

FMECA for use of newly proposed Dissipative mode DT - 05-11-09

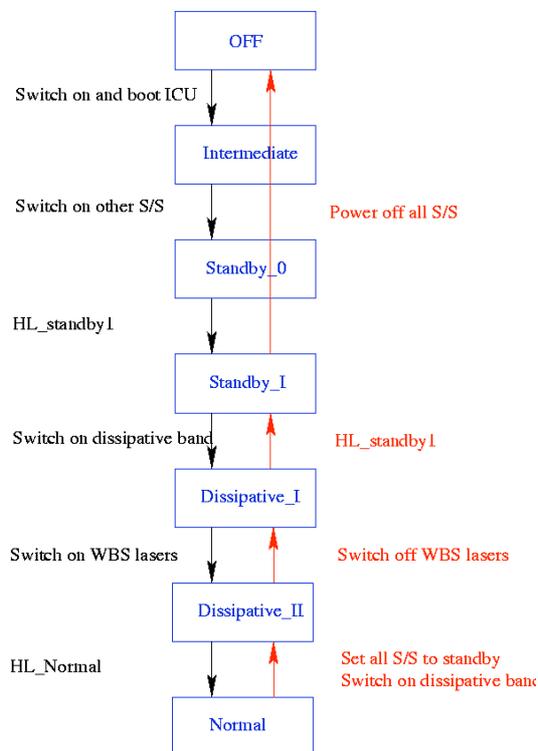
05-11-09: V1.0: first draft

Objectives

To identify potential risks and assess the impact of the proposed Dissipative mode as instrument state during standby (prime and non-prime) periods.

Description of the new mode transition scheme

The new scheme can be sketched as follows:



The mode discussed here is the Dissipative one, which is entered in the respective *Standby_I* to *Dissipative_I* and *Normal* to *Dissipative_II* transitions. Note that the LCU state in *Dissipative_I* and *Dissipative_II* is unchanged.

The properties of the proposed Dissipative mode are described in **SRC/LCU/TN/2009-0758 (TECHNICAL NOTE on LCU SW Redundant ModificationDate: Nov 2009)**, and can be summarized as follows:

“The new command HL_DISSIPATIVE (0xF00D0D0D) from ICU is necessary to force LCU to start DISSIPATIVE mode of operation. In this mode the band remains tuned as it was before entering the mode. None of new tuning can be done in this mode.

MODE in STATUS word (HL_RD_STATUS) for Dissipative mode is now 8 (decimal).

Execution of only 4 commands is allowed in Dissipative mode:

1. HL_NORMAL – return from Dissipative mode to Normal
2. HL_STANDBY – go to Standby (standby 1 mode)
3. HL_SET_RAMPAGE
4. HL_CHECKSUM – calculate checksum of XRAM”

The baseline for the use of the dissipative mode is that it will be set once the LOU has been configured to a dedicated band/index specifically designed to support the dissipative conditions with very RF power. At the present time, only bands 1a to 5b have been considered to provide such indices.

Failure modes and effects

We will distinguish between two cases: HIFI is prime instrument, and HIFI in non-prime instrument. In the first case, HIFI will be in operation on either sides of the standby (DTCP) periods in which it should be in dissipative mode. In the second case, HIFI is put n dissipative mode for longer period, and should remain as such until it becomes prime again. Deviation from the expected state will have different criticality whether HIFI is prime or non-prime instrument.

1. HIFI is prime instrument

Failure ID	P-01
Function/Event	TC to set LOU in dissipative band fails but HL_dissipative is successful
Failure Mode	Lost TC on the time-line
Effect	LOU remains as of last tuning at start of DTCP and is under the TC limitations implied by the Dissipative state. In worst case, HIFI resumes operation at end of DTCP at a new band, and issues the sub-band0 switch which would have been implied by a successful switch to the dissipative band.
Compensation	Operator can set HIFI to the intended dissipative band during DTCP. Most advantage would be stabilization of the band next in use
Remarks	How likely is this ? No safety issue, no extra switch involved

Failure ID	P-02
Function/Event	TC to set LOU in dissipative band succeeds but HL_dissipative fails
Failure Mode	Lost TC on the time-line
Effect	LCU is in the expected band but does not benefit from the TC limitation implied by the Dissipative state.
Compensation	Recommendation is to leave as is. The instrument is sufficiently protected by the running autonomous functions.
Remarks	How likely is this ? No safety issue, no extra switch involved

