

Summary Notes: 13th Meeting of Sub Working Group on the Commissioning of the Machine Protection System.

Wednesday 9th January 2008

Present: Ralph Assmann, Roger Bailey, Bernd Dehning, Eva Barbara Holzer, Verena Kain, Mike Lamont, Alick Macpherson, Laurette Ponce, Stefano Redaelli, Mariusz Sapinski, Jan Uythoven, Jorg Wenniger

CC: Reyes Alemany, Brennan Goddard, Magali Gruwe, Bruno Puccio, Rudiger Schmidt, Walter Venturini, Markus Zerlauth

BLM threshold setting implementation proposals – Marius Sapinski

- Mariusz gave a summary of the presently implemented threshold setting, as well as a new proposal for. Please refer to the presentation for details, but note that this presentation has subsequently become obsolete.
- After some discussion, the meeting attempted to summarise the situation and come to agreement on the design and implementation for BLM threshold settings. The summary is given below.

BLM threshold setting and operation: Summary of agreed baseline

Executive summary

- The thresholds on individual BLM monitors will be trimmable.
- BLM expert actions and all changes of BLM thresholds are restricted to a small group (3 people) who have been assigned the necessary RBAC permission.
- Changes in the BLM Master table are recorded via LSA (Oracle) database snapshots, and the Master table change is confirmed by a before-after comparison.
- Machine Protection requires periodic comparisons of the applied front-end thresholds with the expected applied thresholds and with the Master table, that are at the same SIL level as the BLM hardware implementation.
- It is proposed that all BLMs initially be configured as unmaskable, and that configuring a BLM as maskable only be done under exceptional circumstances.

Philosophy

- The master table should only be changed infrequently
- The master table is the backed up reference table for the BLM system
- Individual BLM monitor thresholds (applied values) must be trimmable, with a recorded trim history
- Families of BLM monitors are to be pre-defined. These families are logical sets defined by monitor location and expected sensitivity, and are to be used for the definition of initial threshold settings.

- The values in the Master table are to be the maximum allowed values.
 - These master table values are set above the quench level parameterisation (for cold element locations) and below the estimated damage level values.
- Whenever the master table is changed, all applied threshold have to be regenerated and sent to the hardware.

Implementation

- **Configuration:** The structure for BLM threshold setting is shown in Figure 1. In relation to this figure, the key points are:
 - There are 4 tables used for the configuration of the BLM system
 - **The Monitor Table.**
 - Contains the family mapping F_m^f used to assign attributes of the pre-defined BLM families.
 - F_m^f can be changed by the BLM expert, but is not trimmable
 - Contains all data specific to an individual monitor.
 - Each monitor is represented in this table
 - **The LSA Settings Table**
 - This is the LSA table of all operational settings, including the BLM.
 - For the BLM, the trimmable individual monitor factor C_m is stored here, as well as any trim history.
 - The monitor factor is required by Oracle constraints to be such that $0 < C_m < 1$
 - **The Family table.**
 - Contains the conversion factors associated with the predefined BLM families that are used to convert threshold settings for using in the logging database.
 - This table is not used for Master Table or applied threshold generation.
 - **The Threshold table.**
 - Contains a threshold based on the estimated quench level parameterisations (or damage level if it is a warm element) for each of the predefined BLM families. Each parameterisation involves 32 energy intervals for each of the 12 different BLM sampling schemes.
 - These T_f thresholds are then taken as the maximum allowed threshold that can be applied.
 - The Monitor, Family, and Threshold tables are only accessible via the BLM expert application.
 - The C_m factors are accessible by the standard trim application.
 - **Note:** After the meeting of 09/01/2008, Chris Roderick vetoed the idea of having an applied table implementation with two trimmable parameters (C_m and a family factor C_f) on the basis of implementation.
 - This has since been discussed with and agreed by Bernd.

