

31st Meeting of the Machine Availability and Reliability Panel (MARF)

Present: A. Apollonio [TE/MPE], T. Cartier-Michaud [TE/MPE], L. Serio [EN/ARP], R. Steerenberg [BE/OP], B. Todd [TE/EPC], J. Uythoven [TE/MPE], M. Zerlauth [ATS/DO]

Excused:

Indico link: <https://indico.cern.ch/event/991185/>

Discussing M. Lamont's answer on the present and future MARF activities (A. Apollonio)

M. Lamont, as new ATS director, replied to the email sent by MARF members asking to confirm MARF's role and mandate for the coming years. He gave positive feedback, acknowledging MARF's contribution in the past years. He also formulated several recommendations and questions.

The first question concerns the formalization of collaborations with other institutes and the involved CERN resources. J. Uythoven confirmed that the MYRRHA collaboration is official and that they are financing a fellow working at CERN (L. Felsberger). M. Zerlauth added that a collaboration agreement also exists for the work between GSI and CERN, in particular for the collaboration with the MPE group on the 'Access System' for GSI. Staff resources involved in these collaborations is limited to the supervision of students and Fellows working on these topics.

M. Lamont asked to whom MARF is reporting in principle. MARF has been initiated by R. Schmidt and J. Gutleber and originally reported directly to F. Bordry. As MARF members come from different machines / domains / groups, the Accelerator Director appears to be the appropriate person to report to. M. Zerlauth suggested proposing a direct reporting to the ATSMB (for relevant topics) once or twice per year to keep the management informed.

M. Lamont encouraged MARF to continue the participation in the risk assessments and consolidation activities. He made clear that there is an interest in the sector to coordinate machine learning activities. J. Uythoven emphasized that the role of the MARF which is supposed to take decisions and coordinate activities, and not to do studies. Studies are done elsewhere, the technical details might be discussed in RASWG, the conclusions are presented to the MARF.

ACTION A. Apollonio will send a draft email and mandate to the MARF members before replying to M. Lamont.

In 2017, MARF had 6 members, each taking care of one of the 6 points of the initial mandate. A. Apollonio recalled the mandate and presented an update:

1) Design of dependable electronic systems: B. Todd and others developed a checklist for dependable electronic designs (EDMS [2002392](#)). The next step could be to establish a panel

for reviews of electronic system designs. In parallel, a similar activity is under discussion by A. Masi and J. Serrano in BE/CEM.

ACTION: A. Apollonio will call for a meeting with B. Todd, A. Masi and J. Serrano.

2) Availability tracking and availability-driven performance optimization: R. Steerenberg suggested that accelerators should record faults as soon as they deliver beam to the next machine in line, following LS2. Prior to that, availability is not an issue and time is rather spent on fixing issues. B. Urbaniec is taking care of technical aspects of AFT for now but he will take other responsibilities soon. A. Apollonio pointed out that in the future the fault review responsibility should be re-discussed and possibly streamlined to reduce the workload. A. Apollonio recalled the weekly meeting with one person representing each machine were very efficient, he proposed to apply the same approach also for the LHC. R. Steerenberg commented that discussions are already ongoing in OP to know how to manage the fault tracking.

3) Machine learning applied to the reliability analysis of complex systems:

L. Serio suggested that the MARF should adapt to what is done in the ATS sector for ML, potentially having a representative in a new official forum that remains to be defined.

4) Reliability analyses and risk assessment for HL-LHC accelerator systems: This point was already included in the previous mandate but now it appears as an independent point because of the growing importance of HL-LHC, entering the production and testing phase. M. Zerlauth commented that in view of the upcoming C&S review, the risk assessment exercise will likely be repeated, following a top-down approach, which is different from the more traditional risk assessments done for reliability studies, which are rather bottom-up. This will be followed-up with H. Garcia Gavela.

5) Risk assessment for consolidation requests: MARF provided a new consolidation form for the risk assessment. The next step could be to take part in the arbitration process for evaluating the forms submitted by the groups. B. Todd shared his experience in this respect, which was challenging to coordinate the ideas, and impose coherency, within EPC. It has to be seen if this approach is appropriate. This should be discussed with the project leader (R. Billen will replace L. Van Den Boogaard as deputy project leader, M. Lamont expects to hand over to a new project leader in the course of 2021).

6) Present and future collaborations in the field of reliability: B. Todd and A. Apollonio mentioned that from collaborations, workshops and papers, it seems that CERN is establishing itself as the reference institute for reliability studies in the research community. CERN has also learned a lot over time from the community, as there's a growing attention on this topic, especially for medical applications.

7) Development of availability/reliability analysis tools and methods: With the consolidation actions and HL-LHC entering the design and production phases (e.g. for new-generation machine protection systems), many new studies will be carried out soon. It is important to keep the combination RASWG – MARF to discuss technical details – take decisions.

L. Serio announced that he is now attached to the TE department and hence cannot represent EN anymore. Someone will have to be mandated to replace him to represent the department (to be discussed with K. Foraz).

It has been decided that MARP will take place on Wednesday afternoon, in the weeks without the LMC and with a periodicity of four weeks.

ACTION: T. Cartier-Michaud will organize the new periodic meetings.

SM18 cluster F study: definition of scales (A. Apollonio)

A. Apollonio recalled the history of the risk assessment of SM18 cluster F, which started by a presentation of B. Fernandez Adiego in the RASWG [1], triggering discussions with A. Apollonio. B. Fernandez Adiego's approach is based on IEC61508 and SIL definition. It requires to define 1) a scale for consequences of failures, 2) exposure parameter, 3) probability of mitigating the hazard and 4) demand rates. First results based on the consequences scale proposed by A. Apollonio indicated more stringent requirements for machine protection compared to personnel protection. Those results have been discussed during the last MARP meeting and offline, leading to a new scale of consequences of failures presented by A. Apollonio.

A. Apollonio recalled that the scale has to have 4 values to fit into the framework used by B. Fernandez Adiego. M. Zerlauth explained that availability has not the same importance in test stations such as SM18 (setting up a test typically takes much longer than the test itself), the scale should be more detailed in the reliability range, for failure modes where the mitigation did not act properly. Also, he pointed out that the best mitigation procedure for equipment might be in contradiction with the best mitigation for personnel safety, such as in case of quenches: fast abort is the best action for equipment protection, but it could be more dangerous for a person nearby due to the high voltages and potential risk of helium release. The MARP agreed that the scale presented by A. Apollonio could be used for the FMEA for SM18 Cluster F. It has to be noted that this is based on a limited experience with the systems involved, thus a conservative approach is recommended.

ACTION: A. Apollonio will communicate the new scale validated by MARP to B. Fernandez Adiego.

[1] <https://indico.cern.ch/event/975306/>