Fieldbus Engineering Operations Procedures

Version: 1.09

Revision History

Rev	Date	Author	Description of Changes Made
1.00		Raj Bandekar	New
1.01	3/17/06	Raj Bandekar	Updated for SP2, added Rule #6
1.02	4/26/06	Raj Bandekar	Minor Editorial changes for clarifications
		Helen Muth	Updated to reflect R300.1 applicability
1.03	5/22/06	Raj Bandekar	Refined Rule 4, added new definition in "Key definitions" section
1.04	5/24/06	Raj Bandekar	Comments from Internal Review. Send out for External Review
1.05	6/1/06	Raj Bandekar	Added Rules 7&8. Comments from External Review
1.06	10/09/06	Raj Bandekar	Comments from Marketing
1.07	10/11/06	Raj Bandekar	Comments from Program Management for Release Numbering
1.08	6/18/07	Matt Schrier	Refined Rule 5, split to add rule 5a. Added Rule 9. Updated for FIM4 (128 VCR max)
1.09	7/3/07	Matt Schrier	Include Review Comments; Add TOC and section on VCR allocation; Clean up rules

Table of Contents

Introduction

Mapping of Rules to Experion Releases

The following chart shows a quick summary of the rules contained in this document and what Experion releases they apply to:

Rule	Description	All Users All Releases	Specific Release(s)
1	Loading structural changes to CM from project		R201 Customers, pre-Update 24 R210 Customers, pre-SP2
2	Deleting CM's from Monitor tree		R201 Customers, pre-Update 23 R210 Customers, pre-Update 9 or 10
3	"Update to Project" of CM		R201 Customers R210 Customers
4	Loading CM's, SCM's, and RCM's involving connections or expressions	X	
5	"Update to Project" of multiple CM's for Fieldbus links using more than 50% of maximum. link VCR count	X	
6	Loading CM's - macrocycle issues		R210 Customers
7	Bulk Edit		R201 Customers R210 Customers, pre-SP2.1
8	Bulk Build and Import		R201 Customers R210 Customerspre-SP3
9	Maximum Control-Related VCR usage	X	
10	Making structural changes to loaded CM's one or more times without re-loading	X	
11	Device Replacement when using maximum link VCRs	X	

Key definitions

Structural Changes: Generally, changes made on the CM or SCM chart. This applies to only Project side of the Fieldbus Configuration. Some of the typical changes are

- Assigning and/or un-assigning Basic Blocks in CMs
- Making and/or deleting connections between basic blocks in CMs
- Adding and/or deleting basic blocks in CM
- Adding/deleting block pins

- Adding/deleting parameters on the faceplate
- Changing colors and Viewing options

Structural changes will cause a change flag (yellow triangle)

Parameter Changes: Changes made to parametric data such as Ranges, Tuning constants, Transducer Channels etc. Generally, these are changes made on a configuration form. Changes made from Project side will cause Engineering Database changes and therefore a change flag (yellow triangle) will be set. Changes made on a monitoring configuration form do not cause any Engineering Database changes and therefore do not trigger a change flag (yellow triangle).

Parameter Connectors: Named connections between Basic Blocks that reside in multiple CMs

Control Connection: Initializable connections between Control Blocks e.g. RegCtl and AO

Definition Block: Basic Block that publishes a value

Reference Block: Basic Block that subscribes to the value published by another basic block.
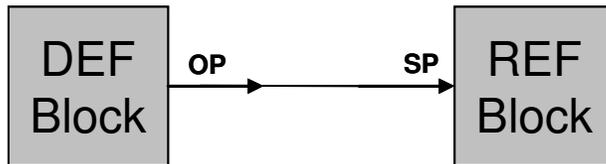
VCR: Virtual Communication Relationship
Foundation Fieldbus™ defined Communication channel which manages data flow between various Fieldbus Datalink Entities

VCR_MAX: Maximum number of VCRsVCRs supported by a FF link in Experion PKS. This value is 64 for each link in a FIM, and is 128 for each link in a FIM4.

