CAN WE MAKE THE PREPARATION OF MDs MORE EFFICIENT?

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Abstract

In 2017, four Machine Development (MD) periods were scheduled at the LHC with the goal to study beam parameters and new ways to optimise the operation of the machine (LHC and HL-LHC). Before the start of the studies certain preparation and coordination is required in order to guarantee a successful MD (if the machine availability permits). This paper reviews the restricted Machine Protection Panel (rMPP) procedures, communication between LHC and injections and possible ways to improve the full process including current web tools.

INTRODUCTION

Dedicated time for Machine Developments is scheduled every year during the LHC Run. In 2017, four MD blocks were allocated with a total of 18 days for different machine studies. Table 1 shows the distribution of these 18 days in the 4 MD blocks including the time dedicated to the short Xenon run. The last MD block was the most intense, in 7.5 days of MDs there were scheduled 28 different tests. Fortunately the machine availability was excellent, 93%, and most of the MDs were successful. This was thanks to the very thoroughly preparation and implementation of the different tests and type of beams and the very optimum coordination between the different accelerators and the experiments. Figure 1 shows the packed schedule during MD4 block.

Table 1: Distribution of days on the different Machine Development blocks in 2017.

Block	Days	Machine Availability	Number of MDs	Average time [h]
MD1	3	85%	8	9
MD2	2	90%	8	6
MD3	5	80%	19	6.3
MD4	7.5	93%	28	6.4
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REQUESTING A MACHINE DEVELOPMENT

Online MD request

A series of steps need to be done upon before the MD takes place. The process starts with the online request of the tests. This is done via a web page tool [1]: `https://md-coord.web.cern.ch/`. In the online request form the user will fill basic information such as a short motivation

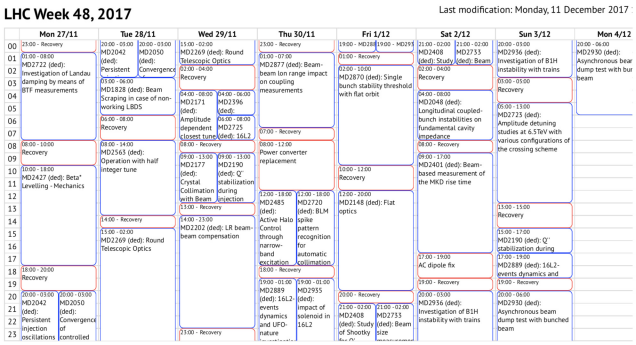

Figure 1: 2017 Schedule of MD4.

for the study, basic beam parameters (energy, number of bunches, optics, etc.). Figure 2 shows an example of the MD request form.

This will be the first input for the MD coordinators who prepare a first selection of tests.

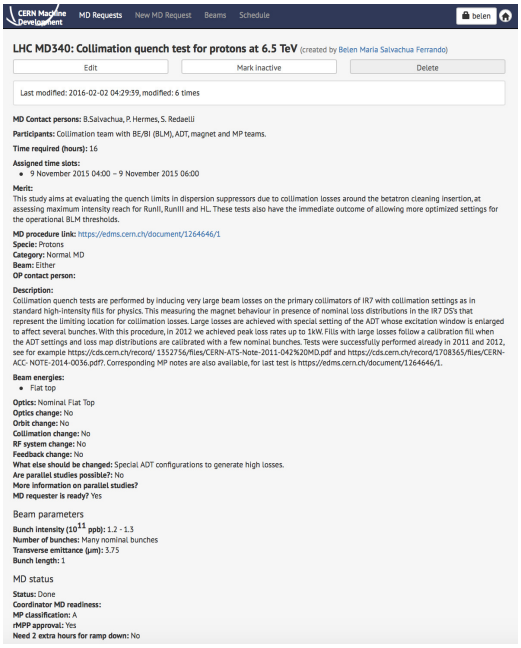

Figure 2: Example of online MD request.

LHC Studies Working Group

If the MD is potentially interesting for the incoming MD block, the requester will be asked to prepare a 5 minutes presentation at the LHC Studies Working Group (LSWG) [2]. The presentation should include in addition to the information added into the request a short introduc-

tion on how the test needs to be done.

After the MD takes palce the MD user will be asked to show the preliminary results in this meeting. This is in particular important for MDs that require additional tests. An MD note needs to be written with the results that will be uploaded to CERN CDS.

An example of the agenda of the meeting is shown in Figure 3. The meeting provides a wide overview of all the tests and the results in a second presentation. Representative from different systems are present, beam instrumentation and machine protection. The first questions on the preparation of the MDs, machine protection issues and expertise needed are discussed during this meeting.

