Status of dry-run planned for the SPS

K. Li for the SPS Commissioning and Operations team

SPS MCM

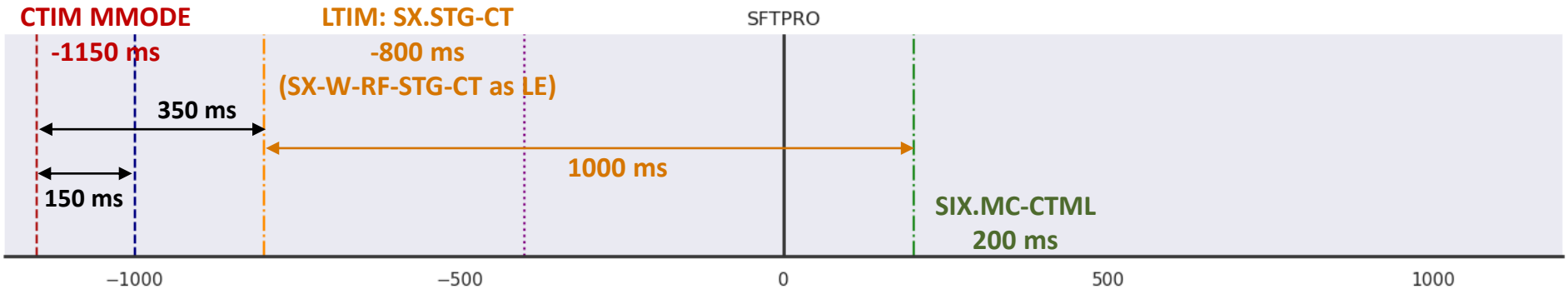
27. January 2020

ATIM updates

- ATIMs during coast:
  - At configuration pulse, ATIM needs to know whether next machine mode is cycling or coast - to prepare timings for next cycle!
  - Agreed with timing team to **add a new timing event at 1150 ms before start of cycle** – then next machine mode is available. This is also the event that is used as “configuration pulse” and triggers the configuration phase for the ATIMs.

