Contents

1. TOT-CLIC Introduction

The TOT shall be developed to allow each energy stage of CLIC, 380 GeV, 1.5 TeV and 3 TeV, to be analysed separately by the user, each energy stage will require tunnels of varying length to allow the beams to reach their desired energy. The proposed schematic for the arrangements can be seen in *figure 2-1* below.

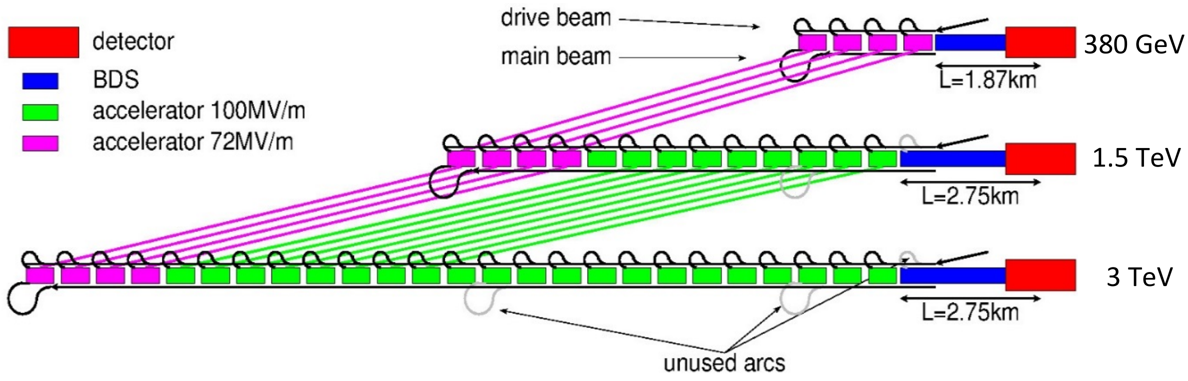

Figure 2-1: Schematic of the proposed energy stages for CLIC.

The 380 GeV, 1.5 TeV and 3 TeV energy stages are expected to require approximately 11km, 29km and 50km of tunnels respectively. It is expected that for the initial lower energy stage the extent of the data acquired for the TOT-FCC will be sufficient, however, for the 1.5 TeV and 3 TeV an expansion of the current TOT-FCC boundary will be required. An overlay of the proposed location and the current dataset, defined by the orange boundary shown, can be seen in *figure 2-2 below.*