- Both the Master Table and the applied thresholds are built as database views in the LSA database, and use the configuration tables as indicated in Figure 1.
- The generation of the applied threshold values to be sent to the front-end hardware is done by the application of a database rule, and implicitly ensures that the applied threshold is less than the master threshold.
- The Master Table values are considered as the maximum allowed threshold values, and are required to be well below the expected damage level.
 - For BLMs on cold elements the Master table values are derived from the quench level parameterisations, by a multiplication factor (greater than 1 – this factor is as yet not specified).
 - For BLMs on warm elements, the Master table values are derived from estimated damage levels. The procedure for this needs to be detailed.
- **The Master Table**
 - The Master Table is an Oracle database view that is generated and stored on the LSA database
 - Once the Master table is generated, it is frozen (ie set as read only) so that inadvertent changes can not be made.
 - In order to change something in the Master Table (as per the Use cases of Table 1) the Master table must then be “unfrozen”, and then the changes can be implemented by experts with the appropriate RBC authorisation (see the section responsibility).
 - The unfreezing (assigning write permission) of the Master Table structure in the database is an action done by the database group. The procedure, responsibility, and time required for this needs to be clarified.
 - Whenever the Master table is changed, both a snapshot record, and full image of the Master Table has to be made before and after the changes.
 - Using such snapshots and images of the Master Table, the changes to the Master Table are explicitly checked and validated.
 - A procedure for this needs to be in place, and should include the ability to restore previous versions of the Master Table, as well as to extract a full history of changes made to the Master Table.
 - The time to change the Master table is required to be less than half a day. This requirement does not cover the time required for hardware interventions, but deals only with the changing of the Master Table, its uploading, the verification procedure, and the propagation of thresholds to the BLM front-end.
 - An estimate of the steps needed and the amount of time needed is requested from the BLM group.
- **Pre-defined families of BLM monitors.**
 - These family structures are understood as logical groupings and are necessary for the generation of the master tables.
 - There is no adjustable family factor assigned to a family
 - Adjustment of thresholds is only done by trimming the monitor factors C_m . F_m^f is not a trimmable parameter.

