Accelerator Complex Status

End week 22 (Monday 7 June 2021)

Technical Infrastructure (Clement Pruneaux):

Statistics:

- Close to 4200 alarms.
- 876 phone calls (568 incoming, 308 outgoing).
- 142 ODM created.

Events worth mentioning:

- Thu. 03.06: EBD1/1XL cable cut accidentally by science gateway works. A "service généraux" sub-station (ME13)had to be switched off twice on short notice on Tuesday and Wednesday to allow the cable to be repaired without risk by EN-EL.
- Fri. 04.06: Fire electrical cabinet BA80. Around 16:00 fire alarms appeared in BA80, firemen came on site and detected fire in an electrical cabinet, they triggered AUG EUB1/A80. The smokes go through TCC2, TDC2, TA802 et TA801 and ventilation had to be switched off manually due to the lack of communication (caused by the cut). At 17:40 EN-EL re-established all the power excepted on EN/CV HAZEMEYER cabinet UBD2/A80 which supply the demineralised water station for BA80 FDED-00019. By chance SPS operation don't need this circuit until Friday 11/06 for North Area beam which allow times for EN-CV to repair.
- Sat. 05.06: CERN wide electrical disturbance without impact on operation. Multiple electrical alarms PSEN. TI verified and no impact for operation. RTE confirmed fault on 225KV Cornier-ST Triphon.
- Sun. 06.06: Unstable helium reservoir SM18. Cryo SM18 operation requesting assistance from EN-CV to help understand why there is water in the cavity below the helium reservoir in SM18. TI went to SM18 and saw the helium reservoir was floating in its cavity- NO alarms active, FTDP-00721 not running. Fire department and Cryo teams in place. TI started one pump in manual FTDP-00721 with agreement of Cryo and firemen. The pump was later stopped with the plan to support the reservoir from above during HO to be able to empty the remaining water and check correct positioning of reservoir. More investigation will be done soon to understand the problem which was firstly detected on Friday.

Details: https://wikis.cern.ch/display/TIOP/2021/06/07/TI+Week+summary%2C+Week+22

LINAC 4 (Jean-Baptiste Lallement):

Not good, not bad… an average week with 98% availability, with many short beam interruptions, a 30 minute planned stop and one machine access.
Smooth operation on Monday and Tuesday with few minor trips (PIMS 11-12, RFQ, LEBT SIS…).
On Wednesday, an issue was found on the pre-chopper high voltage divider. Its replacement required our ABT colleague to access the tunnel (total downtime 1h40).
On Thursday, following the frequent trips of the PIMS 11-12 klystrons, our RF colleagues found the associated klystron vacuum pump in bad shape. Its replacement was scheduled wrt. SPS beam stop, in the afternoon (downtime 30 minutes - an upgrade for the debuncher tuner control was deployed in the shadow).
The rest of the week was rather smooth with only few minor trips related to LEBT SIS, chopper and BLM front-end.

PS Booster (Jean-Francois Comblin):

This week for the PSB was quite good, with an availability of around 96%.

- The main issue was a problem with the power converter of the recombination septum BT1.SMV10 that required the intervention of the piquet for a total downtime of 1 hour.
- During 2 days, we had some difficulties to understand why the beam was not produced in the Linac 4 from time to time. With the help of MPE specialist, we finally found out that BIS was cutting the beam due to a change of the FGC interlock window of BI.SMV10. This was not reported by the diagnostic application because the bad condition was very short.

Main achievements:

- After the GPS line last week, we set-up the beam to the HRS line. Thanks to the new optic model, the steering was simpler. The kick response measurements gave good results. Reference measurements were taken for both ISOHRS and STAGHRS beams.
- New calibration curves for the main bends were tested with good results, but further smoothing is needed.
- MTE beam: The longitudinal emittance was further optimized and the stability problem cured.
- Injection studies: On the MTE beam, the injection oscillations were minimized in both planes and transverse painting applied. This gave a better transverse ring-by-ring emittance uniformity.

ISOLDE (Eleftherios Fadakis):

Low Energy

On Tuesday 1st of June the SEMGRID target was put in HRS from GPS and target #638 was put in GPS. From GPS delivering beam to GLM and GHM

PSB was not able to start measurements on Tuesday, due to signal issues on the fixed SEMGRID. Issue resolved on Wednesday morning by BI and measurements could start.

