DISMANTLE, ASSEMBLY AND INSTALLATION PLANS FOR THE ALBA II UPGRADE

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Abstract

The 3.0 GeV ALBA Synchrotron Light Source, in user operation since 2012, is preparing for a major upgrade aimed at increasing the brightness and coherence of the delivered X-ray beam. The Storage Ring (SR) will be completely renewed while preserving the Insertion Device (ID) source points, the orbit length and the electron beam energy; the current injector will remain in use. A two-year "dark period" is foreseen for 2030–2031.

This paper presents the Implementation Program developed to prepare and execute the removal and installation of the upgraded SR. The program covers storage and logistics of equipment, preparation of testing and assembly areas, recycling and decommissioning of dismantled components, and the coordination of removal, installation and testing activities in both the tunnel and the Service Area (SA). The program structure, work packages and main implementation strategies are presented.

INTRODUCTION

The ALBA Synchrotron Light Source has been operating with users since 2012, delivering synchrotron radiation from infrared to hard X-rays. An upgrade project, ALBA II, has been launched to transform the facility into a diffraction-limited Storage Ring (SR), significantly enhancing beam brightness and coherence [1]. The upgrade does not only affect the accelerators; it also comprises the construction of two new long beamlines (~200 m), that extend beyond the actual plot, and increasing the capabilities of the data acquisition and processing systems for the future high demanding beamlines.

The SR upgrade maintains several key constraints to ensure cost effectiveness and minimize impact on beamlines: preservation of the 3.0 GeV beam energy, orbit length, injector, Insertion Device (ID) source points and shielding tunnel [2]. The SR will nevertheless be fully renewed (Fig. 1), requiring a carefully planned removal and installation process during a limited two-year dark period in 2030–2031, including both the renewal and the commissioning of the new accelerator and beamlines.

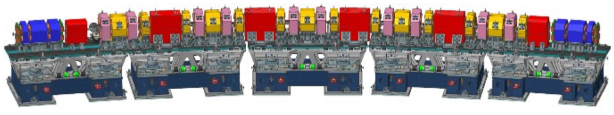

Figure 1: 3D model of one of the 16 ALBA II SR cells.

Given the scale and complexity of the upgrade, ALBA II has been organized under a program-oriented structure that groups the activities into five main programs, each one addressing a major domain of the project while maintaining strong interfaces with the others. The Experiments Program (PG01) covers both, the upgrade of existing beamlines and the construction of the new long beamlines. The Accelerator Program (PG02) is responsible for the design, procurement, integration and commissioning of the upgraded SR [3]. The Computing and Data Program (PG03) addresses the evolution of computing infrastructure, controls, data acquisition and data management required to support both accelerator and user operations. The Infrastructure Program (PG04) encompasses new buildings, modifications to existing facilities, temporary structures and general site works required to host the upgraded accelerator and beamlines.

The focus of this paper is the Implementation Program (PG05), which provides the transversal framework required to physically achieve the upgrade in a safe, coordinated and time-efficient manner. This program is responsible for the preparation and allocation of storage spaces, the logistics and tooling to handle all the equipment, its tracking along all the process, the establishment of testing and assembly areas, the recycling and decommissioning of dismantled hardware, and the coordination of all removal, installation and test activities in the tunnel and Service Area (SA). Acting as the operational interface between the technical programs, the Implementation Program is a key enabler to ensure that the ALBA II upgrade can be executed within the limited dark period while minimising technical risks and impact on the facility schedule.

IMPLEMENTATION PROGRAM

The Implementation Program is structured into six WPs.

WP00 – Program Management

Overall coordination of the program, definition of responsibilities and interfaces between WPs, budget management for external resources, and integration of safety roles within the program.

WP01 – Storage and Logistics

Procurement and assignment of storage areas and handling tools for both, the new ALBA II components and existing ALBA equipment. This WP defines storage requirements, lifting and transport needs, and is responsible for tooling, cranes and logistics.

The different needs along the process and the present available areas to store equipment have been identified. A new temporary building (600~800 m^2) will be built on the ALBA site (Fig. 2). In it, we will store the girders [4] and magnets [5] prior to their characterization and assembly; and later, the girders with assembled and aligned magnets.