Number of VCRs used by Link side of the Fieldbus Connection
Number of VCRs used on a Physical FIM/Link can be found from the Link Form on the Monitor Tab. The Link Form Network Management (Basic) Tab displays the value "Num of Currently Configured VCRs" OR "LSTCHAR.NUMCURCONFD" in the VCR List Characteristics Box.

Every Fieldbus Control Connection between Experion Block and FF Block that use VCRs will have one VCR on the FIM/Link side and another on the Field Device side. This calculation shows how many VCRs are used by FIM/Link side.

Total # VCRs used by Physical FIM/Link = 2+ 2*(# of loaded FF Devices) + 2*(# of un-commissioned FF Devices) +
Wires_FFDevice_to_CPM+2*(#Wires_CPM_to_FFDevice)

Total # VCRs used by Control Builder Project Side = 2+ 2*(# of Project FF Devices) + Wires_FFDevice_to_CPM+2*(#Wires_CPM_to_FFDevice)

An example of #Wires_CPM_to_FFDevice would be a connection from PID.OP to AO.CAS_IN where the PID is in Experion and AO is in FF Device.

Additional details and examples can be found in Foundation Fieldbus Integration Product Specification document.

Device Replacement: The procedure used to replace a loaded FF device, usually due to device failure, with a new device of the same type (manufacturer, model, and device revision must match).

Devices_MAX per Link - Maximum number of Fieldbus Devices that can be connected to a single Link. This number is 16.

UCD: Uncommissioned device. This is a FF device that is physically added to a FF link that is not matched with any corresponding device on the Project side.

FBAP: Function Block Application Process - the area of a FF device that contains the function blocks.

MIB: Management Information Base - the area of a FF device that contains device-level management parameters and operations.

VCR Allocation Background

Control Builder manages resources separately on the Project and Monitor sides. FIM manages resources for the Physical Link for Unconnected Devices also known as UCDs in the document. The ultimate goal is to have all sides in sync, typically after elements on the Project side are loaded to Monitor.

There are always times when the conditions on the two sides are different. The following cases bring out the differences
1) During project configuration, before anything is loaded to Monitor
2) After an initial download of control configuration using Device Function Blocks has occurred and changes have been made to this Control Configuration on the Project side before re-loading to Monitor.

VCR usage is a tightly-controlled resource, since there are a limited number of VCRs available for each FIM link. It is important to be aware of how many VCRs are being used on each link, especially for larger systems and heavily-loaded links. Configuring a system at or near the limit creates operational difficulties which are described in this document.

The differences between Project, Monitor and Link side VCR allocation is described below:

Link: VCR usage on the Link side happen in two phases. First phase is when the device is physically connected to the Link, at which time the FIM software allocates 2 VCRs for this device to the Link. One is for MIB, the other is a temporary VCR for FBAP.

Second Phase is after the device is downloaded from Control Builder's project side. In this phase the Link gives up the temporary FBAP VCR and uses the one configured by Control Builder. However the MIB VCR is still preserved by the Link because Control Builder does not download this. Control Builder however has to take into account this MIB VCR in its MAX VCR Count per Link.

There could be situations such that a User may configure less than Devices_MAX per Link, but use up to VCR_Max on this Link due to configuration of Control Connections. In such a situation FIM will not be able to communicate to UCD's. (see rule #11)

Project: VCR usage on the Project side is related to
1) Number of devices configured on a Link and
2) Number of control connections between Experion Control Blocks and Fieldbus Control Blocks on the same given Link

In addition, as mentioned above individual VCRs that have been loaded to Monitor may not be used for any other purpose (e.g. deleted, modified, etc.) on the Project side until either (a) they are first removed from use (e.g. a connection is deleted) and the particular Control Module (CM) is re-loaded, or (b) the CM is deleted from Monitor. Therefore the actual number of VCRs available for additional configuration activity on the Project side is dependent on what has already been loaded to Monitor.