PSB continued measurements with NORMHRS beam until Friday when they changed for STAGISO.

Friday afternoon measurements finished, proton request turned off. PSB reports no major offset to the beam which agrees with the alignment measurements.

Today morning, we will remove the SEMGRID target from HRS and put a production target in place.

Regarding the fixed SEMGRID. They are getting old and especially on the HRS side it was giving troubles for PSB to get a signal. We will start organising a consolidation plan.

REX/HIE

To follow up on the incident that took place last Sunday. We together with RF (D. Valuch) and with Cryo (N. Guillotin) are evaluating the situation. A few key points (in bold the ones after the previous FOM):

- A failure of one of the temperature sensors in CM3 brought down the cryoplant on Sunday 29th of May. Cryo piquet intervened but was not able to avoid the loss of LHe in the four cryomodules
- The temperature of the 15 SRF cavities in CM1, CM2 and CM4 raised above 10 K (higher than the critical temperature of Niobium)
- The cryo team worked on recovering the stability of the cryoplant on previous Monday and Tuesday
- The SRF specialist assessed the impact on the SRF cavities on Tuesday and Wednesday. The cavities didn't need to be recondition
- The cavities were handed back to the OP team on Thursday 3rd of June
- Phasing of the buncher, IH and the 7gap1 structures completed for beams with A/q=2.857 and A/q=3.333
- Reference set-ups for those A/q's at 1.55 MeV/u prepared and documented
- Problem with the amplifier for the 7gap2 found. The power seems to be limited to ~ 2kW. RF specialist will be contacted this morning

PS (Frank Tecker):

The PS had a good week with about 96% availability. SFTPRO beam and LHC with an increasing number of bunches - from 12 to 72 - were sent to the SPS.

Tuesday morning, an access was scheduled in the shadow of a stop at the SPS. The main activity was the repair of the C20-92 cavity, which could be put back into operation later that day.

Detailed emittance measurements along the LHC25 nominal beam were done thanks to a Python script that Hannes and Alex were adapting from the SPS. For nominal intensity, the horizontal emittance is in the order of 1.7-1.8 mm mrad during the cycle, the vertical is 1.25 at injection, growing to ~1.9 mm mrad before the second injection.
Further extensive wire scanner measurement were performed during the weekend to compare the effect of the low-chromaticity optics, and are being analysed. Much care was taken to properly set the gates for the gates for the acquisition and to avoid saturation.
On a BCMS cycle with low-chromaticity optics, vertical emittance measurements have shown no significant emittance blow-up at the injection plateau, from 0.58 mm mrad @ C180 to 0.72 @ C1350. Horizontal values are in the range of 1.2 to 1.4 mm mrad after injection and at C1100.

Careful optimisation was done on the RF side for the AD beam. Blow-up modulation frequency and amplitudes, transition crossing timings and RF settings were adjusted, and the One-Turn-Delay Feedback was enabled (improving both transition and batch compression). In the transverse, negative chromaticity was corrected, and the intensity increased to the nominal value of 1400e10. Some remaining losses at injection are very sensitive to the magnetic cycle placed just before it.

Many tests were performed for the BCTs in TT2. The signal is much cleaner after removing amplifiers for the BCTs. A number of issues are being followed up with the experts.

Internal dump tests were done with TDI47 after an update of the FESA class and PLC. The test were successful and we can use it without problems up to an interlock setting at 1500e10.

A problem appeared for F16.BHZ377 and F16.BHZ378 with 2 consecutive MTE cycles, first to SPS then to dump D3: the second cycle is also (wrongly) sent towards the SPS. It is related to the way the central timing and the destination based economy mode work. This cannot be changed and as a consequence consecutive 1 and 2BP cycles with the same user but different destinations need to be avoided. This will be implemented in the SC rules.

During the week-end, a number of 10 MHz cavity trips (66, 36 - needs access to be repaired, and 11) required expert follow-up but did not impact the beam sent to the SPS.