Regarding the tooling and besides all the standard logistics equipment, a special device (Fig. 3) is being designed to transport the assembled girders with magnets to/from the assembly zone to the temporary storage building and to the

Experimental Hall (EH), where the orbital crane will take it to its final place in the tunnel.

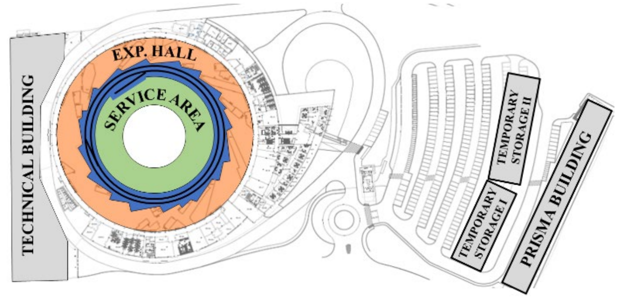

Figure 2: Overall ALBA II site layout showing the Storage Ring, Service Area and temporary buildings foreseen for the implementation phase.

Different tests will be carried out with the girder prototypes and magnet dummies, that are already at ALBA, to ensure that this movement can be done without misaligning the magnets on the girders.

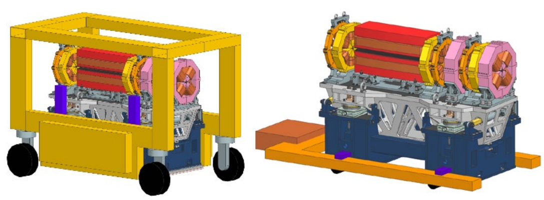

Figure 3: Designs under consideration for the tooling to transport fully assembled girders with magnets.

The structures to hold the vacuum arcs [6] from assembly to bakeout, storage and installation are also being designed within this WP (Fig. 4).

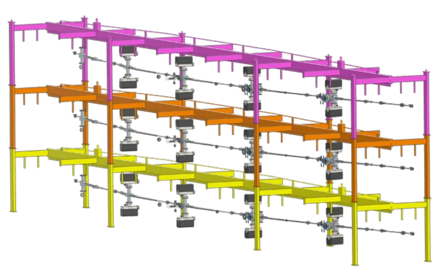

Figure 4: Preliminary design of the structures to be used for vacuum arc assembly, bake-out, storage and installation.

Also, in the scope of this WP, a Components Database (CDB), based on the JIRA Asset tool, is being implemented to track all equipment from arrival to final installation. Automatic notifications and work orders creation will be configured on state changes to ease the day-to-day administrative workload.

WP02 – Assembly and Integration

WP02 will be in charge of the preparation of assembly areas and execution of the assembly of storage ring modules, including girders, magnets, vacuum chamber supports and interfacing systems. Assembly activities are coordinated with subsystem owners and performed prior to the dark period to minimize installation time in the tunnel.

The girders and magnets assembly zone (GIMA) is going to be located in the Prisma building; the actual warehouse that is being converted to a multi-purpose laboratory building. In the GIMA we foresee to work on two girders in parallel using a common laser tracker (Fig. 5). We plan to assemble the 80 girders in two years.

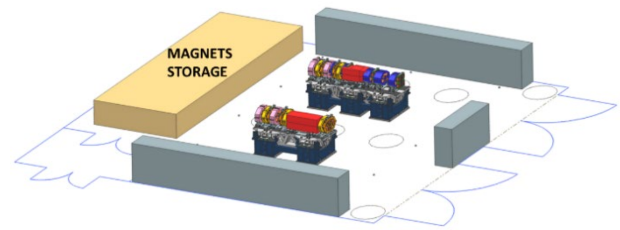

Figure 5: Girders and magnets assembly area.

WP03 – Testing Areas

WP03 will prepare the infrastructure for testing and characterizing magnets (MA), Power Supplies (PS) and other subsystems. Two new testing laboratories, MA and PS, are going to be built in the Prisma building (Fig. 6).

Figure 6: Laboratories and storage area in Prisma building. Four spaces are reserved for: (1) PS racks storage, (2) PS tests, (3) MA measurements and (4) GI and MA assembly area.

The new magnetic measurement lab will have two stretched wire benches and will complement the present magnetic measurement lab, that hosts the Hall probe station.