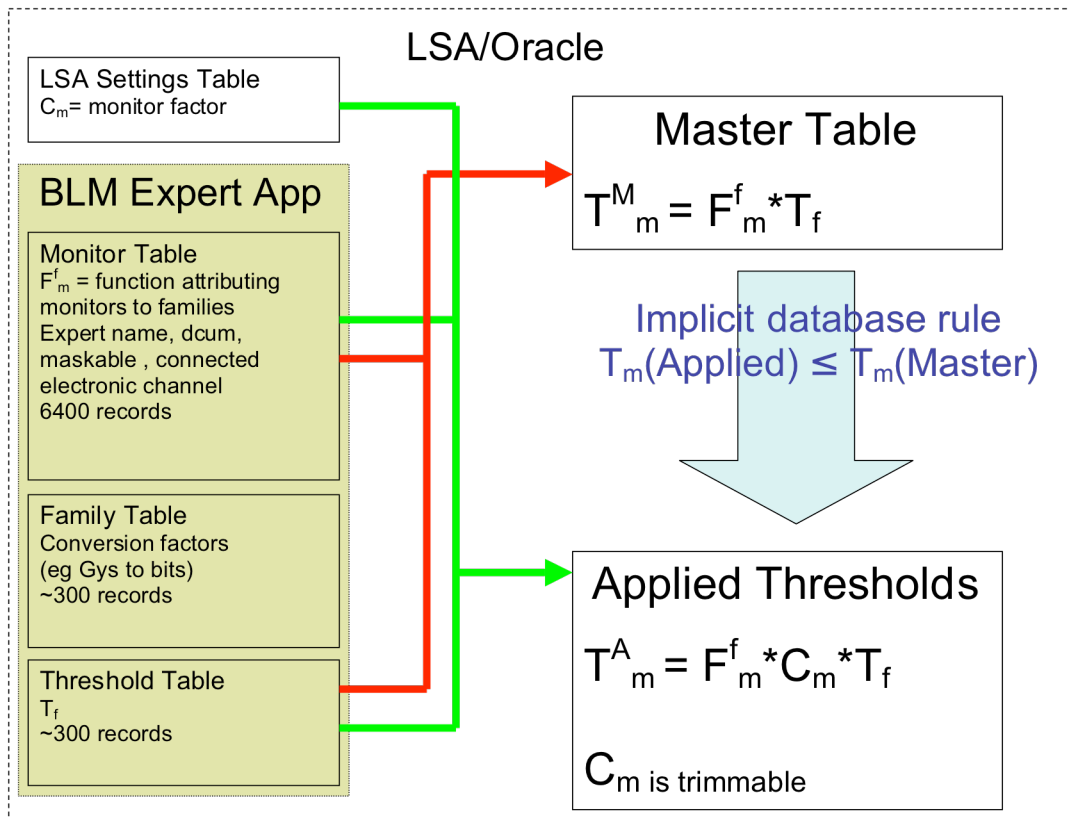


Figure 1: BLM Threshold setting

- **Changes in Thresholds or Settings**
 - Any change in BLM thresholds, whether by the Master table, or by trimming of the monitor factor C_m , must be done when there is no beam in the machine, and can only be done by a restricted set of persons with the correct RBAC permissions.
 - Any change of a parameter in the monitor table (eg location, replacement of CFC card etc) requires a regeneration of the Master table.
 - To change the value of an applied threshold of an individual monitor, the trim application is used to change the monitor factor C_m .
 - Such an action does not require the regeneration of the Master Table, as the C_m factors are stored in the LSA settings table.
 - A full trim history for each C_m is available for a given Master Table configuration.
 - For a change in the Master Table, the trim history for an individual monitor is not lost if parameters related to the monitor thresholds are not changed.
 - If the Master table regeneration is due to a parameter that influences the monitor's performance, then the trim history is not by default applied. It may be kept (to be confirmed), so that the trim history can be reapplied, if required.
 - Clarification is needed in specifying under what conditions (if any) trim history is lost.

- Clarification is needed in specifying under what conditions trim history is applied/not applied after Master Table regeneration.
 - For trimming on a set of monitors, there are two cases to note:
 - In the exceptional case where a trim is applied to all monitors in a pre defined BLM family, cross checks on changes affecting a distributed set of BLM are required to ensure Machine Protection integrity (ie for trims that affect all the monitors in the arcs, additional checks are needed)
 - For trims applied to a localised set of monitors, intelligence should be in the Trim Application.
 - The trim application for the BLMs needs to be defined in more details.
 - The initial default value of the applied thresholds is 30% of the quench level (for BLMs on cold elements).
 - This does not imply that $C_m = 0.3$, as the Master Table values will be above the theoretical quench level values, but below the damage levels.
 - Changes in master table or applied threshold values require the correct RBAC permissions.
 - Changing of applied thresholds is implemented via MCS.
- **Use cases foreseen interventions related to BLM threshold generation**
 - The use cases for changes for all foreseen interventions related to BLM threshold generation are given in Table 1.

	Action	Implication	Attributes affected
1	Disable/remove a monitor (standard -> mobile)	Affects MASTER avoidable but safety critical	Expert and machine name, connected
2	Add a monitor (mobile -> standard)	Affects MASTER	Exp& machine, connected, dcum, maskable
3	Splitting existing family without threshold change	Not foreseen. Affects MASTER.	Family name (in all tables)
4	Change a monitor family	Affects MASTER difficult to avoid	family name (in monitor table)
5	change family master thresholds	affects MASTER unavoidable	family name (in monitor table)
6	change monitor location or electronic chain (new CFC card ...)	Affects MASTER avoidable but desirable?	CFC card, crate name, dcum, channel BLECF
7	change monitor factor (C_m)	Affects APPLIED	C_m
8	Creating new family for monitors (mobile ->standard)	Affects MASTER unavoidable	New entry in family and threshold tables
9	adding mobile monitor (empty mobile ->mobile)	Affects MOBILE monitors only	

