A Surface Assembly Scenario for SiD

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There have been recent suggestions that the ILC schedule and cost might benefit by a utilizing a small below ground interaction region with surface assembly of the detectors in a modest structure, followed by lowering major components to the IR with a temporary hoisting system. This note outlines a plausible assembly procedure and defines the capability of the lowering hoist.

We assume that the iron barrel structure is an n-gon, ($8 \leq n \leq 16$), with the segments fitting between end frame structures so that the segments can be placed by simple vertical descent, assuming that they are lifted at the correct angle for mating to the frame. Then for the barrel, the major assembly to be lowered is the superconducting solenoid already holding the HCal and EMCal. While the barrel tracker might be inserted on the surface, it is light and could be inserted late below[1]. This is not the case for the calorimeters. We have estimated the mass for the coil, HCal, and EMCal making the following assumptions: The tracker radius is 1.25 m; the coil is 6 layers of CMS style conductor; and the HCal is 4 λ thick. The dominant parameter is the tracker radius. Table 1 indicates the approximate masses of the SiD components for the stainless HCal, and Table 2 indicates the masses for the tungsten HCal option. Note that the SiD masses decrease noticeably with the tungsten, even though the HCal is heavier. The coil, HCal, and EMCal are the heaviest "non-negotiable" unit in the surface assembly scenario. It is quite likely that 1000 tonne hoist capacity will be sufficient, even with a substantial spreader.

The barrel sequence:

- The two upper halves of the end frame and the lower segments of the iron are assembled inverted on the surface and form a nest for the coil.
- The coil is assembled and tested.
- The HCal is inserted using a threaded beam. The load is taken by the cryostat.
- The EMCal is inserted into the HCal using a threaded beam. The load is taken by the HCal.
- The lower halves of the end frame are lowered into the pits and placed. The lower segments are attached to the frames.
- The coil is lowered into the lower frames.
- The upper frames are lowered and attached.
- The upper segments are lowered and attached.

The door sequence:

[1] The full length of the barrel tracker is 3.4 meters. This might need the doors moved fully off the detector axis to gain enough maneuvering room. (Each door is 2.65 meters thick). This in turn requires enough room in the IR to temporarily store the doors. Note that this procedure should not be needed to install the vertex detector.

This strategy depends on the hoist capacity. The assembled door will weigh at least 2182 tonnes. If the hoist can manage this mass, then each door can be lowered as a pre-assembled unit. Otherwise, each door consists of two leg assemblies and 4 segments, which can be lowered and placed individually. In this case, the segment mass is about 600 tonnes. Again, a 1000 tonne hoist should be adequate.

Comments:

This scenario puts some constraints on the minimum shaft diameter. The diagonal of the coil is 8.7 meters. The diagonal of the (assembled) door is 10.4 meters, with probably another 2 meters needed for the leg structures. It is not likely that one would want to lower the coil with its axis vertical. It seems reasonable to lower the door in 6 parts. Consequently, a 9 meter shaft diameter is needed.

This scenario is plausible but far from unique. It is not complete assembly on the surface, but a rough guess is that two to three years of IR access would be sufficient for final assembly and commissioning.

Installation

R_Trkr= 1.25 m Stainless Hcal Radiator

Component masses (tonnes)

	Barrel	Endcap	
EMCal	59	19	
Hcal	354	33	
Coil	160		
Iron	2966	2130	Support structure is not included. Probably ~10% more

Coil Installation Package Mass	574
Endcap Package Mass	2182

Table 1. Estimated masses for Baseline Version of SiD

Installation

R_Trkr= 1.25 m W Hcal Radiator

Component masses (tonnes)

	Barrel	Endcap	
EMCal	59	19	
Hcal	438	46	
Coil	140		
Iron	2370	1689	Support structure is not included. Probably ~10% more

Coil Installation Package Mass	637
Endcap Package Mass	1754

Table 2. Estimated masses for tungsten HCal.