MIRACLES: STAP Spectroscopy report (October 2022 – April 2023)

Félix J Villacorta, on behalf the MIRACLES team*

Status and management

The MIRACLES instrument continues with steady progress with the detailed design in the last six months. Three massive SubTG3s have been approved and all their components are in the manufacturing phase). The rest are planned along 2023:

- BTCS† In-bunker: approved.
- BTCS† Out-of-bunker (Part I: BWI, FO chopper, shutter): approved.
- SCS‡ (Part I: Vessel + beam stop): approved.
- SCS‡ (Part II: In-vessel): under review.
- BTCS† Out-of-bunker (Part II: guide + supports): documentation to be submitted in May.
- Experimental End Station: September 2023
- SES§ + slits: November 2023
- Final TG3: December 2023

A general overview of the status of the main work packages, and providers of the detailed design at this stage are depicted in Fig. 1:

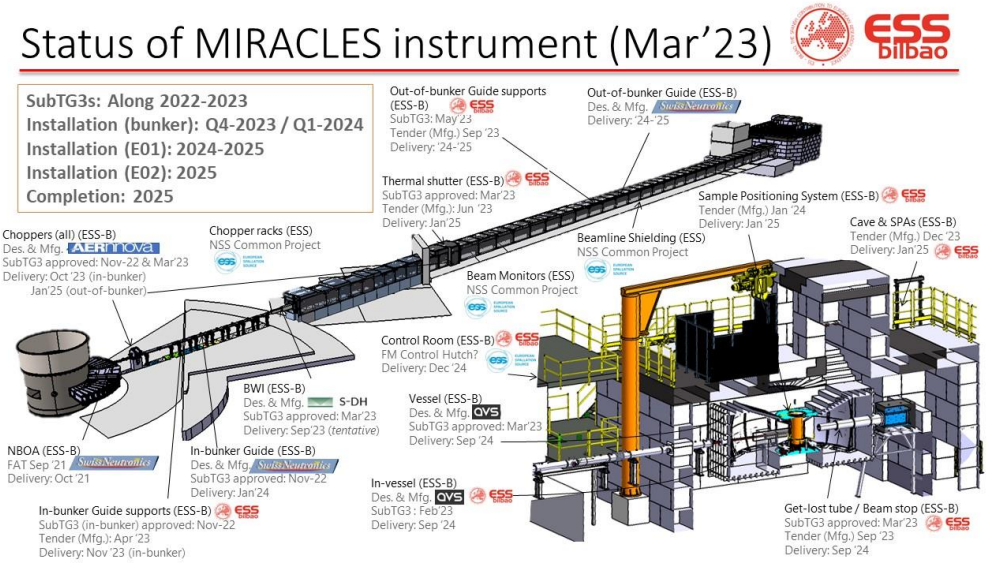

Figure 1. Illustration showing status, providers, and milestones for the different components of MIRACLES.

The main challenge now is the increasing cost of materials and components. This is starting to impinge on the final budget of the project.

---

* MIRACLES team: A. Conde, J.E.M. Pereira, I. Mazkiaran, G. Harper, O. González del Moral, R. Martínez, A. Zugazaga, H.N. Bordallo, F. J. Villacorta

† BTCS: Beam Transport and Conditioning System

‡ SCS: Scattering Characterization System

§ SES: Sample Exposure System

Beamline (Beam Transport and Conditioning System)

Wall feedthrough guides: NBOA & BWI

The Neutron Beam Optical Assembly, NBOA, arrived at ESS site in October 2021. Installation is scheduled by Q3-2023.

The design of the Bunker Wall Insert, BWI, has been approved and it is in the manufacturing phase. Installation is tentatively scheduled by Q4-2023.

In-bunker beamline

The in-bunker guide and choppers are being manufactured. Installation is scheduled by Q1-2024. However, a strategy for installation coordination of the instruments of the West sector (mainly the four to the right of BIFROST, i.e., MIRACLES, MAGIC, T-REX and HEIMDAL), will be carried out, coordinated by NSS and involving the instrument teams and the providers.

