**Taskforce Weekly Plenary Meeting**
***Minutes and Actions, 10 March 2025***

**Meeting time:** 14:30 – 16:00 CET

**Zoom meeting room:**

[Zoom link](https://cern.zoom.us/j/61274255815?pwd=2fwGbaMrZAYmUfpUfMCjKwpoYzPCKd.1)

Attendees: All task force members

Chair: Fiodor Sorentino

**Key Takeaways:**

* Cryogenic system design crucial; requires expert input for 300m+ depth configuration
* Updated detector layout revealed new issues (e.g., logistics flow, access to vessels)
* Need to classify and compare a manageable number of layout configurations
* Critical requirements for optical elements (e.g. folding mirror height) need clarification

**Next Steps:**

* Gather feedback on proposed layout configuration classification
* Explore fast-track method to obtain critical optical element requirements (e.g. ET-LF folding mirror height)
* Begin risk analysis based on current configuration options, adjusting as needed
* Translate open points into actions and identify responsible parties
* Discuss tactical layout points with Jonathan and Patrick
* **Safety requirements from cryogenics**

***14:30-14:50 CET***

**Point presented by:** Piero Rapagnani

**Point submitted for:** information

**Summary of discussion:**

Piero presented an overview of the safety requirements for cryogenic systems, including the use of helium and nitrogen, and the challenges of handling and distributing these fluids over long distances. The task force members discussed the differences between the CERN LHC setup and the requirements for this project, particularly around the increased hydrostatic pressure and volume of high-pressure cold gas that would be needed for a 300+ meter distribution system.

**Takeaways:**

* Helium and nitrogen behave differently when leaked; helium rises, nitrogen sinks when cold
* LHC-like setup: surface-level cooling stations, cold gas piped down ~100m
* 300m+ depth poses unique challenges (hydrostatic pressure, volume of cold gas)
* Expert input needed for conceptual design; technology exists but specifics unclear
* **Technical infrastructure**

***14:50-15:10 CET***

**Point presented by:** Patrick Werneke

**Point submitted for:** information

**Summary of discussion:**

Patrick gave an overview of the technical infrastructure elements that were already implemented in the detector layout design (ETO ED) and the parts that were still under discussion. The clean room space and scaffolding volumes were already added, but other aspects like noisy room allocation (cryogenic supply system: KAGRA examples), dewatering system, HVAC ventilation system for tunnels (examples: CERN/CLIC) are still under discussion. The Task Force members discussed which elements were relevant for the Task Force deliverable and which can be mentioned in the document without detailed study. The discussion will be revisited in the Amsterdam meeting.

* **Flexibility demands from optical layout**

***15:10-15:30 CET***

**Point presented by:** Anna Green

**Point submitted for:** information

**Summary of discussion:**

Anna shared an overview of the flexibility demands for the optical layout and also mentioned a working document that was being set up. The link to the working document can be found here: [Layout Flexibility](https://docs.google.com/document/d/1j1lpcTlEcxF0ltQnxL4O26Qr7eW3z0q8Jw6njYtSK-I/edit?usp=sharing).

This document contains an overview on examples in LVK where this design study can improve on. The Task Force members discussed on the flexibility needed to be implemented in order to not be constrained in commission troubleshooting, assembly and upgrade path. Future updates need to be taken into account: e.g. if one would want ET-HF to be cryogenic as well, what would be the procedure to do this? Instable cavities also need to be considered, because in VIRGO not enough room to improve or fix such problems was considered.

**Takeaways:**

* Minimum height for ET-LF folding mirrors impacts infrastructure costs
* Residual length requirements for signal recycling cavity at 3 Hz challenging
* Suggestion to consult ISB for expert input on requirements
* **Open points in detector layout**

***15:30-15:45 CET***

**Point presented by:** Max Majoor

**Point submitted for:** information and discussion

Action points and issues with the updated Detector Layout (result of 1st ETO Task Force in-person workshop in Pisa)

