16 Implementation, infrastructure, and safety

16.1 ALICE experimental area

The ALICE detector will be installed at Point 2 of the LHC accelerator. The Point 2 experimental area was designed for the L3 experiment. The main access shaft, 23 m in diameter, provides a 15×7 m^2 installation passage and space for counting rooms. The counting rooms are separated from the experimental area by a concrete shielding plug (see Fig. 16.1). The experimental cavern is 21.4 m in diameter and will be re-equipped with a 2 x 20 t crane having a clearance of about 3 m above the L3 magnet. The L3 magnet provides an 11.6 m long and 11.2 m diameter solenoidal field of up to 0.5 T. The end-caps have a door-like construction. The door frames will support large beams traversing the L3 magnet, from which the ALICE central detectors will be supported.

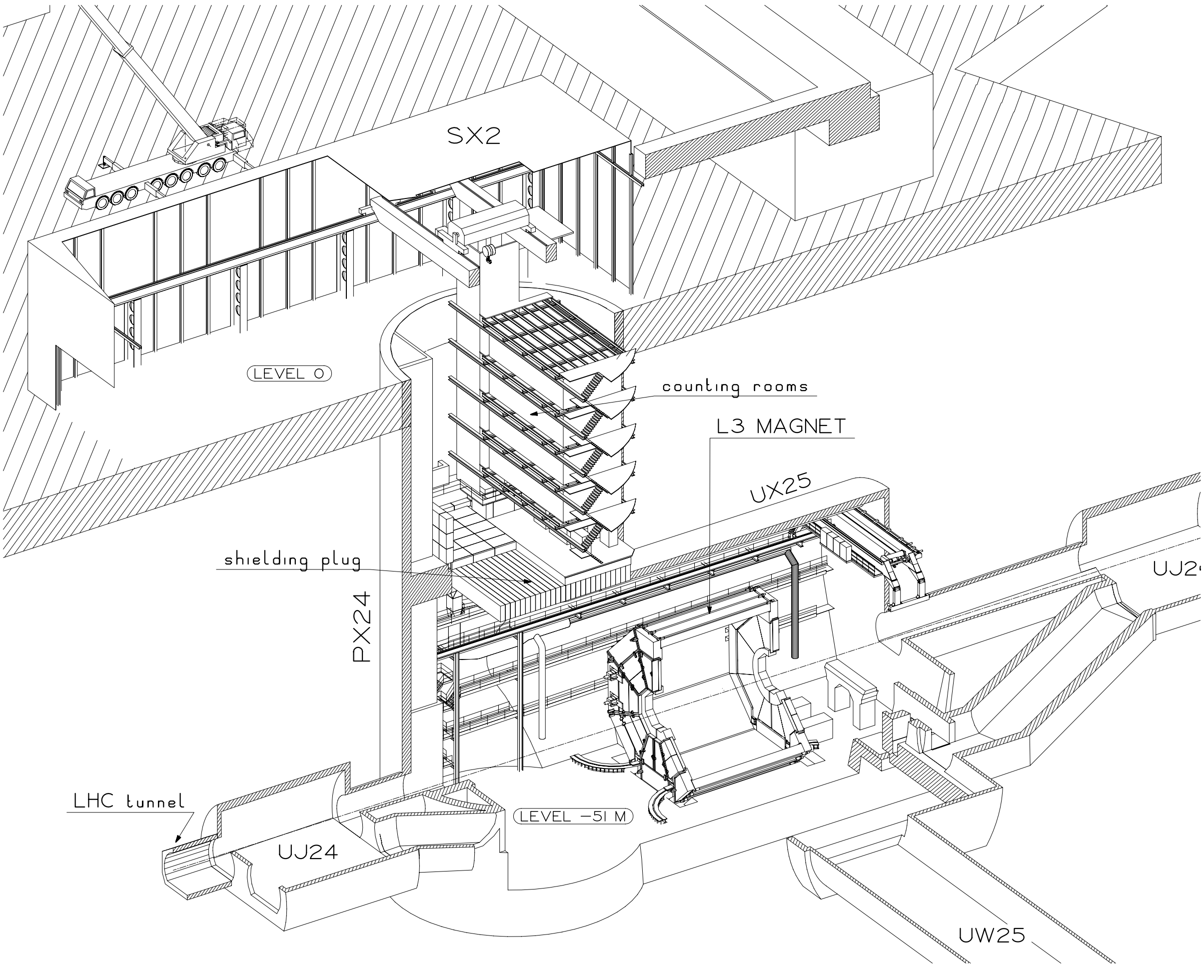

Figure 16.1: General layout of the basic underground structures at Point 2, showing the L3 magnet and the counting rooms.