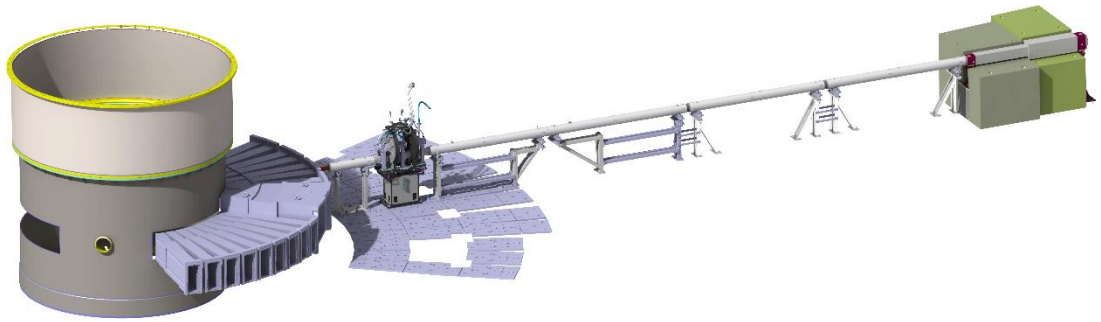

Figure 2. 3D model of MIRACLES in-bunker components (including the guide wall feedthrough guide units, the NBOA on one end and the BWI at the other end).

Out-of-bunker beamline

The out-of-bunker guide is in its detailed design phase and under internal review, prior to ESS SubTG3.

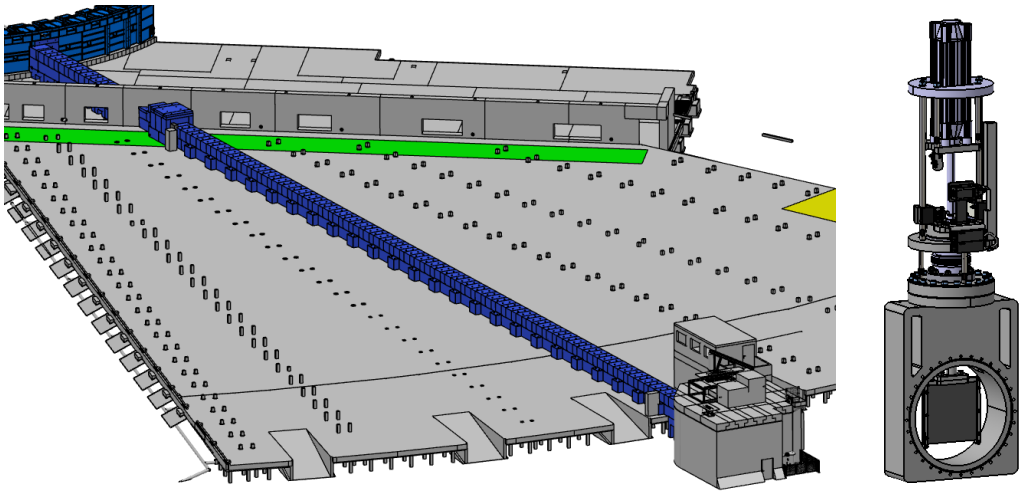

Figure 3. 3D models of the MIRACLES out-of-bunker beamline and thermal shutter.

The shutter and the bandwidth FO chopper have successfully passed their SubTG3 and they have entered in the manufacturing phase.

A preliminary design of the beamline shielding (under the scope of the NSS Common Shielding Project) has been recently developed, and a more mature design is expected in the following months.

Scattering System

Vessel

The design of the vessel has been completed (see Fig. 4). The raw material has been purchased and manufacturing started at the beginning of this year.