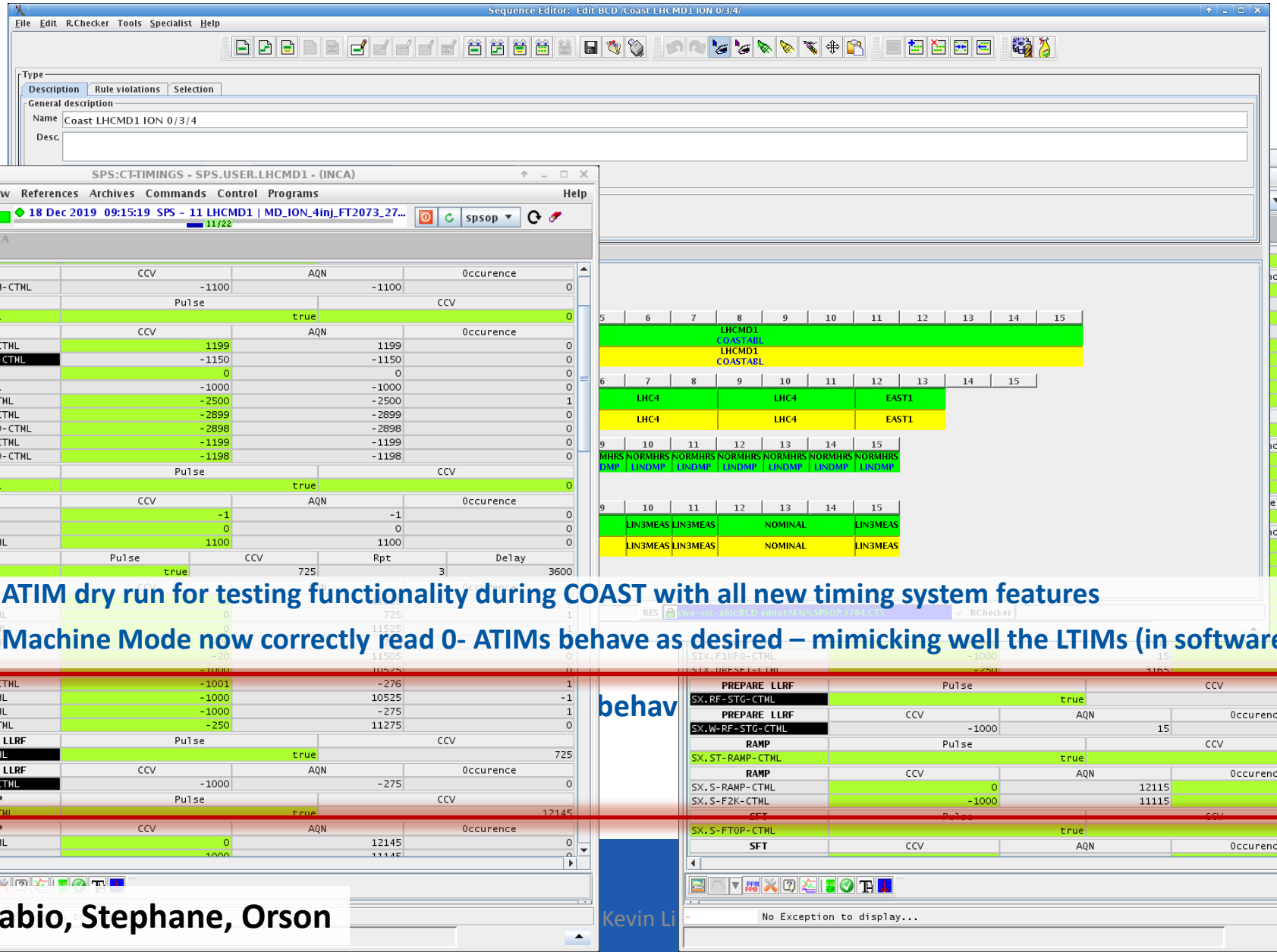
- ATIMs start timing generator:
  - ~~Use a forewarning start cycle (FCY1K) as load event for the LTIM~~
  - ~~Trigger occurrence with respect to injection forewarning – **equivalent F1KFO; use Makerules to compute delays from FCY1K**~~
  - ~~Original plan to use a new event similar to F1KFO, occurring also in case of missed injection, brought many more complications~~
  - We got a separate configurable timing event here as well, that we can use as load event to start the timing generator – SX.RF-STG-CTML with first injection and SX.W-RF-STG-CTML currently set at 1k seconds before first injection

ATIM cycle architecture



- New timing event at **1150 ms before start cycle** to trigger ATIM configuration and carrying machine mode
- ~~Load event forewarning **1s before start cycle** (SX.FCY1K-CT) is used for start timing generator (SX.STG-CT)~~
- SX.STG-CT now triggered directly via SX.W-RF-STG-CT – no more makerules needed here
- ~~Start timing generator delay computed to occur with forewarning **1s before first injection via Makerule**:~~
  - ~~SX.STG-CT load event = SX.FCY1K-CTML~~
  - ~~SX.STG-CT delay = **SIX.MC-CTML + SX.F1KFO-CTML – SX.FCY1K-CTML**~~
- ~~Earliest possible start timing generator can occur **150 ms after trigger ATIM configuration**~~
- ~~For SFTPRO, which is earliest possible injection time today the start timing generator occurs **350 ms after start ATIM configuration** → **well within the chosen window of 200 ms (with margins)**~~

Last ATIM dry run done 18. December 2019



- ATIM dry run for testing functionality during COAST with all new timing system features
- Machine Mode now correctly read 0- ATIMs behave as desired – mimicking well the LTIMs (in software)

behav

Fabio, Stephane, Orson

Kevin Li

LSA RF preparations – 27. January 2020

- **LSA RF clean-up implemented – some minor items still to be checked**
- High level parameters for cavity control mostly in LSA
- LQR beam control partly in LSA
- RF synchro in LSA and ready with value generators
- ATIMs value generators in the making