16.2 Implementation of the TRD detector

16.2.1 General integration considerations

The TRD detector is supported by a cylindrical space frame construction, which also serves as a support for all the central detector units. The space frame is placed on large support beams straddling the coil section of the L3 magnet. This allows for the complete assembly of the central detector units to take place outside the L3 magnet. Each of the 18 TRD supermodules will be individually supported by two rails attached to the inner rings of the space frame (see Fig. 16.2). The services for the TRD will be supported by separate support frames, which will also serve as access platforms. The service support frame on the muon-arm side will be installed as a fixed structure, however, the service support frame on the access shaft side, will be installed on the same rails as the space frame and have the same diameter and modularity (it will be referred to as the 'baby' space frame). The main purpose of the 'baby' space frame is to carry the weight of all services of the central detectors, but also serve as a convenient installation frame for the TRD modules.

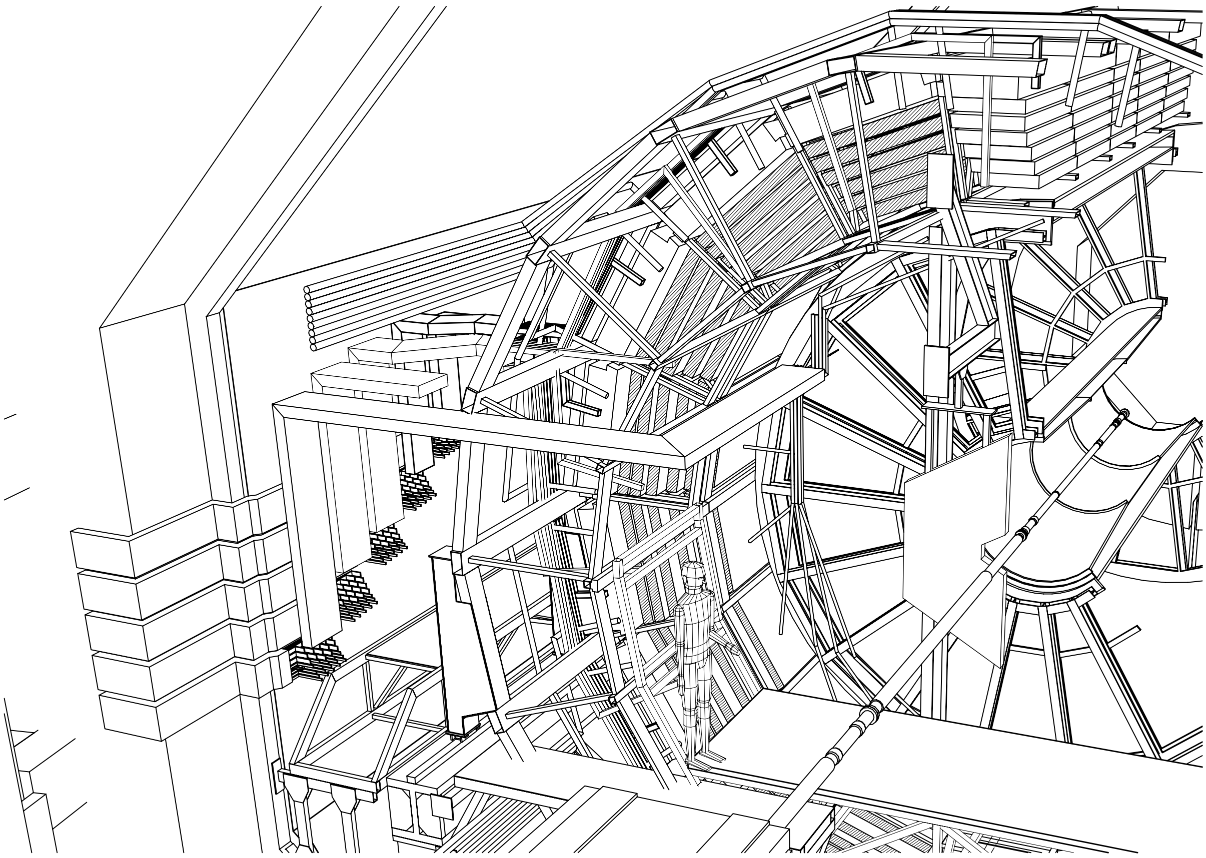

Figure 16.2: General view of the TRD detector and the space frame inside the L3 magnet. The 'baby' space frame is also partly visible.

16.2.2 The space frame

The space frame is divided into 18 sectors of 20° (following the agreed sectorization of the central detectors. All material has been concentrated at the sector boundaries and two concentrically placed support rings as indicated in Fig. 16.3.

