is different from "DBARS", specify the jobname in the DBARS_JN statement.

If multiple DB2 systems are recorded, you should specify the name of the DBARS region that records the intended DB2 system.

OUTTABLE *nnn* [APPEND]

The OUTTABLE statement requests report output to the result table named *nnn*. That table should have been created previously by the user. The APPEND option allows to extend an existing report table with a new report. Without APPEND, DBARSRR will delete all rows, if any, from the target result table.

OUTLINES {*nn*|66}

The OUTLINES statement requests a printed report and specifies the number of lines per page.

OUTTABLE and OUTLINES are mutually exclusive. If neither OUTTABLE or OUTLINES is specified, the report will be printed with a linecount of 66.

6.2 Selection Statement Syntax

Recorder selection criteria are coded on SYSIN. They have the following syntax:
variable operator value

- **VARIABLE** names the Recorder field to be tested as follows:

DATE	Date of recorded access (a valid DB2 date expression)
TIME	Time of recorded access (a valid DB2 time expression)
TCREATOR	Creator of the recorded table
TNAME	Name of the recorded table
DB2ID	DB2 userid issuing the recorded SQL statement
ZOSID	z/OS userid issuing the recorded SQL statement
CORRELATION	Name of the process issuing the recorded SQL statement
CONNECTION	Type of the users DB2 connection ('batch', 'tso', ...)
PROGRAM	Name of the program containing the recorded SQL statement
STMTYPE	SQL statement type as SELECT, INSERT, DELETE, UPDATE
SQLCODE	SQLCODE resulting from statement execution
SQLROWS	Number of rows modified by the statement
SERVER	DB2 subsystem where the recorded statement was executed
DYNAMIC	Y will report SQL statements executed in dynamic mode N will report SQL statements executed in static mode blank will report both static and dynamic statements
EXT_SERVER	Name of the DB2 system sending the SQL statement (distributed data access only)
EXT_APPL	Name of the external application sending the SQL statement (distributed data access only)
EXT_WS	Name of the workstation from which the SQL statement was sent (distributed data access only)

- **OPERATOR** requests the test operation to be performed between "variable" and "value", as follows:

=	to test equal
<	to test lower than
>	to test higher than
<=	to test lower or equal than
>=	to test higher or equal than
<>	to test not equal
LIKE	to perform a generic test using trailing % sign

- **VALUE**

- Alpha values may, but need not, be enclosed in quotes.
- A trailing % sign used with the = operator will act as a LIKE operator.
- Leading zeroes need not be supplied for a column that is logically numerical.
- The elements of the expression may, but need not, be separated by one or more blanks.
- If multiple column expressions are specified, a recorded statement will be reported only when it satisfies all the expressions.
- To test whether a column value is present, use the expression <> ''. For example: EXT_SERVER <> ''
- DB2 date/time expressions may be entered for the DATE and TIME columns. For example : DATE >= CURRENT DATE - 1 MONTH

6.3 Sample JCL

```
//DBARSRR JOB (...),'...',REGION=8M,CLASS=A,MSGCLASS=A,
//          USER=...,PASSWORD=...
//DBARSRR EXEC PGM=DBARSRR
//STEPLIB DD DSN=DBARS.LOADLIB,DISP=SHR
//RECORDA DD DSN=DBARS.RECORDER.A,DISP=SHR
//RECORDB DD DSN=DBARS.RECORDER.B,DISP=SHR
//SYSPRINT DD SYSOUT=A
//SYSUDUMP DD SYSOUT=A
//SYSIN DD *
DATE = CURRENT DATE
TIME = 14.05%
/*
```

The above JCL will scan the active Recorder and print all accesses at 14.05 of the current date.

7 Exception Reporting

The online Exception Reporting program DBARSXR is used to scan the DBARS EXCEPTIONS table.

DBARSXR is called from a TSO session using the TSO command

```
CALL 'DBARS.LOADLIB(DBARSXR)' ['SSID=xxxx']
```

or using an installation defined ISPF shortcut.

The SSID parameter on the above CALL statement can be used if the TSO session is not implicitly connected to the DB2 subsystem where the DBARS tables reside, that is, if the TSO login procedure does not contain a DD statement for the corresponding SDSNEXIT dataset.

DBARSXR can be invoked only if the TSO terminal has at least 32 lines.

7.1 Entering Report Criteria

At entry into the DBARSXR program, the report selection criteria are requested. Report criteria can be entered for the columns of the Exceptions table.

Enter selection values for one or more of the following table columns:

Recording date	Date of the recorded access (as a valid DB2 date expression)
Recording time	Time of the access (as a valid DB2 time expression)
Exception Code	Exception code stored by the Exception user exit
Table creator	Creator of the table accessed
Table name	Name of the table accessed
Appl server	Name of the DB2 system where the SQL statement was executed
DB2 authid	DB2 userid issuing the recorded SQL statement
z/OS userid	z/OS userid issuing the recorded SQL statement
Correlation name	Name of the process issuing the recorded SQL statement (for example the z/OS job name)
Connection type	Type of the users DB2 connection ('batch', 'tso', ...)
Appl requester	Name of the DB2 system sending the SQL statement
Ext_application	Name of the external application issuing the SQL statement (distributed data access only)
Ext_workstation	Name of the workstation issuing the SQL statement (distributed data access only)

Program name	Name of the program containing the recorded SQL statement
Statement type	Type of the recorded SQL statement as SELECT, INSERT, DELETE or UPDATE
SQLCODE	SQLCODE resulting from statement execution
SQLROWS	Number of rows modified by the statement
Location	Name of the DB2 subsystem where the recorded statement was executed
Dynamic SQL	<ul style="list-style-type: none"> • Y will report SQL statements executed in dynamic mode • N will report SQL statements executed in static mode • blank will report both static and dynamic statements
Order by	<p>Insert the column-names or column-numbers for sorting the report. If multiple columns are specified, they should be separated by a comma. The keywords ASC and DESC request an ascending or descending order.</p> <p>For example:</p> <p>ORDER BY DB2_ID, ACCESS_STAMP DESC</p> <p><i>or</i></p> <p>ORDER BY 5, 1 DESC</p> <p>For a list of the report column-names and numbers, refer to at the end of this section</p>

Criteria syntax rules:

- Criteria can be entered as a simple value, for example:
TABLE NAME : **CUSTOMER**
- A generic value may be supplied using a trailing % sign, for example:
PROGRAM NAME : **DSQ%**
- Selection criteria may be entered as a DB2 expression, for example:
STATEMENT TYPE : **<> 'SELECT'**
or
RECORDING DATE : **> CURRENT DATE - 2 MONTHS**
- DB2 expressions on recorder table columns are executed using DB2 calls. Therefore, these expressions must obey DB2 syntax rules. All columns of the Recorder table, except SQLCODE and SQLROWS, have the CHARACTER format. Search values entered for CHARACTER columns must be enclosed in quotes.
- When multiple selection values are entered, the Recorder table rows must satisfy all criteria before being selected.

ORDER BY column-names and column-numbers

<u>Column-nr</u>	<u>Column-name</u>
1	ACCESS_STAMP
2	DATE(ACCESS_STAMP)
3	TIME(ACCESS_STAMP)
4	EXCEPTION CODE
5	LOCATION
6	DB2_ID
7	MVS_ID
8	CORRELATION
11	TCREATOR
12	TNAME
13	PROGRAM
14	STMNTNR
15	SQLCODE
16	SQLROWS
17	OPCODE
18	DYNAMIC
19	CONNECT_ID
20	LUWID
21	EXT_SERVER
22	EXT_APPL
23	EXT_STATION

7.2 **PFkey Assignments on the Report Criteria Screen**

- PF1 Displays a help file.
- PF3 Terminates the report program.
- PF5 Recalls the previous report selection parameters⁷
- PF6 Recalls the next report selection parameters

⁷ All report selection parameters are saved into a DB2 table, for the active TSO userid. Up to 32 sets of selection parameters are retained. Using the PF5 and PF6 keys, the user can browse these saved parameter sets.