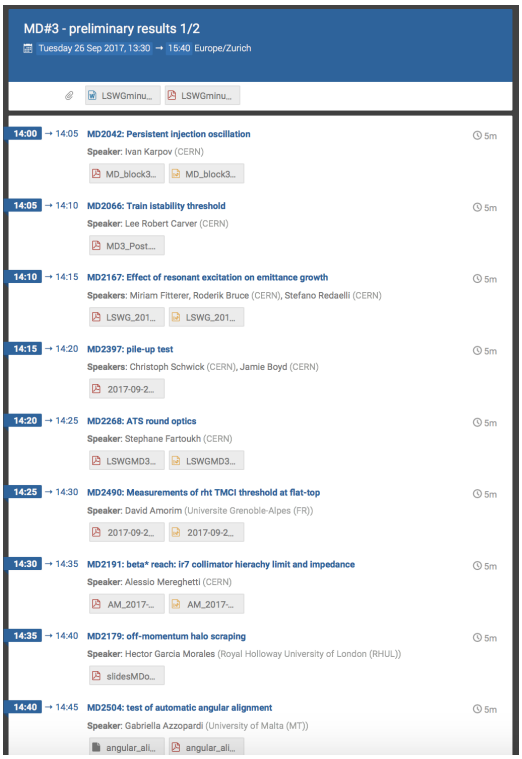

Figure 3: Example of LSWG Indico agenda.

MD Procedure

In addition to the LSWG, the MD requesters are asked to provide with a document that will contain the detailed steps to be taken before, during and after the MD in order to prepare and recover the machine. Ideally this document should provide already with the beam type information, filling scheme, new sequences (if they are needed), etc. In order to be effective, the document should have been prepared by the MD requester and one person from the operations (OP) team. However, the selected person from the OP team is sometimes not contacted which at the end results on a not well prepared MD. And example of the document is shown in Figure 5.

All the documents are collected by the MD coordinators and stored in a DFS public directory of one of the MD coordinators [3], see Figure 4. This is useful, however the document could be instead be linked to the initial online request. It is the case that after discussions in the LSWG or following meetings the MD document and the initial request are different.

If the MD is classified to have any potential risk for machine protection then another presentation with more details is done at the Machine Protection Panel (MPP) [4]. In this case the document is also uploaded to EDMS for distribution and comments.

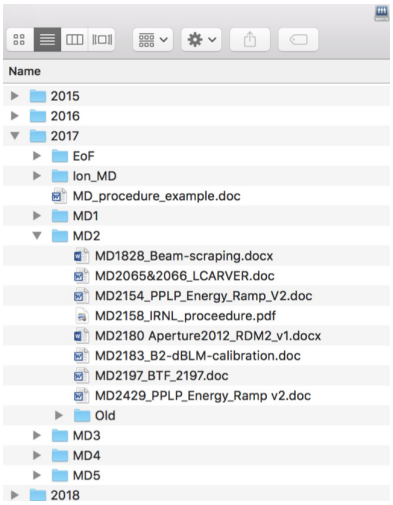

Figure 4: DFS directory with MD procedures.

IMPROVEMENTS?

There is a lot of work and effort on the preparation on the MDs. However, it seems that information is spread and presented in many different places: LSWG, rMPP, sometimes also at the LHC Machine Committee (LMC) [5]. The details are in the Procedure, however the final selection of beams are in tables that are sent to the injectors. The information is lost on the transmission, a common central place for the updated procedures, schedules and selection of beam types for LHC and injectors is recommended.

During the preparation of the MD one engineer in charge of the LHC could be assigned as *coach*. This was already proposed in the previous years, however again the information was not clearly transmitted, some MD users though that the MD coordinators would contact the person in operations. The role of the OP person should be to participate in the preparation of the procedure that should contain more specific information such as Beam Processes, name of OP sequences, Hypercycle name, etc.

Regarding the preparation of the beams, it will help if the filling scheme and basic beam characteristics are also specified in the procedure, as well as a comment in the beam quality. As an example, some MDs required very well controlled emittance or bunch intensity, others not. Preparing the beams with higher quality requires time and this needs to be taken into account on the assigned MD time.

The parallelisation of the MDs is also a bit controversial.