Open / unresolved issues Detector layout update

* New tunnel layout following the input parameters presented by P. Werneke with the LF FC integrated in the main arm tunnel provides 2200mm clearance between the beampipe supports. Following the 700mm emergency clearance, 1500mm for logistics is reserved. The towers on optical nodes LFC1-EM, LFC2-EM, LSQ-EM1 and LSQ-EM2 are required to be transported through this 1500mm logistical envelope (or 2200mm depending on the safety strategy) once the beampipes are in place. An alternative strategy would be to transport these vessels first before installing the beampipes. Alternatives such as enlarging these clearances between the beampipe supports should not be considered, as the main arm tunnel is the largest driver in terms of excavation volume. *This induces either safety risk, on-site assembling (design possibilities) or financial risk by enlarging the tunnel*
* HF Beamsplitter area is too crowded  to be resolved preferably before 2nd in-person meeting in Amsterdam

New issues from Pisa meeting conclusions

* Access to the LF BS, SEM and INJ are not yet resolved as it is obstructed by either the main vacuum tubes, the squeezing vacuum tube or the BHD vacuum tube. For the BS, access possibilities are the following:
	+ Diagonal lateral access (45° access)
	+ Bottom access (might pose problems later with flexibility demand from ITF Div)
	+ LIGO-like walk-through pipe from either LPRM or LSEM
	+ *Other options not listed*
* Given that for SUSP RM CAT2 a LIGO-like solution is assumed for the new baseline (approx. 3.5m SUSP height -> approx. 5.2m total tower height), a permanent scaffolding structure is not necessarily required. Choosing a temporary solution only in place when maintenance to the upper part is required could reduce the overall envelope of the tower. On the other hand, if maintenance is required, the temporary scaffolding must be inside the cleanroom, causing potentially contamination inside the cleanroom or requiring more set-up time before maintenance is actually able. *As temporary scaffolding likely reduces 2m span of the caverns, especially in the HF corner station, the current assumption is that this does not result in a lot of costs saving. It is more important to think about how the scaffoldings for these types of towers will look like, as the tower base and upper part does not resemble the other tower types used in higher RM categories*
* The tower integration activities primarily focussed on the suspension systems and partly on the optical layout tower node merging. As a result from both, the tower base vacuum vessel classification should be updated. Furthermore, an effort to reduce the footprints of the tower bases must be done in order to further reduce tower envelopes (specifying what is really required, not what is nice to have)
* Assessing the different cleanroom strategies. Using mobile cleanrooms might reduce footprint and will reduce technical infrastructure costs. It might on the other hand increase the operational costs. It is assumed that access to the central ITF is much less than to the auxiliary vessels. Could it be possible to make use of mobile cleanrooms to be placed around auxiliary vessels, but moved to a core optic node if access is required?

Optional issues to address for the Detector layout update

* Re-assess logistical volumes. To further reduce envelope in the caverns, an alternative strategy might be to transport smaller size components to be assembled on-site instead of on the surface.
* Reducing the clearance between the beampipe supports even further to shrink down the tunnel diameter. As the main arm tunnel is approx. 75% of the excavation volume, it is likely that the most costs can be reduced there. Reducing the clearance between the beampipe supports results in reduced safety clearance and reduced logistical clearance. This will change the safety strategy (risk) and accessibility in the tunnel (risk).
* An alternative detector layout with the 3-beam-crossing for the LF-FC can be created to have another layout to compare (to be scored later on science case, costs and risk). *This will be done by Max and Jonathan as most of the inputs are provided. A dedicated session for this layout is not necessary and can be done offline by Jonathan and Max.*

**Summary of discussion:**

As mentioned in the description, Max gave an update on the detector layout (issues), where two categories can be considered:

* Know issues before the Pisa meeting: some of those issues were not solved and will be needed revisiting in the in-person Amsterdam meeting.
* Issues that arose from the discussions and work in Pisa: these new issues will need to be considered as well in the next in-person meeting in Amsterdam.

The whole overview can be found in Max’s [presentation](https://istnazfisnucl.sharepoint.com/%3Ap%3A/r/sites/ETOTaskForce/Shared%20Documents/General/Agenda%20and%20Minutes%20Archive/250310_Taskforce_Meeting/250310%20ETO%20Task%20Force%20-%20new%20and%20unresolved%20issues%20with%20the%20updated%20DL.pptx?d=w08e98ae79bd6474fb2d0e31afd7bdca3&csf=1&web=1&e=cDnFif).