7.3 Processing the Access Report

When the report criteria have been entered, DBARSXR extracts the requested rows from the Exceptions table into a list and displays the first page of that list on the terminal.

Program Function keys (PFkeys) are used to process the report list. Some of the PFkeys operate on the "current row", that is the row on the line pointed to by the cursor. To execute these functions, move the cursor to the line showing the object and press the corresponding PF key.

Only the PF keys labelled with a function name on the bottom of the screen are enabled.

- PF1 Requests help.
- PF2 Shows the SQL statement text in formatted mode.
- PF3 Terminates list display.
- PF4 If in list mode, takes a hardcopy of the entire list.
If in page mode, takes a hardcopy of the current screen.
- PF5 Invokes the "format" function.

The format function displays all column names in the list, preceded by a + sign if the column is displayed or by a - sign if the column has been hidden previously. You may override the + or - sign in the following manner:

- + Unhides a previously hidden column, i.e. the column will be displayed again.
 - Hides a column so that it is no longer displayed, although it remains in the list.
 - < Sorts the list on this column in ascending sequence (low to high). Only one ordering column can be designated.
 - > Sorts the list on this column in descending sequence (high to low). Only one ordering column can be designated.
 - 2-9 Entering a number from 2 to 9 will move the column to the corresponding position in the list. The column previously on that position will take the position of the column moved.
- PF6 Places the current line on the first line of the list.
 - PF7 Displays the previous page in the list.
 - PF8 Displays the next page in the list.
 - PF9 Makes the first line of the last page in the list current.

PF10 When displaying the list in pagemode, calls the "Search" function which allows to search list columns on their value. Search can be done using the logical operators = ^= > >. Functions are also provided to locate the highest and lowest column value in the list.

When in listmode, moves the display window to the left.

PF11 Moves the display window to the right if the screen capacity does not allow to display the entire list line.

PF12 Swaps the listformat between column and page mode.

In column mode, several table rows are displayed on one screen.
In page mode, only one row is displayed.

ENTER Will make the object on the line pointed to by the cursor to the current object and highlight it. Other functions may operate on the "current object". Pressing ENTER is not required : it is sufficient to place the cursor on the required line and press the function PFkey. On return from the function, the object will be shown as current automatically.

8 Archiving the DBARS Recorder

The DBARSA program transfers a selected number of rows from the Recorder to a sequential dataset (identified by the ARCHIVE DD) or to a DB2 table.

8.1 KEEP Statement

The KEEP statement is used only with a Recorder on a DB2 table. KEEP is entered in the PARM field of the EXEC DBARSA statement.

Syntax:

KEEP n {DAY(S)|MONTH(S)|YEAR(S)} [NOPURGE]

The KEEP operand states how long the recorder rows must be kept in the Recorder table before being transferred to the ARCHIVE dataset, for example: 6 MONTHS, 1 YEAR.

The KEEP specification is used to build the WHERE clause on the Recorder SELECT and DELETE statements issued by DBARSA:

WHERE DATE(ACCESS_STAMP) <= CURRENT DATE - (KEEP_specification)

The NOPURGE operand states that the Recorder rows should be written to the Archive without being deleted from the Recorder table.

8.2 SEQREC statement

The SEQREC statement indicates that the Recorder is a VSAM cluster. SEQREC is entered in the PARM field of the EXEC DBARSA statement.

Syntax:

SEQREC [Jobname] [RESTART|NORESTART] [TABLE owner.name] [RECID A|B]

- The optional Jobname should be entered only when the z/OS JOB name for the main DBARS address space is different from "DBARS".
- When the previous archive run did not complete normally, the RESTART or the NORESTART argument must be supplied.
 - RESTART should be specified to continue archiving the recorder which was being processed when theabend occurred.
 - NORESTART should be specified only when it is not possible to resume the archive.

The restart arguments are ignored when the previous archive run was successful.

- The TABLE keyword allows to archive the VSAM Recorder to a named DB2 table. This table should have been created previously LIKE the DBARS Recorder table. The archive table can be processed using the DBARSIR program, as described earlier in section 4.2.
- The RECID keyword allows to explicitly archive a named Recorder. This facility should only be used in an automated archive procedure, as described in [Automated Recorder Archiving](#). In all other cases, DBARSA will determine the current Recorder and archive it.

Notes

- Unless archiving is from a DB2 table, DD statements must be provided for both RECORDA and RECORDB.
- Unless archiving is to a DB2 table, a DD statement must be provided for the ARCHIVE dataset.
- The DBARS distribution file provides the member DBARS\JCL\DBARSCAT with a sample JCL stream to create a DBARS archive table.
- The archive program automatically determines the current recorder cluster to be archived. During archiving, recording continues on the alternate cluster.

8.3 Coding the ARCHIVE DD

The disposition of the ARCHIVE dataset and the physical volume specifications are the responsibility of the user.

If a recorder archive is kept for a given period (a quarter for example), a DISP=(NEW,CATLG) should be specified at the begin of the period. Within the archiving period, a DISP=MOD could be used to extend the current archive volume.

8.4 Archive a DB2 Recorder to disk

```
//DBARSA    JOB (xxxx),'xxx',REGION=4M,CLASS=A,MSGCLASS=A,  
//          USER=xxxx,PASSWORD=xxxx  
//DBARSA    EXEC PGM=DBARSA,PARM='KEEP 3 MONTHS'  
//ARCHIVE   DD DSN=DBARS.ARCHIVE,DISP=(MOD),UNIT=SYSDA  
//STEPLIB   DD DSN=DBARS.LOADLIB,DISP=SHARE  
//SYSPRINT  DD SYSOUT=A  
//SYSUDUMP  DD SYSOUT=A
```

8.5 Archive a VSAM Recorder to disk

```
//DBARSA    JOB (xxxx),'xxx',REGION=4M,CLASS=A,MSGCLASS=A,  
//          USER=xxxx,PASSWORD=xxxx  
//DBARSA    EXEC PGM=DBARSA,PARM='SEQREC'  
//ARCHIVE   DD DSN=DBARS.ARCHIVE,DISP=(MOD),UNIT=SYSDA  
//RECORDA   DD DSN=DBARS.RECORDER.A,DISP=SHR  
//RECORDB   DD DSN=DBARS.RECORDER.B,DISP=SHR  
//STEPLIB   DD DSN=DBARS.LOADLIB,DISP=SHARE  
//SYSPRINT  DD SYSOUT=A  
//SYSUDUMP  DD SYSOUT=A
```

8.6 Archive a VSAM Recorder to a DB2 table

```
//DBARSA    JOB (xxxx),'xxx',REGION=4M,CLASS=A,MSGCLASS=A,  
//          USER=xxxx,PASSWORD=xxxx  
//DBARSA    EXEC PGM=DBARSA,PARM='SEQREC TABLE DBARS.ARCHIVE'  
//RECORDA   DD DSN=DBARS.RECORDER.A,DISP=SHR  
//RECORDB   DD DSN=DBARS.RECORDER.B,DISP=SHR  
//STEPLIB   DD DSN=DBARS.LOADLIB,DISP=SHARE  
//SYSPRINT  DD SYSOUT=A  
//SYSUDUMP  DD SYSOUT=A
```

8.7 Combined Recorder Archiving

When the Recorder has been defined as a VSAM cluster, it can be archived frequently (perhaps daily) to the DBARS.RECORDER table, using the SEQREC TABLE option.

The DBARS.RECORDER table can then be used for fast Recorder access, using the DBARSIR program.

The DBARS.RECORDER can be archived to a sequential dataset using the KEEP option of the DBARSA program.

9 Access Reporting from an Archive

The DBARS archive dataset, identified by the DD ARCHIVE, is processed by the DBARSAR program, to generate a printed report or a result table. Using a result table allows to import from an archive into the Recorder table.

The result table should be a DB2 table created previously with a table structure identical to that of the DBARS Recorder (created "LIKE"). After the reporting run, the result table can be displayed using interactive DBARS reporting, as shown [above](#). It is possible to use the DBARS.RECORDER table as OUTTABLE. This should be done only when a VSAM Recorder is being used.

Report control and report selection statements are supplied after a DD SYSIN.