AD (Laurette Ponce):

- Installation of the plastic covers on quadrupoles completed, dipoles will be equipped during the YETS.
- Tests of ejection septum postponed to next week, successful test of injection septum
- Xray done on injection kicker, results presented at IEFC
- AD target dogleg tests: fixed a damaged cable, continuation of the tests this week.
- BCCC refill with helium, leak seems to be fixed

ELENA (Laurette Ponce):

Some issues with ion source reliability. Beam position found again to move necessitating re-steering with correctors just after the source and leading sometimes to high settings.

A firmware bug of the LLRF system was identified and corrected on Thursday. This had prevented machine cycles with different harmonics for different RF segments (e.g. injection, acceleration and re-deceleration to intermediate plateau with h=1, followed by debunching and further deceleration with h=2) to work properly. At a first glance, this change seems to have solved many of our difficulties during the last weeks and is probably a big step forward.

We finally got help from specialists from the RF group for the setting up of the system. As a result, we have a cleaner recapture with the gain of the phase and radial loop now ramped up during a few ms. I hope that we have learnt how to improve the setting up of the system in future.

For the next three weeks, no tests with circulating beam will be possible due to an intervention to exchange profile monitors in the vacuum sector comprising the injection line and the extraction line towards the "old" experimental area. Thus, is will not make sense to send weekly reports. If there is an issue with the intervention, we will inform you. This week, converters will be locked out for a cable pulling campaign for the PUMA experiment (bad surprise for us last week). Next week, we will probably do tests with the electron beam aiming at finding a better setting for the intermediate plateau (now, we cannot measure the electron beam position at the intermediate plateau very likely due to electrons lost and hitting the pick-up electrodes).
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SPS (Kevin Li):

An eventful week for the SPS. This week was foreseen for officially moving into scrubbing with multi-bunch beams with the goal of ultimately storing up to 72 bunches on the long flat bottom cycle. In addition the plan was to finish off extraction setting up for the SFTPRO and LHC type beams as well as setting up the RF gymnastics on the AWAKE cycle. A couple of accesses had been carried over from last week and got scheduled for Tuesday; moreover, COLDEX and the crab cavities were supposed to move in towards the end of the week.

SFTPRO was taken with all 5 turns; items to be checked was the correct setting up of the DFAs in the PS and getting good steering on both core and islands; BSI and mini-scans were to be tested and the RF gymnastics has to be set up. The access on Tuesday allowed the SEM's for the mini-scans to be repaired and also the BSI to be checked. Together with Ewald, the BSI issue could be followed up and another check with beam should be done next week; Ewald has changed the filter to try and reduce the noise on the servo-spill. The SEMs are working now but acquisitions via the application still look confusing; also needs to be checked once more next week. The extraction optimization in the PS could not be completed fully and also needs to be checked next week. And finally, the RF gymnastics was not yet tested. On the other hand, the slow extraction was done will the full beam; the voltage program has been optimized and losses could be significantly reduced. There have been a few observations with jittering radial position for a short time. This could not be reproduced later and the orbit remained stable.

AWAKE was extracted down to the experiment and AWAKE profited from taking a few measurements on their side. The re-phasing issue from last week was solved; re-phasing is much ore stable. There is still a failure about every 10th shot, which however is understood and a fix is underway. On Wednesday, the RF team worked intensively on the AWAKE RF gymnastics using the voltage jump. There has been good progress, but more work still needs to be done next week. Conditioning has been stopped for the moment, to allow stable conditions during setting up.

LHCPILOT was taken on Wednesday for the aperture checks of extraction channel together with the TPSG alignment; the kicker waveform scan still needs to be done next week.

Scrubbing had started well with 12 bunches circulating on FB already on Monday morning; switching to 24 bunches then awakened the MKDV, which is heavily out-gassing and requires intense conditioning. In order to be able to condition efficiently, the pressure thresholds for the MKDV interlock has to be raised from 5e-8 to 1e-6 mbar. Doing this, however, it is strictly necessary to

inhibit any dump at higher energies. Therefore, the supercycle was regularly changed, removing any high energy cycles from the supercycle and the masking the conditioning valid flag in the SBDS before raising the thresholds. The inverse sequence + a soft-start had to be followed when recovering from the scrubbing period. Since this procedure is error-prone it was decided to move to dedicated scrubbing rather soon and to try to push into a situation where cool-down periods would emerge naturally due to kicker heating, etc. With the MKDV conditioning well, an exchanged chamber in BA6 next to the crab cavities become the more limiting factor; hence, the nearby fast valves have been blocked open. By the end of the week, it was possible to store a first batch of 72 bunches along the full flat bottom. A second batch of 48 bunches is now injected and kept for a few seconds. Scrubbing had to be interrupted for different reasons, namely, vacuum problems in BA6 and BA5 and a problem with the MKP which emerged on the weekend.