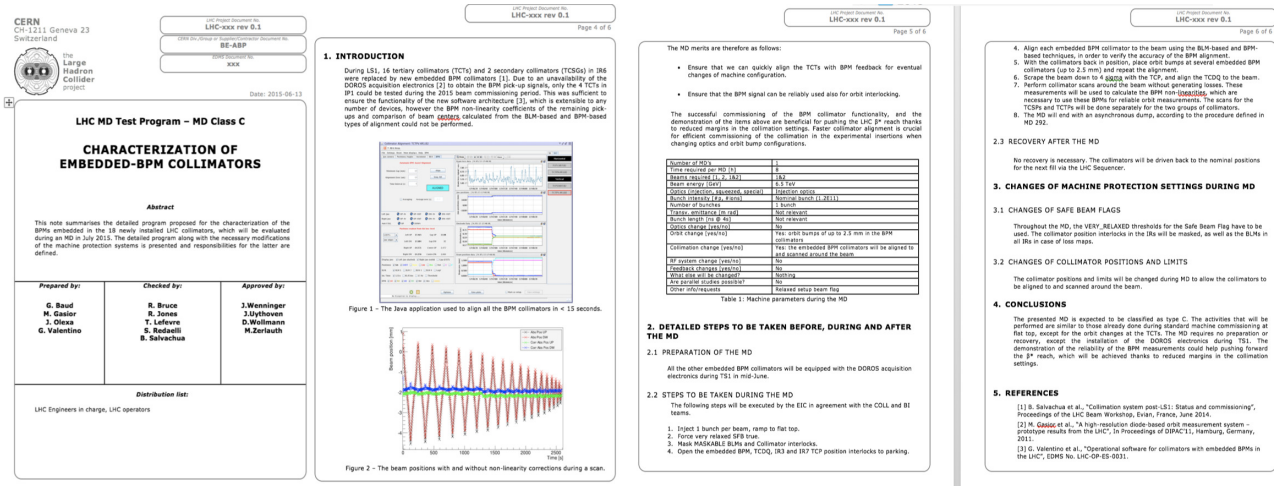

Figure 5: Example of MD procedure.

There has been very successful parallel MDs that would not had happened otherwise. However there were others not that lucky and the MD users were interfering with each other. It was discussed that the parallelisation is a very good way to optimise the machine time, however the MD requesters should agree and maybe prepare a common procedure in order to understand the sharing of time and the constrains of each test.

It was requested also to avoid LHC tests during MD days on the injectors when possible.

NEW WEB TOOL

The group of BE-CO is providing next year with a new web tool to ease the MD requests and scheduling. The tool can be accessed via the following link [6]: `https://asm.cern.ch`. It will include all the CERN accelerator complex. The scheduling part can be used during Commissioning of the accelerators as well as during the Machine Developments. Experts and coordinators could insert constrains on the schedule, this information will be then taken into account.

Concerning the MD request part, they have the flexibility to integrate the MD request and the procedure in the same interface, either via a link to the procedure or by writting text and attachments into the web tool directly. It has an interface to LSA database, so it can, for example, it can offer a pre-set menu of available beams. As the tool is still in development phase, the developers would like to get feedback from MD coordinators before the final deployment.

Once all the MD requests are in, the tool offers the possibility to sort them, which could be interest for example to make a sort depending on beam intensities for MPP classification.

During 2017, the beam parameters definition was shared with the injectors via a share point [7]. This was very useful, however not all accelerators were aware of this share point and is is difficult to find unless you received the e-mail with the link. Ideally, this part could be integrated in the same online tool.

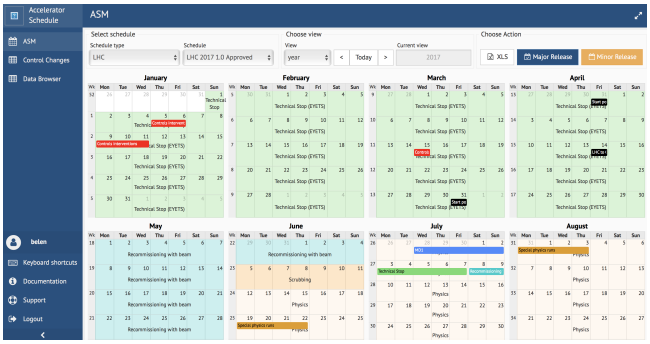

Figure 6: New BE-CO web tool to request MD and coordinate activities.

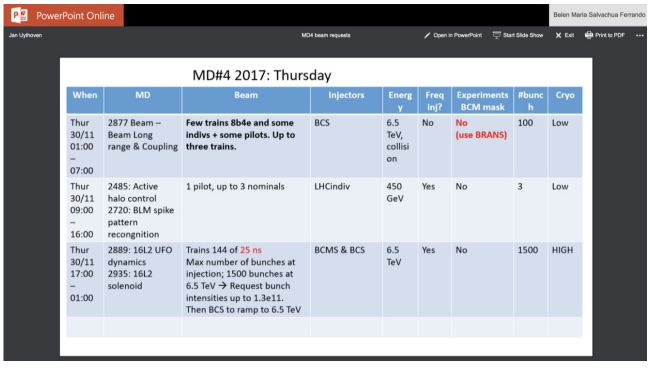

Figure 7: Example of Share Point information on beam types.

CONCLUSION

Many Machine Developments were successfully scheduled, prepared and implemented in operations during 2017. However it is still difficult to find the correct and updated information. There are many people involved, MD users,

MD coordinators, operations team, LHC, Injectors, etc. the information needs to be better transmitted.

The MD users write in different places similar information, in the request, in the procedure and in the presentations. A centralised place to find the updated information would be recommended. The most complex MDs they have an OP person attached that contributes significantly to the preparation of the MD. We should encourage that other MDs also interact more the OP team.

ACKNOWLEDGMENT

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REFERENCES

[1] https://md-coord.web.cern.ch/

[2] https://indico.cern.ch/category/3693/

[3] https://dfs.cern.ch/dfs/Users/u/uythoven/Public/LHC_MD_Procedures

[4] https://indico.cern.ch/category/9003/

[5] https://indico.cern.ch/category/5986/

[6] https://asm.cern.ch

[7] https://social.cern.ch/me/uythoven/_layouts/15/WopiFrame.aspx?sourcedoc=/me/uythoven/Documents/MD4%20beam%20requests.pptx&action=default