# Outline

- Scope
- Architecture
- Coordination
- Status
- Dry Runs
- Conclusion

Scope

Controls and software to achieve the **operation**, **diagnostics**, **logging** and **analysis** of the IT String HWC and specific tests program:

- Controls of equipment systems:
  Cryogenics & insulation **Vacuum**, **Power Converters** & **Power Interlocks**,
  Quench Protection, **Alignment**.
- Software required for the **Operation** & **Analysis.**
- **Configuration** of the Powering Applications.
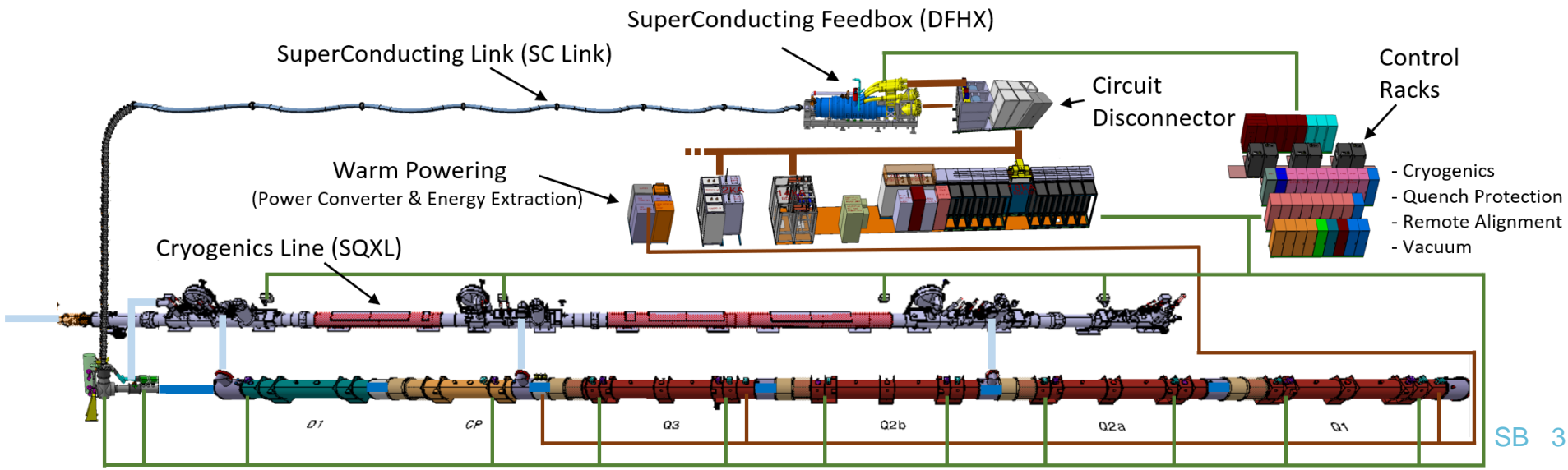
3-layers Controls Architecture

Analysis   **Hardware Commissioning Powering**   **Supervisory Powering**   **Specific test Powering**   **Monitoring & Operation tools**
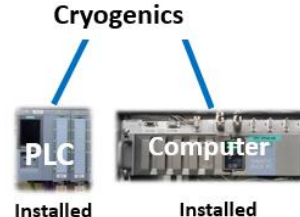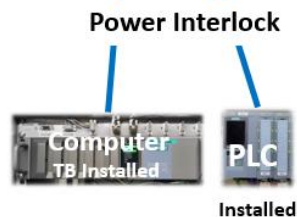
Operation & Analysis Application Layer

- Sigmon — WEB — Swan Notebook
- AccTesting — DESKTOP — Available
- Sequencer — DESKTOP — Available
- Circuit Synoptic
- Power Interlock & Permit
- PowerApp — LabVIEW — Available
- Fixed Display — WEB — Proto + String Monitoring
- Operation Tools — DESKTOP — Available

Systems Application Layer

- Alignment Controls — TB Deployed 2025-Q1 — WinCC OA
- Circuit Disconnector switches Monitoring — WinCC OA — Final Version
- Power Converter Control — WEB — Available
- Circuit Synoptic — WinCC OA — TB Deployed 2024-Q4
- Quench Protection Controls — Energy Extraction
- Power Interlock — WinCC OA — Operational Version
- Monitoring — WinCC OA — Access Version
- CRYO Controls — WinCC OA — SQXL Version
- Vacuum Controls — WinCC OA — SQXL Version