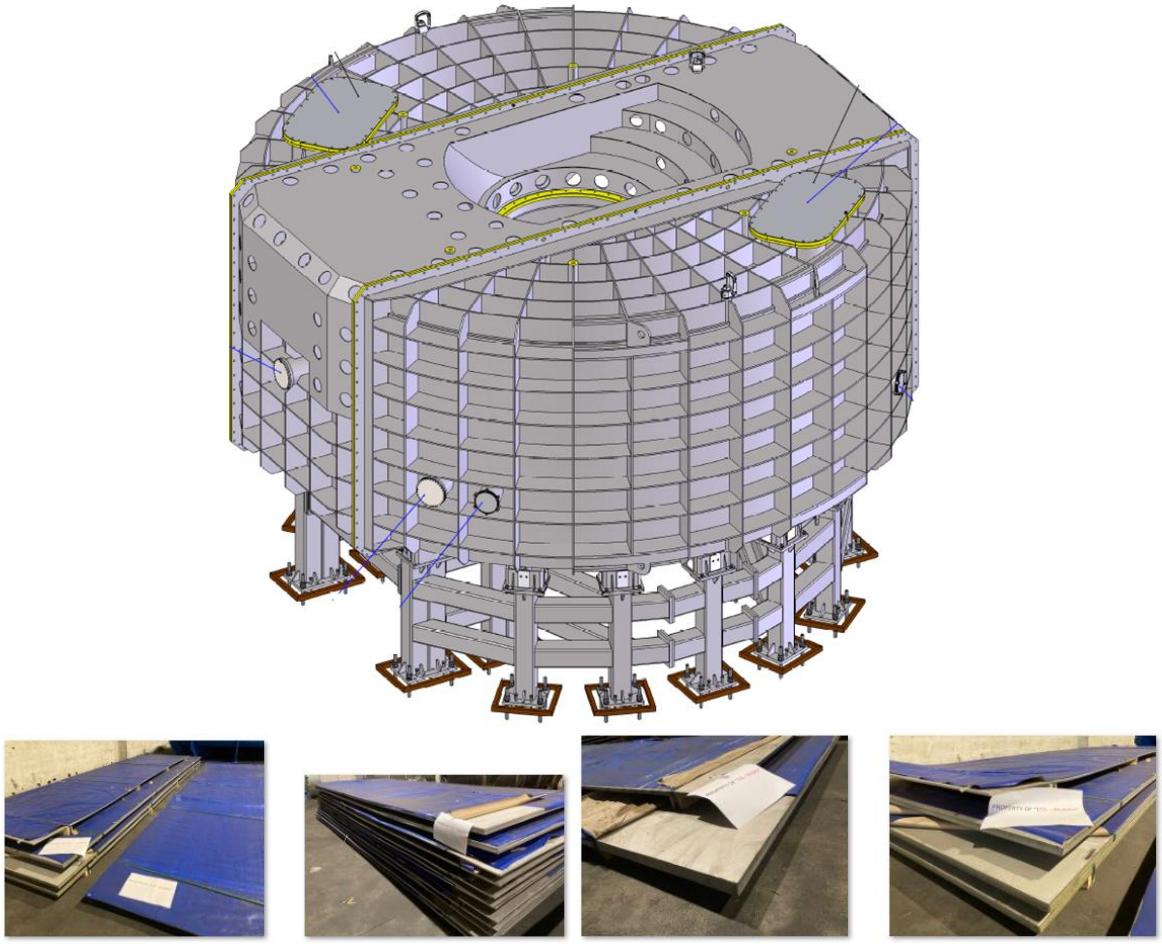

Figure 4. 3D model of the MIRACLES vessel and raw material (steel 316L) to manufacture it.

Radial collimator

The mechanical design and motion control of the collimator is in its final form (SubTG3 under review) and a prototype has been developed to validate the fabrication method and evaluate potential issues.

Analyzer

The mechanical assembly of the analyzer is in the manufacturing stage (an early manufacturing process of the panels was carried out, see Fig. 5).

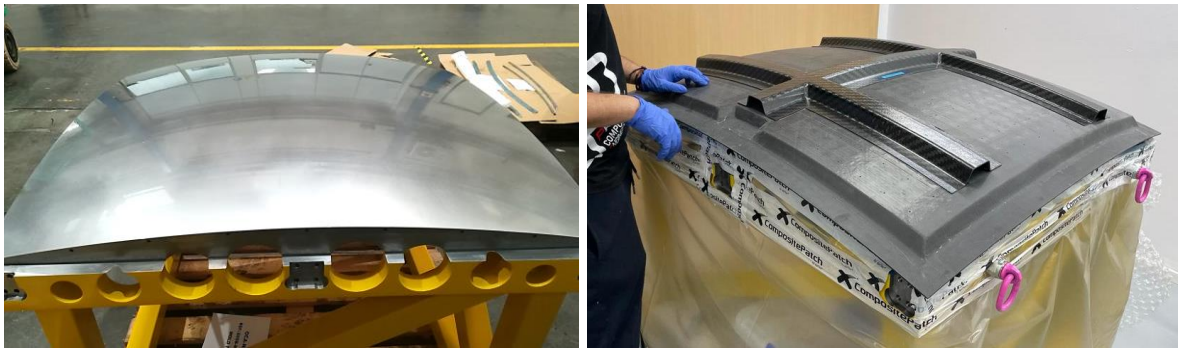

Figure 5. (Left) mold (Right) one of the panels of the analyzer.