9.1 Report Control Statements

OUTTABLE *nnn* [APPEND]

The OUTTABLE statement requests archive report output to the result table named *nnn*. That table should have been created previously by the user. The APPEND option allows to extend an existing report table with a new report. Without APPEND, DBARSAR will delete all rows, if any, from the target result table.

OUTLINES {nn|66}

The OUTLINES statement requests a printed archive report and specifies the number of lines per page.

OUTTABLE and OUTLINES are mutually exclusive. If neither OUTTABLE or OUTLINES is specified, the archive report will be printed with a linecount of 66.

9.2 Selection Statement Syntax

Archive selection criteria are coded on SYSIN. They have the following syntax:
variable operator value

- **VARIABLE** names the Recorder field to be tested as follows:

DATE	Date of recorded access (a valid DB2 date expression)
TIME	Time of recorded access (a valid DB2 time expression)
TCREATOR	Creator of the recorded table
TNAME	Name of the recorded table
DB2ID	DB2 userid issuing the recorded SQL statement
ZOSID	z/OS userid issuing the recorded SQL statement
CORRELATION	Name of the process issuing the recorded SQL statement
CONNECTION	Type of the users DB2 connection ('batch', 'tso', ...)
PROGRAM	Name of the program containing the recorded SQL statement
STMTYPE	SQL statement type as SELECT, INSERT, DELETE, UPDATE
SQLCODE	SQLCODE resulting from statement execution
SQLROWS	Number of rows modified by the statement
SERVER	DB2 subsystem where the recorded statement was executed
DYNAMIC	Y will report SQL statements executed in dynamic mode N will report SQL statements executed in static mode blank will report both static and dynamic statements
EXT_SERVER	Name of the DB2 system sending the SQL statement (distributed data access only)
EXT_APPL	Name of the external application sending the SQL statement (distributed data access only)
EXT_WS	Name of the workstation from which the SQL statement was sent (distributed data access only)

- **OPERATOR** requests the test operation to be performed between "variable" and "value", as follows:

=	to test equal
<	to test lower than
>	to test higher than
<=	to test lower or equal than
>=	to test higher or equal than
<>	to test not equal
LIKE	to perform a generic test using trailing % sign

- **VALUE**

- Alpha values may, but need not, be enclosed in quotes.
- DB2 date/time expressions may be entered for the DATE and TIME columns. For example : DATE >= CURRENT DATE - 1 MONTH
- A trailing % sign used with the = operator will act as a LIKE operator.
- Leading zeroes need not be supplied for a column that is logically numerical.
- The elements of the expression may, but need not, be separated by one or more blanks.
- If multiple column expressions are specified, a recorded statement will be reported only when it satisfies all the expressions.
- To test whether a column value is present, use the expression <> ''.

9.3 Sample JCL

```
//DBARSAR JOB (....),'...',REGION=4M,CLASS=A,MSGCLASS=A,  
//      USER=...,PASSWORD=...  
//DBARSAR EXEC PGM=DBARSAR  
//STEPLIB DD DSN=DBARS.LOADLIB,DISP=SHARE  
//ARCHIVE DD DSN=DBARS.ARCHIVE.Y2008.Q4,DISP=OLD  
//SYSPRINT DD SYSOUT=A  
//SYSUDUMP DD SYSOUT=A  
//SYSIN DD *  
DATE = 2008-10-11  
DB2ID = U1234  
TNAME = CUSTOMERS  
STMTYPE = UPDATE  
/*
```

The above JCL will scan the archive and print all updates of the customer table by the named user on the specified date.

10 Writing a DBARS User Exit

A DBARS user exit is declared with an EXIT statement in the EXECPARM member of the DBARS JCLLIB.

The user exit is written in REXX and called by the DBARS Writer task before the access is stored in the Recorder table.

The exit runs under the DBARS userid. At entry, there is a connection to the DB2 system that holds the DBARS Recorder table. The exit may perform any necessary action including SQL access. However, if SQL statements are issued, a COMMIT should be used before returning to DBARS.

Following arguments are passed to the exit:

Argument number	Content of argument	Maximum length of argument
1	Access timestamp	26
2	TCB address	8
3	Name of DB2 application server	16
4	DB2 userid	8
5	z/OS userid	8
6	Correlation name	12
7	Connection type	8
8	LUW_id	12
9	External Server Name	16
10	External Application Name	32
11	External Workstation Name	18
12	RDI Call Type	4
13	RDI Statement Type	4
14	Table Creator	8
15	Table Name	128
16	Program Name	8
17	Program Section number	4
18	SQLCODE	8
19	Number of rows modified	16
20	Operation Code	8
21	Dynamic access flag	1
22	Length of SQL Statement_text	8
23	Pointer to SQL Statement_text	8

The exit may pass a returncode 8 to bypass the recording of the SQL statement. Exiting with a returncode other than 8, will record the statement.

DBARS Sample User Exit

```
/*      Sample DBARS User Exit      */
```

```
Arg Stamp TCB DB2_server DB2_userid zOS_userid Correlation Connection ,  
LUWid External_Server External_Application External_Workstation      ,  
RDI_Call_Type RDI_Statement_Type Table_Creator Table_Name          ,  
Program_Name Program_Section SQLCODE Rows_modified Operation        ,  
Dynamic_access Length_SQL_Statement SQL_Statement                  .
```

```
/*      Display all input arguments, except statement text */
```

```
Say Stamp TCB DB2_server DB2_userid zOS_userid Correlation Connection  
Say LUWid External_Server External_Application External_Workstation  
Say RDI_Call_Type RDI_Statement_Type Table_Creator Table_Name  
Say Program_Name Program_Section SQLCODE Rows_modified Operation
```

```
/*      Display the SQL statement text */
```

```
Say STORAGE(SQL_Statement,Length_SQL_Statement)
```

```
Exit 0
```

11 Reporting Access Exceptions

An installation may wish to screen all data accesses to audited tables by examining, within a DBARS User Exit, the data captured by DBARS and presented to the Exit as entry arguments.

11.1 Detecting an access exception

Access exceptions may be detected:

- By checking combined values in the exit entry arguments, using REXX statements.

The [Sample Exception Exit](#) uses the arguments **Table_Name** and **DB2_server** to detect remote access to the Customer table.

- By scanning the SQL statement text for occurrence of unusual values in specified table columns. To facilitate SQL text scanning, DBARS provides the DBARSXRI function.

The function is called as follows:

address linkmvs "DBARSXRI SCAN statement expression"

where:

<i>statement</i>	Is the text of the SQL statement received as input.
<i>expression</i>	Is a logical expression specified in DB2 syntax.

The expression states a column name and a column value. DBARSXRI will check the INSERT VALUES and the WHERE clauses to detect whether the statement accesses the named column with the named value. If it does, DBARSXRI returns an rc=1. Else rc=0 is returned.

11.2 Signalling an access exception

- An access exception will be stored into the DBARS EXCEPTIONS table, when the exit returns to DBARS with a returncode greater than 12. The returncode is then considered as an exception code and stored in the Exceptions table, along with all other access informations passed to the exit as input arguments.
- Furthermore, when an exception is detected, the exit can send a message to the z/OS console or to a designated z/OS userid. This can be done by calling the DBARSXRI function as follows:

address linkmvs "DBARSXRI SEND {userid|CONSOLE} messagetext"

11.3 Notes

- The Exceptions table is always a DB2 table, even when the Recorder is a VSAM cluster.
- Storing the access in the Exceptions table does **not** prevent the actual data access. In fact, the access will be recorded in both the Recorder and in the Exceptions table.
- DBARS provides the DBARSXR utility to inspect the Exceptions table in TSO.