Monitor: VCR usage on the Monitor side is related to loaded number of Fieldbus devices and running control connections between Experion Control Blocks and Fieldbus Control Blocks on the same given Link

Engineering Operations

Rule 1: When Loading Structural Changes to CMs from Project
Applicable to: R210 pre-SP2

The following sequence is affected by this rule:
- Perform 'Load' from Project Tree
- Perform 'Update to Project' from Monitor Tree
- Perform 'Load' From Project Tree again

A structural change can be detected ***prior to load*** in the following manner:
- For CM's that have never been loaded, a chevron is displayed next to the strategy in the project tree.
- For CM's that have been previously loaded, run _CheckErdb.sql.cmd to determine if a structural change has been made. A structural change has been made if the following check reports a finding on the CM :
    - **CM's and SCMs that have major structure changes**

PAR 1-1J55XN addresses this issue post and including R210 SP2

Rule 2: 'Delete' from Monitor Tree
Applicable to: R210 pre-Update 9

Do not 'Delete' a CM from Monitor Tree if Fieldbus connection changes have been made on the project tree.

The change can be detected ***prior to 'Delete' from Monitor Tree*** by running _CheckErdb.sql.cmd. The Delete of the CM should not be performed if the following check reports a finding on the CM to be deleted :

- **CM's that contain FF blocks with unused VCRS**

Workaround: Load the CM from the project Tree and re-run _CheckErdb.sql.cmd. The CM should no longer report the finding and may now be deleted from the monitor tree.

This rule is needed because of a PAR 1-18XLSH. The PAR has been fixed in R201 update 23 as well as post R210 Update 9.

Rule 3: 'Update to Project' of CM
Applicable to: Releases before R300.1

Special actions may need to be taken after Update to Project of a CM if there are any structural changes on the Project version of the CM prior to the Update to Project.

If structural changes have been made to project, the Update to Project may be performed. When this occurs, VCR (fieldbus connections) may be rendered unavailable for re-use until the CM is reloaded.   This can be detected *after the 'Update to Project'* by running _CheckErdb.sql.cmd.   Look for the following check to report a finding on the CM that was updated:

- **CM's that contain FF blocks with unused VCRS**

If the CM reports a finding, the VCRs will only be made available by a reload of the CM:

- In the case if the CM can be reloaded at this time, it should be.
- For the case that the CM can not be reloaded, it should be planned to be reloaded in the future. A possible method to track this is to force a delta flag on the tree by opening the CM form, make a minor change (such as adding or removing a space from the DESC parameter) and saving the change.

Rule 4: Loading Control Modules, SCMs and RCMs involving Parameter Connectors or Expressions

Applicable to: All Releases for Fieldbus and non Fieldbus points

If a Configuration change involves deleting/modifying parameter connectors or Expressions of loaded CMs from Project, then it is desired that both the definition block CM and reference block CM be loaded in the same load operation or two different load operations.

This rule applies to the following specific cases; however, it would be easier to remember to load both such CMs.

See the following use cases and scenarios where this rule is applicable. If none of the following cases apply then a reload of both ends is not needed.

1. When the parameter connectors are control connections.
   - Fieldbus Example CM1.PIDA.OP is connected to CM2.AO.CASIN. The reference side for forward connection is CM2.PIDA.CASIN and CM1.PIDA. BACKCALCIN for back initialization (hidden connection) Both the CMs have to be loaded from Project if the forward connection is changed by the user
   - Non Fieldbus Example CM3.PIDA.OP is connected to CM4.PIDA.SP. The reference side for forward connection is CM4.PIDA.SP and the reference side for back initialization connection is or CM3.PIDA.BACKCALCIN. Both the CMs have to be loaded from Project if the forward connection is changed by the user

2. Un-assign or delete a DEF Block from Project CM and replace this with another block of the same or different type.

- Fieldbus Example CM1.AI.OUT is connected to CM2.DACA.P1. Replace AI block with AI from same or a different device. Both CM1 and CM2 have to be re-loaded from Project.
- Non Fieldbus Example CM3.NUMERIC.PV is connected to CM4.DACA.P1. Replace NUMBERIC block with another NUMERIC. Both CM3 and CM4 have to be reloaded.

Note: The above examples intentionally uses same name for the replaced block to show that the user may assume or lose track of such a change later. The replaced block does not have to have same name, but then this case would be obvious to the user when they see that a connection is not working.