Two prototypes of the analyzer are being manufactured to validate the Gd paint coating procedure and the gluing procedure as well as to evaluate the effect of different fabrication conditions of the Si crystals (method, etching) and thickness for the Si(111) crystal reflectors. To this purpose, we have carried out internal methodic procedures for the Gd painting process (see Fig.6). A systematic study will be carried out (hopefully during summer) in collaboration with the staff at IN16B (ILL).

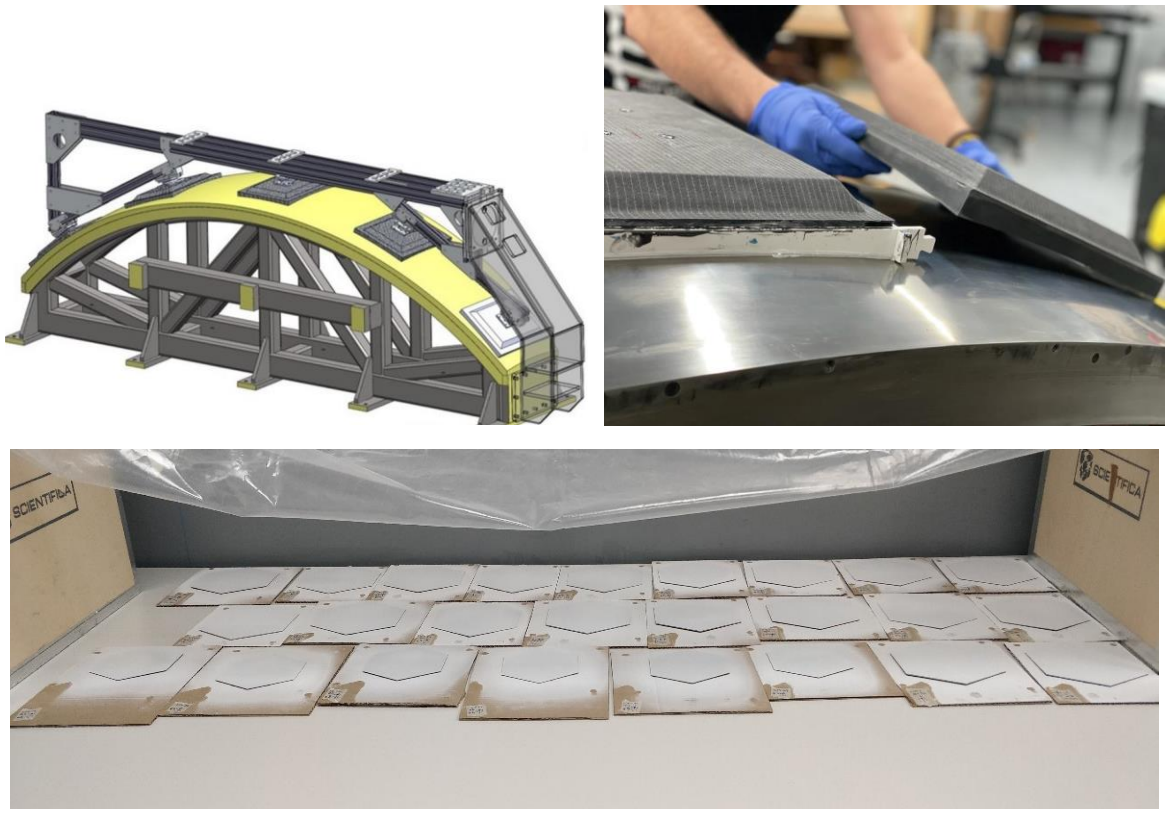

Figure 6. (Top) Panel prototype of the MIRACLES analyzer, for the tests in IN16B (developed by AVS); (Bottom) Si-111 crystals (manufactured and cut by Holm) coated with Gd paint (developed by ESS-Bilbao).

Detectors, beam monitors and readout

Detectors

Some prototypes were developed by Reuter-Stokes to test the ^{3}He tubes U-shaped serial connection. These tests have been simultaneously harnessed to select the proper preamplifier to bridge the detectors to the CAEN R5560 digitizer. Such experiments were carried out using the Am/Be source available at the Universidad Politécnica of Madrid (UPM).

Experiments this year were more successful than last year. Besides the validation of the design of the tubes and the integration with the CAEN electronics, the tests have clarified the final selection of the preamps that will be chosen for the MIRACLES detectors (the CAEN R1443 preamplifier). Tenders for detectors and electronics are imminent.