Two dry runs foreseen for execution

- **Week 5 RF: LHC cycle generation:**
  - **Cavity control:**
    - **High level settings (bucket area, synchrotron tune)**
    - **Total voltage generation and propagation**
    - **Missing: dpOverP, full links to 800 phase offset**
  - **Beam control:**
    - **LQR for radial and synchro loops**
  - **RF synchro:**
    - **Cleaned up – value generators ready for test**
  - **Timing:**
    - **Value generators in the making – FESA classes subset ready for deployment**
  - **Re-phasing:**
    - **Value generators ready on paper – wait for FESA class**

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Two dry runs foreseen for execution

- **Week 4 ALPS:**
  - **BA3 FIFO**
  - **BA3 Orbit**
  - **BA3 Injection trajectory**

- **Status → moved to Thursday, 6 February (FESA classes still needed some final works)**
  - **FESA classes are now ready**
  - **All features implemented in YASP (Jorg):**
    - **First turn: choice of**
      - **FIFO**
      - **any injection (1-16)**
    - **Orbit: choice of**
      - **triggered single acquisition available shortly after the selected cycle time**
      - **cycle acquisition (at the end of the cycle), either for a single selected time or the evolution along the cycle**
    - **Settings can also be configured from YASP**
  - **Ready for dry run on …**

- **Next:**
  - **Monday March 2: Multi-turn (simulating a BST triggered oscillation on the simulated position), logging depending on what is there**
  - **Tuesday May 12: Test interlocks algorithms - Validation of the algorithm via emulated bumps and oscillations**
  - **Week 24: BIS checks - Andrea to see with Ivan Ramirez**

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Overview

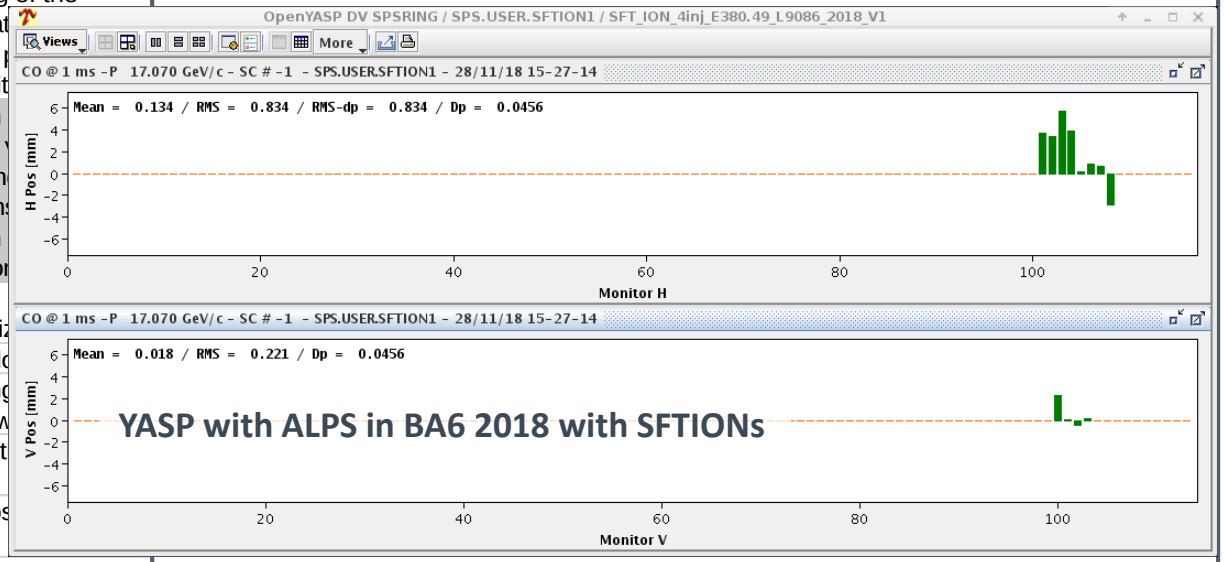
- **Dry run: full (sub-)system functionality tests in operational conditions**
- Plan and schedule tests per equipment or system ideally **from highest level (application)** through LSA/INCA and FESA **down to hardware**

- Identified different groups of tests – established a list of tests and an idea of when to schedule these
- Tests will start early next year (February 2020)
- Not all tests can be done immediately full vertical slice; we will **need to go staged tests** – as far up and as far down as we can go; we will show an example for the RF tests