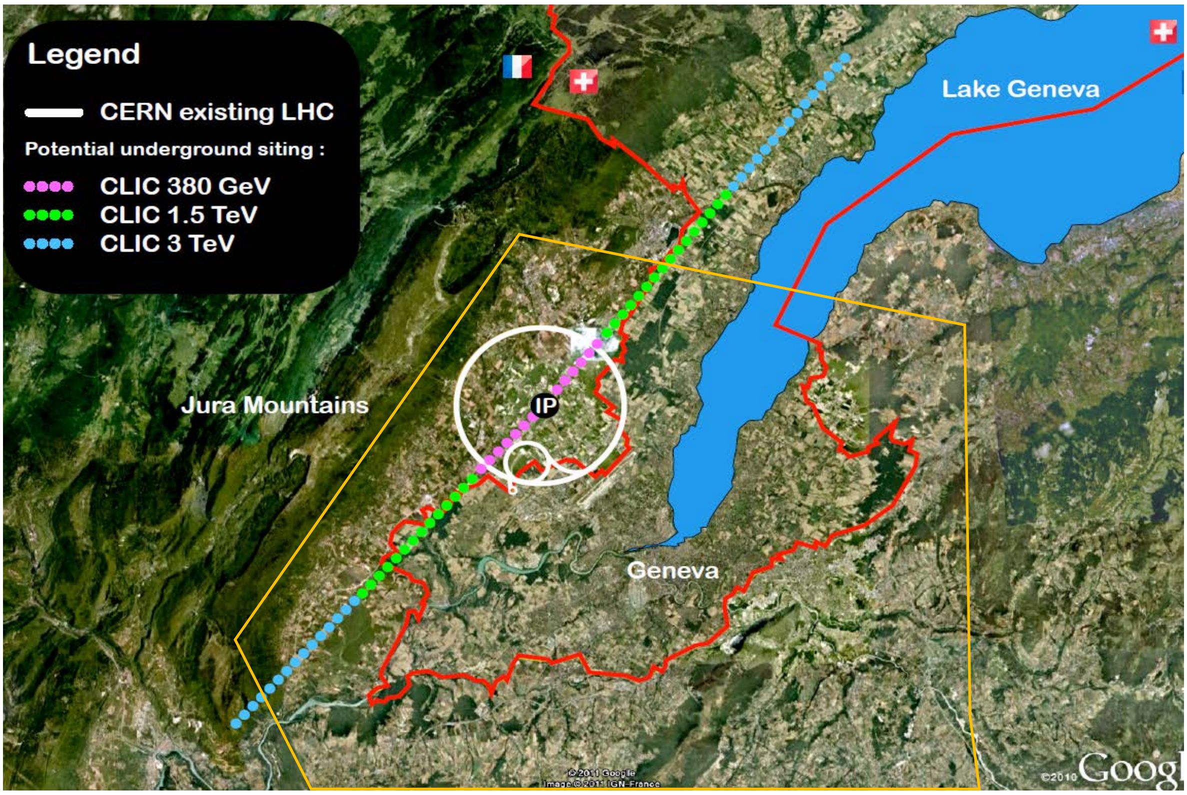

Figure 2-2: Proposed location of CLIC relative to existing data boundary.

2. Baseline Design

The Civil Engineering baseline consists of:

- A single 50km laser straight tunnel with a crossing angle of 20mrad, a turnaround located at both ends and a main tunnel internal diameter of 5.6m.
    - First energy stage 380 GeV: 11km tunnel.
    - Second energy stage 1.5 TeV: 29km tunnel.
    - Third energy stage 3 TeV: 50km tunnel.
- One Interaction Region (IR) Consisting of:
    - One detector Cavern 31.6m x 62m x 33.5m with an 18m diameter shaft connected and a corresponding surface hall.
    - One transfer tunnel at an approximate length of 340m.
    - One bypass tunnel.
- 9m diameter Shafts and surface installations at approximately every 5km *(shaft locations and numbers can be seen in figure 4-2).* It is expected that each shaft will have surface buildings consisting of:
    - First Energy stage: shafts 1, 2 and 3.
    - Second energy stage: shafts 4 and 5.
    - Third energy stage: shafts 6, 7, 8, 9, 10 and 11.
- Drive Beam turnarounds located approximately every 878m consisting of the turnaround tunnels with a bend radius of 10m and 25m long beam dump caverns:
    - First energy stage: 4 turnarounds and beam dumps.
    - Second energy stage: 13 turnarounds plus one redundant turnaround and beam dumps.
    - Third stage: 25 turnarounds plus one redundant turnaround and beam dumps.
- Central injection complex, located on CERN land in Prévessin, consisting of surface buildings and shallow underground galleries. This complex will be divided into several parts:
    - The Main Beam injector complex:
        - 8 x surface buildings, largest of which is approximately 400m x 7m x 3m.
        - 9 x shallow cut and cover type tunnels of varying sizes.
    - The Drive Beam injector complex:
        - 3 x surface buildings, the largest of which will be approximately 2560m x 30m x 9m.
        - 7 x shallow cut and cover type tunnels of varying sizes.
    - Common transfer tunnel from junction point to separation point 277m x 6m x 3m and surface building 30m x 30m x 5m
    - 2 x Final Transfer tunnels (from separation point).
    - Experimental area surface buildings consisting of:
        - 17 x surface buildings.
        - 1 x gas storage areas.
        - 1 x transformer switching yard.
        - Access roads and a car park.
    - RF Tunnel lengths/layout – to be discussed with Daniel – is the required for TOT

The schematic for the central injector complex can be seen in *figure 3-1 below.*

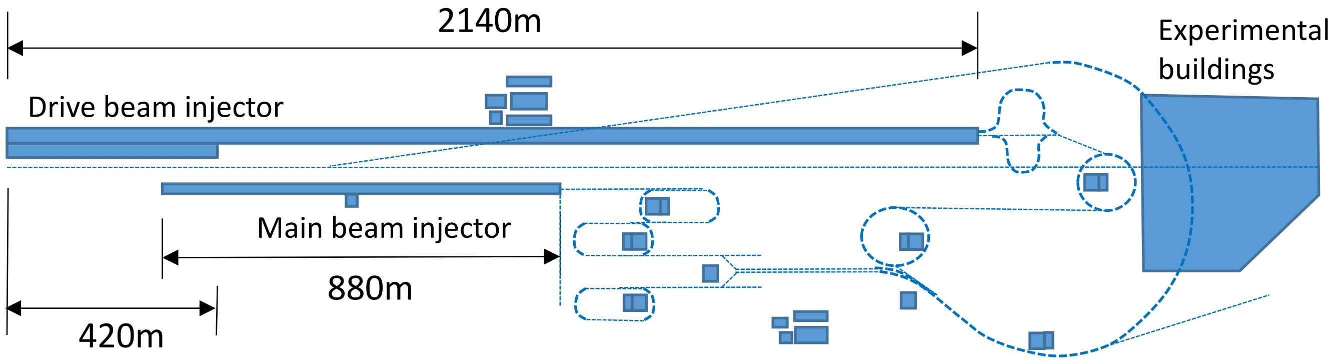

Figure 3-1: Central injector complex schematic, main beam, drive beam and surface buildings layout.