11.4 Sample Exception Exit

```
/*
    If an access is from a remote server, the exit considers as exceptions:

    - update attempts to the customer table
    - accesses to "sensitive" customer numbers

    All exceptions are stored in the DBARS EXCEPTIONS table with the specific
    exception code.

*/

Arg Stamp TCB DB2_server DB2_userid zOS_userid Correlation Connection ,
LUWid External_Server External_Application External_Workstation ,
RDI_Call_Type RDI_Statement_Type Table_Creator Table_Name ,
Program_Name Program_Section SQLCODE Rows_modified Operation ,
Dynamic_access Length_SQL_Statement SQL_Statement ,
.

exception_code = 0
local_DB2 = "LOCDBV8"
statement = STORAGE(SQL_Statement,Length_SQL_Statement)
if Table_Name = "CUSTOMER_TABLE" then do
    if DB2_server <> local_DB2 then do
        if Operation <> "SELECT" then exception_code = 2040
        else do
            expression = "SENSITIVE <> 0"
            address linkmvs "DBARSRXI SCAN statement expression"
            if rc = 1 then exception_code = 2041
        end
    end
end
end
exit exception_code
```

DBARSGUI

12.1 Installing DBARSGUI

12.1.1 Installing on z/OS

The standard DBARS installation also installs the mainframe DBARSGUI components.

12.1.2 Installing on a workstation

The DBARS distribution file contains a folder, named DBARSGUI. The entire folder should be moved to a Windows folder accessible to the users that will invoke DBARSGUI from their workstation.

12.2 Configuring DBARSGUI

12.2.1 Configuring on z/OS

The DBARS distribution file contains in its JCL folder, the DBARSGUI SAMPJCL file, for starting the DBARSGUI server on z/OS.

```
EXEC PGM=DBARSGUI,PARM='PORT=...,MAXCLIENT=.'
```

Following optional server configuration options may be coded on the DBARSGUI PARM operand :

PORT

Specify the TCP/IP port to be used by DBARSGUI for communication with the workstations. Default is 1946.

MAXCLIENT

Specify the maximum **concurrent** number of DBARSGUI clients allowed. Default is 16.

The distributed DBARSGUI JCL includes the DD statements for a VSAM Recorder. If your installation does not use a VSAM Recorder, these DD statements should be omitted.

12.2.2 Configuring on the workstation

The DBARS distribution folder DBARSGUI contains the DBARS.BAT which starts the DBARS application as follows:

```
start "DBARS" /min java -classpath . DBARS <IP_address> 1946 A
```

In the above command, replace:

- <IP_address> with the IP address of your z/OS system
- the default port 1946 (only if the default port was modified in the DBARSGUI PARM described above)
- replace **A** by **B** if DBARS uses a VSAM Recorder

12.3 Starting DBARSGUI

12.3.1 Starting the DBARSGUI server on z/OS

DBARSGUI can be started by submitting the customized DBARSGUI JCL. Alternatively, DBARSGUI can be invoked as a started task.

DBARSGUI issues TCP/IP Listen commands to wait for workstation requests. Note that there is no command provided to shutdown the DBARSGUI server. Use the z/OS cancel command instead.

12.3.2 Starting the DBARSGUI server on the workstation

Start the DBARS.BAT configured above. You will probably want to create a shortcut to DBARS.BAT on the Windows desktop.

12.4 Using DBARSGUI

12.4.1 Logon

When the DBARS BAT has been started, the user is requested to logon to the DBARSGUI server, using his DB2 Userid and Password.



The screenshot shows a Windows-style window titled "DBARS Logon Screen". The window has a blue title bar with standard minimize, maximize, and close buttons. The main area is light gray and contains the following elements:

- Labels "DB2 Userid" and "Password" are positioned to the left of two empty text input boxes.
- Below the input boxes, the text "Press ENTER to continue Logon." and "Press ESC to cancel." is displayed.
- At the bottom of the window, the copyright notice "(c) Copyright Software Product Research 2007" is visible.

12.4.2 Recorder Search Criteria

The next screen requests the user to enter the Recorder Search Criteria.

DBARS Report Criteria

Submit **Help** **Quit** **NextParm** **PrevParm**

Recording date CURRENT DATE

Recording time

Table Creator

Table Name EMP

Application Server

DB2 Authorization ID

z/OS User ID

Correlation Name

Connection Type

Application Requester

External Application

External Workstation

Program Name

SQL Statement Type

SQLCODE

SQLROWS

Dynamic SQL

DBARS RegionName DBARS

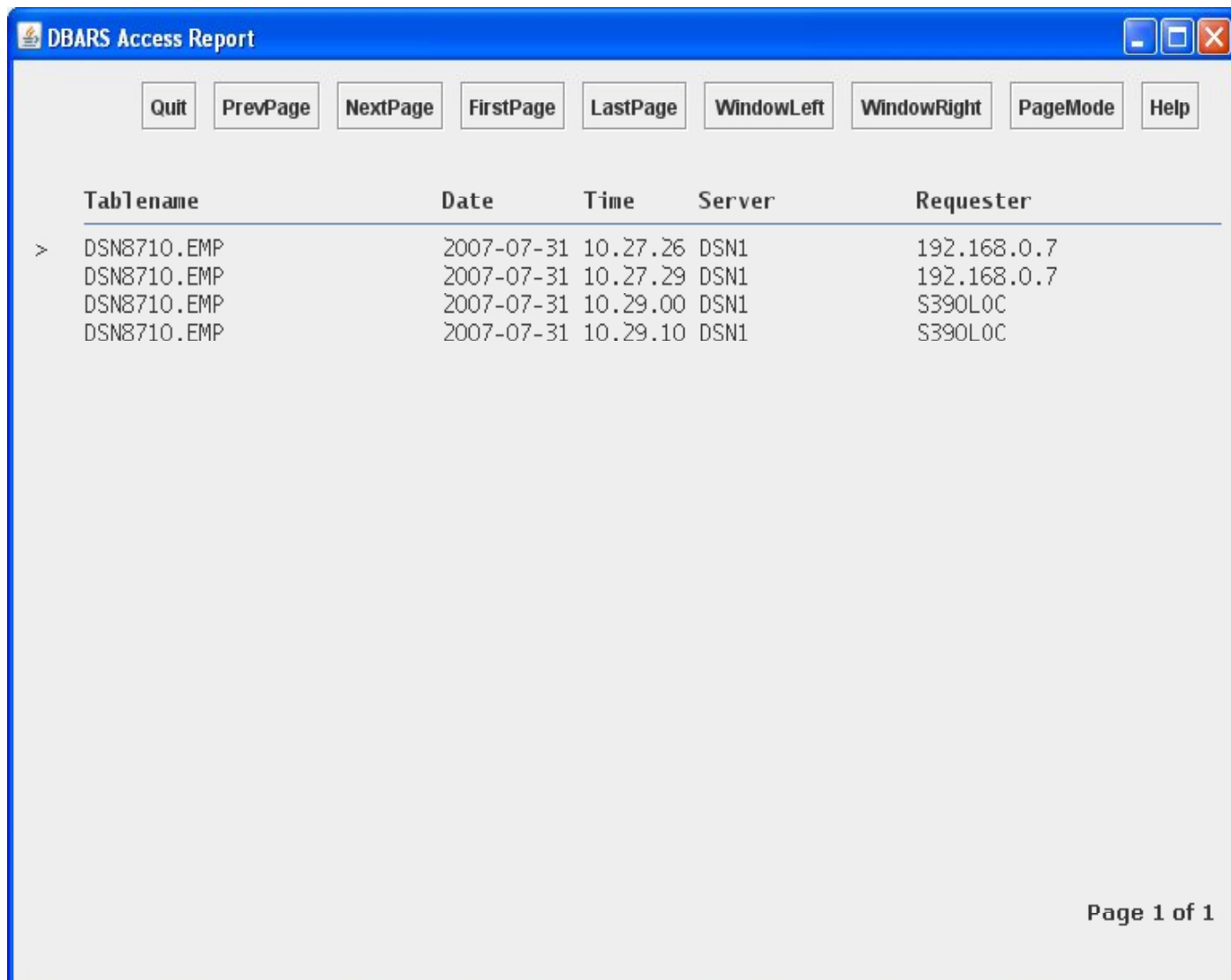
SQL Statement Expressions:

How to enter the search is described in the [Entering Report Criteria](#) section of this manual.

Alternatively, the user can press the Help button for a description of the columns and buttons to be used. The Help file is an HTML document.

Also, when moving the mouse over a button or a criteria field, a short descriptive text is displayed for the item.