Tests list – BI ALPS

Name	Week	Description
BA6 – FIFO mode	4	Sending on selected channels (BPMs) N calibration pulses
BA6 – Injection trajectory	DR 1 4	Using a BST controlled start for the calibration pulses
BA6 – orbit	4	Simulating bumps with a specified pattern
BA6 – trajectory	9	Simulating a BST triggered oscillation on the simulated position
BA6 – logging	9	Monitoring of the logged dat extended p cycle orbit
Interlocks tests – algorithms	20	Validation algorithm bumps an oscillation
Interlock tests – BIS	24	Validation connectio
Full ring tests	28	Points synchroniz
Full ring logging	28	Full data lo
Ring interlock tests	28	Check ring – with new
Extraction interlock tests	28	Check ext interlocks
Post mortem push	28	Check pos push
Final YASP integration checks	32	Check new system with ALPS

- YASP as was connected to BA6 crate – new:
  - Expert mode for orbit acquisition
  - Slightly modified FESA API
  - Injection oscillations
  - FIFO operation mode
  - Q26, Q20 optics with post-LS2 sequence

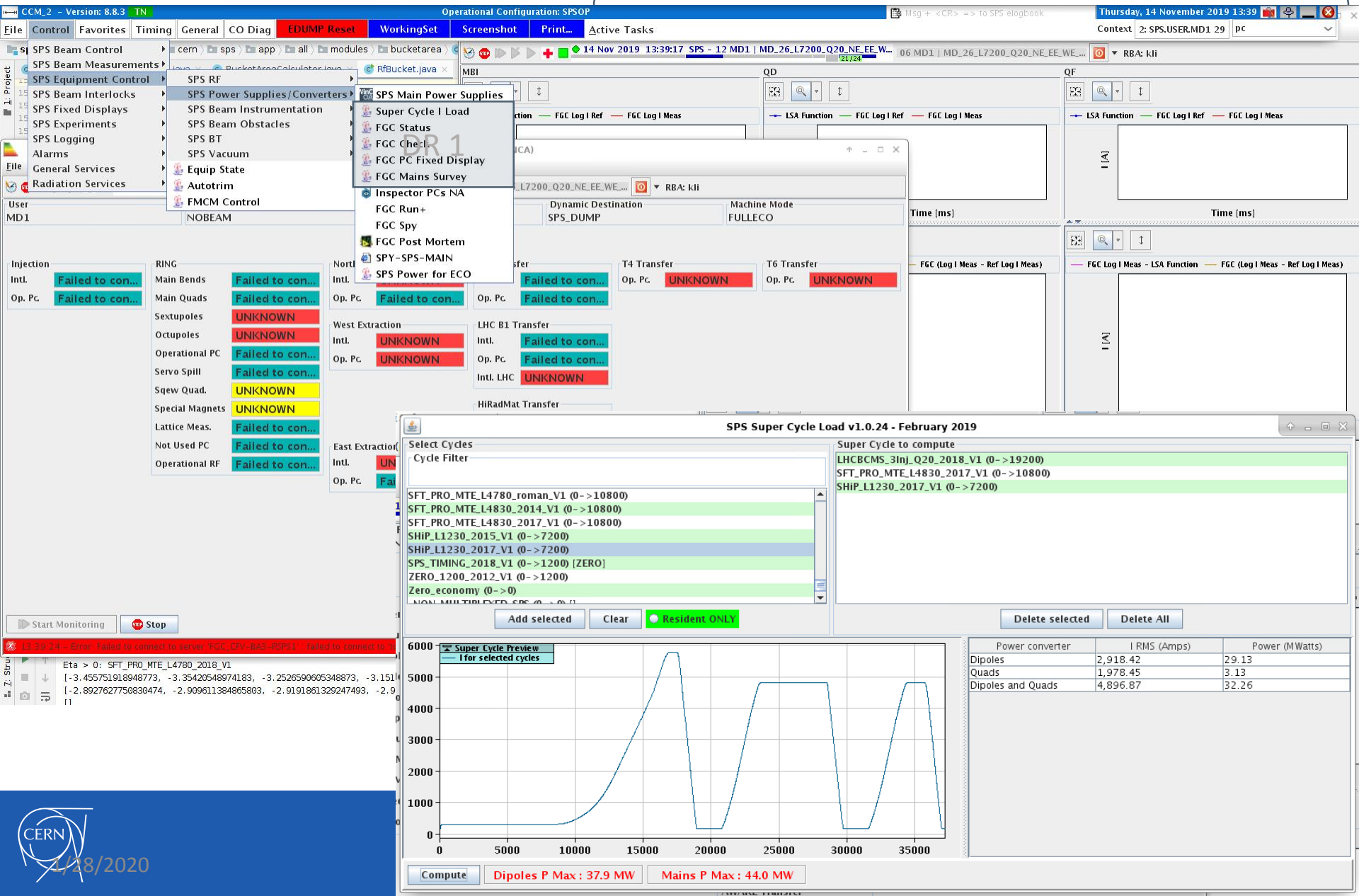


Tests list – EPC

Name	Week	Description
FGC interfaces	Check	FGC interface available
LSA integration	10	Check settings generation and management in LSA complete
FGC tests	DR 1 14	Simulation tests for state control, interlock, acquisition, pc check,…
Economy modes, COAST etc.	14	Test FGCs in special machine modes
FEI tests	22	FEI tests in TT10 and after fast extraction
FEI tests		FEI in TT10 with BHZ during HWC

- FGC dry run in simulation mode (new mains and cods):