Accesses were mostly carried out successfully. COLDEX could be moved in on Thursday evening after a long problem with the access system in BA4 which had to be repaired and delayed the intervention by 3 hours. The crab cavities underwent their security checks after the access for COLDEX which were finally completed successfully. Having been notified about the strongly outgassing vacuum chamber nearby, the crab cavity team decided, finally not to move the cavities in in order to preserve cavity conditioning. COLDEX has been informed they can stay in until early next week, as the extraction setting up could not yet fully be completed on all cycles.

Problems have been encountered on various fronts; a timing system issue caused the BHZ in the PS to pulse even when there was no request from the SPS, causing an MTE beam to be extracted down TT10 and impacting into the SPS injection region. This was quickly spotted on the PS side and the cycle was removed. The issue is being followed up by the PS. The exchanged vacuum chamber in 6 is giving strong limitations; it needs to be seen whether the thresholds can be further increased in this region. Moreover a vacuum intervention is required in BA5 before scrubbing can proceed at full pace. And finally, over the weekend, there have been regularly recurring occurrences of the LHC multi-bunch beam being injected into TT10, however, with the MKP not pulsing, causing the beam to be dumped onto the TPSJ. The situation was very fluctuating and hard to reproduce and the origins were hard to diagnose. Long investigations and several attempts for fixing the problem turned out to be unsuccessful. With calm periods in-between, by Sunday late afternoon, the situation got worse and it was decided to move back to an LHCPILOT to prevent high intensity dumps to occur onto the TPSJ. On Sunday late evening investigations from the kicker experts had led to the identification of an issue on the FEC. A temporal fix was implemented by the kicker experts, which allowed to move back to scrubbing over night.

Plans for next week will be to continue scrubbing to reach injection of all 4 batched onto the long flat bottom. SFTPRO and AWAKE need to be taken back to finalize the extraction and RF gymnastics setting up. LHCPILOT needs to be taken for the kicker waveform scan. On Tuedasy a test of the access system needs to be done; in the shadow of this, COLDEX could be move out and VSC could do their intervention in BA5. Finally, it will have to be seen how to continue all activities in parallel with the MDKV pressure situation.

SPS North Area:

Friday 4 June the electrical cabinet of the BA80 cooling system caught fire. The cause of the incident is not known for the moment. The system has been stopped and has been put in a safe mode until further investigation.

AWAKE (Giovanni Zevi Della Porta):

First of 3 weeks of access. PXI upgrade, pulling network cables, laser motor replacements. BONUS: protons from SPS on Monday afternoon.

- **Protons**: at the morning meeting, SPS mentioned possible further tests on AWAKE (since the RF jitter problem was fixed). We agreed on proton beam for Monday afternoon, and got several hours of beam, with 1 extraction per supercycle.
- On the SPS side, the 2018 golden trajectory was achieved, although there was no time for a dedicated BLM scan to ensure that beam was centered in the plasma cell.
- On the AWAKE side, we kept electrons and lasers off, and once again focused on commissioning diagnostics and DAQ. In addition to all the diagnostics commissioned on May 22, we were able to observe protons on the streak camera (although not in streak mode yet), we had live plots of protons crossing all our screens made from EventBuilder files, and we had time to properly set filters and exposure for our cameras.
- We look forward to future beam time, if possible, for the BLM scan, and for us to find the proton beam in time on the streak camera, and for testing the RF controls that allow us to move it in time.
- **Post-proton Lights issue**: we had a different lights issue than after the May22 proton beam. After May22, TAG41 and TSG4 had lights off. This time, TT41 and TCC4 have lights off. The cause is not clear, and might be a set of coincidences.
- **Post-proton Access System issue:** RadVeto of TAG41 should lift automatically 30 minutes after the end of Beam, but it does not. Bug has been found and fixed by Access System team, but deployment will require reboot of Global Interlock controller, so it will have to be coordinated with SPS.
- **Laser access**: repaired FMOUNT01 (needed to switch between high- and low-power), and recalibrated all three dumps and checked their switches (including LBDP1 which sends veto to SPS and which had dropped the beam on May 22.
- **Other accesses**: software upgrade for both PXIs, VIC for network cables, new spectrometer camera installation
- **Laser training**: dedicated Friday to training new laser operators

PLAN FOR WEEK 23: open vacuum on Monday, probably stay open for 2 weeks. Week 23: new screen on BTV412442 and new mirror on LBDP3. Week 24: Rb recycling with external contractor (travel from UK approved!)