12.4.3 ListMode Access Report



Tablename	Date	Time	Server	Requester
> DSN8710.EMP	2007-07-31	10.27.26	DSN1	192.168.0.7
DSN8710.EMP	2007-07-31	10.27.29	DSN1	192.168.0.7
DSN8710.EMP	2007-07-31	10.29.00	DSN1	S390LOC
DSN8710.EMP	2007-07-31	10.29.10	DSN1	S390LOC

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The initial result of the Recorder Scan is a ListMode report shown above. The report shows all Recorder rows that meet the supplied Search Criteria.

The user can press the Help button for a description of the buttons to be used. The Help file is an HTML document.


Moving the mouse over a button will show the action initiated by the button. A number of keyboard keys can be used as a shortcut for the button. The PageDown and PageUp keys for instance can be used instead of the PrevPage and NextPage buttons.

The ListMode screen is too small to display all columns for a given Recorder row. The WindowLeft and WindowRight buttons are provided for sliding the screen to the left or the right.

12.4.4 PageMode Access Report

The PageMode Report will show all columns for a selected Recorder row on one screen. The PageMode report is invoked:

- By left clicking the mouse on a ListMode screenline.
- By selecting a line with the cursor up and down keys and pressing Enter or the PageMode button. (The "current report line" is indicated by a > sign at the begin of the line.)

The image shows a screenshot of a software window titled "DBARS PageMode Access Report". The window has a blue title bar with standard Windows-style window controls (minimize, maximize, close) on the right. Below the title bar is a toolbar with buttons for "Quit", "PrevPage", "NextPage", "FirstPage", "LastPage", "SQLText", "Copy", "Search", and "Help". The main content area is divided into two columns of text. The left column contains: "TableName DSN8710.EMP", "Date 2007-07-31", "Server DSN1", "DB2 Userid IBMUSER", "Correlation IBMUSER", "Program EMP01", "Access UPDATE", "SQLCODE 0", "LUW_Id COFA05084A11", and "External Appl". The right column contains: "Time 10.29.10", "Requester S390LOC", "z/OS Userid IBMUSER", "Connection TSO", "Section 4", "Dynamic N", "Rows Modified 1", and "External WS". A horizontal line separates this header information from the main body of the report. The main body contains a single line of SQL code: "UPDATE DSN8710 , EMP SET SALARY = 44145.00 WHERE EMPNO = '000200'". At the bottom right of the window, the text "Page 4 of 4" is displayed.

Quit	PrevPage	NextPage	FirstPage	LastPage	SQLText	Copy	Search	Help
-------------	-----------------	-----------------	------------------	-----------------	----------------	-------------	---------------	-------------

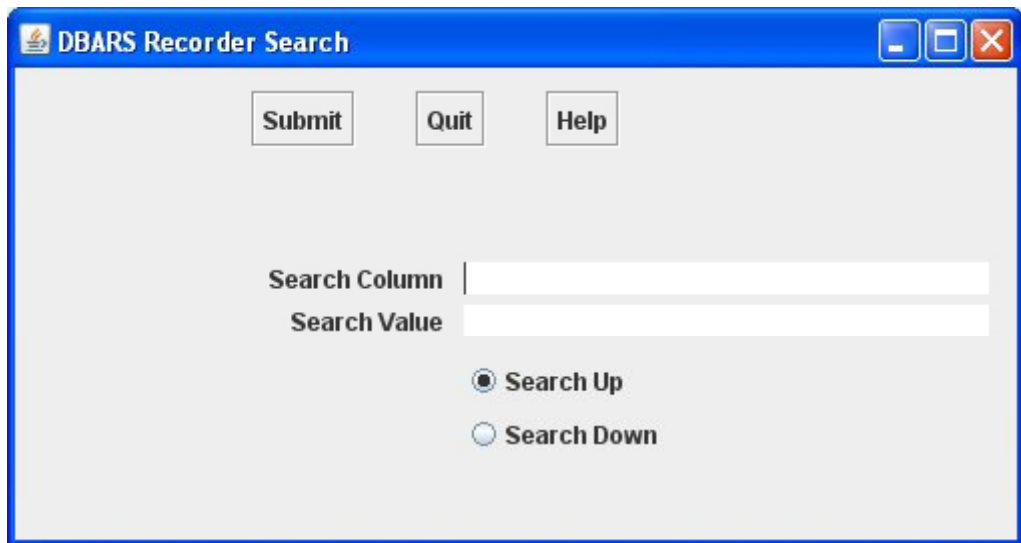
TableName	DSN8710.EMP	Time	10.29.10
Date	2007-07-31	Requester	S390LOC
Server	DSN1	z/OS Userid	IBMUSER
DB2 Userid	IBMUSER	Connection	TSO
Correlation	IBMUSER	Section	4
Program	EMP01	Dynamic	N
Access	UPDATE	Rows Modified	1
SQLCODE	0	External WS	
LUW_Id	COFA05084A11		
External Appl			

UPDATE DSN8710 , EMP SET SALARY = 44145.00 WHERE EMPNO = '000200'

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- The NextPage, PrevPage, FirstPage and LastPage keys allow to browse the Access Report in page mode.
- The SQLText button provides a formatted display of the current SQL statement.
- The Copy button writes the current screen to the workstation file C:\DBARS_Hardcopy.doc.
- The Search key allows to search the current report as shown below.
- The Help button displays the function help file.

12.4.5 Access Report Search



The screenshot shows a Windows-style dialog box titled "DBARS Recorder Search". At the top, there are three buttons: "Submit", "Quit", and "Help". Below these buttons, there are two text input fields. The first field is labeled "Search Column" and the second is labeled "Search Value". Below the input fields, there are two radio buttons. The first radio button is selected and is labeled "Search Up". The second radio button is unselected and is labeled "Search Down".

Search is performed by supplying:

- the name of a Recorder column as it appears on the PageMode report screen in **Search Column** (for example PROGRAM)
- the column value in **Search Value** (for example EMP01)

The Search Up and Search Down radio buttons provide for forward and backward Report search.

13 Recorder Table Structure

ACCESS_STAMP	TIMESTAMP	Timestamp of statement execution
INSERT_STAMP	TIMESTAMP	Timestamp of statement recording
TCB	INTEGER	User's TCB address
LOCATION	CHAR(16)	Name of the DB2 subsystem accessed
DB2_ID	CHAR(8)	DB2 userid performing the statement
MVS_ID	CHAR(8)	zOS userid performing the statement
CORRELATION	CHAR(12)	Access association (such as jobname)
CONNECT_ID	CHAR(8)	TSO BATCH CICS DDF
LUWID	CHAR(12)	LUW identification
EXT_SERVER	CHAR(16)	Name of external DB2 server (if DDF)
EXT_APPL	CHAR(32)	Name of external application (if DDF)
EXT_STATION	CHAR(18)	Name of workstation (if DDF)
TCREATOR	CHAR(8)	Table creator
TNAME	VARCHAR(128)	Tablename accessed
PROGRAM	CHAR(8)	Name of program issuing the SQL statement
STMNTNR	SMALLINT	Statement number within PROGRAM
CALL_TYPE	SMALLINT	Internal DB2 request identifier ⁸
STMT_TYPE	SMALLINT	Internal DB2 request identifier
OPCODE	CHAR(8)	SELECT UPDATE DELETE INSERT
SQLCODE	INTEGER	SQLCODE of the recorded statement
SQLROWS	INTEGER	Number of rows modified by the statement
DYNAMIC	CHAR(1)	Y if a dynamic, N if a static statement
STMNT_TEXT	LONG VARCHAR	Text of the recorded SQL statement

Note

When the Recorder is a VSAM cluster, the VSAM record has an identical layout.

⁸ These identifiers are described in the DSNXRDI member of the DB2 library DSNxxx.SDSNMACS.