3. *Scope of Works*

3.1. *Introduction*

It is anticipated that by expanding on the data provided and collected from the TOT-FCC study a modified tool can be developed for CLIC.

3.2. *Datasets*

- Identifying all data that is available from the previous FCC study and the limit of this data.
- Reviewing of the existing data and co-ordinates with the CLIC team to identify where further data may be required, the boundary extents for data collection are to be agreed with the client and shall include the following none exhaustive list:
  - Geological data:
    - Hydrological layers.
    - Fault lines.
    - Limestone extents.
    - Seismic lines.
    - Aquifers.
  - Geothermal Drillings
  - Existing underground Infrastructure
  - Surface constraints:
    - Roads.
    - Houses and settlements.
    - Protected zones.
    - Rivers and lakes.
  - Expected new and existing borehole locations.
  - Baseline position to be agreed with client.
  - A new higher resolution topography survey to be introduced.
- It is expected that once the extent of the geological data has been defined the client will provide the Consultant with all further geological data required to modify the existing TOT-FCC and to produce TOT-CLIC.
- Determine the information to be provided by the client to the contractor to enable the development of the TOT-CLIC as defined in *section 4.3*.

3.3. Functionality

The TOT-CLIC platform shall allow the user to modify the position of the collider around the "baseline" position. The tool shall enable effective analysis and manipulation of the data mentioned in section 4.2 to help inform performance, risk and cost optimised options.

The functionality of the TOT-CLIC shall include all of the parameters from the none-exhaustive list below:

- User controlled outputs:
  - Change the depth of the machine
  - Rotate the machine in the X-Y and X-Z plane. *(See figure 4-1 & 4-2)*
  - Select and change the three proposed energy stages with the potential to add further stages including the possibility to show an overlay of the full layout with individual energy stages highlighted.
  - Rotate 180 degrees around the z axis to allow one to "mirror" the machine, *(see figure 4-2 and 4-3)*.
  - All Geological layers to have an enable/disable function.
  - Central Injection complex surface buildings to be included in layers, the location of this should be directly related to the location of the Interaction point (IP).
  - Inclined tunnel location assessment tool should be included (similar to that produced for the TOT-ILC.
  - A layer allowing the user to view all CERN owned land (fenced and unfenced) is to be included.
  - Crossing angle to be adjustable.
  - Input Lattice files to adjust the length of the tunnel.
- TOT-CLIC Outputs should provide the client with all the information given in the TOT-FCC tool as well as:
  - Co-ordinate outputs for the shaft location. The co-ordinate system to be used is the Swiss system, LV95.
  - Co-ordinate outputs for the inclined tunnel portals and the connection to the main tunnel. The co-ordinate system to be used is the Swiss system, LV95.
  - Geological data for the inclined tunnels (similar to that given for the main tunnel for TOT-FCC.
  - Geological profile to be either artificially flattened or follow the Earths curvature? To be agreed with client and contractor.

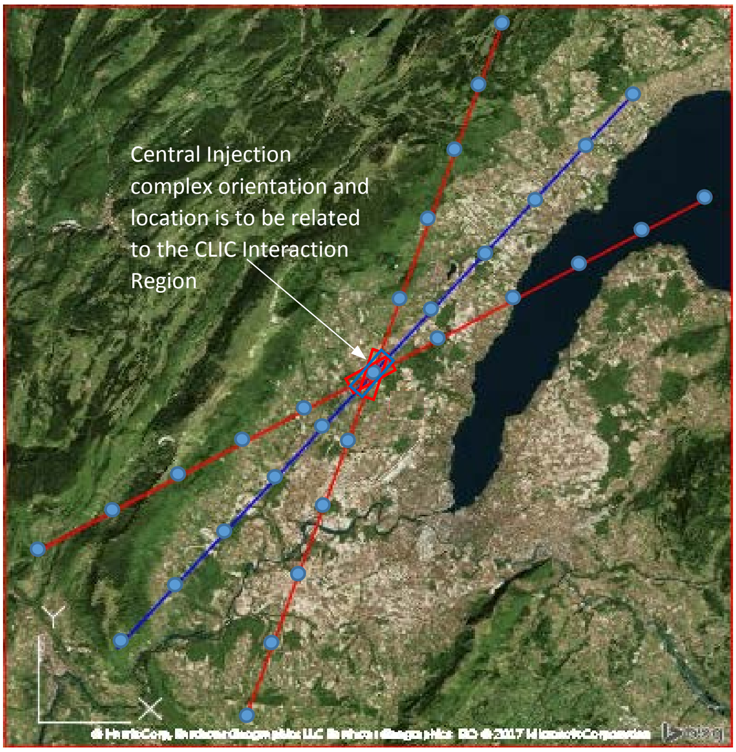

Figure 4-1: Rotation of CLIC in the X-Y plane including shaft and central injection complex locations.