See M. Sosin "Status of FRAS" Thu AM

Front-End Layer

- Alignment — Computer — Installed
- Circuits Disconnector Boxes — PLC — Installed
- Power Converter — Computer — Installed
- Quench Protection — Computer — Installed
- Power Interlock — Computer — TB Installed — PLC — Installed
- Cryogenics — PLC — Installed — Computer — Installed
- Vacuum — PLC — Installed

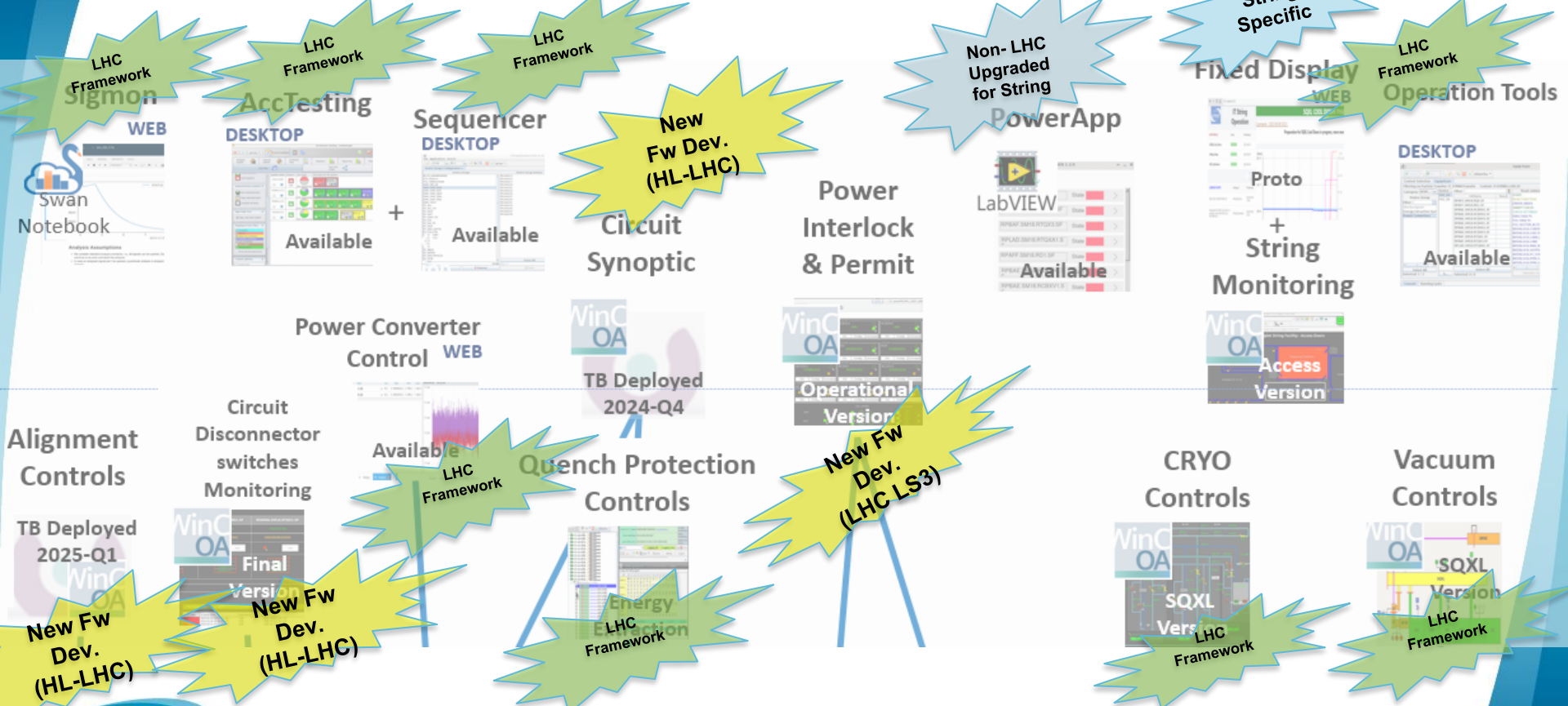SB   4

Architecture: Frameworks & Developments

- Based on:
    - **Industrial control systems** (Vacuum, Cryogenics, Power Interlock, …)
    - **Accelerator Front-End Software Architecture** (Powering, Quench Protection,…)
    - Accelerator **standard operation and diagnostic software**