14 Exceptions Table Structure

ACCESS_STAMP	TIMESTAMP	Timestamp of statement execution
INSERT_STAMP	TIMESTAMP	Timestamp of statement recording
EXCEPTION	INTEGER	Exception code passed by the User Exit
LOCATION	CHAR(16)	Name of the DB2 subsystem accessed
DB2_ID	CHAR(8)	DB2 userid performing the statement
MVS_ID	CHAR(8)	zOS userid performing the statement
CORRELATION	CHAR(12)	Access association (such as jobname)
CONNECT_ID	CHAR(8)	TSO BATCH CICS DDF
LUWID	CHAR(12)	LUW identification
EXT_SERVER	CHAR(16)	Name of external DB2 server (if DDF)
EXT_APPL	CHAR(32)	Name of external application (if DDF)
EXT_STATION	CHAR(18)	Name of workstation (if DDF)
TCREATOR	CHAR(8)	Table creator
TNAME	VARCHAR(128)	Tablename accessed
PROGRAM	CHAR(8)	Name of program issuing the SQL statement
STMNTNR	SMALLINT	Statement number within the PROGRAM
CALL_TYPE	SMALLINT	Internal DB2 request identifier
STMT_TYPE	SMALLINT	Internal DB2 request identifier
OPCODE	CHAR(8)	SELECT UPDATE DELETE INSERT
SQLCODE	INTEGER	SQLCODE of the recorded statement
SQLROWS	INTEGER	Number of rows modified by the statement
DYNAMIC	CHAR(1)	Y if a dynamic, N if a static statement
STMNT_TEXT	LONG VARCHAR	Text of the recorded SQL statement

15 Recorder Archive Record Structure

ACCESS_STAMP	CHAR(26)	Timestamp of statement execution
INSERT_STAMP	CHAR(26)	Timestamp of statement recording
TCB	INTEGER	User's TCB address
LOCATION	CHAR(16)	Name of the DB2 subsystem accessed
DB2_ID	CHAR(8)	DB2 userid performing the statement
MVS_ID	CHAR(8)	zOS userid performing the statement
TCREATOR	CHAR(8)	Table creator
TNAME	CHAR(64)	Tablename accessed
CORRELATION	CHAR(12)	Access association (such as jobname)
PROGRAM	CHAR(8)	Name of program issuing the SQL statement
STMNTNR	SMALLINT	Statement number within PROGRAM
CALL_TYPE	SMALLINT	Internal DB2 request identifier
STMT_TYPE	SMALLINT	Internal DB2 request identifier
FILLER	CHAR(2)	
SQLCODE	INTEGER	SQLCODE of the recorded statement
SQLROWS	INTEGER	Number of rows modified by the statement
OPCODE	CHAR(8)	SELECT UPDATE DELETE INSERT
DYNAMIC	CHAR(1)	Y if a dynamic, N if a static statement
CONNECT_ID	CHAR(8)	TSO BATCH CICS DDF
LUWID	CHAR(12)	LUW identification
EXT_SERVER	CHAR(16)	Name of external DB2 server (if DDF)
EXT_APPL	CHAR(32)	Name of external application (if DDF)
EXT_STATION	CHAR(18)	Name of workstation (if DDF)
FILLER	CHAR(1)	
L_STMNT_TEXT	SMALLINT	Length of the recorded SQL statement
STMNT_TEXT	VARCHAR(30720)	Text of the recorded SQL statement

16 DBARS Messages

16.1 Messages issued by the DBARS Main task

DBARS00I	<p>Default DB2 subsystem is <i>nnnn</i></p> <p>The current DSNHDECP member points to the named DB2 subsystem or a DB2_SUBSYS parameter has been specified. DBARS will connect to this subsystem.</p>
DBARS01I	<p>Recording enabled for Server <i>nnn</i></p> <p>The message indicates that all audited accesses to the named DB2 server will be recorded.</p>
DBARS02I	<p>Waiting on DB2 subsystem</p> <p>The message indicates that the DB2 server whose accesses must be recorded, is not active. DBARS waits until the DB2 server has been started. This message is more likely to appear when DBARS is started during z/OS IPL.</p>
DBARS03I	<p><i>n</i> DB2 objects selected for recording.</p> <p>The message shows the number of objects that will be recorded because they relate to audited tables.</p>
DBARS04I	<p>Current startup parameters using member xxxxxxxx:</p> <p>The message shows the DBARS execution parameters obtained using the system defaults and the specifications of the DBARS startup member. This member resides in the DBARS.JCLLIB. The name of the member defaults to EXEC Parm, but can be specified in a PARM operand of the EXEC DBARS JCL statement.</p>
DBARS05I	<p>Initiator loaded at nnnnnnnn</p> <p>The message shows the load address of the DBARS Initiator function.</p>
DBARS06I	<p>Writer task active</p> <p>The message indicates that the DBARS Writer function has been started.</p>
DBARS07I	<p>STOP request has been queued</p> <p>The message is issued after a DBARS STOP command has been submitted. DBARS shutdown will start as soon as all recorded information has been written to the RECORDER table.</p>
DBARS08I	<p>DBARS shutdown started</p> <p>The message is issued when DBARS shutdown starts.</p>

DBARS10I	DBARS Version v.r ModLevel <i>nnnn</i>
	Version number, release number and modification level of the DBARS software being loaded.
DBARS11A	<i>nnn</i> Address Space not found
	The named DB2 database address space is not active. The name of this address space is supplied in the DB2_ADDRSPACE parameter of the DBARS EXEC Parm, or is defaulted to <subsystem>DBM1.
	Action: Find the name of the DB2 database address space and supply it in the EXEC Parm.
DBARS12A	RC= <i>nn</i> during license check
	An error occurred when verifying the DBARS software license key. Another message will explain the license problem.
	Action: Contact SPR Software Support to obtain a valid license key.
DBARS13A	DBARS License key has expired
	The DBARS evaluation period has expired.
DBARS14A	DBARS License key not found
	The license key (member SCF in DBARS.JCLLIB) was not found.
DBARS15A	DBARS not licensed for CPU-id <i>nnnnn</i>
	The license key was not built for the named CPU-id.
DBARS16A	DBARS License key has no valid content
	The license key seems corrupted.
DBARS17I	DBARS License Info:
DBARS18I	Machine-type <i>nnnn</i> CPU-id <i>nnnnn</i>
DBARS19I	Customer Name <i>nnn</i>
DBARS20I	Software key expires on <i>yyyy-mm-01</i>
	Messages DBARS17I to DBARS20I are informational and describe the current DBARS license key. Message DBARS20I is issued for evaluation licenses only.
DBARS21I	Maxlength of recorded SQL statement is nK
	The message shows the maximum length of the SQL statements in the RECORDER table. This maximum depends on the bufferpool where the DBARS tablespace is located.

DBARS90A	EXEC PARM syntax error
	An syntax error has been detected in the DBARS startup parameters. DBARS startup is terminated.
DBARS91A	Parameter no longer required
	The specified startup parameter was valid in a previous DBARS version, but is no longer required in the current release. The parameter is accepted for compatibility reasons but effectively ignored. DBARS startup continues.
DBARS97A	DB2 component not recognized
	An error occurred when installing the DBARS to DB2 interface.
	Contact SPR software support.
DBARS98A	DBARS already active
	An attempt was made to start DBARS more than once in the same z/OS system.
DBARS99A	APF Authorization failure
	The DBARS.LOADLIB is not an APF-authorized library.

