DarkSide-20k
Integration of Optical Planes in CR2 with PDU, vPDU, Gd-PMMA bricks and cables

November 30th 2023
Draft v. 1.3

Mandate of the Task Force

Preamble

DarkSide-20k modified the detector integration provided in CR2, moving the integration of the TPC into the cryostat and leaving the integration of the two Optical Planes (OP), i.e. the integration of the stainless-steel support structures with PDUs and vPDUs, with the related signal/power cables and with Gd-PMMA bricks. The CR2 cleanroom has a 2 x 2 m material door with an airlock, larger pieces require dismantling of the south wall. This procedure requires the intervention of the company that built the structure, and this operation can occur a maximum of a few times in the life of the structure.
PDUs and vPDUs must be tested at room temperature once connected to cables and, in the event of a fault, the relevant components (cables, cards) must be replaced to make them work. Cables must be organized and secured on the support structure before placing the PDUs or vPDUs. The remaining part of the cables, which will be connected to the PCBs in the cryostat chimneys, will have to be organized and temporarily fixed to the structure which will temporarily support the optical planes for assembly in CR2 and subsequent transport to Hall C.
The optical planes, once assembled, will need to be boxed and bagged to keep them clean and for transportation.

Mandate charges:

The Task Force (TF), considering the new scenario of integration and installation of the TPC and the Internal Veto (TAV) which occurred after the collaboration meeting in June 2023, will have to review the integration procedure (named *Procedure* in the following) of the two optical planes.

in particular, the TS must define and analyse the feasibility of a *Procedure* that allows the optical planes to be assembled, tested and then transported to Hall C taking into consideration:
1. **Optimization of the schedule** and possibility of gaining contingency in the schedule by having the CR2 only for the assembly of the OPs;
2. **Entry into CR2** of the OP support structures and subsequent exit of the OPs assembled and packaged for transport - removal and subsequent installation of the south wall of CR2. First evaluation of feasibility, costs and times necessary for such operations - any incompatibilities with work in progress in CR3 - heavy load handling (OP);
3. **Compatibility of the space available in CR2** with the *Procedure,* considering, for example, dimensions of the support jigs, any scaffolding, the space to handle components to be assembled (PDU, vPDU, cables, Gd-PMMA bricks), test system. Among the tasks of the TFs there is also that of identifying the necessary **services that are missing** in CR2;
4. **Wishlist of tools** for the *Procedure* with a definition of their basic functionality and main requirements - for example tools and jigs to support the movement of OPs, to position cables, PDUs, vPDUs, bricks, to support the part of cables that will subsequently have to be positioned at the inside the cryostat and taken up to the chimneys.
5. **Checking the compatibility** of the *Procedure* with the operations that must be performed in the cryostat to assemble the TAV - integration of the OPs with the TPC and Inner Veto - arrangement of

the cables to pass from the OPs, inside the vessel up to the chimneys and the respective PCBs - elimination of support jigs for transporting cables together with OPs when no longer needed - etc.;

6. Refer to the procedure steps with the **WBS and Schedule** - this is to help evaluate any **missing resources** in manpower and funds.

In the integration of the OP, very fragile components must be inserted (PDU, vPDU, thin cables) which require jigs, tools to handle them and fix them on the stainless-steel support structure. The layout of the cables is complex both on the support structure and in the temporary structure for transport and installation in Hall C. The PDUs have very limited spaces between one and its neighbor and must never come into contact on their upper face completely covered with SiPM. If a defective electronic component or cable is found, it must be replaced. This may be even longer and more complex than placing them in the first instance. To achieve reasonable certainty that all operations can be carried out safely and that the tools work for the purpose, it is important to be able to carry out tests on a **sufficiently large mock-up** of the final support structure: let's say a quarter of the final one.

> *Briefly*: *It will be charge of the TF to identify a path that allows preparation for the integration of the final parts, with a qualification of the procedure before moving on to the final parts. The aim is to maintain an aggressive schedule by reducing the risks of errors in the design of parts or of procedures that are not well qualified.*

The TF must also consider the possibility that the **Grid is assembled in CR2**. If so, what would be the implications for optical plane integration: schedule, CR2 space utilization, entry and exit of large components (which need south wall removal).

Working method and reporting of the Task Force

The Task Force must organize itself internally in the way it considers most efficient to respond to the requests of the mandate. Where the TF requires expertise not available internally, it will draw on external expertise using existing meeting organization in DarkSide-20k where possible, avoiding duplication of meeting structures. TF will document their meetings on the WEB (in indico) under a specific heading. The TF will make a **final report with findings, conclusions and recommendations**.

The task force is established at Project Directorate level and will report to this and, where appropriate, also to collaboration meetings.

Timescale maximum 4 months.

Task Force Membership
Co-chairs: Alessio Caminata, Eugenio Paoloni.

Members: Pierre-André Amaudruz, Bianca Bottino, John Brandt, Saverio D'Auria, Lidio Pietrofaccia, Andrea Pocar, **Martin Spangenberg.**

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