THE STATUS OF THE VACUUM SYSTEM OF ALBA SYNCHROTRON

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Abstract

The vacuum system of CELLS is in the installation stage. The booster vacuum chambers have been assembled and baked out in a provisional laboratory ex-situ in the ALBA building, and in less than two months (starting from February 2009) all the booster vacuum system was installed inside the tunnel and under vacuum. All the storage ring vacuum chambers have been delivered and ready for installation, several chambers were tested at CELLS (tests include vacuum tests, dimensional check, magnetic permeability tests…etc). All the tools needed for the assembly of the storage ring vacuum chambers have been delivered and tested at CELLS to validate the assembly procedure. Concerning the standard vacuum components; all the gauges and residual gas analyzers were delivered, all the ion pumps and controllers are at CELLS, the NEG pumps, leak detectors, roughing stations and the UHV valves were delivered too.

THE BOOSTER SYNCHROTRON INSTALLATION

The 250m circumference booster synchrotron was divided into 53 vacuum section, the splitting up was considering the complexity of the different sectors and the length. Each section was assembled with the required ion pumps, flanges, gauges, diagnostics components…etc. Following this, the section was vacuum tested then moved to the bake out oven, where it was baked together with another set of 3 sectors, see Figure 1. After the bake out, the chambers were leak tested and then carefully vented with dry nitrogen and stored inside plastic bags filled with dry nitrogen. The assembly and testing process was from September 2008 until March 2009.

On February 2009, the brackets and the magnets were ready to start the vacuum assembly in the tunnel. The assembly was divided based on the location of the sector valves (8 sections of various lengths), during one week, each quadrant was assembled, aligned, pumped down and vacuum tested and put under vacuum. Once the quadrant passed the leak tests, the top part of the magnets were placed.

The average pressure from the gauges, following the powering of the ion pumps is in the mid. of 10^{-9} mbar range (data April 2009).

Figure 2 shows part of the vacuum assembly of the booster synchrotron inside the tunnel.

Figure 1: Four sections of the booster inside the oven prepared for bake out.

Figure 2: Part of the booster vacuum installation inside the tunnel.

THE STATUS OF THE STORAGE RING VACUUM SYSTEM

The production of the main vacuum chambers of the storage ring of ALBA was during 2007 and 2008; FMB-Berlin delivered to CELLS 116 vacuum chambers of several types in several batches based in the storage ring vacuum sectors (unit cells, matching cells and straights).

All the chambers were tested in the manufacturer premises and part of the chambers was tested at CELLS. The tests covered the following: beam position monitor (BPM) testing, dimensional tests, permeability test and vacuum testing which includes: leak test, bake out, outgassing rate test, total and partial pressure measurement.

By February 2009, all the vacuum chambers were delivered to CELLS.

The crotch absorbers were manufactured from OFHC copper and Glidcop, the main part of them was delivered to CELLS. The vacuum testing results of the absorber were according to CELLS specifications, however, few issues concerning the dimensional test results of few crotch absorbers were not according to the specified tolerances; the acceptance is under discussion.

For the in-air insertion devices, NEG coated aluminium vacuum chambers were manufactured and delivered to CELLS, as part of the site acceptance tests, one vacuum chamber being tested at CELLS including activation of the NEG coating, with good results, Figure 3 shows the Al chamber with the support during the vacuum testing at CELLS.

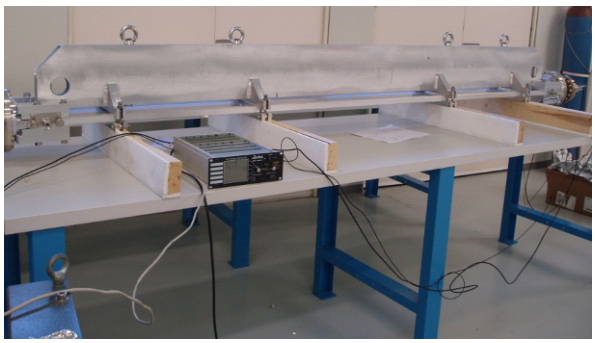

Figure 3: NEG coated Al vacuum chamber during the testing at CELLS.

The bellows and tapers needed before and after the straight sections are under manufacturing, the prototype was accepted end of 2008 and the first batch arrived to CELLS in April 2009. The testing of the bellows included: vacuum tests, dimensional test, magnetic permeability, movement and cycling test. Figure 4 shows the bellows during the cycling test.