Failure ID	P-03
Function/Event	TC to set LOU in dissipative band and HL_dissipative both fail
Failure Mode	Lost TC on the time-line
Effect	LOU remains as of last tuning at start of DTCP and does not benefit from the TC limitations implied by the Dissipative state. In worst case, HIFI resumes operation at end of DTCP at a new band, and issues the sub-band0 switch which would have been implied by a successful switch to the dissipative band.
Compensation	Operator can set HIFI to the intended dissipative band during DTCP. Most advantage would be stabilization of the band next in use
Remarks	How likely is this ? No safety issue, no extra sub-band 0 switch involved

Failure ID	P-04
Function/Event	TC to set LOU in dissipative mode is not executed
Failure Mode	No communication with LCU
Effect	OBSW should set LOU to standby1 within the next minute. This will mean an extra sub-band0 switch
Compensation	Investigation on the ground needed to understand loss of communication. Likely loss of observation in the next OD (sub-schedule will be disabled if HIFI cannot be recovered during the DTCP). Communication lock should be released in the next DTCP.
Remarks	No safety issue, extra sub-band0 switch involved

Failure ID	P-05
Function/Event	Wrong frequency was used to put the LCU in dissipative mode, resulting in not using the dedicated dissipative index
Failure Mode	Error in CUS tables
Effect	LOU is set at the correct band, at another frequency than the planned, and with the safe Vd2 setting. It will remain like this during at most 3h.
Compensation	Operator can set HIFI to the intended dissipative band during DTCP, or just leave instrument as is until operation resumes
Remarks	No safety issue, no extra sub-band 0 switch involved

Failure ID	P-06
Function/Event	Wrong frequency and non-safe (high) Vd2 was used to put the LCU in dissipative mode, resulting in not using the dedicated dissipative index
Failure Mode	Error in CUS tables
Effect	LOU is set at the correct band, at another frequency than the

	planned, and with a Vd2 setting compatible with a pumped mixer. It will remain like this during at most 3h.
Compensation	Operator can set HIFI to the intended dissipative band during DTCP, or just leave instrument as is until operation resumes. Decision may depend on what band is involved in this failure
Remarks	No safety issue, no extra sub-band 0 switch involved

Failure ID	P-07
Function/Event	Wrong “dissipative” band/index was used to put the LCU in dissipative mode.
Failure Mode	Error of the HSC scheduler
Effect	LOU is set to a different band from the intended one for the next OD. This will imply at least one extra sub-band0 switch when the next OD start with the switch-on of another band. Also, stabilization will not be as good as could.
Compensation	Operator can set HIFI to the intended dissipative band during DTCP, or just leave instrument as is until operation resumes. Other than that, sanity checks could be implemented at the HSC to check for band consistency in POS files
Remarks	No safety issue, extra sub-band 0 switch involved

Failure ID	P-08
Function/Event	Engineer mode to move from <i>Normal</i> to <i>Dissipative_II</i> missing from the schedule
Failure Mode	Error of the HSC scheduler
Effect	Same as P-03
Compensation	Same as P-03 Other than that, sanity checks could be implemented at the HSC to check for missing mode transition AOR missing from POS files
Remarks	No safety issue, no extra sub-band 0 switch involved

Failure ID	P-09
Function/Event	Engineer mode to move from <i>Normal</i> to <i>Dissipative_II</i> accidentally swapped with or followed by transition to <i>standby_I</i>
Failure Mode	Error of the HSC scheduler
Effect	The LCU is off and in standby-1. An extra sub-band 0 switch was issued because of this
Compensation	CUS mode to transit to standby1 should not be made available to scheduler
Remarks	No safety issue, extra sub-band 0 switch involved

Failure ID	P-10
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Function/Event	Correct band/index were used and the LCU is brought to dissipative mode, but the LCU table contained wrong settings for that particular index
Failure Mode	Safety table error
Effect	RF power may not be as low as expected. Safety issue unclear (Bonn to comment)
Compensation	If safety at stake, operator could set the LCU in dissipative mode with another band, involving 2 extra sub-band 0 switch (one for the recovery dissipative band, and one at start of next OD). Otherwise, leave as is, similar to P-06 . In near future, need for update of the safety table.
Remarks	Possible safety issue, TBC which tools exist in table generation that avoid this kind of error. Potentially two extra sub-band 0 switch involved

Failure ID	P-11
Function/Event	LOU temperature out of standard range, while in dissipative mode
Failure Mode	Unexpected thermal change (e.g. LO heater dead)
Effect	Because LO FDIR currently not active when in dissipative mode, nothing will happen, leaving the LO with settings assuming a different temperature range. Consequence TBD
Compensation	SCR-3087: LOU FDIR needs to be also active in dissipative mode
Remarks	S/W change

