

RAS Working Group meeting 16.12.2021

Participants: A. Apollonio, A. Asko, F. Asvesta, P. Bell, M. Blaszkiewicz, H. Boukabache, M. Braeger, M. Brucoli, M. Buttner, T. Cartier-Michaud, S. Danzeca, L. Delprat, G. P. Di Giovanni, L. Felsberger, E. Fortescue-Beck, P. Gkoutoumis, G. Iadarola, V. Kain, T. Ladzinski, I. D. Lopez-Miguel, A. P. Marccone, B. Mikulec, S. Ramberger, P. K. Skowronski, B. Todd, J.-C. Tournier, W. Viganò

The slides are available on Indico:

<https://indico.cern.ch/event/1104980/>

A. Apollonio discussed the minutes of the previous two meetings. There were no actions. For the meeting on the 18.11.2021, he points out the discussion for an electronics design dependability checklist to which the RASWG will get back in the new year. For the joint meeting with the Electronics Forum and Industrial Controls Forum on the 09.12.2021 he points to added information by B. Fernandez Adiego for two mailing lists and a *readthedocs* page on Formal Methods, see: <https://indico.cern.ch/event/1103063/>.

2021 Availability Statistics for the Injector Complex - Speakers: P. K. Skowronski, G. P. Di Giovanni, B. Mikulec, V. Kain

Four presentations were given summarising the availability statistics for the LINAC 4, PSB, PS and SPS machines. Each speaker presented the weekly availability over the operational period of 2021 together with an analysis of the main events, responsible systems, and related root causes contributing to downtime. Subsequently, the actions performed during the year, as well as planned for the future to improve the systems and to reduce the fault downtime have been presented per each machine. In addition, suggestions were given how to further improve the Accelerator Fault Tracking (AFT) tool. For the individually set availability targets, all machines reached their goals.

Questions and discussion after the presentations:

LINAC4:

The conditions for fault creation and termination were discussed in detail. These are in the general case machine-dependent and destination-dependent. The idea would be to create faults in a given machine and propagate them automatically to all affected downstream machines and destinations. The absence of beam in that case would also be picked up by the automatic fault tracking tool in the downstream machines, so one should ensure that no duplication is produced. The details have to be discussed with the AFT team.

A. Apollonio comments that the condition to end a fault is well defined, but asks about the start of a fault. He asks if one could wait a few pulses to assure that it is nothing intermittent. P. K. Skowronski replies that it could already be a problem with only one cycle and that this would be a fault. Whenever the chopper goes into NOT-OK it is currently a fault. He furthermore asks if this should be discussed with the software designers. It could indeed be that the analysis shows that the beam is still ok for certain destinations, so the fault could be deleted for these.

A. Apollonio asked if there is something to worry about regarding the spare stock and if it would be beneficial to do a risk analysis. G. P. Di Giovanni replied that the transformer is critical, but that this has already been covered by the IEFC proposal. There is only one company in the world producing this component. The new one should be received during the EYETS. Furthermore it is being investigated with another company in Europe to produce this component. A. Apollonio adds that if support is needed to reach out to the RASWG.

S. Ramberger asks if the spare modulator component also includes such a spare transformer to which P. K. Skowronski replies that the specs are different, but if the full system is changed that it should be fine. It is to be checked if it's compatible with a 600ms pulse. S. Ramberger adds that in that case one wouldn't need to wait for weeks.

PSB:

A. Apollonio commented on the AFT desiderata, that the AFT logic could become complex, as the PSB has multiple destinations and multiple rings. Depending on the destination and type of beam produced, only a subset of the rings might be necessary. A. Asko added that for a correct implementation, this would be something to be followed up after the meeting.

A. Apollonio furthermore commented regarding the feedback of the IEFC workshop that within the MARP a new risk definition is ongoing within the consolidation project. V. Kain added, that one should also start a discussion on what availability really means. She elaborates that hardware availability is represented by AFT faults, but that there is also availability of software and operational tools which is not easy to monitor. This is also part of the availability figures and is not yet fully addressed. A. Apollonio agrees, that tracking the "hardware availability" can be seen as the first level. It is crucial to address for instance the availability of spares, which should be included in the consolidation project. To monitor software availability or availability of operational tools he agrees that this is complex.

