Carpenter*: superconducting magnet test facility management system

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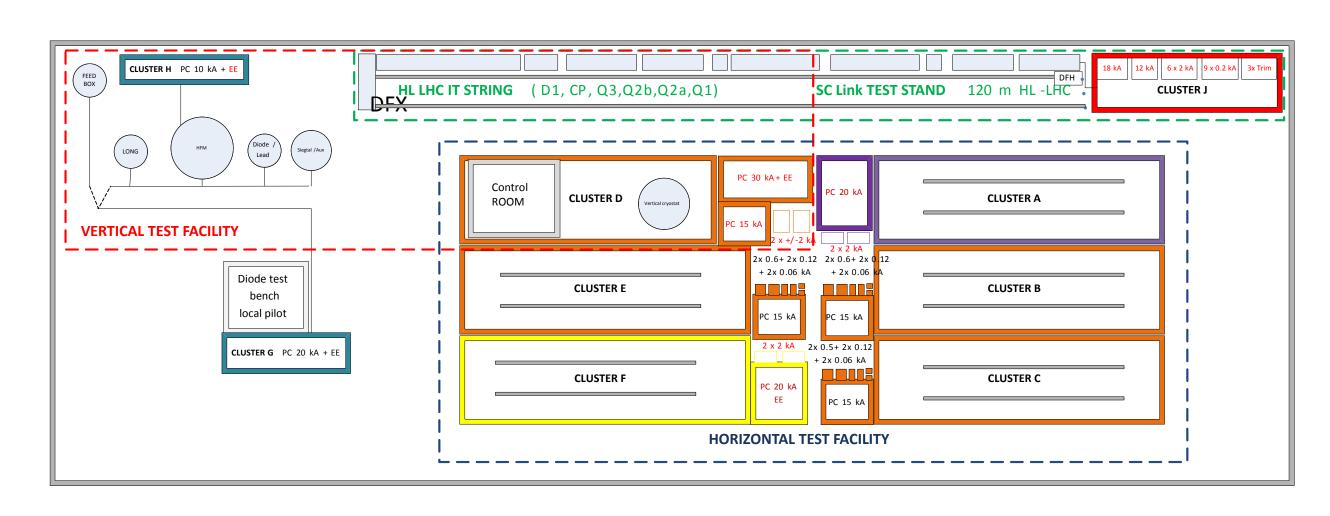
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INTRODUCTION

Superconducting magnets at CERN are being tested in one of the largest testing facilities around the world known as SM18.

This unique infrastructure requires a well-designed and optimized **quality assurance and control system** to follow-up, monitor and trace all ongoing activities. In 2017 we created Carpenter, a fully customized management system to improve work organization. In addition to its main functionality of quality control for tested items and assemblies, the system enables also to **store all relevant test results** which can be later used for **automatic test report generation**. Carpenter uses a **web interface** for easily access and **database** for storage. Since January 2018, Carpenter system is fully operational at SM18 and it is being introduced to other superconducting magnet test facilities.

CONCEPTUAL DESIGN

- ☐ Support for different test stations
- ☐ Different items and assemblies to be tested
- ☐ Many test setups and variety of testing procedures

- ☐ Users with different privileges
- ☐ Life cycle of tested item
- ☐ Travel around a testing facility
- ☐ All types of data to store:
  - checkmarks,
  - manually uploaded,
  - software loaded

Item Registration → Assembly Creation → Assembly Check-in → Testplan Creation

Technical assumptions
- ○ Web based system with easy access and sharing options
- ○ System notifications and communication tools
- ○ Data stored in a relational database

MAIN FUNCTIONALITIES

Quality Assurance
Communication efficiency and effectiveness via feedback loops (email and SMS) between the test participants internally and/or externally from the group

Quality Control
Show what we are doing to interested people in real-time

Internal/external users follow-up of activities at SM18

Data storage and processing
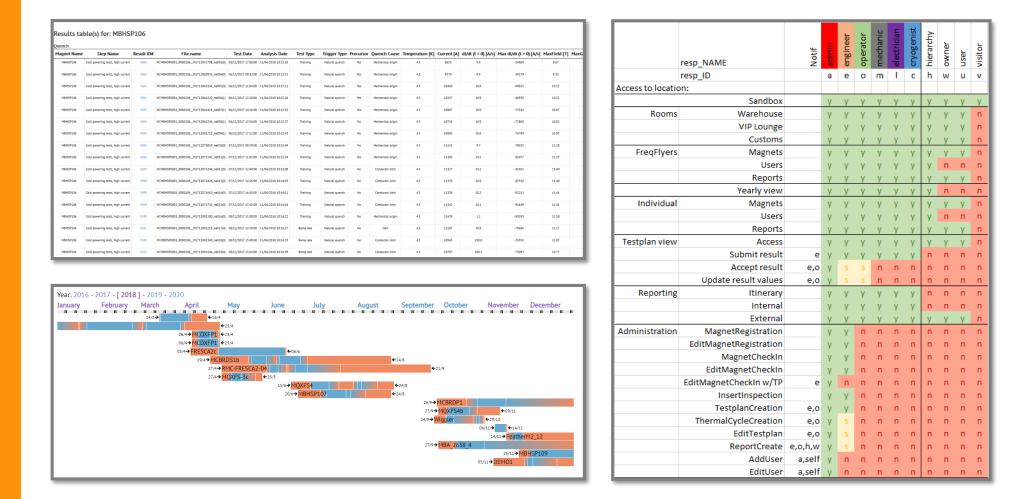Store data from selected activities (e.g. quench, HV test)