3. Rename a DEF Block followed by a reload of an already loaded CM. In this situation the CM containing the REF Block also needs to be loaded except when the DEF blocks are Fieldbus, PMIO or Series C IO channel Blocks.

4. Un-assign a CM containing DEF Block from one controller and reassign it to any other controller including itself. In this situation the CM containing the REF Block also needs to be loaded except when the DEF blocks are Fieldbus, PMIO or Series C IO channel Blocks.

5. Un-assign CM containing REF Block with *Control Connections* from one controller and reassign it to any other controller including itself. In this situation the CM containing the DEF Block also needs to be loaded except when the REF blocks are Fieldbus, PMIO or Series C IO channel Blocks.

6. Physical Address Change (Slot number or FTE Address) of Controller with CM containing DEF Block followed by load of this CM. In this situation the CM containing the REF Block also needs to be loaded

7. Physical Address Change of Fieldbus Device whose Function Block is used as a DEF block. In this situation the CM containing REF block need to be reloaded.

Rule 5: 'Update to Project' of multiple CMs for Fieldbus Links using more than 50% of maximum link VCR count

Applicable to: All Releases. Two User Actions are captured where the rule applies. A work around solution is provided for both the user actions. This work around solution should satisfy more than 80% of User Goals. It is highly recommended to follow these workarounds.

System State: Structural Changes on Project Side of Control Builder

If the number of VCRs used on an FF Link are greater than VCR_MAX / 2, following workaround applies

Workaround (1) for Pre-R300.1 : Update to Project need to be performed in multiple steps. For each step select only as many CMs such that total number of VCRs used by these CMs is less than VCR_MAX-total # of VCRs used by Control Builder on Project Side.

Work Around (2) for R300.1 and post releases: Update to Project dialog box includes an option (selected by default) to update only parameter values from Monitor. This setting prevents the VCR problems described in this rule. It is highly recommended that this checkbox be selected when updating to project.

Note however that using this option would update only parameter values from Monitor to Project side which should satisfy more than 80% of User Goal.

In the event where you need to un-check the box, please follow Workaround (1)

VCRsRule 6: Loading Control Modules

Applicable to: R210 pre-SP2.1

If during load of a Control Module you get "FF schedule exceeds macro cycle" error there could be two situations for this.

1. The CM that is being loaded does not truly fit the macro cycle of the Loaded link schedule. This can be seen by opening the Schedule UI on Monitor side and see the available time for unscheduled traffic. A minimum of 60% time is necessary for unscheduled traffic. If by adding this CM the time available for unscheduled traffic is going to get below 60% this is a then a legitimate error and you could either optimize the schedule if not already optimized or increase the Macro Cycle or delete some CMs from Monitoring side of this Link.

2. If #1 is not the case then problem here could be that the schedule on Monitoring Side got un-optimized although it was supposed to be optimized. This could happen because of a PAR 1-1YEA8J. The root cause for this is that is if Connections between Functions blocks in a Control Modules on Project side for a particular link are modified and these CMs are not downloaded, but some other CMs from the Project Side on the same link are attempted to be downloaded the schedule optimization algorithm cannot find all the necessary connections to optimize the schedule for this particular Link and hence defaults to an un-optimized schedule.

If the user gets into the 2nd situation, user should , run _CheckErdb.sql.cmd to determine if a structural change (connections which is also a structural change in this case) has been made to such CMs previous loaded. A structural change has been made if the following check reports a finding on the CM :
    o **CM's and SCMs that have major structure changes**

Look for the CMs under this Link in this report and load from Project Tree.

Rule 7: Bulk Edit

Applicable to: R210 pre-SP2.1

Bulk Edit should not be used to edit or Build Control Modules containing Fieldbus Blocks with connections to Experion Blocks, if these Fieldbus Devices or Control Modules are already loaded and when the **Number of VCRs exceed 50% of the total specified for a given Link.** This happens because of PAR 1-1WT5X4

Rule 8: Bulk Build and Import

Applicable to: R210 pre-Update SP3

Bulk Build and Import should not be used to Build Control Modules containing Fieldbus Blocks with connections to Experion Blocks, if these Fieldbus Devices or Control Modules are already loaded and when the **Number of VCRs exceed 50% of the total specified for a given Link**. This happens because of PARs 1-2JTQG1 1-2HAAON

Post R210 SP3, import and Bulk Build is prevented on loaded Tagged Objects.