- **Use frameworks** (UNICOS/JCOB, FESA,…)

- **No specific framework development:** only LHC or HL-LHC developments (excepted String Monitoring app / Fixed Display)

- Operation software configured with **Accelerator Databases** (Control Configuration DB, LHC Software Architecture DB, Layout DB, …)
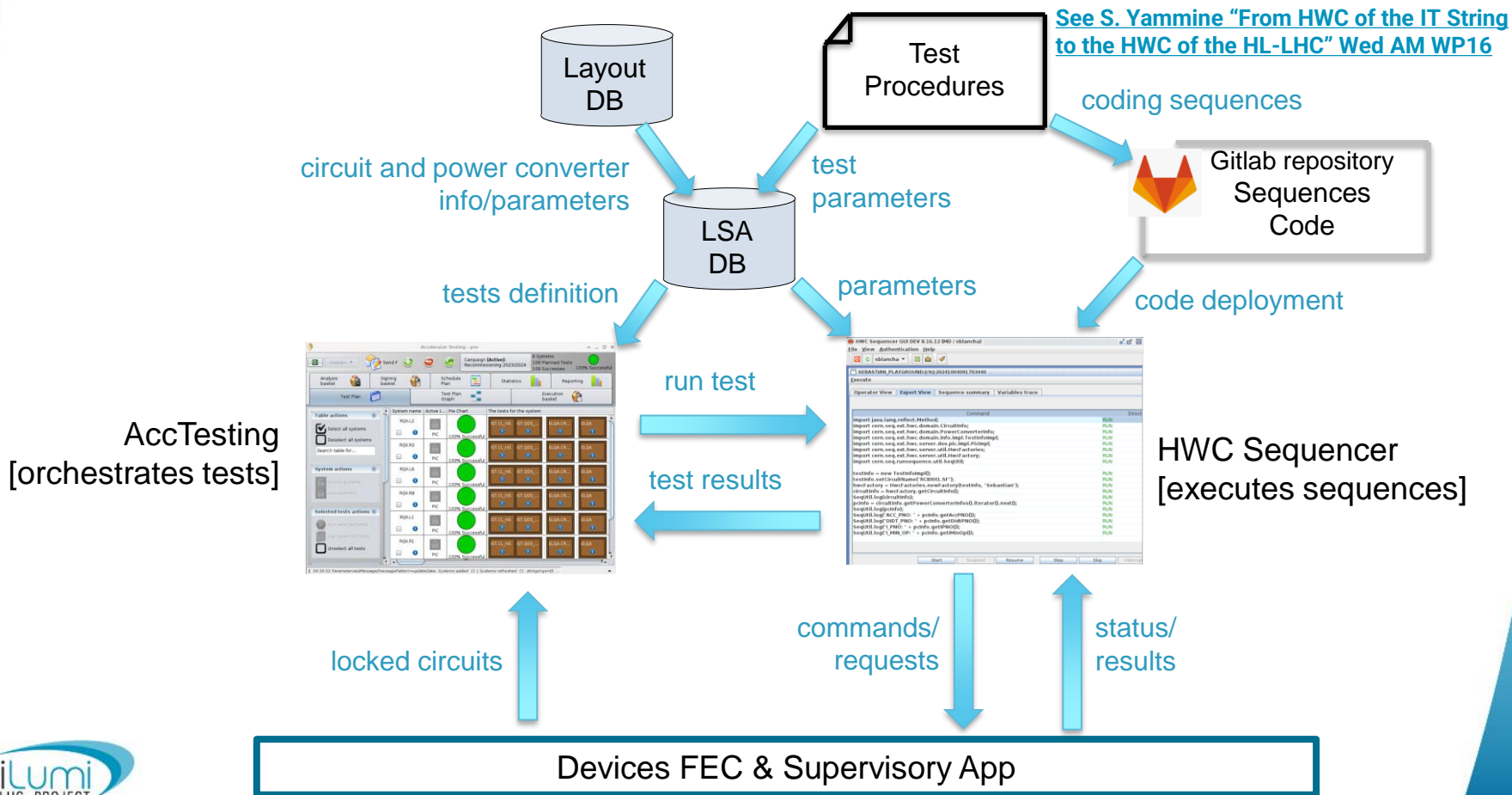
Architecture: Developments