The PS laboratory will be also placed in the Prisma building and will have all the required measurement equipment and loads to test and calibrate the ALBA II 1,152 new PS. Next to it, a storage zone of 300m^2 is foreseen to host the PS racks.

WP04 – Recycling and Decommissioning

This WP is responsible for the definition and execution of protocols for dismantling, activation measurement, waste classification and recycling of the existing storage ring and service area equipment.

Another temporary building (~400 m^2) will be built to host the present SR just after its disassembly. There, all the activation measurements required by the Nuclear Safety Council as well as the disassembly process prior to recycling will take place.

WP05 – Removal and Installation

WP05 is in charge of coordinating all removal and installation activities in the tunnel and SA, including cabling, conventional services, equipment protection and post-installation testing.

The main deliverable of this work package is a detailed schedule of all the activities that will take place during the dark period. In constant communication with all the subsystems leaders, a project management approach is being carried out to consider tasks, durations, dependencies, resources, logistics and spaces. The tunnel and SA activities are being considered in the same project due to the high dependency between both plans. The different phases of the schedule are described in the next section.

Once the dark period starts, follow up and continuous retuning of the plan will be a must. This WP concludes when all the subsystems are installed, tested and ready to start commissioning with beam.

REMOVAL AND INSTALLATION PHASES

In the following paragraphs, we describe the removal and installation phases. With few exceptions, the different works are organized in quadrants, to have differentiated parcels where the teams can work safely without collisions; four labyrinth doors give access to the tunnel. This split introduces some flexibility allowing the quadrants to be in different phases at the same time. Only the removal/installation of roof and general survey campaigns are done as a whole.

The removal and installation is constrained by the availability of the two orbital cranes. Early removal of the tunnel roof slabs is foreseen to reduce crane workload and improve flexibility.

The installation sequence prioritizes the safety and protection of fragile components. Once the roof is taken away, equipment to be re-used such as RF cavities, IDs and Front Ends (FEs) will be temporarily removed from the tunnel and stored in protected areas of the EH.

After this, the removal of SR and SA equipment as well as services like secondary cooling, trays and cables will take place. Then, we will work on the preparation of the tunnel and SA: floor reparation, supports for new racks, SA electrical distribution and cooling.

Three months after the dark period starts, the SR girders with assembled and aligned magnets will be installed. In parallel, the new racks at the SA can be installed, followed by the SA-to-SA cabling process.

As soon as the work described in the last paragraph is finished, the installation of the vacuum arcs will take place by sectors. For this, the upper half magnets will be taken out and stored in the straight sections space; except the QDS, the permanent quadrupole-dipole magnets, that will be slided out instead of opened. After finishing this process in each sector, neighbouring FEs will come in.

Once SR and FEs are in place, the tunnel cabling campaign will start. Note that the straight sections equipment, (IDs, RF and injection) will still not be there; allowing an easy pass to the FEs. The cables for the straight section equipment will be placed but pending to be connected. In parallel with the cabling, the secondary water-cooling piping will be installed.

After this, the straight sections installation will happen, including the vacuum chambers connection with the arcs that are equipped with valves at their ends. The straight section equipment (IDs and RF) will have been stored and modified, if needed, in the EH during the first half year of the dark period.

At this time, there will be no more tunnel activities that require the use of the crane. Therefore, we foresee evening shifts to close the tunnel roof during the following six weeks. Once this is finished, safety will check the shielding and alignment will make the final alignment campaign. During the daytime, subsystem tests can start.

Regarding the equipment tests, it will gradually take place according to the readiness. We plan to have the network racks ready and powered as soon as possible for an early start of the control systems tests. Activities like the power up of magnets will have to wait for the readiness of the control system, the equipment protection system, the cabling and the cooling.

Overall, we are aiming to remove, install and tests the equipment within one year. After it, the commissioning with beam will start.

CONCLUSION

The Implementation Program for the ALBA II upgrade provides the organisational and technical framework required to safely and efficiently execute the removal and installation of the new SR within the limited dark period time. Through a structured set of work packages, early preparation of storage, assembly and testing areas, and detailed coordination of logistics and installation activities, the program aims to minimise technical risks and downtime for users. The implementation planning is progressing in parallel with the accelerator design and procurement activities and will be further refined as the project advances toward execution.

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