LINAC 3 (Rolf Wegner):

Here is a short report on Linac3 for week 22 (31 May – 7 June):

- There was no beam operation on Monday and Tuesday (scheduled).
- Monday morning an internal timing card in the RFQ amplifier was found broken. This also damaged further sub-components. Giampaolo Piccinini (SY/RF/LIS) could repair all systems and the amplifier was pulsing again late afternoon.
- Wednesday was the last day with Oxygen ions. The investigations performed by ABP and BI on the Faraday Cup FC5 signal was continued with Oxygen ions of different charge states to correlate the adjacent BCT (BCT 15 and 25) readings. The final analysis is ongoing.
- Wednesday around mid-day a broken wire in the Stripper ITF.STRIP02 had to be repaired. This intervention was straight forward (1.5 h), however it required the RF amplifiers to be switched off and restarted – something they do not like. During the restart a filter box in the Tank 3 amplifier broke as well as an auxiliary power supply in the RFQ amplifier. Giampaolo could find and repair both faults within 1 h.
- Thursday the source was reconfigured back to lead ions, using lead which had already been used before (to save buget).
- Thursday morning again trouble with the RFQ amplifier. Ageing capacitors caused false readings of internal parameters and interlocked the amplifier. Giampaolo repaired the concerned card and preventively the other cards as well. Since then the RFQ amplifier has been running without problems.
- On Friday a quite stable lead beam was reached with a good intensity of above 30 uA.

CLEAR ():

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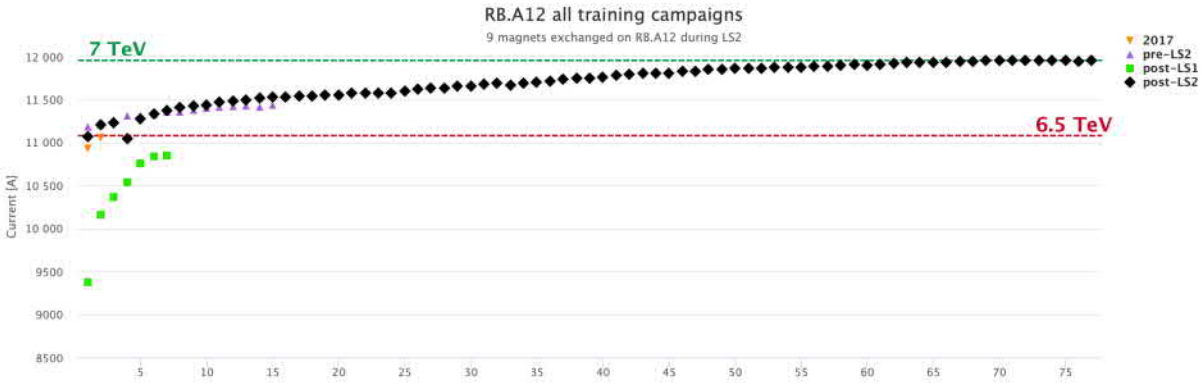
LHC (Jörg Wenninger, M. Lamont & LHC Powering Test webpage):