LHC Framework — Sigmon WEB — Swan Notebook — Analysis Assumptions

LHC Framework — AccTesting DESKTOP — Available

LHC Framework — Sequencer DESKTOP — Available

New Fw Dev. (HL-LHC) — Circuit Synoptic

Power Interlock & Permit — Operational Version

Non- LHC Upgraded for String — PowerApp — LabVIEW — Available

New String Specific — Fixed Display WEB — Proto + String Monitoring

LHC Framework — Operation Tools DESKTOP — Available

Access Version

Power Converter Control WEB — Available — TB Deployed 2024-Q4

Alignment Controls — TB Deployed 2025-Q1

Circuit Disconnector switches Monitoring — Final Version

New Fw Dev. (HL-LHC)

New Fw Dev. (HL-LHC)

LHC Framework — Quench Protection Controls — Energy Extraction

New Fw Dev. (LHC LS3)

LHC Framework

CRYO Controls — SQXL Version

LHC Framework

Vacuum Controls — SQXL Version

LHC Framework

3 Departments, 9 Groups

Focus on:
Interfaces required for the **HWC Powering tests.**

More than 100 interfaces represented, including:
- Hardware alarm signals between systems
- Software Communication between applications/services
- Configuration and Logging

Check that all the required **interfaces** have been deployed.

Configuration of services for Powering Tests

See S. Yammine "From HWC of the IT String to the HWC of the HL-LHC" Wed AM WP16

Layout DB

Test Procedures

coding sequences

circuit and power converter info/parameters

test parameters

Gitlab repository
Sequences
Code

LSA DB

tests definition

parameters

code deployment

AccTesting
[orchestrates tests]

run test

test results

HWC Sequencer
[executes sequences]

locked circuits

commands/ requests

status/ results

Devices FEC & Supervisory App

SB   8

Coordination inside the IT String Work Package

STRING Technical Coordination

organized and reported ↑

- Front Ends **hardware** intervention
- Software **upgrades & updates**
- Services **interventions** & **outages**

STRING Validation Program

↓ *provides*

- **Tests** definition
- Test **parameters**
- Test **sequences/transitions** in HWC Sequencer
- Specifications **Analysis** software notebook

See S. Yammine "From HWC of the IT String to the HWC of the HL-LHC" Wed AM WP16

STRING Quality Assurance and Control

↓ *includes in QA plan*

- Controls **hardware alarm** signals checkout
- Test **parameters integrity** (conform with test procedure specifications)

See N. Heredia "Quality Assurance / Quality Control in the IT String" Wed AM WP16

Coordination meetings and communication

Coordination and follow-up Meetings

— address →

- **Readiness** of services and applications
- **Deployment** strategy
- **Status** reports

Topical Meetings

— address →

- Availability of **functionalities**
- Implementation of **interfaces**
- **Configuration** of DB
- **Code** definition of test **sequences**

CERN Accelerator Controls Smooth Upgrades Working Group

— address →

- Coordination of **accelerator controls upgrades & interventions**
- Announce impacting interventions and report on **outages**