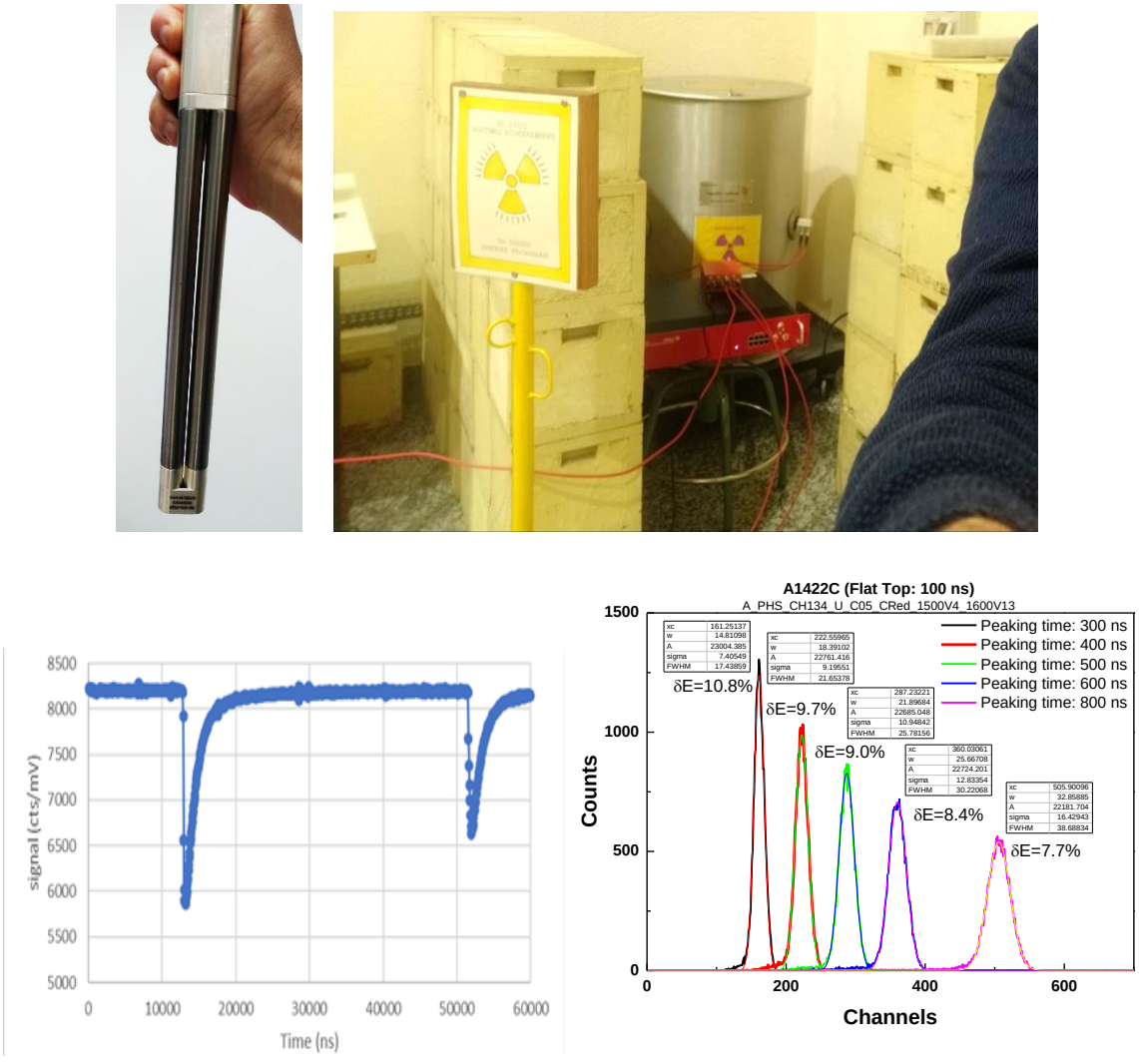

Figure 7. (Top) Pictures from the U-tube prototype and the experimental bunker at the UPM (with the preamplifiers studied); (Bottom) Some results of the tests, analyzing the risetime and time decay of the preamps and energy resolution of the 3He detectors.

Readout

There is no progress since the last STAP meeting related to the interface between the MIRACLES detector readout and DMSC. Work is still in progress using the MIRACLES McSTAS input to simulate the interface to the event formation unit (EFU).

