

Interface parameters.

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**Interface parameters, constraints, preferences, responsibilities, as well as questions and possible solutions. DRAFT.**

Speed of push-pull operation and responsibility.

Hardware design should allow the moving operation and reconnections to be performed in a few days, say less than a week.

Responsibility for operation – ILC machine group.

Alignment parameters.

Assume that after the push-pull operation the detector elements can be placed within  $\pm 1$ mm from ideal position. Final adjustment of FD and Tracker will have to be done with main magnetic field on to do away with various displacement of detector parts under magnetic stresses.

FD has its own alignment system of the  $\mu$ m range that can be used for finer alignment without beam or with beam. Before starting the beam, the FD apertures and Vertex apertures need to be aligned better than to  $\mu$ m.

The beam-based measurement of FD position and application of its alignment system will bring it to ideal position within  $\mu$ m.

Tracker location is measured with respect to the Vertex to 1micron. Also the different parts of the tracker need to be measured (verified) w.r.to each other at 1micron level.

Tracker to calorimeter position needs to be measured with 1mm accuracy.

Responsibility for alignment FD – ILC machine group.

Responsibility for alignment and on-line survey of subdetectors – Collaboration.

(Alignment – requirements on angles? Any requirements for the line of sight from alignment point of view?)

Stability parameters.

The needed stability of the Final Doublet is about 100-200nm (this and all numbers in nm below are rms relative displacement of two FDs between any two 5Hz pulses).

Assume that it implies that the needed stability of detector surface on which the FD rests, is about 50-100nm.

Assume that this implies that the needed stability of the collider hall floor is about 25-50nm.

The needed stability of the BDS quadrupoles in the in-tunnel beamline is 20-30nm (?). Assume that it implies the BDS tunnel floor stability about 10-15nm.

Assembly of detector.

Assembly is done on surface, in a dedicated building, and only final assembly is done in the collider hall underground, using a light crane for example around 20-40 ton capacity.

A reasonable limit for the maximum mass to be handled from the surface seems to be around 2000 tons, but this may be adjusted to the needs of detectors.

From cost and logistic consideration the gantry crane must be stationary when handling heavy loads, however, with no load, the gantry crane can be slid over one or the other shaft to service one detector or the other, as needed.

The gantry crane being stationary when handling heavy loads, then one shaft cover is needed as handling ancillary. This shaft cover can also be slid to service one shaft or the other, as needed. => *This assumption needs follow-up discussion with GLD which for the moment assume ~400t crane in the hall.*

The gantry crane being stationary when handling heavy loads, then one shaft cover is needed as handling ancillary. This shaft cover can also be slid to service one shaft or the other, as needed. The gantry crane could also be shared between the two shafts (and if needed moved between shafts in a week). => *This also was not discussed in details yet.*

#### Segmentation of detector.

Segmentation of detector is a choice of detector collaboration, provided that it does not contradict the assembly and other requirements.

The question whether the detector door is split vertically or not, seems to have most interference with machine design. For this latter, the preferences as they seen now are the following. Split vertically – makes vacuum chamber easier, but require extending support for FD, and may limit cryogenic line connection options; large magnetic forces complicates design of the end caps. Door not split – complicated vacuum chamber, more tight requirements on the external size of the FD, require sliding support of FD from the door.

#### Surface buildings

The choice of surface assembly for the detectors and the sharing of gantry crane and shaft cover imposes the disposition of the main assembly halls.

The other ancillary buildings are disposed at best around the main assembly halls. => *more discussion of that will follow.*

#### Underground hall

*Present assumption:*

Service area on one side only, with 9m access shaft; large shafts for detector, which also include stairs and elevators.

*Discussed:*

It seems reasonable to have a main service area on the side of the by pass, and a smaller service area, at the opposite side for the other detector. Size will depend of which services have really to be there. These two service caverns will be served by ≠9m shafts comprising lift, stairs, services and sufficient space to lower loads to the service caverns. This will render the main shafts nearly empty, apart from main ventilation ducts.

The trench needed by a possible push pull platform and cable chains should stay inside the space naturally provided by the bottom invert.

It may be needed on one side for each detector to enlarge the hall to allow extracting Tracker or TPC in the garage position, especially if the doors are not split.

Radiation and shielding.