Status Hardware

- Front End **Hardware** (Computers, PLC, DI/O-Tier), Servers (Supervisory Applications) are **installed and available**.
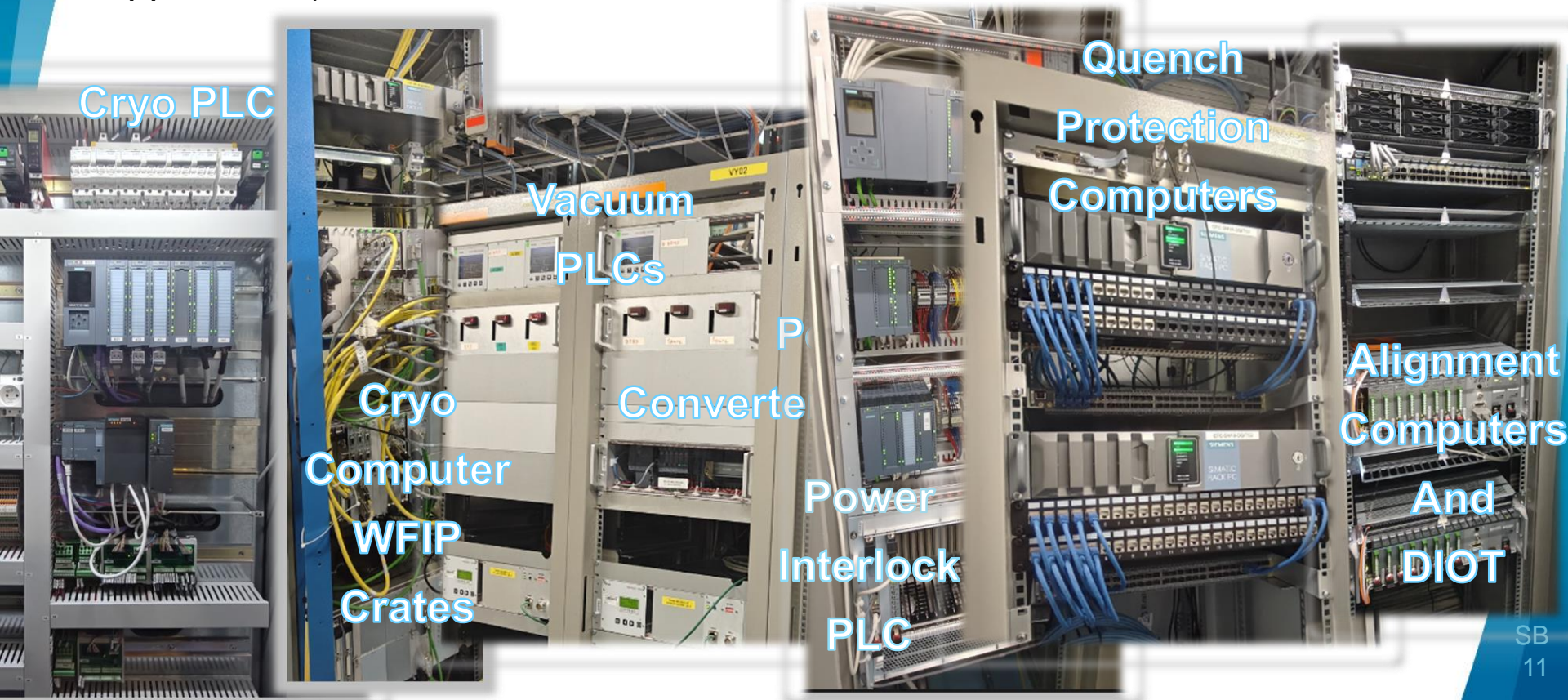
Status software (and future milestones)
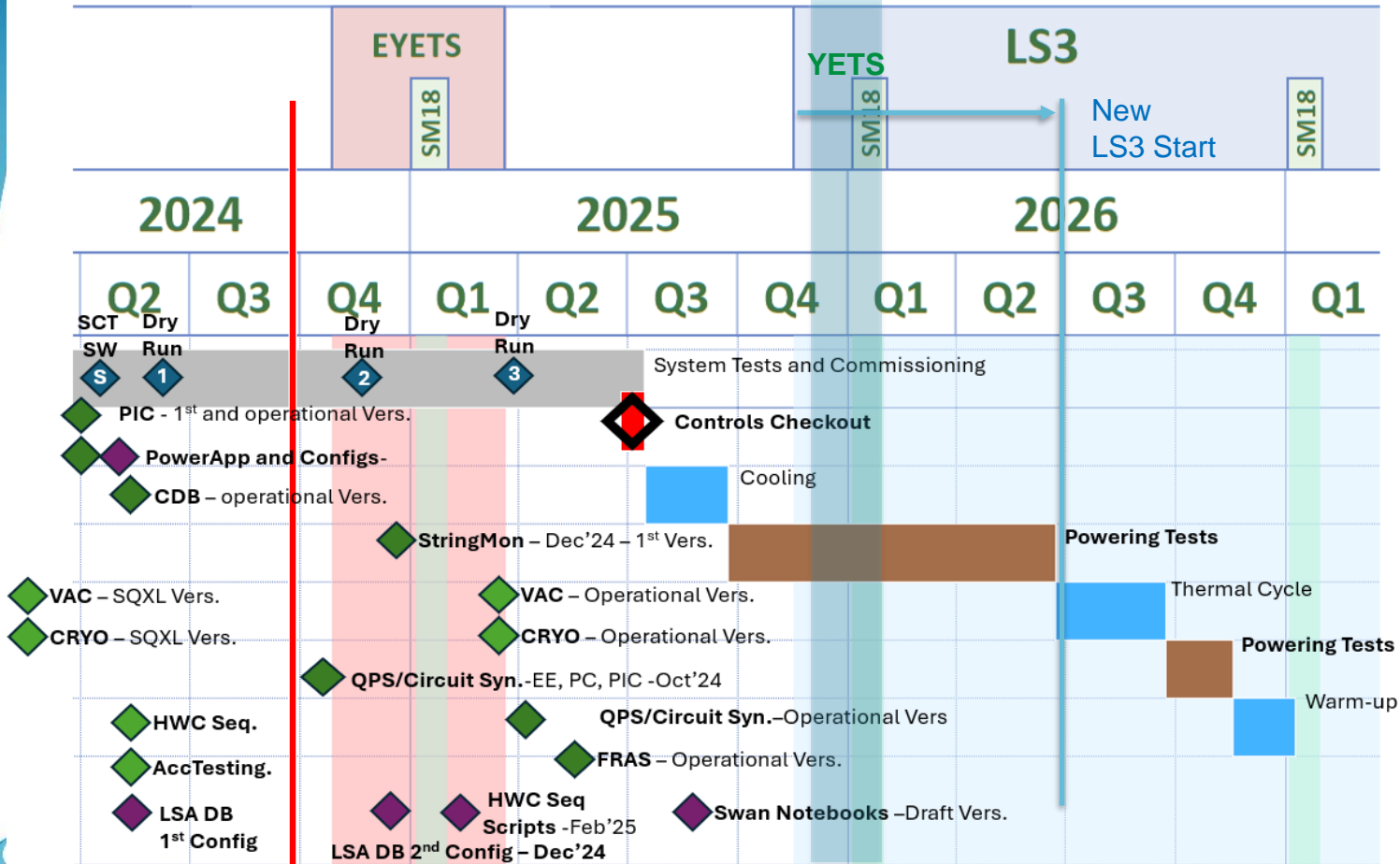
Software deployment and configurations