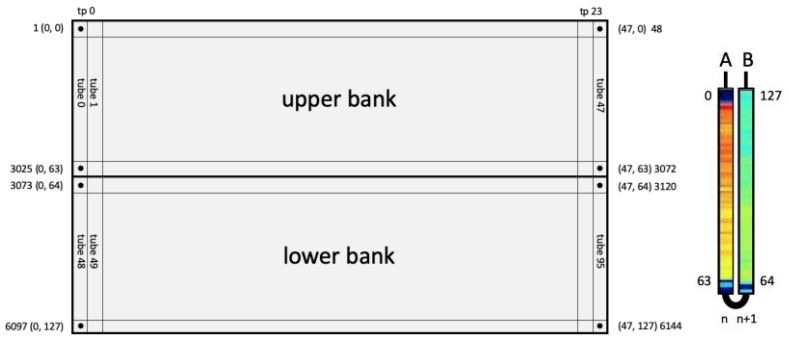

Figure 8. Logical geometry and pixel identification of MIRACLES detector banks

Beam monitors

There is no significant progress at the Beam Monitor Common Project. However, some advances are expected in the following months with the arrival of a new project leader.

Experimental station

Cave

The cave has a preliminary design. However, issues with the floor load requires a slight redesign in some parts. Work is ongoing, and the design is expected to be completed with the integration of the utilities in the following months.

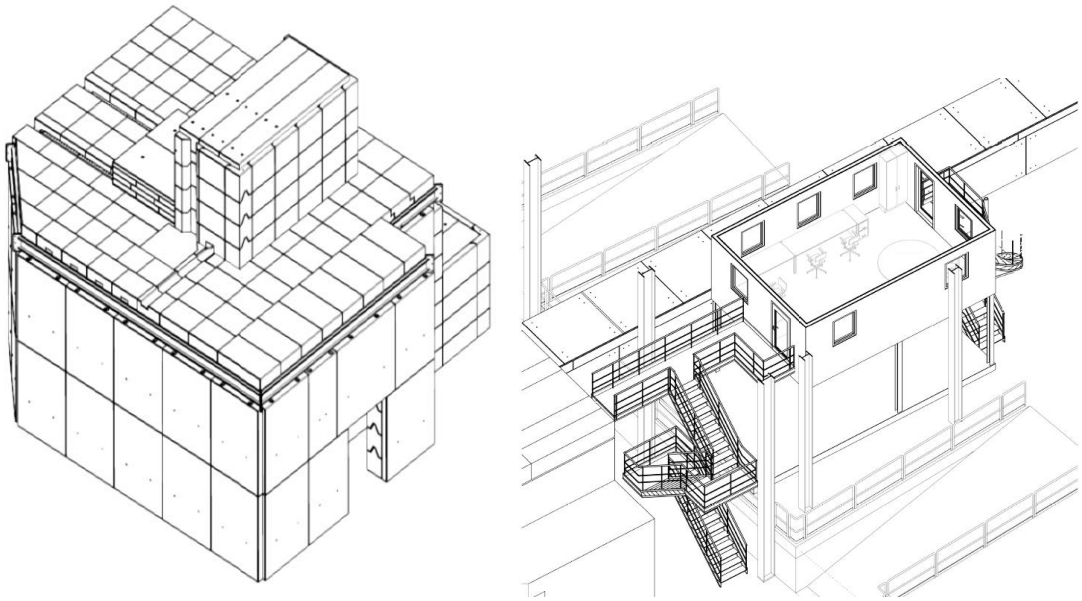

Figure 9. Preliminary CAD design of (Left) the MIRACLES cave, (Right) the MIRACLES control hutch

Control hutch

We have had several meetings with ESS Facility Management related to the potential delivery of the Control Hutch by ESS. We appreciate the efforts of Irina Pavelic, from ESS FM, to find an agreement.

Due to the significant cost of the first offer, we are envisioning a more modest control room that brings the price closer to our budget (we have assumed that the final value exceeds our cost book allocated for the room).

Infrastructure NSS common projects

Utilities

The MIRACLES Team has had discussions with NSS to join the NSS Common Utilities Project. A document with technical specifications is completed by ESS-Bilbao, and a document with requirements have been completed by NSS. We are just waiting for a formal offer.

Electrical

The MIRACLES Team has resumed the discussions with NSS to join the NSS Electrical Project. A requirements document is expected by Q2-2023, and once agreed, a formal offer will be the next step.