  - All applications
  - State control
  - Acquisition
  - SIS
  - Different modes, coast economy,…
- FEI dry runs:
  - For given BI node can set converters to test mode, will drive A channel to true and can read channel
  - Real interlockfunctnality check is taken out of chain in simulation mode
- BHZ dry runs – when ready to test? Comments from David:
  - Preconditions: gateway and BIS in place, need to be able to drive permit out of interlock system; also need to be able to mask all inputs, all functions set up for TT10 for TT10 PC giving FEI conditions to true; check different energy levels prepare different cycles. Dry run to check permits come in.
  - We cannot run TT10 PCs just in simulation mode, thus, we will need to do a full dry run of the BHZ only during the HWC period.
  - Running in simulation mode, one could however still run it through the FEI application and check at least the anticipated results. (Actual result will always be false as we are in simulation) – run FEI app in a couple of scenarios – this is already planned.
  - David recommends to target the first week of August for the BHZ dry run; that would fit with the PS schedule. To be negotiated with the PS. He also recommends the first things to drive and check TT10 settings – try several attempts first August to mid September.

Tests list – EPC



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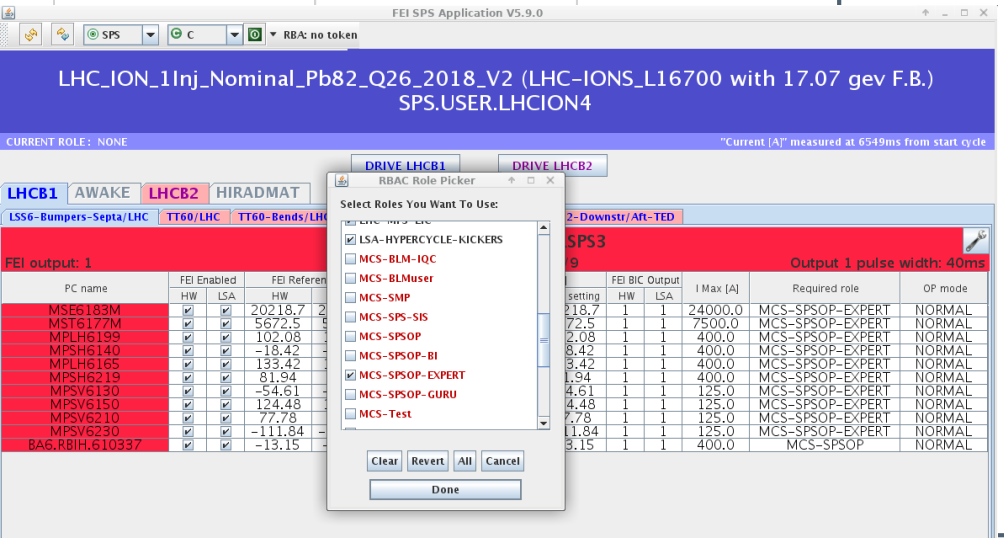
FEI tests	DR 2 22	FEI tests in TT10 and after fast extraction