Easy statistics and data mining

Automatic reporting

FREQUENT FLYERS & TRAVEL INFORMATION

Additional modules allow for:
- ○ Filtered data mining and automatic reporting
- ○ Creating logbook-type reports
- ○ Yearly reporting about test station occupation
- ○ User access and privileges administration

PLAYGROUND

TRAVEL AROUND TEST FACILITY

Warehouse
Here are the items waiting for a setup or testplan. It is also possible from here to register new coming items and later to check them in.
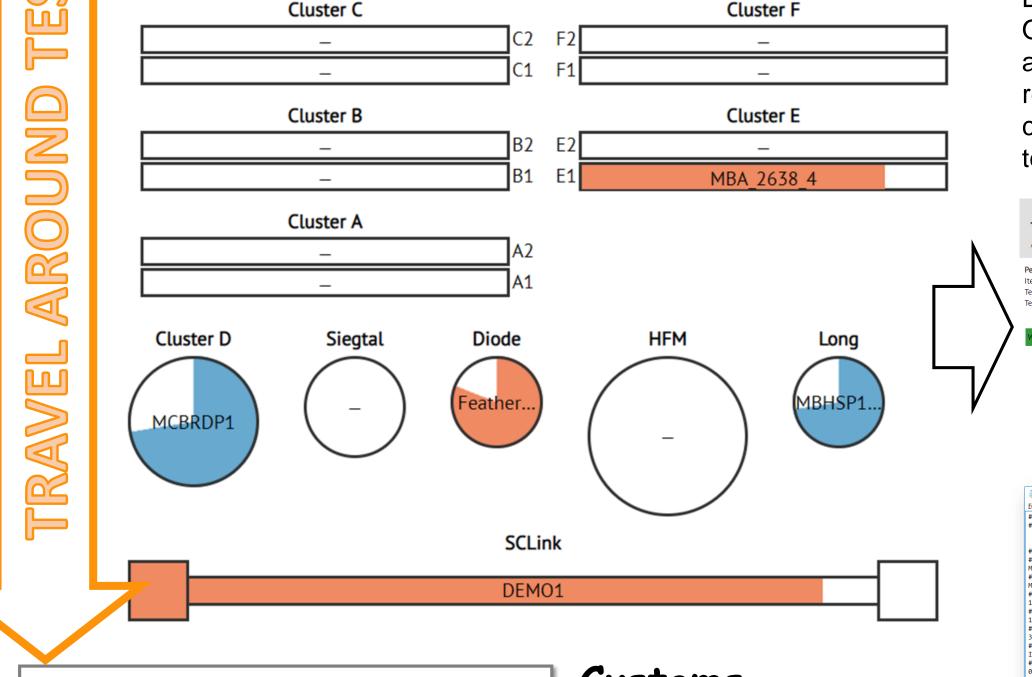
Lounge
The place where items rest while the first few checks are done. Once they are put on an insert or a testbench, they move to the Sandbox.

Sandbox
The main attraction of the Playground. All the test stations have their representation here, with the items or cryomodules that are occupying them. Station colour represents the actual temperature condition – warm or cold, testplan progress is also visible from here.
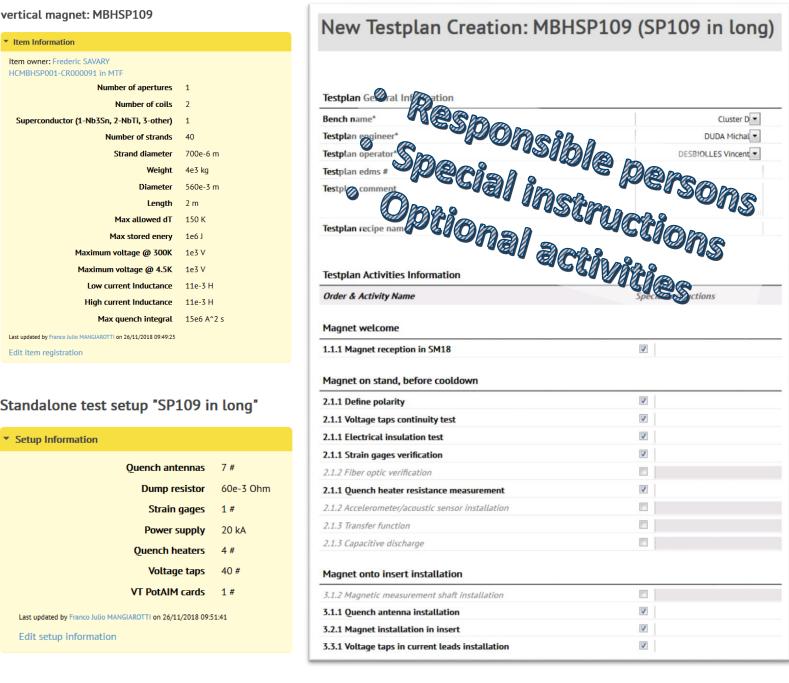
Customs
The place where all items are held hostage for a few last checks. Test subjects that don't have their paperwork (report) finished are also kept here.