Failure ID	P-12
Function/Event	Tuning macro always call HL_normal when achieved from CUS blocks.
Failure Mode	More a warning than a failure mode: the concept of the dissipative state is that it prohibits sending any tuning macro if transition to Normal was not done previously. This condition will always be met if one tries to achieve a tuning macro via a CUS mode (i.e. both MTL and ManCmd) because tuning macros are always preceded by a switch to Normal (to clean potential failure mode occurrences.) As such the protective state aimed by the dissipative mode is fictive.
Effect	None
Compensation	None desired.
Remarks	None

Failure ID	P-13
Function/Event	Use of SIS dissipative band in DTCP between two HEB ODs
Failure Mode	Because currently HEB LO bands do not offer a dissipative index, when an OD ends in an HEB bands, and is followed by

	another HEB OD, the transition to dissipative during the DTCP will have to be done with another band than the running one
Effect	It will add two extra sub-band 0 changed, and will not offer the optimum stabilization possibilities for the band to start with in the next OD
Compensation	Add a dissipative index in HEB bands, or use P-14
Remarks	Potentially 150 switches to sub-band 0 added in the mission

Failure ID	P-14
Function/Event	Use of HEB band with safe settings in dissipative mode
Failure Mode	As a potential solution to P-13 , in order to avoid sub-band 0 switches, the HEB band to be used at start of the next OD could be leave ON at a "normal" index, with safe Vd2 setting
Effect	Band is left on for at most 3h per affected DTCP with low but not minimum RF power.
Compensation	Implement first proposed solution to P-13
Remarks	No extra band sub-band 0 switch. Life-time issues ?

Failure ID	P-15
Function/Event	Reboot of LCU while LCU in dissipative mode
Failure Mode	SEU ?
Effect	LCU will go to standby1 ?
Compensation	None needed
Remarks	Failure case is non specific to dissipative mode, and applies as well to normal mode

Failure ID	P-16
Function/Event	Power cycle of LCU while LCU in dissipative mode
Failure Mode	LCL under-voltage ?
Effect	INT0 will be triggered and smooth transition to standby1 performed, hopefully before power cycle of the LCU. LCU will wake up in standby0, and communication will be blocked by OBSW
Compensation	Should be covered by INT0
Remarks	Failure case is non specific to dissipative mode, and applies as well to normal mode

Failure ID	P-17
Function/Event	Checksum error detected by OBSW while LCU in dissipative mode
Failure Mode	Checksum mismatch
Effect	LCU sent to standby1 and communication with LCU locked
Compensation	Memory should be dumped, and Patch and table should be uploaded again, after investigation is complete. In the short

	term, HIFI sub-schedule should likely be disabled in the next ODs
Remarks	Failure case is non specific to dissipative mode, and applies as well to normal mode

2. HIFI is non-prime instrument

Failure ID	S-01
Function/Event	TC to set LOU in dissipative band fails but HL_dissipative is successful
Failure Mode	Lost TC on the time-line
Effect	LOU remains as of last tuning at start of DTCP and is under the TC limitations implied by the Dissipative state. This is not recommended to leave the LOU in this state for potentially the following 2 weeks.
Compensation	Operator should set HIFI to the intended dissipative band during the next DTCP.
Remarks	How likely is this ? No safety issue, no extra switch involved

Failure ID	S-02
Function/Event	TC to set LOU in dissipative band succeeds but HL_dissipative fails
Failure Mode	Lost TC on the time-line
Effect	LCU is in the expected band but does not benefit from the TC limitation implied by the Dissipative state.
Compensation	The instrument is sufficiently protected by the running autonomous functions, recommendation is to ask operator to enter the HL_dissipative mode during the next DTCP so that the formal dissipative state is achieved for the coming weeks of HIFI being non-prime.
Remarks	How likely is this ? No safety issue, no extra sub-band 0 switch involved

Failure ID	S-03
Function/Event	TC to set LOU in dissipative band and HL_dissipative both fail
Failure Mode	Lost TC on the time-line
Effect	LOU remains as of last tuning at start of DTCP and does not benefit from the TC limitations implied by the Dissipative state. This is not recommended to leave the LOU in this state for potentially the following 2 weeks.
Compensation	Operator should set HIFI to the intended dissipative band during the next DTCP.
Remarks	How likely is this ? No safety issue, no extra sub-band 0 switch involved