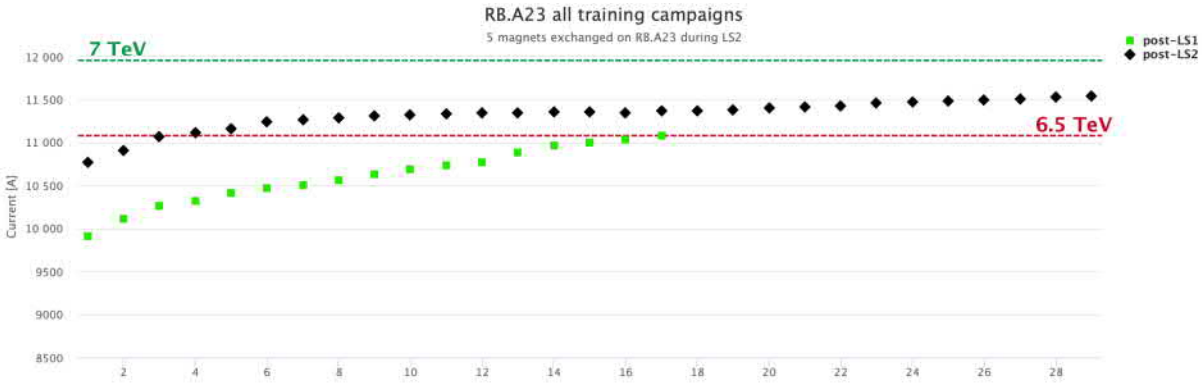
S12	S23	S34	S45	S56	S67	S78	S81
Trained	Warm up for repair	Completed	Training	Training	Cold	Warm up for repair	Phase 2
78 / 11950 A	29 / 11538 A	71 / 11950 A	86 / 11938 A	27 / 11261 A		69 / 11585 A	

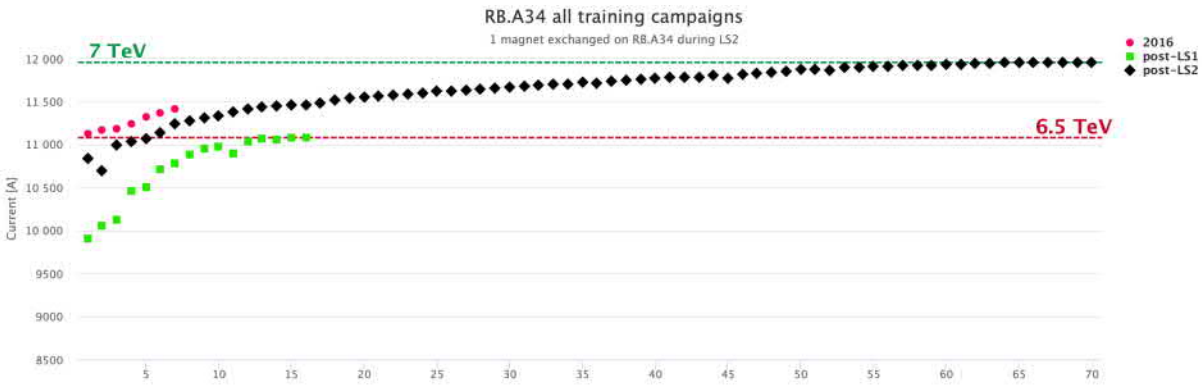
Warm up started for S23 diode repair. S12 finished training with 10 quenches at FT. S34 completed all powering tests, warm up to 20K for connection cryostat realignment. S45 reached FT, followed by 2 de-training quenches of 150A.

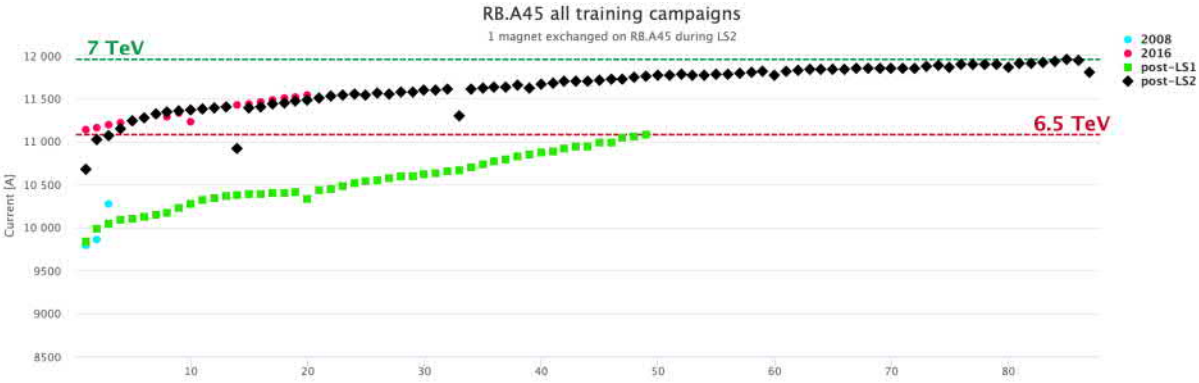
LASS test completed successfully Friday 04.06.2021. A hardware issue affecting the cabled loop was found on a key distributor, bypassed for the tests (repair asap).
Given the potential consequences of another intervention requiring a WU/CD, the decision has been taken to proceed with training with a reduced target energy for the 2022 run of 6.8 TeV. To be reconsidered once risk analysis or analyses have been performed.