Detector should either be self-shielded or need to assume responsibility for additional local fixed or movable shielding (walls) to provide area accessible for people near the second detector when the other one is running with beam. The radiation criteria to be satisfied are for normal operation and for accident case. In the normal operation, the dose anywhere near non-operational second detector should be less than 0.05mrem/hour. In the accident case the dose should be less than 25rem/h for maximum credible beam (simultaneous loss of both e+ and e- beams near IP, at maximum beam power), and the integrated dose less than 100mrem per accident.

(The outcome of these requirements is understood to be the need for packman shielding of the IR beamlines, and additional shielding of detector and a shielding wall for non-self shielding detector.)

Vacuum requirements.

To limit beam gas interaction, the vacuum should be less than 1nTorr within 200m of the IP, 10nTorr from 200m to 800m from the IP, and 50nTorr more than 800m from the IP. One needs to assess the allowed pressure level in the QD0-QD0 drift.

Magnetic field outside of detector.

Field outside of detector body should be smaller than 50Gauss.

This parameter is under discussion. Need to specify areas (on beamline, near barrel, etc) and consider if relaxing is possible (may reduce amount of iron & cost).

Opening of detector on the beamline.

Hardware design should allow opening or closing to be performed in half-a-day. At least 2m of opening should be provided.

The corresponding detector collaboration is responsible for the operation.

Cryogenic system for the FD.

There is single service cryostat connected to QD0 cryostat (i.e. service cryostat is not split in two). The service cryostat is placed under the packman, outside it. The cryo-line (with 1Bar He-II and current leads) connects QD0 cryostat to the service cryostat. This line is never disconnected except for major repairs. The QD0-service cryostat connection line has to permit 2 m opening by door and it goes through pacman in such a way that there is no direct view to the beamline from outside (thus, a knee is needed). The service cryostat is connected (to?) via flexible line containing LHe single phase supply and low pressure He return. The current leads, instrumentation, process gas, vacuum line, etc., are connected to service cryostat outside, to minimize penetration of pacman.

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For sizing the connection between QD0 and the service cryostat we take the maximum 1.9K heat load to be 15 watts (14 static + 1 dynamic).

(An observation: The cryo lines are not restricted to be only in a plane, as soon as they contain just a single phase, and two phase system is present only in heat exchangers.)

Support of forward instrumentation.

The masks or other IR hardware and instrumentation should not be supported from the final doublet, if the total mass recalculated to the IR FD edge exceeds 10kg.

Calibration of detector.

After routine push pull operation or other routine switch of the magnetic field is performed with data tracks, at nominal or other energy. This operation is the detector collaboration choice and responsibility and its time is not counted as push-pull operation.

Splitting of beamline.

Beamline is split into the part which moves together with detector and the one which stay fixed in the tunnel. The splitting is preferred in a drift between QD0 and QF1, which then requires having two independent cryostats for the FD.

Safety – add details.

Fire safety requirement

Basic concept for evacuation in case of fire in the service tunnel is that the occupants escape to the Beam Tunnel through the Cross Passageways provided at an interval of 500 m. Then they move to the access shaft base cavern which forms a safety compartment equipped with an egress to the surface. Such safe evacuation route must be secured in IR area.

Are there any hazards associated with the detector? If gas, need to know type, volume, ventilation system, etc.

Fire safety requirements for detectors

No flammable gas mixture should be used underground.

Smoke detection, like Vesda type, with sufficient granularity inside the subdetectors should be mandatory.

As it is long to maneuver the heavy doors of detectors, the inner volume of vacuum tanks must be maintained at low oxygen content.

Outside the detectors fire fighting systems must be foreseen, suppression gases and sprinkler or foam.

Only the halogen free cables can be allowed to use.

Elements for commissioning

Additional temporary shielding and FD supports should be constructed for beamline commissioning when detectors are not yet on beamline. The FD for

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commissioning is not specially made, but one of the main ones, not yet installed in a detector.

Air sealing of collider hall.

Assume that beam losses in IR hall are so small that we do not have issues with air activation in IR (provided that there is air separation from other high loss areas such as beam dump and collimation). Thus the IR does not need negative pressure, or the hermetically sealed detector.

When push-pull ends, with what?

Power, services, water, air for detector and IR beamlines?

Need for He, quantity?

T stability, humidity.

Procedures to be done in garage position and on beamline.

Grounding. How quiet electrically the circuits should be.

See CFS questionnaire that need to be answered.