- FGC dry run in simulation mode (new mains and cods):
  - All applications
  - State control
  - Acquisition
  - SIS
  - Different modes, coast economy,…

FEI application (screenshot)

- 3 test cycles with different references (14 GeV, 26 GeV, Ions, HiRadMat, AWAKE)



Tests list – SBDS

Name	Week	Description
TIDVG FESA classes	24	Test individual TIDVG sensors readings that will go into the SIS; SIS and TIDVG monitoring application
SBDS individual FESA classes	32	Signals, post-mortem push
SBDS	42	Verify arming sequence of SBDS alone
SBDS + f_rev + injection + BIS	42	Verify arming sequence of SBDS with RF and BIS
SBDS TSU, MKD, BIS	DR 1 42	measurements of delays, validate time between dump request and pulse
SBDS + f_rev + injection + BIS	42	Test of SBDS arming and pulsing with different SC configurations (very important to test all possible configurations)
SBDS PM bins, SBDS and TIDVG FESA classes	42	Test of individual interlocks, test of analysis, test of python server for BTV

F. Velotti

- Different steps of what needs to be tested here
- Systems dry runs will be done already before as system test
- Injection tests:
  - BIS loop must be closed as of week 42.
  - Check the events for injection BIS; timing distribution which will be used by FGCs on BHZ – check with Stephane whether this is already part of HWC.
- TIDVG FESA classes as soon as it is ready – week 24 (application dry run)
  - Erik and Yannick to prepare SIS and TIDGV monitoring application
  - Can test TIDVG in signals → check whether we will get some simulated data… (temperature, cooling, LVTD… tbd)
- Test of individual classes for the SBDS – week 32 (PM beans which could come later):
  - Kickers, TSUs, check signals, post-mortem push
  - Not much needed around this inter terms of applications etc.

Tests list – RF

Name	Week	Description
LHC generation	5	Test LSA generation for LHC type cycle with RF synchro, RF loops, RF cavity control & timings
Radial steering	8	Test settings for radial steering on synchro and radial loop
SPS2PS Synchro	10	Test synchro
Synchro & phase loop diagnostics	13	Test acquisition and display of synchro and phase errors using simulated data
Cavity control loops	16	Test generation and settings of full cavity control loops – with comb filters
SFTPRO generation	22	Test LSA generation for SFTPRO type cycle of RF synchro, RF loops, RF cavity control & timings
Phase & position diagnostics	25	Test acquisition and display of phase and position using simulated data
Diagnostics test	27	Test what can be tested from diagnostics not tested so far
800 MHz	29	Verify settings in 800 MHz; improve generation using new functions for voltage ratio, add harmonic ratio, add offset
FFA generation	31	Generate ion cycle with FFA – all settings; also synchro
Longitudinal damper	33	Interface and settings for longitudinal damper ready for testing
RF gymnastics	36	Interface and settings for RF gymnastics ready for testing
Longitudinal blow-up	39	Interface and settings for longitudinal blow-up ready for testing
AWAKE and LHC rephasing	40	Generation and settings with tests for rephasing
Slip stacking application	44	Slip stacking application ready with preparation of functions for settings

- Staged tests
  - HW **not available from start of tests – test as far vertical as possible**, coming from both sides