16.2 Messages issued by the DBARS Initiator

DBARSI997A	<p>DBARS Initiator recovery has been entered</p> <p>A cancel condition has been detected during DBARS processing. Problem determination information has been stored to the DBARS trace buffer. DBARS processing continues.</p> <p>To print the trace buffers, stop DBARS and contact DBARS software support.</p>
DBARSI998A	<p>RC xx requesting CSA storage</p> <p>Returncode xx was returned by the z/OS STORAGE OBTAIN function when a storage buffer was requested in the CSA.</p> <p>If the RC equals 8, insufficient storage was available in the CSA.</p>
DBARSI999A	<p>DBARS Initiator disabled.</p> <p>A severe error condition exists which does not allow DBARS recording to continue. Another message will precede and explain the error condition.</p>

16.3 Messages issued by the DBARS Queue Manager

DBARSM01A	<p>Recorder queue space full. Recording disabled until queue space becomes available..</p> <p>The recorder queue space in the DBARS address space has no more free space after executing the defined number of queue extensions. DBARS recording is temporarily disabled until queue space becomes available again. Queue space is released when queue entries are written to the DBARS Recorder table or cluster.</p> <p>Action Enlarge the Q2_SIZE startup parameter or the size of the DBARS address space.</p>
DBARSM02I	<p>Recorder space <i>nn</i> percent full</p> <p>Warning message issued when the recorder space in the DBARS address space is more than 75 percent full.</p> <p>Action If the message persists and if queue extensions do not solve the problem, enlarge the Q2_SIZE startup parameter or the DBARS address space size.</p>
DBARSM03I	<p>Recorder Queue Statistics</p> <p>Recorder queue statistics are displayed at DBARS shutdown or as a reply to the DBARS STATS command.</p>
DBARSM04I	<p>Requests queued: <i>n</i></p> <p>Total number of SQL statements stored into the recorder queue. The counter is reset at begin of day.</p>
DBARSM05I	<p>Requests processed: <i>n</i></p> <p>Total number of SQL statements retrieved from the recorder queue and written to the DBARS table. The counter is reset at begin of day.</p>
DBARSM06I	<p>Times recorder space full: <i>n</i></p> <p>Total number of times no space was found in the recorder queue. If this value is greater than zero, recorded events have been lost.</p>
DBARSM07I	<p>Pages in free queue: <i>n</i></p> <p>Number of 32K pages currently in the free queue of the recorder space.</p>

DBARSM08I	<p>Pages in request queue: n</p> <p>Number of 32K pages currently in the “in-use” queue of the recorder space.</p> <p>The sum of free and request pages should be equal to $(Q2_SIZE/32)$ where $Q2_SIZE$ is the startup parameter in EXECPARM, taking into account the eventual Q2 extensions executed.</p>
DBARSM09I	<p>Max pages in request queue: n</p> <p>Maximum number of 32K pages ever in the “in-use” queue of the recorder space.</p>
DBARSM11I	<p>Number of Q2 extensions: n</p> <p>Number of times that the recorder queue was extended. Each extension adds $(Q2_SIZE)$ pages to the queue.</p>
DBARSM12I	<p>Initiating Q2 extension n</p> <p>A queue 2 extension is in progress. The value n shows how many extensions have been performed already.</p>
DBARSM13I	<p>Maximum number of Q2 extensions is n</p> <p>The value of n depends on the startup parameter $Q2_SIZE$. n is computed as $1024 \div (Q2_SIZE \div 1024)$.</p> <p>The total size of Q2 after extensions will never exceed 1 Gigabyte or the size of the DBARS address space, whichever is smaller.</p>

DBARSM14I

Recorder Statistics

The following messages are produced in reply to the RECSTATS command. They show statistical information about the DBARS Recorder.

DBARSM15I

Primary | Secondary Recorder currently in use

Shows the Recorder that is currently receiving output.

DBARSM16I

Recorder table statistics:

The following statistics are provided when the Recorder is a DB2 table.

- Recorder rows inserted in session
- Average SQL INSERT duration in milliseconds
- Maximum SQL INSERT duration in milliseconds

Each Recorder record is inserted as a single DB2 row.

DBARSM17I

Recorder cluster statistics:

The following statistics are provided when the Recorder is a VSAM cluster.

Notes

- Recorder blocks written (1)
- Recorder blocks written in session (2)
- Length of a Recorder block (3)
- Average records in Recorder block (4)
- Allocated VSAM cluster extents
- Ending VSAM cluster RBA (5)
- High-allocated VSAM cluster RBA (6)
- Available cluster space in bytes (7)
- Available cluster space percentage
- Average IO duration in milliseconds (8)
- Maximum IO duration in milliseconds

Notes

1. The total number of VSAM records (Recorder blocks) in the cluster.
2. The number of VSAM records (Recorder blocks) written during the current DBARS session.
3. The length of a VSAM record (Recorder block).
4. Individual Recorder records are blocked by DBARS before being written to the cluster as a block. The length of a Recorder record depends on the length of the recorded SQL statement.
5. The highest RBA defined for the Recorder cluster.
6. The highest RBA used for the Recorder cluster.
7. The available Recorder cluster space, in bytes and as a percentage.
8. The duration of writing the Recorder blocks to the VSAM cluster. Writing a block stores multiple Recorder records, as shown under (4).

DBARSM18I

Recorder cluster not opened yet

No records have been written yet to the Recorder. Statistics are not available.

16.4 Messages issued by the DBARS Writer task

DBARSW00A	<p>SQL error during CONNECT to <i>server</i></p> <p>An SQLCODE was returned when DBARS connects to <i>server</i>. The SQLCA is formatted upon the console and DBARS terminates.</p> <p>Action Examine the SQLCODE and perform the necessary correction. If needed, contact SPR Software Support .</p>
DBARSW01A	<p>SQL error getting audited table list</p> <p>An SQLCODE was returned when DBARS obtains the list of audited tables. The SQLCA is formatted upon the console and DBARS terminates.</p> <p>Action Examine the SQLCODE and perform the necessary correction. If needed, contact SPR Software Support .</p>
DBARSW02A	<p>SQL error getting audited view list</p> <p>An SQLCODE was returned when DBARS obtains the list of views depending on audited tables. The SQLCA is formatted upon the console and DBARS terminates.</p> <p>Action Examine the SQLCODE and perform the necessary correction. If needed, contact SPR Software Support.</p>
DBARSW03A	<p>SQL error inserting into DBARS.RECORDER</p> <p>An SQLCODE was returned when DBARS inserts an access row into the RECORDER table. The SQLCA is formatted upon the console.</p> <p>If the SQLCODE shows a recoverable error (such as lack of space) on the primary recorder, DBARS automatically switches to the auxiliary recorder table AUX_RECORDER. If the SQLCODE persists on the AUX_RECORDER as well, DBARS abends.</p> <p>Action Examine the SQLCODE and perform the necessary correction. If needed, contact SPR Software Support.</p>
DBARSW04I	<p>Switching to auxiliary recorder</p> <p>A recoverable error has occurred on the RECORDER table and the auxiliary recorder has been activated.</p> <p>Action Resolve the error on the primary recorder and issue the SWITCH_REC command to activate the primary recorder again.</p>

DBARSW05I	Switched to alternate recorder
	The alternate Recorder is active.
DBARSW06I	Switched to primary recorder
	The primary Recorder is active.
DBARSW07A	SQL error deleting from DBARS.RECORDER
	A SWITCH_REC command was issued and an SQLCODE was returned when deleting rows from the primary recorder. The SQLCA is formatted upon the console and DBARS terminates.
	Action Examine the SQLCODE and perform the necessary correction. If needed, contact SPR Software Support.
DBARSW08A	SQL error deleting from DBARS.AUX_RECORDER
	A SWITCH_REC command was issued and an SQLCODE was returned when deleting the rows from the auxiliary recorder. The SQLCA is formatted upon the console and DBARS terminates.
	Action Examine the SQLCODE and perform the necessary correction. If needed, contact SPR Software Support.
DBARSW09A	SQL error getting audited object_ids
	An SQLCODE was returned when DBARS obtains the list of audited object ID's. The SQLCA is formatted upon the console and DBARS terminates.
	Action Examine the SQLCODE and perform the necessary correction. If needed, contact SPR Software Support.
DBARSW10A	SQLCODE xxx selecting from DBARS_RECID
	An SQLCODE was returned when DBARS obtains the ID of the current recorder. The SQLCA is formatted upon the console and DBARS terminates.
	Action Examine the SQLCODE and perform the necessary correction. If needed, contact SPR Software Support.