W. Viganò pointed out the mentioned water leak and failure of some magnets which appears to be worrisome. He asks if this could be followed up and whether a forecast of potential future failures, as well as a strategy can be worked out to avoid issues in the future. A. Apollonio replied, that B. Todd already proposed a Weibull analysis. G. P. Di Giovanni replied that for the magnets it looks indeed like a systematic issue. They did not fail for 40 years and now it seems that one is failing after the other, this is being studied by the magnet group.

A. Apollonio asked about the coil issue (slide 4) and whether there has not yet a decision been taken. G. P. Di Giovanni replied that the investigation is ongoing. It has been opened and repaired meanwhile, a decision will come after the investigation. A. Apollonio asked about spare availability for this component to which G. P. Di Giovanni replied that thanks to the LIU project there is a spare available which hasn't been available before. A. Apollonio mentioned that in the worst case this would probably create a week of downtime to which G. P. Di Giovanni clarified that in a worst case it would be even more, but that one week would be a realistic figure.

PS:

B. Mikulec pointed out that the AFT dashboard and the detailed fault entries in some cases don't appear to match, because non-blocking faults are not excluded on the dashboard. In the detailed statistics these are greyed out. A. Asko replied that not all filters are implemented for all AFT statistics.

Action: To be verified and checked after the meeting if this is to be implemented in the AFT.

B. Mikulec pointed to the data logging in AFT and that the quality can vary between different weeks based on different operators and machine coordinators performing the logging. A. Apollonio replied that in an ideal world the coordinators should do the first screening and the system experts then the detailed logging and classification of the faults. He agrees that the data quality depends on the person logging it. A. Asko pointed to the free text field in the logging which does not get registered in any statistics. This could be blocked to improve the logging. B. Mikulec agreed that this could be discussed. She adds that a proposal should be made for the next run. A. Apollonio replies that in that case the free text would only be in the description and additional info would have to be added there.

Action: Discuss about keeping or removing the free text field to log faults.

B. Mikulec proposed a logic for Big Sister to check the intensity before each extraction for a certain time, e.g. >1min or maybe >2min, in order to create a fault. A. Apollonio replied that based on calculations of L. Felsberger a <=2min error should be acceptable which is why this should be changed to 2min. He adds that for the SPS this time window has been 2min. Below that, everything has been left unclassified.

SPS:

V. Kain presented the prototype to execute automatic fault tracking and fault assignment to the root cause using the SIS, which should cover 60% of faults to which A. Apollonio commented that the automatic fault integration looks very nice. He comments and asks that at this first step however it's probably capturing more the symptom of a fault rather than the cause. V. Kain adds that nevertheless the SIS is monitoring almost everything already to which A. Apollonio asks whether this can be extended to other machines. He also asks whether this depends on the SIS. B. Mikulec replies that indeed this would involve a lot of work to implement all this in the SIS for the other machines. W. Viganò comments to keep in mind what one wants to obtain by doing such an analysis. He asks what is the goal in terms of the RASWG and adds

that we want to identify the weakest system parts and give feedback to the system experts what are the best next actions to improve the system. He adds that a future meeting could be organised to discuss and align each other. A. Apollonio agrees and adds to also invite the hardware groups to that meeting.

Overview of Future AFT Developments – Speaker: A. Asko

A. Asko presented future developments for the AFT which involves the Big Sister integration in the accelerator complex and various bug fixes and improvements foreseen. A. Asko points out that if something may be missing to get in touch with him. To facilitate potential AFT user requests and display existing issues he points to a Jira epic created:

<https://issues.cern.ch/browse/AFT-1304>

Questions and discussion after the presentation:

V. Kain asked about the fact that all machines have now automatic fault tracking, if the possibility exists that two fault entries will be created for a single fault and how this can be sorted out. A. Asko replied that the fault creation of Big Sister per each machine has to be somehow connected to each other. AFT cannot know which faults it has to register and which not. The solution is yet to be worked out, but ideas already exist. V. Kain replies that information sharing between the machine already exists which can be accessed and used by Big Sister. A. Asko agrees that a discussion regarding this is already ongoing. For instance how a PSB fault can be communicated to PS or ISOLDE. A. Apollonio added that it would make sense to meet with the experts next year, to which A. Asko agrees that one has to go into these details and figure out how faults are connected and how this can be implemented in AFT. A. Apollonio adds that in the easiest case time stamps of the faults can be crosschecked. A. Asko adds that the entire time window can also be connected.

Action: Meet with machine experts and assure that fault logging of Big Sister does not get registered twice in AFT for two machines.