- Requirements
  - Test crate on TN trusted
  - HW progressively coming in

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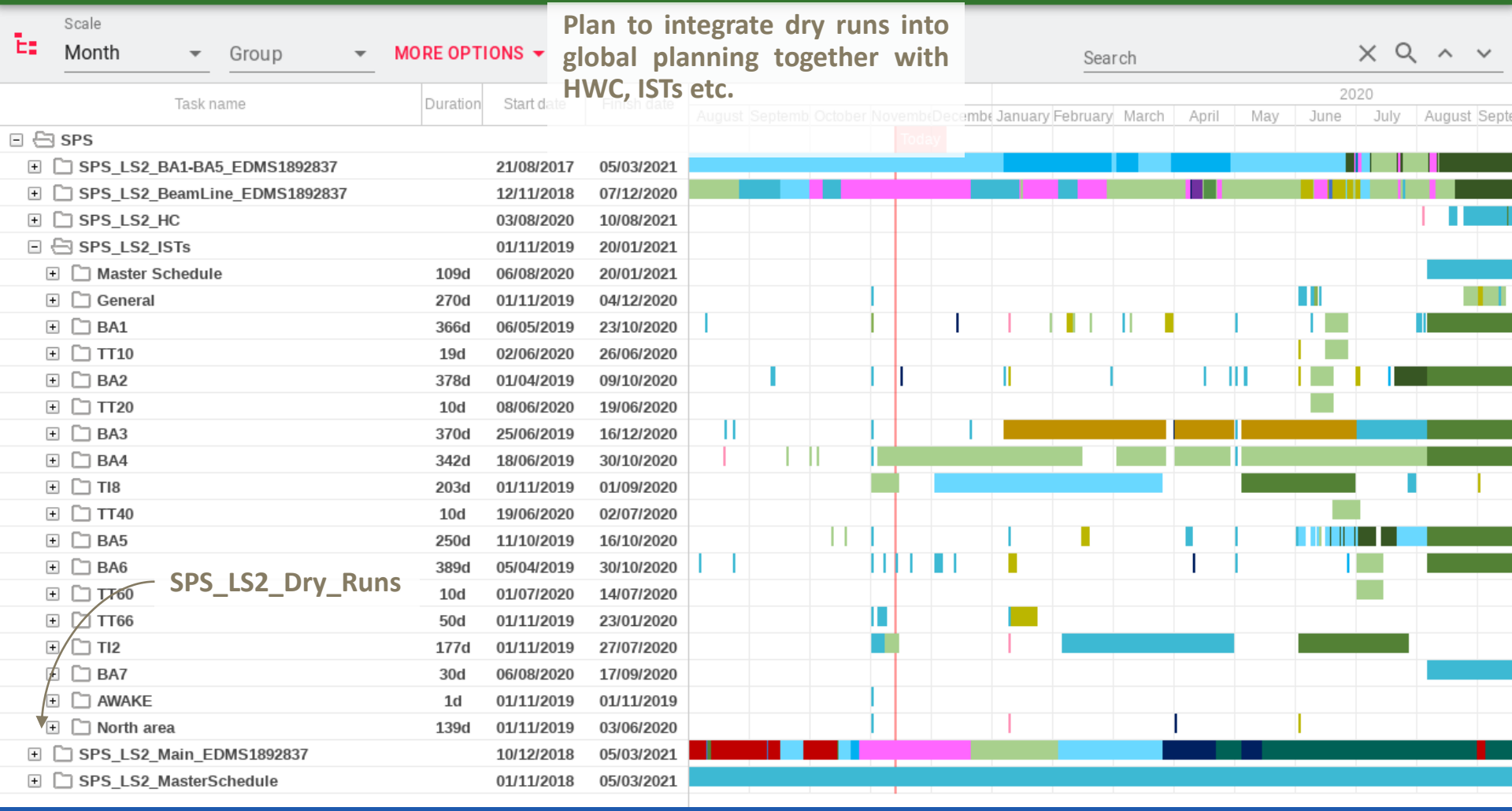
- More about software readiness, OP integration with application – **HW readiness dates still need confirmation**:
  - Settings integrated, value generators and makerules prepared – LSA trim editor to test trims
  - Appall (RF application) – trim and monitor functions from application; trim and monitor timings from application
  - Other specific applications – trim and monitor from application (requires also better Python integration!)
- Cycles:
  - LHC, SFTPRO-type cycles
- Services:
  - LSA
  - FESA
  - Timing
- Periphery:
  - TN trusted test crate
  - Python deployment