Table 1: BLM Threshold Table Changes - Use Cases

Functionality

- **Machine Protection Integrity**: In order to establish the reliability required by Machine Protection when changing thresholds, independent checks on the applied front-end threshold must be made. ie the threshold setting is required to have a SIL level equivalent to the BLM hardware.
 - These checks will be done both on change of any parameter in the BLM system, and before each fill.
 - These checks will ensure that the front-end values match with the expected applied values, and are compatible with the Master Table.
 - These required cross-checks are:
 - Comparison of the LSA database applied threshold value with the front-end applied threshold value.
 - This comparison is done via MCS, with encryption keys to ensure the correct transmission of the correct value.
 - Independently, the front-end applied threshold value is read back by monitoring software and compared with the LSA database applied value.
 - Comparison of the applied threshold value with the Master table at the LSA database level. This is done by the database software, and is an explicit check that the applied threshold generated from the Master table is less than the Master table value.
 - Note: this is an explicit check of the implicit database rule used to generate the applied threshold.
- **Disabling of BLM channels**
 - Disabling of individual channels can be done, but this requires a regeneration of the Master table (Use case 1 in Table 1).
 - For monitoring of the enabled/disabled BLM channels the “connected” flag in the Monitor table is used. This flag is propagated to the Master table.
- **Masking of BLM channels**
 - In the present baseline the hardware implementation is such that BLM monitors can be classified as either maskable or unmaskable.
 - The list of maskable monitors has not yet been agreed upon.
 - Maskable monitors are defined by a flag in the Master table, and so can be defined as maskable/unmaskable by a regeneration of the Master Table ie no front-end hardware intervention is needed.
 - Note that if a monitor is defined as maskable, it must then be set as masked in order to mask its input to the BIC.
- **Masking: Proposal for the baseline system**
 - The present proposal for masking is as follows:
 - All BLMs are initially configured as unmaskable. The infrastructure for masking channels is implemented, but it is not foreseen to be used at this stage.
 - **Request from Rudiger**: If we start defining all BLMs unmaskable, I request that it is possible within a short time (some hours) to set all monitors to maskable.

- Why: even injection tests will not be possible when all monitors are unmaskable, and the BLM system is still being debugged.
 - Points to be noted about this present proposal
 - Masking is discouraged as individual channels can not be masked, as masking a channel masks all the maskable channels that belong to the same BIC
 - If single BLMs fail, and cannot be fixed, then they must be disabled. Masking of such channels is not an option, as masking is only valid at Safe Beam intensities, and as mentioned above, masking of a channel also masks channels in the same BIC.
 - Independent of masking, one can trim a monitor threshold above the quench level if necessary, by trimming C_m .
 - By having a baseline that does not use the masking of BLMs in the initial configuration, there is no dependence on the reliability of the Safe Beam flag (both at 450 GeV and 7TeV)
- **Mobile monitors:**
 - A pre-determined set of mobile BLM monitors have been defined, and normally their deployment does not require an update of the Master table, as they do not create interlocks.
 - If interlocks of Mobile Monitors need to be taken into account, the Master Table will need to be updated.

Responsibility

- **BLM Expert Operation:** The responsibility for changing BLM threshold, disabling BLMs, or any other actions that involve the BLM expert applications is assigned to a BLM Expert Operations team.
 - This team is composed of 3 or 4 people who have the understanding and RBAC permissions to perform the following tasks
 - BLM threshold changes via the trim application
 - Master table regeneration
 - Disabling of individual monitors.
 - Re-configuring a monitor from un-maskable to maskable
 - **Proposal from OP(Laurette):**
 - Given that monitors thresholds can be adjusted via the standard trim application, and the trimming on C_m is constrained to be within MPS defined safe limits, the EIC should be allowed to change the C_m factors (by trimming) without the requiring a sign-off from the BLM Expert Operations Team.
 - The members of the BLM Expert Operations team are to be appointed by the BLM project leader after consultation with Machine Protection and LHC Operations.
 - Bernd has been asked to propose 3 people for this BLM Expert Operations team

Specifications

- A technical specification is required for the threshold setting, and Mariusz Sapinski has agreed to produce this document.

AOB

- Next MPSC meeting
 - **Date: 30th January 2008**
 - **Time: 10:00 - 12:00**
 - **Room: 865-1-D17**