Using additional software it is possible to load result files or read data from database for further analysis.
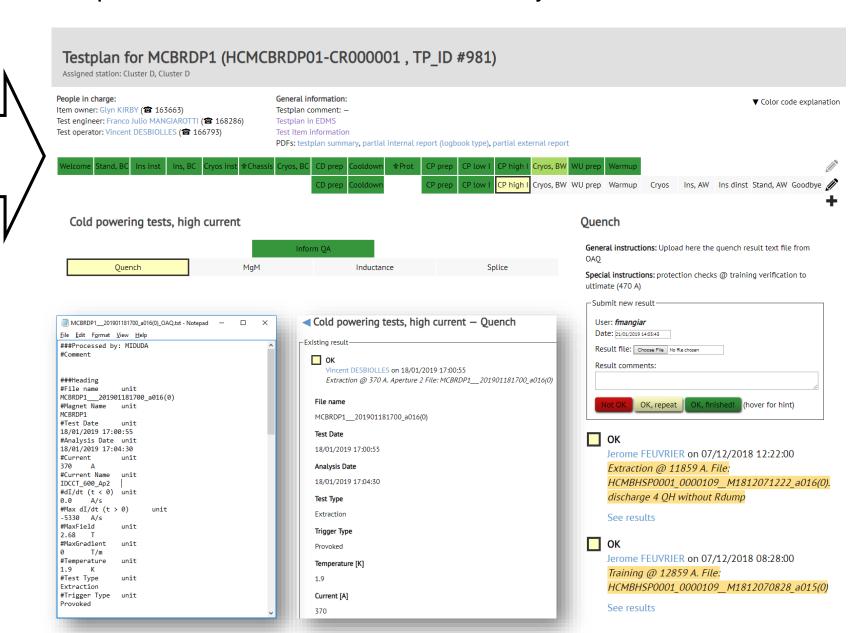
Items or cryomodules registration and check-in
All relevant data about a test item or its assembly, testplan setup and responsible persons are stored in the database. Based on these information a semi-automatic testplan can be created.

Testplan follow-up
The detailed testplan of the item is represented by a colored ribbon. Below on the left side panel step corresponding activities are listed. On the right side detailed instructions are given with options to mark activity as completed or to upload results and below - already posted results with comments. The color code represents the acceptance criteria of the result. It is also possible from here to modify the testplan or to add an additional thermal cycle.

DEVELOPMENT & DEPLOYMENT TIMELINE

2 main developers (+ beta-testers)
- ○ First beta version: 1.5 months @ 100%
- ○ First working version: 4 months @ 20%
- ○ Maintenance during 2018 @ ~10%

To deploy Carpenter in a new place:
- ○ Detailed test procedure & workflow
- ○ Test object properties, test result data

Estimated time required
- ○ By local engineer: 1-2 weeks full time
- ○ Database and website installation: 1 week full time
- ○ Maintenance: ~10%

Other groups that will adopt Carpenter:
- ○ GSI/Fair/SuperFRS i– already deployed
- ○ Freia (HL-LHC cooperation) in Uppsala University
- ○ Interest from other groups testing HL-LHC magnets

UNDER THE HOOD

Hypertext Preprocessor (or simply **PHP**) is a general-purpose programming language originally designed for web development. The standard PHP interpreter, powered by the Zend Engine, is free software released under the PHP License. PHP has been widely ported and can be deployed on most web servers on almost every operating system and platform, free of charge.

PHP is used by **78.9%** of all websites with **a known server-side programming language.**

php ORACLE

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* carpenter /ˈkɑːp(ə)ntə/
noun
1. a person who makes and repairs wooden objects and structures. synonyms: woodworker, joiner, cabinetmaker.
2. a logging software (like CERN Timber) that also does some post-processing of the data.

To visit and to check the current status of the SM18 test facility and items under test you may visit (CERN lightweight account is required):

https://cern.ch/**sm18-carpenter**