

Status update of the DarkSide 20k AAr Cryogenic System

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1. Criotec contract – current and upcoming activities

- Final design of all 9 VB (3 batches) approved
- Final design of 16 TL (3 batches) to be approved between 26/06/2024 (FDR-TL 1st batch) and 10/07/2024 (FDR-TL 3rd batch, date TBC)
- Manufacturing of 1st batch of VB: NP, HR, LF
 - Manufacturing of outer vessel completed, all valves installed, pressure tests completed on inner vessels
 - Internal piping and support structures manufactured and prepositioned
 - Internal piping being X-rayed by subcontractor (10% weld radiography)
 - MLI installed on inner vessels LF, HR and on X-rayed piping
- FAT of 1st batch of VB: scheduled for 2nd week of July (CERN will attend)
- Manufacturing of 2nd batch of VB: AP, CA, GF
 - All dished heads machined by subcontractor, delivered to Criotec on 21/06/2024
 - In-house manufacturing activities starting today (24/06/2024)
- Manufacturing of 3rd batch of VB and all TL
 - Manufacturing activities to start end of July

1. Criotec contract – current and upcoming activities



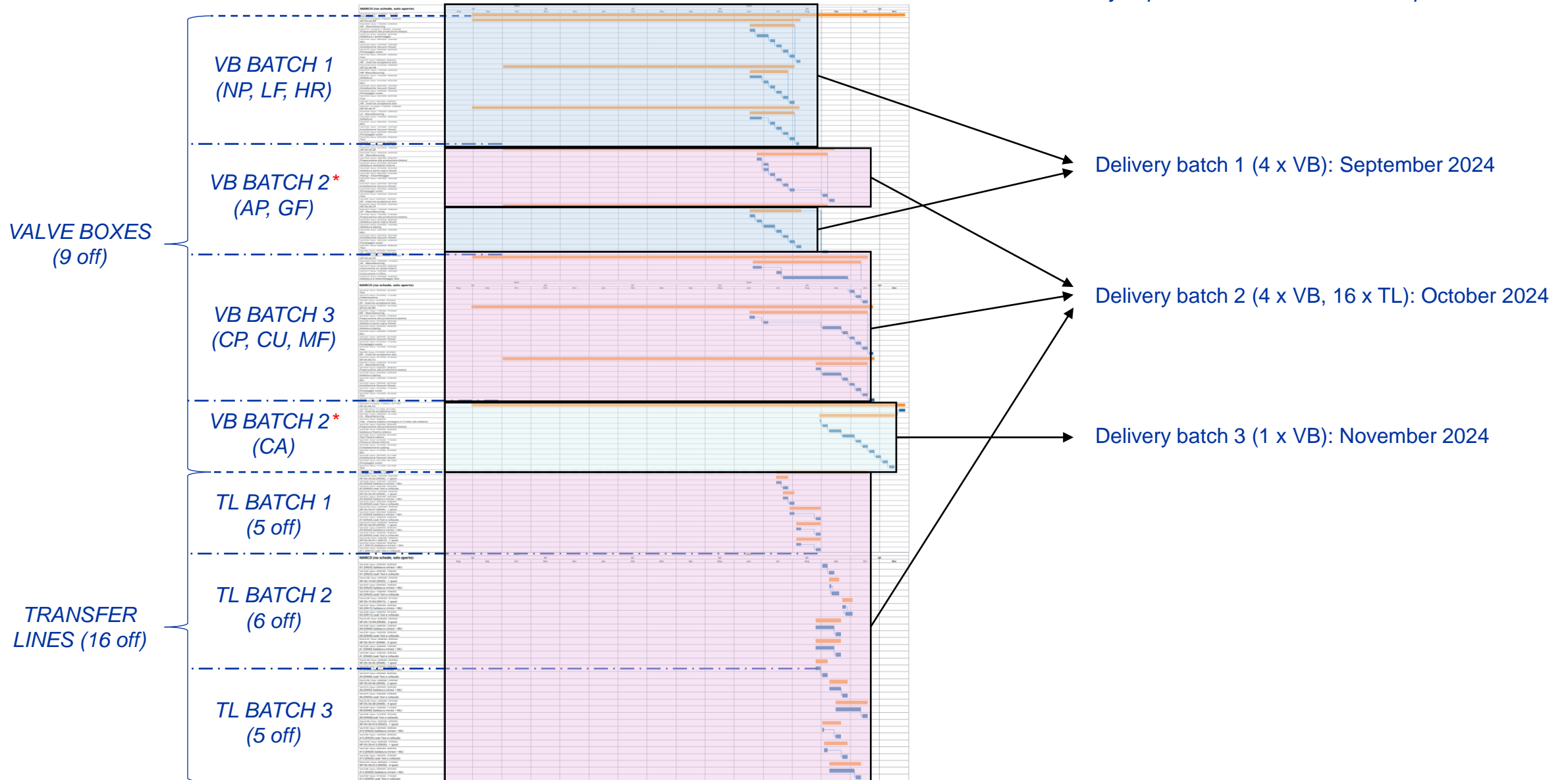
Fig. 1 – Ongoing manufacturing activities: HR valve box, inner vessels wrapped in MLI, internal structure and HEX installed (left); LF valve box, B4110 Cu filter wrapped in MLI, piping disassembled for welding + X-rays (middle); HR, LF, and NP piping sub-assemblies ready for X-rays (right).