For Rule 7 and Rule 8 please refer to CPN 2006-03

Rule 9: Maximum Control-Related VCR Usage

Applicable to: All Releases

Using the VCR count formula definition, the maximum number of control-related VCRs per link can be specified as follows:

Maximum Control-Related VCRs = VCR_MAX - 2 - 2*(# of Project FF Devices)

These VCRs can be used as part of the following types of connections:

Control-Related VCRs = Wires_FFDevice_to_CPM + 2*(#Wires_CPM_to_FFDevice)

Example: You are configuring a system with 13 FF devices on one FIM4 link, each with a maximum of 8 analog output values that can be linked to Experion blocks in a one or more CM's. This is a potential total of 104 control connections (8 connections for each of the 13 devices). First we calculate the maximum number of VCRs that will be available for control connections:

Maximum Control-Related VCRs = 128 - 2 - 2*(13) = 100

Since in this example all connections will be of the type "*Wires_FFDevice_to_CPM*" only 100 control connections can be made.

Rule 10: Making structural change(s) to a loaded CM (on the Project side) one or more times without re-loading

Applicable to: All Releases

Control Builder provides flexibility to reconfigure connections between Fieldbus blocks on Project Tab while they are still loaded on the Monitor Tab. Therefore the project side and monitor side both keep count of used VCRs. If a user keeps reconfiguring already loaded connections on the project side without re-loading the link may run out of VCRs because the combination or total for both sides exceeds VCR_MAX for any link.

The workaround is to follow the following generalized steps:
- Delete unneeded connections first on the Project side
- Load those changes to Monitor
- Create the desired connections on the Project Side
- Load those changes to Monitor

This prevents the VCR usage from going higher than VCR_MAX at any point in time, since unused VCRs are "released" when a load is performed.

Rule 11: Device Replacement when using maximum link VCRs

Applicable to: All Releases

In order to handle a Device Replacement procedure the FIM must communicate to the replacement device (aka UCD) using a VCR. If the link has all of its VCRs used then none will be available for this procedure.

There are two workarounds:

(1) Delete the device and/or related CM from the Monitoring tree to free up at least one VCR for the link. This will allow the FIM to communicate to the UCD.
(2) If possible always leave at least one spare VCR available (preferably more) on each link when configuring the system. This will eliminate the need to take special actions if a Device Replacement becomes necessary.

Other Topics

Information about _CheckErdb.sql.cmd

This is a utility that could be downloaded from SSOL Web site at the following location, Experion PKS>Software Library > opm Tools.