Figure 4: The bellows prototype during the movement tests.

All the standard vacuum components needed for the installation of the storage ring was delivered to CELLS before the end of 2008.

THE STORAGE RING VACUUM SYSTEM INSTALLATION

For the installation of the storage ring, several material and tools were needed for this purpose; this includes: strong back (frame) for supporting the chamber during the bake out and movement, large bake out oven, assembly and dimensional check tables.

All these items were ordered during 2008; they have been tested for verifying the assembly procedure at the manufacturer premises and then assembled again at CELLS.

For the assembly of the storage ring, a clean room (ISO 8) was built and conditioned and the assembly tables were placed and aligned in this room.

The procedure of the assembly was adapted from the experience of other synchrotron light sources, which was based on the following main steps:

- Assembly of one complete sector, including the sector valves.
- Pump down and vacuum test.
- Bake out inside large oven for vacuum conditioning.
- Moving the sector under vacuum to the tunnel.
- Connection of the straights between two vacuum sectors.
- In-situ bake out of the straights.

Figure 5 shows the assembly of the first sector inside the clean room, the sector must pass all the vacuum tests before proceeding into the bake out.

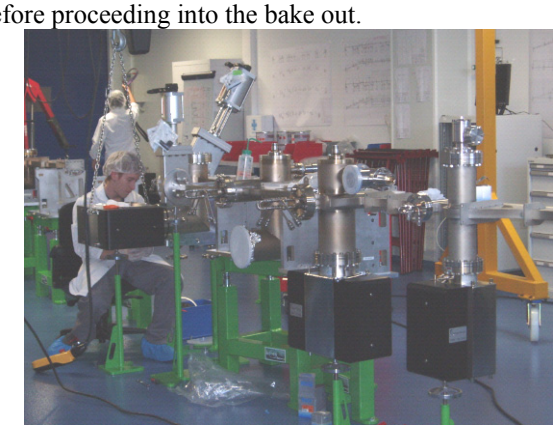

Figure 5: The assembly of the storage ring sector inside the clean room.

Once the testing inside the lab is done, the chambers were suspended with chains into the strong back where they will be transfer into the oven for the bake out. The bake out process is for 48 hours at 200C, followed by activation of the NEG pumps. Figure 6 shows the preparation of the sector for the bake out,

Figure 6: the sector suspended to the strong back inside the bake out oven.

Once the bake out is done, the sector is moved with the crane to the opened magnets, where it will be supported at the location of the BPM, valves and flanges supports to the girder. Figure 7 shows the sector installed inside the tunnel during the alignment process. At the moment (April 2009), one sector was successfully installed inside the tunnel, the sector passed all the tests and assembly process, with leak tightness less than 1.10^{-10} mbar.l/sec and the ultimate pressure with the ion pumps is 2.10^{-10} mbar (reading from the pressure gauges).

It is estimated that each sector of the storage ring will need one week from the start of the assembly to the placement in the tunnel.

CONCLUSION

The booster vacuum system installation was successful and ahead of the schedule, the pressure inside the vacuum chambers is according to the requirements.

Almost all the vacuum chambers and standard components were delivered to CELLS, which facilitate the installation.

The installation of the storage ring has started with initial results which are promising.

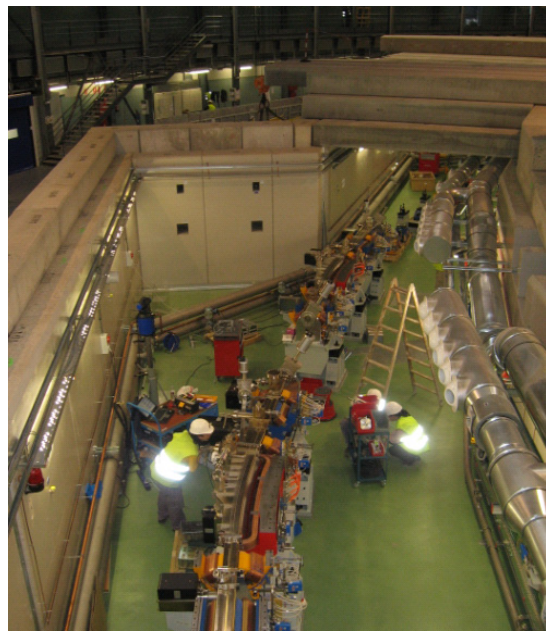

Figure 7: the sector placed in the girders with the magnets open.