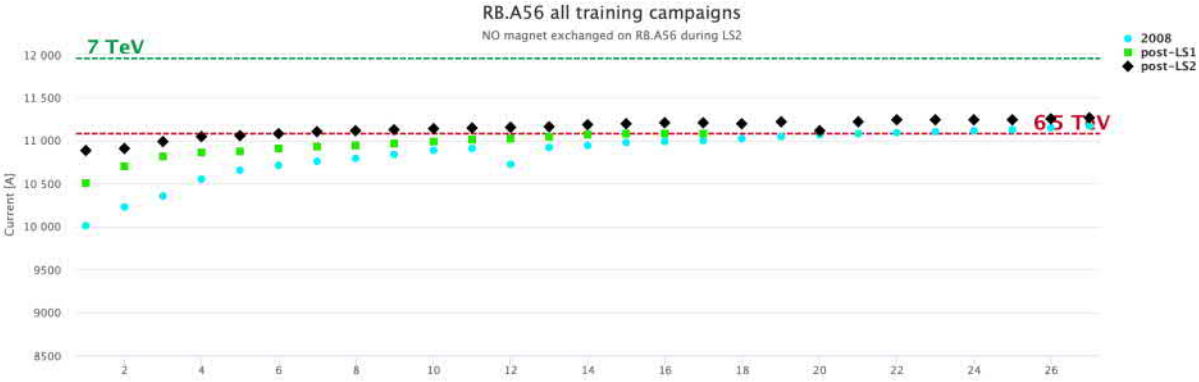
Circuit	Circuit quenches	Last quench current	Equivalent E	Target reached?
RB.A78	69	11585	6.79	NO
RB.A34	70	11950	7.00	YES
RB.A45	87	11799	6.91	NO
RB.A12	77	11950	7.00	NO
RB.A23	29	11538	6.76	NO
RB.A56	27	11261	6.60	NO

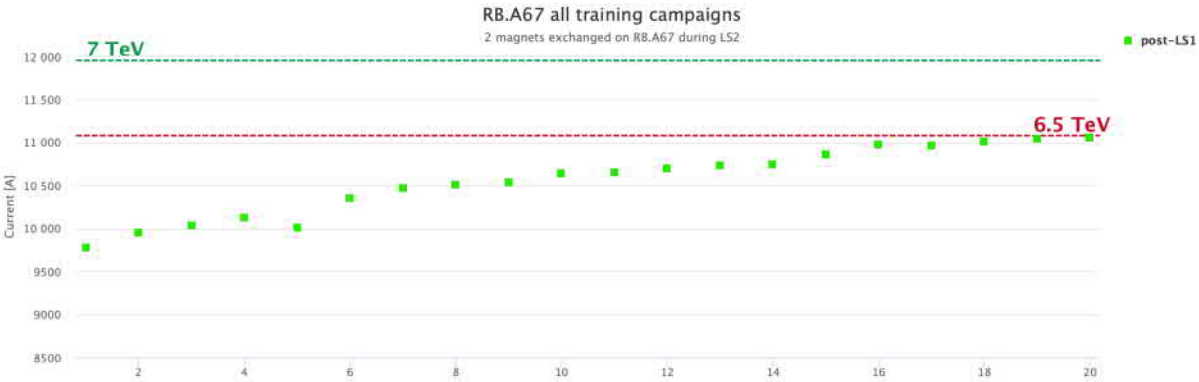







RB.A45 all training campaigns
1 magnet exchanged on RB.A45 during LS2
7 TeV
6.5 TeV
2008
2016
post-LS1
post-LS2
Current [A]
12 000
11 500
11 000
10 500
10 000
9500
9000
8500
10
20
30
40
50
60
70
80