DBARSW11A	<p>SQLCODE xxx updating DBARS_RECID</p> <p>An SQLCODE was returned when DBARS updates the ID of the current recorder. The SQLCA is formatted upon the console and DBARS terminates.</p> <p>Action Examine the SQLCODE and perform the necessary correction. If needed, contact SPR Software Support.</p>
DBARSW12A	<p>VSAMRC xxxx writing to RECORDx</p> <p>A VSAM error occurred when writing to the primary (RECORDA) or the auxiliary (RECORDB) recorder.</p> <p>Action Examine the VSAM PUT returncode and perform the necessary correction. If needed, contact SPR Software Support.</p>
DBARSW13I	<p>VSAM Recorder cluster x opened</p> <p>The active VSAM Recorder cluster (A or B) is shown under "x".</p>
DBARSW14A	<p>VSAM error xxxx opening Recorder y</p> <p>The VSAM Recorder cluster (A or B) could not be opened. The decimal open error code is shown in "xxxx".</p> <p>DBARS abends.</p>
DBARSW15A	<p>VSAM error xxxx opening Recorder Index y</p> <p>The VSAM Recorder cluster (A or B) could not be opened. The decimal open error code is shown in "xxxx".</p> <p>DBARS abends.</p>
DBARSW16A	<p>VSAMRC xxxx writing to RECORDxB</p> <p>A VSAM error occurred when writing to the primary (RECORDAX) or the auxiliary (RECORDBX) recorder index.</p> <p>Action Examine the VSAM PUT returncode and perform the necessary correction. If needed, contact SPR Software Support.</p>
DBARSW17A	<p>SQL error inserting into DBARS.EXCEPTIONS</p> <p>An SQLCODE was returned when DBARS inserts a row into the EXCEPTIONS table. The SQLCA is formatted upon the console.</p> <p>Action Examine the SQLCODE and perform the necessary correction. If needed, contact SPR Software Support.</p>

DBARSW18A	Starting Recorder Archive procedure xxxx
	A full condition has been detected for the current Recorder and the ARCHIVE_PROC statement was specified in the DBARS startup parameters. The user provided procedure named on the ARCHIVE_PROC statement, is now started.
DBARSW19A	SQLCODE xxx creating temporary tables
	A CREATE GLOBAL TEMPORARY TABLE statement failed. DBARS is terminated.
DBARSW20A	Syntax error in AUDIT statement
	A syntax error was detected in an AUDITNAMES table specification in the DBARS EXECPARM dataset. DBARS is terminated.
DBARSW21I	Tablenames recorded by DBARS:
	Output of the AUDITTAB command.
DBARSW22I	tablecreator.tablename
	Output of the AUDITTAB command.
DBARSW23I	Emptying Recorder queue before shutdown ...
	A DBARS STOP command has been submitted. Before terminating, the DBARS Writer task will write the remaining Recorder queue entries to the Recorder table or cluster.
DBARSW24I	Abend recovery completed.
	A program check interruption has occurred while the Write is processing a recording request.
	The Writer abend routines display diagnostic information on the console and create a formatted dump in the z/OS spool. Processing is then resumed.
	Action
	Forward the system log and the formatted dump to SPR software support.

16.5 Messages issued during Interactive Access Reporting

DBARSIR01A	<p>A terminal with at least 32 lines is required</p> <p>The DBARSI program requires a terminal with 32 lines at least.</p>
DBARSIR02A	<p>SQLCODE <i>nnn</i> evaluating "xxx"</p> <p>When evaluating the selection expression <i>xxx</i>, SQLCODE <i>nnn</i> was returned.</p> <p>Action</p> <p>Ensure that the selection expression obeys DB2 syntax.</p>
DBARSIR03A	<p>PF key unassigned or function not available</p> <p>You pressed a program function key other than the ones listed in the screen footer.</p>
DBARSIR04A	<p>Column reformat code is invalid</p> <p>When reformatting the screen, a character other than + - < > or 2-9 was entered. You may want to display the help screen for the reformat function.</p>
DBARSIR05A	<p>No more than one ordering column allowed</p> <p>When reformatting the screen, more than one sort column was indicated.</p>
DBARSIR06A	<p>Sort error code <i>nnn</i></p> <p>An error occurred during the sort requested from the reformat function.</p> <p>Action</p> <p>Retry the sort with a larger virtual storage. If the error persists, contact SPR Software Support.</p>

16.6 Messages issued during Exception Reporting

DBARSXR01A	<p>A terminal with at least 32 lines is required</p> <p>The DBARSXR program requires a terminal with 32 lines at least.</p>
DBARSXR02A	<p>SQLCODE <i>nnn</i> evaluating "xxx"</p> <p>When evaluating the selection expression <i>xxx</i>, SQLCODE <i>nnn</i> was returned.</p> <p>Action</p> <p>Ensure that the selection expression obeys DB2 syntax.</p>
DBARSXR03A	<p>PF key unassigned or function not available</p> <p>You pressed a program function key other than the ones listed in the screen footer.</p>
DBARSXR04A	<p>Column reformat code is invalid</p> <p>When reformatting the screen, a character other than + - < > or 2-9 was entered. You may want to display the help screen for the reformat function.</p>
DBARSXR05A	<p>No more than one ordering column allowed</p> <p>When reformatting the screen, more than one sort column was indicated.</p>
DBARSXR06A	<p>Sort error code <i>nnn</i></p> <p>An error occurred during the sort requested from the reformat function.</p> <p>Action</p> <p>Retry the sort with a larger virtual storage. If the error persists, contact SPR Software Support.</p>

16.7 Messages issued by the DBARS Archiving program

DBARSA01A	<p>Missing RESTART parameter</p> <p>The Archive program detected that a previous archive run did not complete normally. In this case, the user must supply the RESTART or the NORESTART PARM argument.</p> <p>Action Refer to the description of the archive control parameters.</p>
DBARSA02A	<p>Invalid PARM argument <i>nnn</i></p> <p>Invalid syntax on the PARM operand of the EXEC DBARSA JCL statement.</p> <p>Action Refer to the description of the archive control parameters.</p>
DBARSA03I	<p>Archiving from DBARS.RECORDER <i>nnn</i></p> <p>Informatory message that shows the SQL statement built by the DBARSA program to select the rows to be archived.</p>
DBARSA04I	<p><i>n</i> rows deleted from DBARS.RECORDER</p> <p>Informatory message showing the number of rows written to the archive and deleted from the Recorder table.</p>
DBARSA05A	<p>DBARS_RECID table cannot be accessed.</p> <p>The SEQREC archiving option was specified and an attempt was made to retrieve the current recorder cluster ID (A or B) from the DBARS_RECID table. This attempt failed.</p>
DBARSA06A	<p>VSAMRC x reading from RECORDA/RECORDB</p> <p>A VSAM read failure occurred when reading from the recorder cluster. The VSAM RPL feedback field is displayed under "x".</p> <p>Action Examine the VSAM GET returncode and perform the necessary correction. If needed, contact SPR Software Support.</p>
DBARSA07I	<p>Archiving cluster xxx</p> <p>The SEQREC archiving option has been specified. The message shows the name of the recorder cluster being archived as DBARS.RECORDER.A or DBARS.RECORDER.B</p>
DBARSA08I	<p>Submitting SWITCH_REC command to DBARS.</p> <p>The SEQREC archiving option has been specified. Before starting the archive, a request is sent to the DBARS address space for switching to the alternate recorder cluster.</p>

16.8 Messages issued during Archive Reporting

DBARSAR01A RC *nn* opening ARCHIVE dataset

Returncode *nn* was received from z/OS when opening the ARCHIVE dataset.

Action

Review the ARCHIVE DD statement.

DBARSAR91A Parameter name too long

DBARSAR92A Parameter name invalid

DBARSAR93A Operation code invalid

DBARSAR94A Invalid alpha expression

DBARSAR95A Invalid numeric expression

DBARSAR96A Expression has no valid syntax

DBARSAR97A OUTTABLE statement incorrect

DBARSAR98A OUTLINES statement incorrect

Messages DBARSAR91A through DBARSAR98A signal a syntax error in the selection criteria supplied to the Archive Reporting program DBARSAR.

Action

Refer to [Access Reporting from an Archive](#) for a description of the DBARSAR parameter syntax.

16.9 Messages issued during batch Reporting from a VSAM Recorder

DBARSRR97A	OUTTABLE statement incorrect
DBARSRR98A	OUTLINES statement incorrect
DBARSRR99A	DBARS_JN statement incorrect