The ERDB consistency check will provide status of the ERDB. The check should be run on the same node as the primary ERDB (Server B). To run the checker:
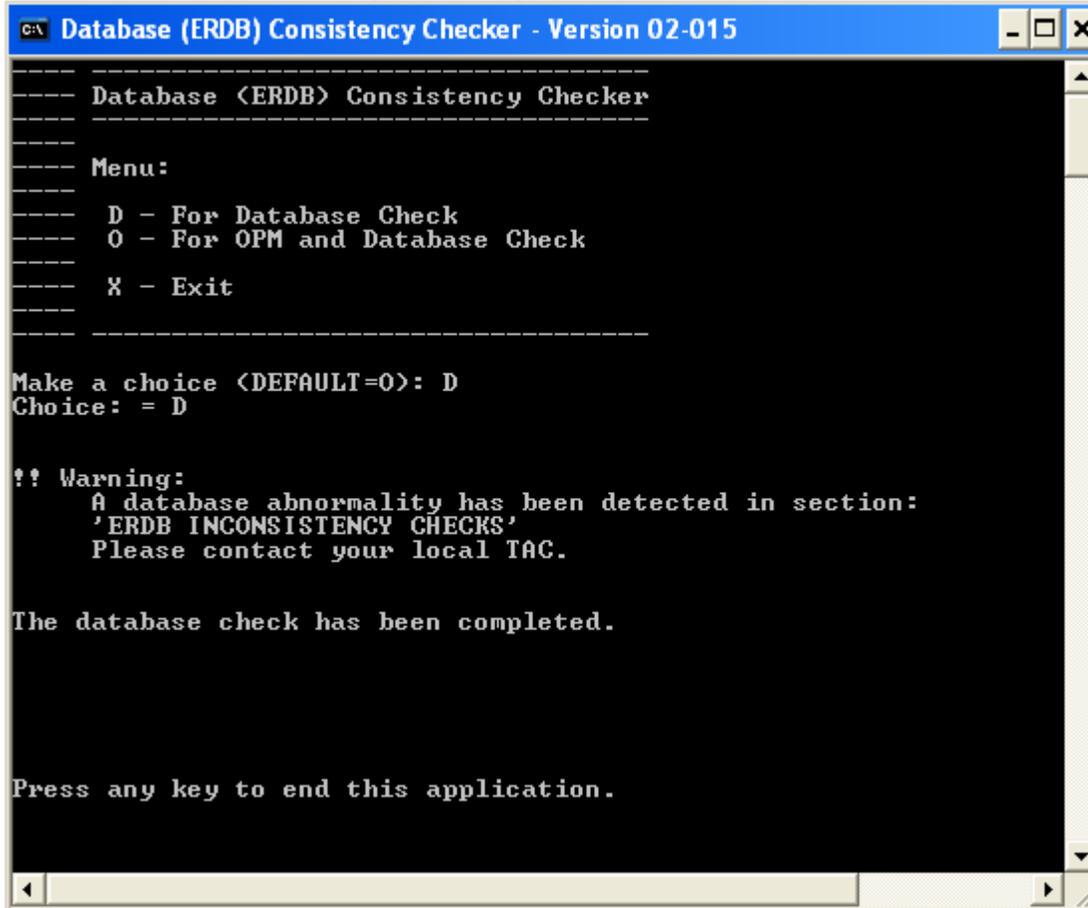
- Double click on the _CheckErdb.sql.cmd icon on the desktop

Enter 'D' and hit enter to execute the DB checks.

If errors are detected, the output will display as follows:
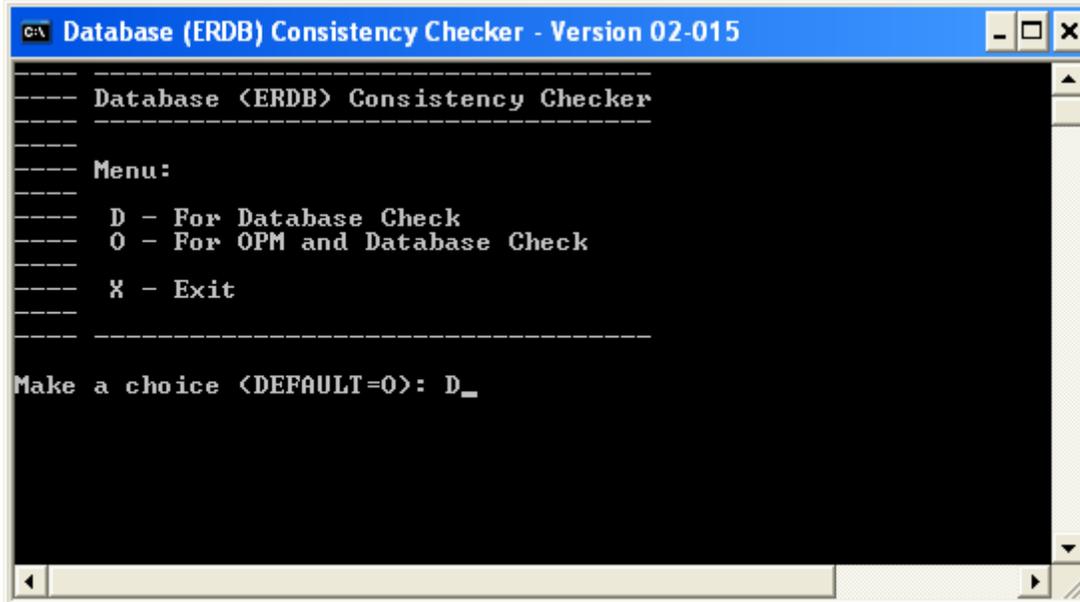
```
[GX] Database (ERDB) Consistency Checker - Version 02-015          _ □ ✕

----  -------------------------------------------
----  Database (ERDB) Consistency Checker
----  -------------------------------------------
----
----  Menu:
----
----    D - For Database Check
----    O - For OPM and Database Check
----
----    X - Exit
----
----  -------------------------------------------

Make a choice (DEFAULT=O): D
Choice: = D


!! Warning:
      A database abnormality has been detected in section:
      'ERDB INCONSISTENCY CHECKS'
      Please contact your local TAC.


The database check has been completed.




Press any key to end this application.
```