2. Criotec contract – preparation for shipment and installation

- Contractor highlighted some delays during our last visit, mainly associated with CA valve box (not ready before beginning of November).
- Internal CERN meeting to assess mitigation strategies, then discussed with Criotec. Proposal:
 - Criotec's supply will be delivered in 3 batches as follows:
 - 1st batch containing 4 VB (HR, LF, NP and AP), will be **delivered beginning of October** as initially planned. The 4 VB will be pre-positioned onto the platform by LNGS's contractor, under Criotec's supervision. This will also reduce the storage space required during installation.
 - 2nd batch containing all other VB except CA (GF, CP, CU, and MF) and all 16 TL, will be **delivered in mid-October**. Criotec will perform the final installation of all the first 8 VB, plus all TL that do not interfere with the CA valve box.
 - 3rd batch containing only CA, will be **delivered beginning of November**. Criotec will install this VB and all remaining TL and test everything.
 - It has been clarified that everything must be installed and tested well before Christmas.
- This strategy aims to minimise delays by staggering delivery and (partly) installation.
- Particular attention required to prepare shipment and installation in multiple steps (requires coordination among CERN, LNGS, and Criotec teams and relative sub-contractors).
- Installation Readiness Review (IRR) foreseen for beginning of September 2024.

3. Criotec contract – project schedule

**Note: CA, AP, and GF are all parts of VB batch 2. They are only separated in this Gantt chart representation.*



4. CERN site – current and upcoming activities

- **DS warm panel**

- All valves, parts, and instruments ordered and delivered
- 1st skid completed
- 2nd skid: structural frame completed; piping sub-assemblies machined; piping, valves, parts, and instruments to be integrated in July/August (depending on welder's availability)
- Testing of both skids: beginning of September 2024
- Warm lines
 - Design (July-August 2024)
 - Internal procurement @ CERN (beginning of September 2024)
- **Delivery (warm panel + warm lines) to LNGS: end of September 2024**

4. CERN site – current and upcoming activities



Fig. 2 – Warm panel, 1st skid fully assembled, ready for testing.

4. CERN site – current and upcoming activities

- **DS cryostat safety relief equipment** (2 x pilot-operated safety valves; 1 x diverter valve)
 - Sizing and calculation note completed
 - Technical specifications and tender form completed and revised, currently with procurement office
 - Contract specifications to be sent out for bids in 1st week of July
 - Lead time: 38-42 weeks from contract signature, **delivery foreseen around April 2025**.
- **DS cryostat membrane – N₂ purging equipment**
 - Valves sizing and selection completed (2 x PRR, 4 x CV, 8 x HV, 3 x SV)
 - Cryostat pressure sensors already delivered (6 off)
 - All valves yet to be procured
 - **Delivery foreseen end of September 2024** (together with warm skid and piping)
- **AP support structure**
 - Mechanical design and FEM analyses completed
 - Structural verifications ongoing (according to EN 1993-1), calculation note will follow
 - Fabrication foreseen for July/August, **delivery foreseen end of September 2024** (together with the rest)