Status software (and future milestones)

Example of control systems Graphical User Interface already deployed:

Action points, issues tracking and calendar

Use of Atlassian™ products: JIRA and Confluence (**collaboration and documentation tools**).

Action points (IT STRING JIRA project) and **issues tracking** (contributors JIRA projects):
https://confluence.cern.ch/display/SKB/Controls+Issues+Tracking

Confluence Controls **Calendar** based on **IT STRING JIRA Project**:
https://confluence.cern.ch/display/SKB/calendars

When impacts → STRING Technical Coordination

Dry Runs – Definition, Goal, and Environment

<u>Definition:</u>
- Series of powering tests involving the Warm Powering devices available.

<u>Goal:</u>
- Check and validate the software behaviour for the powering tests.

<u>Environment:</u>
- Power Converters operated either in **Simulation** or **Short Circuit** mode
- Role-Based Access Control: limits the access to **IT String devices only**.
- Configuration Database (LSA DB): **DEV environment** schema (no impact on accelerator configurations).

Dry Runs – Objectives & Results

Objectives:
- **Check** all the **applications** involved in Powering Tests inside the IT String environment.
- **Check** the **availability** of the test definitions and parameters in **Configuration** DB.
- Check data logging.
- **Tests** typical **sequences** and their transition conditions.
- Gives **feedback** to applications and services providers.
- **Train** String team coding sequences and configuring database

First Results:
- Validation of the **functionalities** provided by Power Interlocks (**PIC**) application.
- **Validation** of **PowerApp** application (String specific test).
- Circuit **Parameters** (from Layout DB) are **accessible** in the Configuration DB.
- Effective **interface** between AccTesting (orchestration) and HWC Sequencer application (execution).
- **Post-Mortem** data logging of **Energy Extraction** to DB.

Conclusion

- Front End **Hardware** (FEC, PLC, DIOT), Servers (Supervisory Applications) are **installed**.

- **Configuration** of the powering application and **coding** first sequences **in progress**.

- Intensive validation and **tests** of the software and its interfaces during **Dry Runs.**

- The conditions to be able to **proceed with the Dry Run depends on the availability of devices.**

- Globally, **positive feedback** on the functionalities & performance of the already tested applications.