RB.A56 all training campaigns
NO magnet exchanged on RB.A56 during LS2
7 TeV
6.5 TeV
2008
post-LS1
post-LS2
Current [A]
12 000
11 500
11 000
10 500
10 000
9500
9000
8500
2
4
6
8
10
12
14
16
18
20
22
24
26


RB.A67 all training campaigns
2 magnets exchanged on RB.A67 during LS2
7 TeV
6.5 TeV
post-LS1
Current [A]
12 000
11 500
11 000
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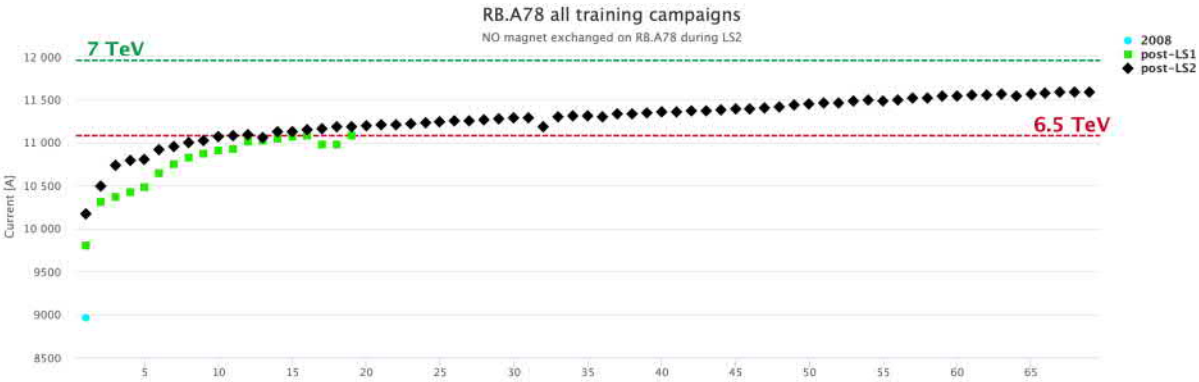
10 000
9500
9000
8500
2
4
6
8
10
12
14
16
18
20


RB.A78 all training campaigns
NO magnet exchanged on RB.A78 during LS2
7 TeV
6.5 TeV
2008
post-LS1
post-LS2
Current [A]
12 000
11 500
11 000
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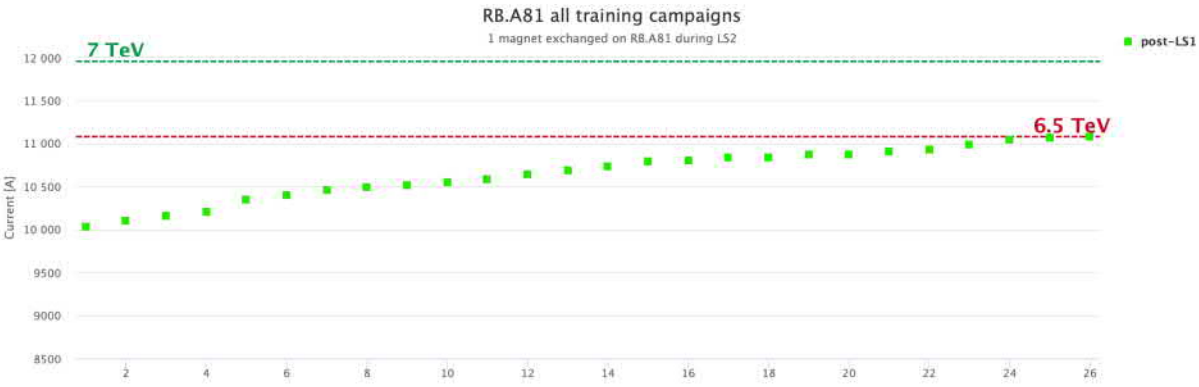
8500
5
10
15
20
25
30
35
40
45
50
55
60
65


RB.A81 all training campaigns
1 magnet exchanged on RB.A81 during LS2
post-LS1
7 TeV
6.5 TeV
Current [A]
12 000
11 500
11 000
10 500
10 000
9500
9000
8500
2
4
6
8
10
12
14
16
18
20
22
24
26