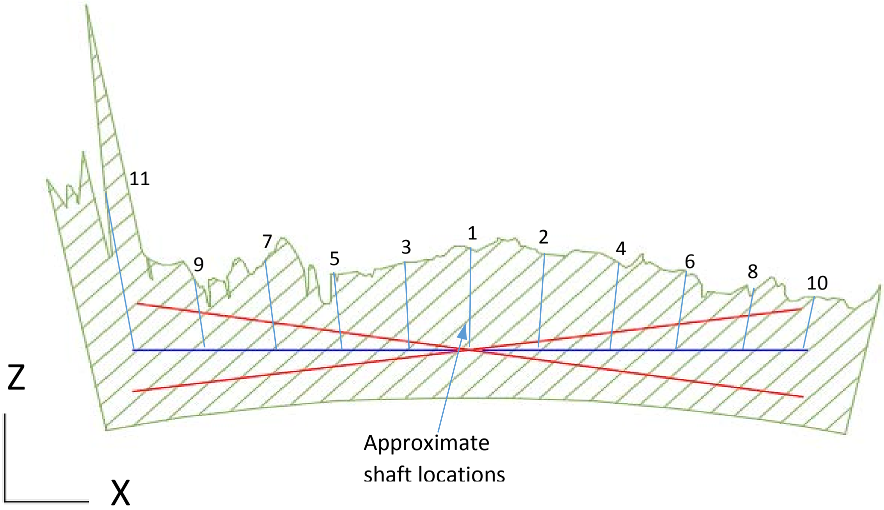

Figure 4-2: Rotation of CLIC in X-Z plane and shaft numbers and approximate locations.

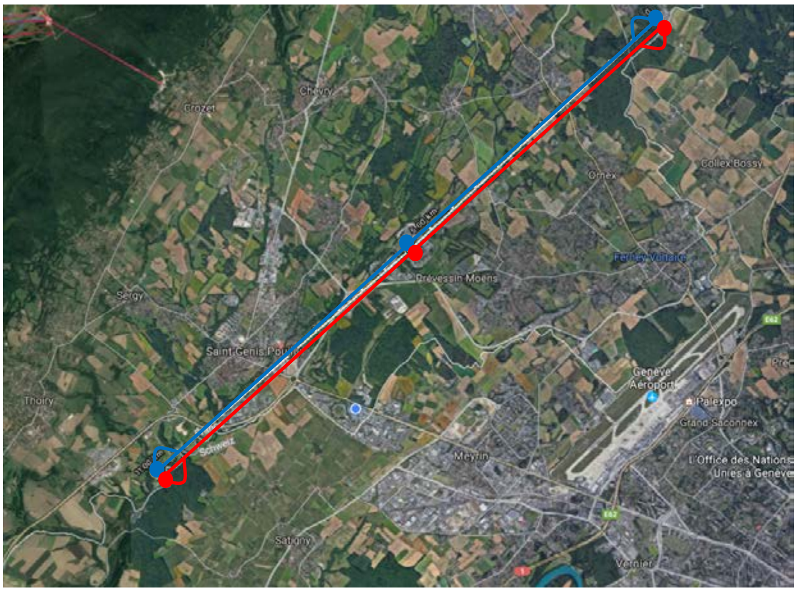

Figure 4-3: 380 GeV example of "mirror" option to be available on TOT-CLIC.

3.4. Agreement of Parameters

Following a Kick-Off meeting, a short period will be available for CERN and the consultant to come to agreement on certain parameters prior to commencement of the study. At the end of this period, the consultant shall deliver a report via CERN's online file sharing system, Sharepoint. This report shall contain the consultant's feedback on following areas:

- The feasibility of the extra outputs required for the TOT-CLIC comparative to that of the TOT-FCC.
- The feasibility of the extra user inputs for the TOT-CLIC comparative to that of the TOT-FCC.
- Suggested breakdown of cost to produce the TOT-CLIC platform
- Suggested breakdown of activity schedule to produce the TOT-CLIC platform.