- Still a lot of work for the **configuration**, **sequences** implementation, **tests**, and **learning** of operation applications and tools.

Control room String II (2002)….

Control room IT String Sep' 2024….

smart Controls for smarter Operations

Acknowledgment

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… Apologies for those I have certainly forgotten in this non-exhaustive list

Spare Slides

Impacts of accelerators Technical Stops and Long Shutdown

- Accelerator **control services availability** is **not guarantee** during the period of YETS and LS3.
- Dependencies have been listed from the Interfaces diagram, and mitigation actions are put in place
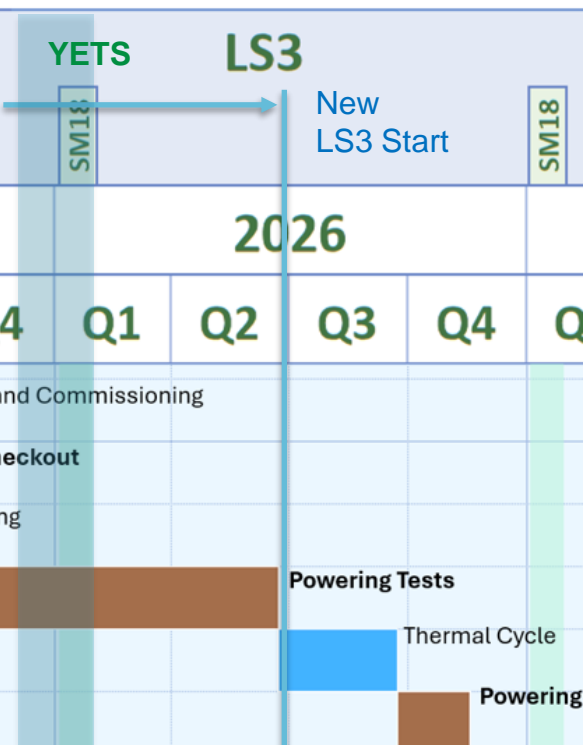
<u>List of dependencies and mitigation actions:</u>

Dependencies	Possible interrupt Time Slot	Comment
NXCALS, RDA, DIP, RBAC, NFS, EOS, SCALAR DB…	No (24h/365d services)	No long interruption foreseen except short interruption and unpredictable outage
OS/Patch update (FEC, Op Console, Application servers)	systAdmin days	Can be tested before and even anticipated/postponed
Timing	YETS, LS3	Timing will migrate to White Rabbit - Migration to be coordinated for String with CEM
LSA/INCA (accelerators software architecture)	systAdmin days, LS3	TO BE CHECKED CSS
RMI (java communication protocole)	End of Life interrupt	This interface should not be used for operation but still required for the test plan (EOL to be coordinated with MPE)
PostMorten DB	Should be 24h/365d services	TO BE CHECKED MPE
PostMorten Triggering mechanism	??	TO BE INVESTEGATED
Supervisory (WCCOA) Applications and Power App updates	Depend on application (see next slide)	TO BE CHECKED Groups and ICS (Most of time String dedicated applications means no other depencies with other facilities, update slot to be approved by String Operation)
Operations Applications updates	YETS, LS3 (but depends on group owner schedule)	TO BE CHECKED Can be related with other facilities required update (because generic application not only for String)
Operation tools (e-logbook, eqp state, eqp monitoring, pm browser, i-viewer…)	LS3 (depends on many different owners, availabilities may be difficult to foreseen during LS3)	TO BE INVESTEGATED
Triggering mechanism between Operation Applications and Operation Tools		
Expert Applications updates	YETS, LS3 (but depends on group owner schedule)	TO BE CHECKED Can be related with other facilities required update (because generic application not only for String)
Analysis software updates (SIGMON)	YETS, LS3 (but depends on MPE-CB schedule)	Rather related with the availabilities of all the functionnalities and API
Analysis software updates (Script)	Not related with YETS/LS3 (depends how the scripts are managed)	Do we rely intirely on MPE-PE? If not how to manage it?
Servers, APIs, Apache Sparks, Kubernetes and other services… for analysis software	No (24h/365d services)	IT Services not only ACC related should be independent to YETS/LS3 - only short interruption and unpredictable outage expected