LHC commissioning and first operation at 6.5 TeV

Jorg Wenninger[1]

[1] *CERN, Ch-1212 Geneva, Switzerland*
Jorg.Wenninger@cern.ch

After a successful run at beam energies of 3.5 and 4 TeV between 2010 and spring 2013, the Large Hadron Collider (LHC) entered a 2 year long shutdown to consolidate electrical connections and perform major maintenance of its services, in particular of the cryogenic system. The main driver for the long shutdown was the repair of the high current interconnections between the main dipole and quadrupole magnets. More than 10'000 such interconnections had to be checked, and roughly 30% of them had to be completely redone.

In September 2014 the first of the 8 LHC sectors was ready for the commissioning of the magnet circuit (powering tests). During the fall of 2014 one sector after the other was cooled down to 1.9 K and prepared for the powering tests that lasted until end of March 2015. More than 11'000 individual test steps had to be executed and validated. As part of the last powering steps the dipole magnets had to be trained to reach the new target energy of 6.5 TeV. More than 150 training quenches had to be executed until the entire magnet system could be operated stably at 6.5 TeV.

Just 3 days after the completion of the last powering tests, the first beams were injected on Easter Sunday 2015. The beams were threaded around the circumference in less than 30 minutes, and on the evening of the first day both beams were circulating. Five days later the first beam was accelerated to an energy of 6.5 TeV. In the 2 following months the different systems required to operate the LHC at high intensity were commissioned one after the other. June 3rd 2015 marked the start of the data taking of the LHC experiments at 6.5 TeV.

The start of data taking is only the first step of the second phase of the machine commissioning with the goal of operation with high intensity beams consisting of bunches spaces by 25 ns. The schedule for this second commissioning and operation phase of the LHC has been elaborated in detail. A first scrubbing run at 450 GeV aims to reduce the e-cloud activity induced by the closely spaced bunches for a larger bunch spacing of 50 ns. This will be followed by intensity ramp-up with 50 ns beams, with the aim of delivering 0.5-1 fb^{-1} of integrated luminosity to the experiments. A second scrubbing using 25 ns bunch trains will follow that period. If successful operation with 25 ns bunch spacing will start at 6.5 TeV with a progressive intensity ramps up of a few weeks.