**Some takeaways:**

* High-frequency beam splitter area overcrowded; limited vessel access
* Clean room requirements for auxiliary bench vessels not fully addressed
* Logistics flow for filter cavities in main arm tunnel (1500mm clearance) needs verification
* Low-frequency balanced homodyne detection may limit access to extraction mirror
* Possibility of reducing clearances between beam pipes to minimize excavation
* **Classification of detector layout configurations**

***15:45-15:55 CET***

**Point presented by:** Fiodor Sorrentino

**Point submitted for:** information

In the workflow for the ETO task force we assume that our design effort will yield a number of different configurations for the detector layout, to be then separately evaluated in terms of risk, flexibility, performance, and impact on civil infrastructure cost.

As the risk analysis exercises started, there’s now the need to assess which are the configurations under study. The phase space of possible configurations is made up of a number of discrete options, e.g. tower height for a given category, optical routing of SQZ beam to OFI, etc., and some continuous variables, e.g. the length of optical cavities. Within the extremely wide space of possible configurations generated by the combination of available options on individual design elements, we should decide how we are going to choose the detector layout configurations for the comparative analysis. Some comparative information will be given at the level of individual design parameters (e.g. TRL for design of suspensions or cryostat), but our work should eventually compare a few global configurations in order to be used by local teams in their technical feasibility studies.

 The down selection of configurations should be made under some general criteria:

1) provide a representative sampling of the space of configuration parameters, i.e. show how risk, flexibility, performance and cost scale with design options;

2) provide a usable set, i.e. a small number of options.

For 1) we should probably identify configurations with sufficiently different impact on civil infrastructure and/or on detector layout.

For 2) the initial brainstorming in the task force led to identify 4 coarse concepts (FCs in main tunnels, optics co-location in vertex, double cavern, separation of HFI from LFI); we’d likely define sub-options around such main configurations in order to represent the impact of main design parameters; likely having up to 3÷4 sub-options for each configuration would still be quite manageable.

We will briefly discuss the general concept and the specific example of the outcomes from the Pisa meeting. A document listing the main changes with respect to the baseline 2L layout was started during the last risk analysis meeting (path: Documents → General → Working Documents → Risk Study → Configurations Definition (Brainstorming)). A proposal would be to group the changes done on optical layout and vacuum system envelope, and to consider a set of sub-options depending on the various implementations for the FC relocation. Specific topics for discussion:

- does this decomposition into options and sub-options make sense in general?

- would we consider additional sub-options other than the choice of ITF planes and the routing of SQZ beam to OFI?

- do we identify reasons to just exclude any of the suggested sub-options?

**Summary of discussion:**

Fiodor led a discussion on how to define a manageable set of detector layout configuration options to be evaluated and compared. The goal is to have a representative sample of different design choices that can be reasonably analyzed, rather than trying to evaluate the full combinatorial space of possibilities. The task force members (quickly) reviewed a draft document ([draft document link](https://istnazfisnucl.sharepoint.com/%3Aw%3A/r/sites/ETOTaskForce/Shared%20Documents/General/Working%20Documents/Risk%20Study/Configurations%20definition%20%28brainstorming%29.docx?d=wc0dc6abb6c9d489f8f47ab09f35c80ef&csf=1&web=1&e=1ODnqn)) outlining several high-level configuration options and sub-options to consider.

**Takeaways:**

* Goal: Select representative, distinct configurations for comparison
* Draft document groups main changes to optical layout and vacuum system
* Current proposal: 4 sub-configurations based on combinations of two key options
* Feedback needed on proposed classification structure

**Actions:**

* Select representative, distinct configurations for comparison
* **Agenda for the Amsterdam meeting**

***15:50-16:00 CET***

**Point presented by:** Fiodor Sorrentino

**Point submitted for:** information

A draft agenda for the in-person workshop in Amsterdam (March 18÷20) was presented during the task force weekly meeting on March 3rd. An updated version incorporating input and suggestions will be presented and discussed today, together with the list of preparatory actions to be carried out during this week.

**Summary of discussion:**

Fiodor Sorrentino shared the latest version of the Task Force meeting agenda for the in-person meeting next week. The Indico page with timetable will be updated during this week to contain these different slots.