When abnormalities are detected, the output is stored in c:\temp. The file has no extension. This is an example of an output file name:

- _CheckErdb+02-006+PA62D-XPWKS065A+ps_erdb+E773E128E0DC.ChkErdb

Information about checks related to this document

CM's and SCMs that have major structure changes

An example of output that has detected structural changes:

```
#############################################################################
# BEGIN CAT  1 - ERDB INCONSISTENCY CHECKS
#############################################################################
…
--+ CM's and SCMs that have major structure changes:

 If any of the strategies listed below are to be loaded from Project
 and contain FieldBus Blocks:
```

          - Load from project tree
          - Update to project
          - Load from project tree again

```
StrategyName                          Project_SructRev
----------------------------------- ----------------
08AI0158A                             131071
08FA0711                              131071
08FA0828                              131071
08FA0829                              131071
08FA0830                              131071
```

An example of output where no structural changes have been detected:
```
########################################################################
# BEGIN CAT  1 - ERDB INCONSISTENCY CHECKS
########################################################################
```
…
--+ CM's and SCMs that have major structure changes: NONE
…

CM's that contain FF blocks with unused VCRS

An example of output that has detected unused VCRs:

--+ CM's that contain FF blocks with unused VCRS:

  Reload the following control modules to cleanup VCRs
  DO NOT delete any of the CM's listed below from Monitor!!!

```
CMName                      LinkorResource                        Value     ParamIndex
--------------------------------- --------------------------------------- ----------- ----------
08AI0158A                   E08FIM21S08L2                         -1        0
08AI0158A                   E08FIM21S08L2                         -1        1
08PI0125                    E08FIM21S08L2                         -1        2
```

An example of output that has NOT detected unused VCRs:

--+ CM's that contain FF blocks with unused VCRS: NONE

Parameter Value found without Strategy

An example of output that has detected the anomaly:

--+ Number of Entries in the Strategy Parameter Value table without a strategy:

No Workaround: Contact TAC Immediately before proceeding with configuration

SPVNoStrategy

ORDERINCM - Parameter Value exists, no Strategy Found

An example of output that has NOT detected the anomaly:

--+ Number of Entries in the Strategy Parameter Value table without a strategy:
NONE

Multi User Control Builder Considerations

Control Builder supports multi-user functionality, however, it should be noted that there are some operations that are restricted.

Specifically, loads should only be carried out from a single machine at a time. This can be achieved by nominating a load machine, and only allowing loads from that machine, thereby ensuring that two machines will not load simultaneously.

Additionally, if a load or a delete is carried out at the same time as server database modifications are in progress then these operations may fail, displaying related error messages.

Examples of such errors include:

• Database Modification in Progress, Try Again Later
• Point Build Error

In extreme cases these errors may cause the Control Builder to stop functioning. If this happens you should restart the Control Builder and reload the server points to ensure that the changes take effect. Data should not be affected.

Also check for Locks using DB Admin Tool. If all Control Builders are shut down and you still see Locks, clear locks before continuing.