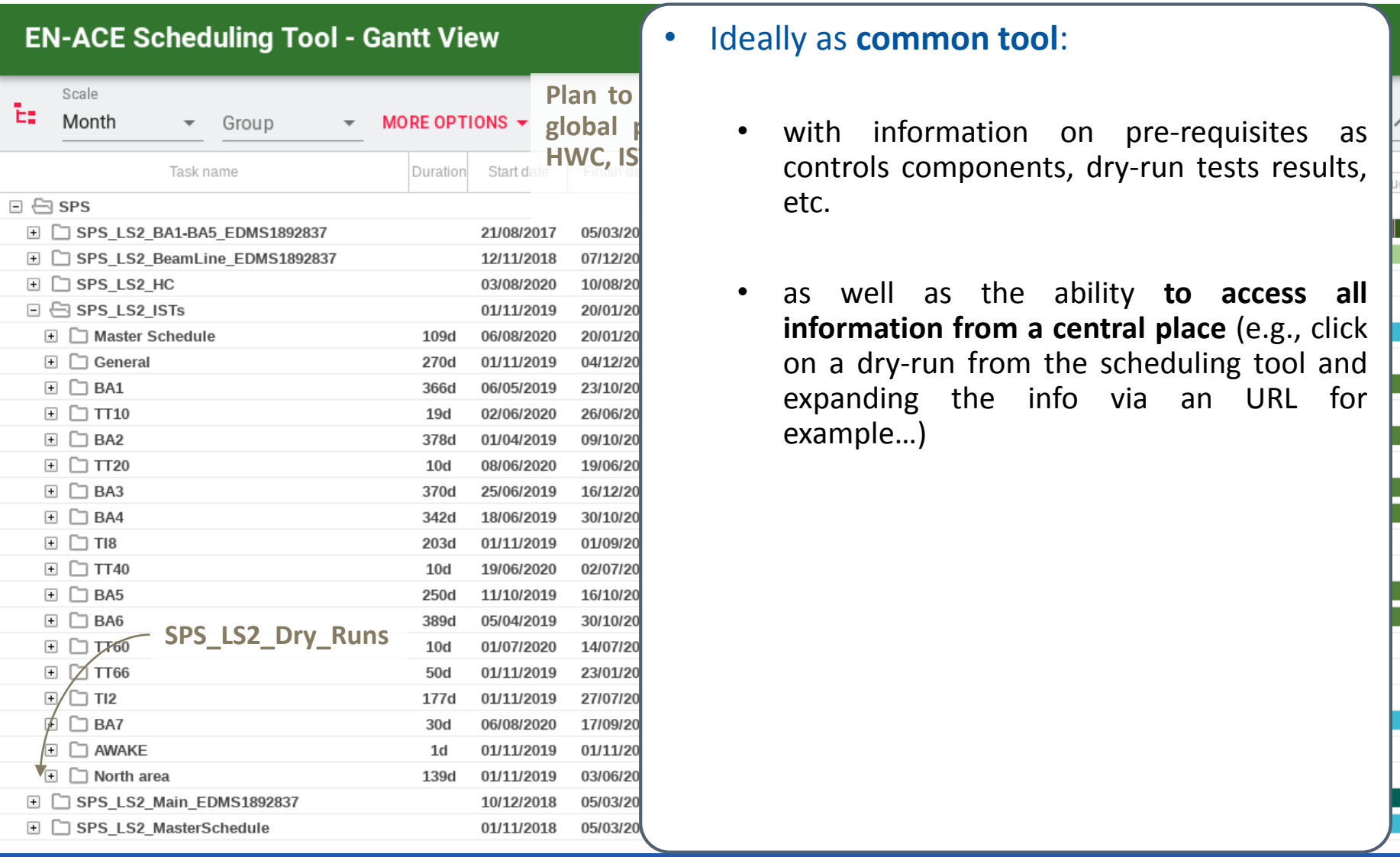
Integration of dry runs in general planning tool

EN-ACE Scheduling Tool - Gantt View

Plan to integrate dry runs into global planning together with HWC, ISTs etc.



Integration of dry runs in general planning tool



- Ideally as **common tool**:
  - with information on pre-requisites as controls components, dry-run tests results, etc.
  - as well as the ability **to access all information from a central place** (e.g., click on a dry-run from the scheduling tool and expanding the info via an URL for example…)

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