Failure ID	S-04
Function/Event	TC to set LOU in dissipative mode is not executed
Failure Mode	No communication with LCU
Effect	OBSW should set LOU to standby1 within the next minute. This will mean an extra sub-band 0 switch
Compensation	Investigation on the ground needed to understand loss of communication. Likely loss of observation in the next OD but not an issue when HIFI is to become non-prime. Communication lock should be released in the next DTCP.
Remarks	No safety issue, extra sub-band0 switch involved

Failure ID	S-05
Function/Event	Wrong frequency was used to put the LCU in dissipative mode, resulting in not using the dedicated dissipative index
Failure Mode	Error in CUS tables
Effect	LOU is set at the correct band, at another frequency than the planned, and with the safe Vd2 setting. This is not recommended to leave the LOU in this state for potentially the following 2 weeks.
Compensation	Operator should set HIFI to the intended dissipative band during the next DTCP.
Remarks	No safety issue, no extra sub-band 0 switch involved

Failure ID	S-06
Function/Event	Wrong frequency and non-safe (high) Vd2 was used to put the LCU in dissipative mode, resulting in not using the dedicated dissipative index
Failure Mode	Error in CUS tables
Effect	LOU is set at the correct band, at another frequency than the planned, and with a Vd2 setting compatible with a pumped mixer. This is not recommended to leave the LOU in this state for potentially the following 2 weeks.
Compensation	Operator should set HIFI to the intended dissipative band during the next DTCP.
Remarks	No safety issue, no extra sub-band 0 switch involved

Failure ID	S-07
Function/Event	Wrong "dissipative" band/index was used to put the LCU in dissipative mode.
Failure Mode	Error of the HSC scheduler
Effect	LOU is set to a different band from the intended one for the upcoming weeks This will imply at least one extra sub-band0 switch when the next HIFI OD start with the switch-on to another band. Also, stabilization will not be as good as could.

Compensation	Operator should set HIFI to the intended dissipative band during the next DTCP. Other than that, sanity checks could be implemented at the HSC to check for band consistency in POS files
Remarks	No safety issue, extra sub-band 0 switch involved

Failure ID	S-08
Function/Event	Engineer mode to move from <i>Normal</i> to <i>Dissipative_II</i> missing from the schedule
Failure Mode	Error of the HSC scheduler
Effect	Same as S-03
Compensation	Same as S-03 Other than that, sanity checks could be implemented at the HSC to check for missing mode transition AOR missing from POS files
Remarks	No safety issue, no extra sub-band 0 switch involved

Failure ID	S-09
Function/Event	Engineer mode to move from <i>Normal</i> to <i>Dissipative_II</i> accidentally swapped with or followed by transition to <i>standby_1</i>
Failure Mode	Error of the HSC scheduler
Effect	The LCU is off and in standby-1. An extra sub-band 0 switch was issued because of this
Compensation	CUS mode to transit to standby1 should not be made available to scheduler
Remarks	No safety issue, extra sub-band 0 switch involved

Failure ID	S-10
Function/Event	Correct band/index were used and the LCU is brought to dissipative mode, but the LCU table contained wrong settings for that particular index
Failure Mode	Safety table error
Effect	RF power may not be as low as expected. Safety issue unclear (Bonn to comment)
Compensation	If safety at stake, operator should set the LCU in dissipative mode with another band, involving 2 extra sub-band 0 switch (one for the recovery dissipative band, and one at start of next HIFI OD). In near future, need for update of the safety table.
Remarks	Possible safety issue, TBC which tools exist in table generation that avoid this kind of error. Potentially two extra sub-band 0 switch involved

Failure ID	S-13
Function/Event	Use of SIS dissipative band prior to an HEB ODs
Failure Mode	Because currently HEB LO bands do not offer a dissipative index, when an OD starts in an HEB bands, the transition to dissipative during the non-prime period will have to be done with another band than the HEB one.
Effect	It will add at least one extra sub-band 0 switch, and will not offer the optimum stabilization possibilities for the band to start with in the next OD
Compensation	Add a dissipative index in HEB bands, or use S-14
Remarks	Additional sub-band 0 switches

Failure ID	S-14
Function/Event	Use of HEB band with safe settings in dissipative mode
Failure Mode	As a potential solution to S-13 , in order to avoid sub-band 0 switches, the HEB band to be used at start of the next HIFI OD could be set at a “normal” index, with safe Vd2 setting.
Effect	Band is left on for about 2 weeks in a row with low but not minimum RF power.
Compensation	Implement first proposed solution to S-13
Remarks	No extra band sub-band 0 switch. Life-time issues ?