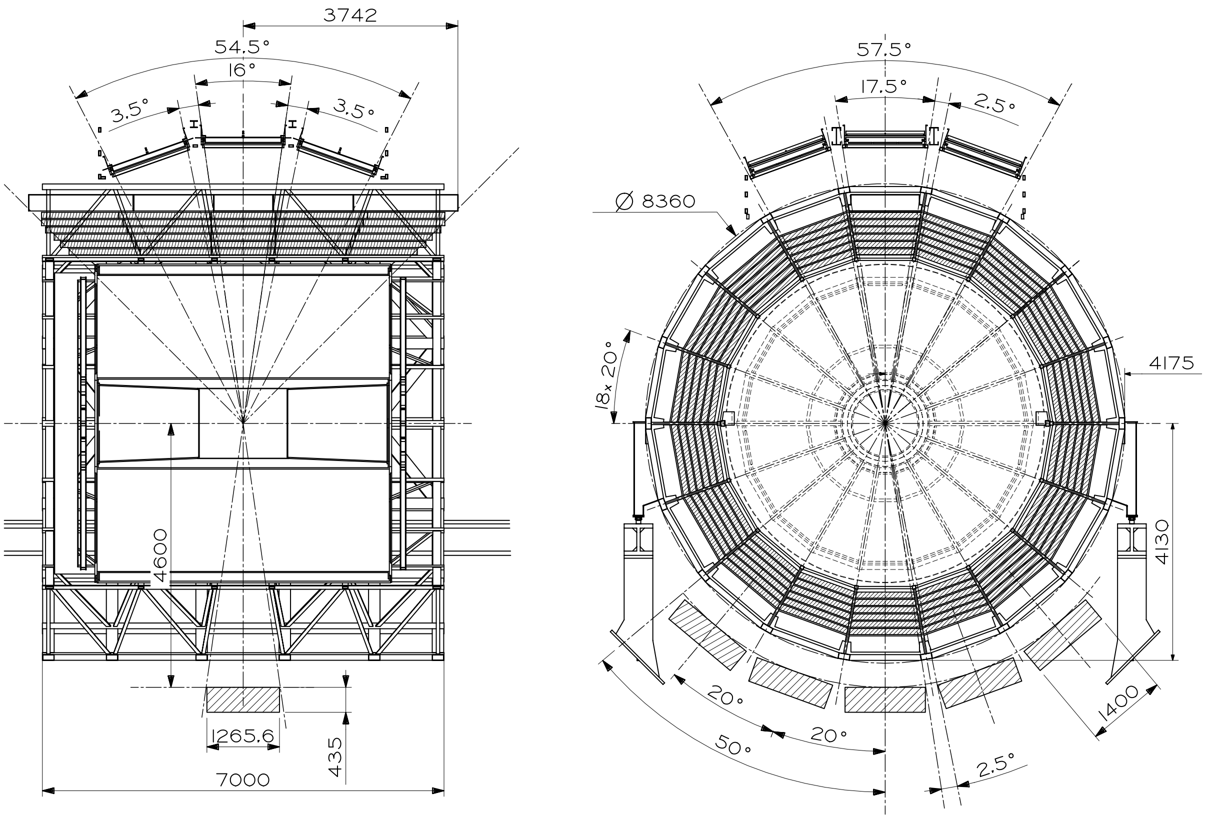

Figure 16.3: General layout of the space frame showing the geometrical arrangement of the central detectors.

The frame is supported on two support beams. There are two support points on each beam, which assures the same vertical displacement of the frame and the beams at all support points. The horizontal displacement of the frame is blocked on one side and free to move on the other side. The support beams are 12.1 m long and supported at their extremities by the L3 door structure. The combined space frame and support beam structure has been calculated for a total load of 75 t (Ref. [1]). The calculations were based on reducing the deformation of any two points on the space frame to a few mm and to limit the overall vertical displacement to less than 5mm. These calculations show that the movements of the TRD support rails can be limited to the displacements quoted in Chapter 2.

16.2.3 Pre-assembly phase

The present surface zone at Point 2 includes sufficient assembly hall space to meet the ALICE requirements and no new hall construction will be necessary for the detector assembly. The overall ALICE planning foresees a pre-assembly phase for the complete TRD detector to take place in the SXL2 assembly hall prior to the installation in the underground area, as indicated in Fig. 16.4. The detector will be fully assembled together with the space frame structure. This will allow an early preparation of the various detector services and permit the installation and access scenarios to be analyzed and corrected before lowering the TRD into the experimental cavern. All handling of the TRD outside the space frame will be made using a transport jig, which must also be able to orient the modules, such as to align the modules with the corresponding azimuthal position.

16.2.4 Installation in the underground cavern

It is conceivable that the complete space frame, with the TRD detector installed, is lowered down as one unit into the experimental area, however, the present installation scenario foresees a separate installation

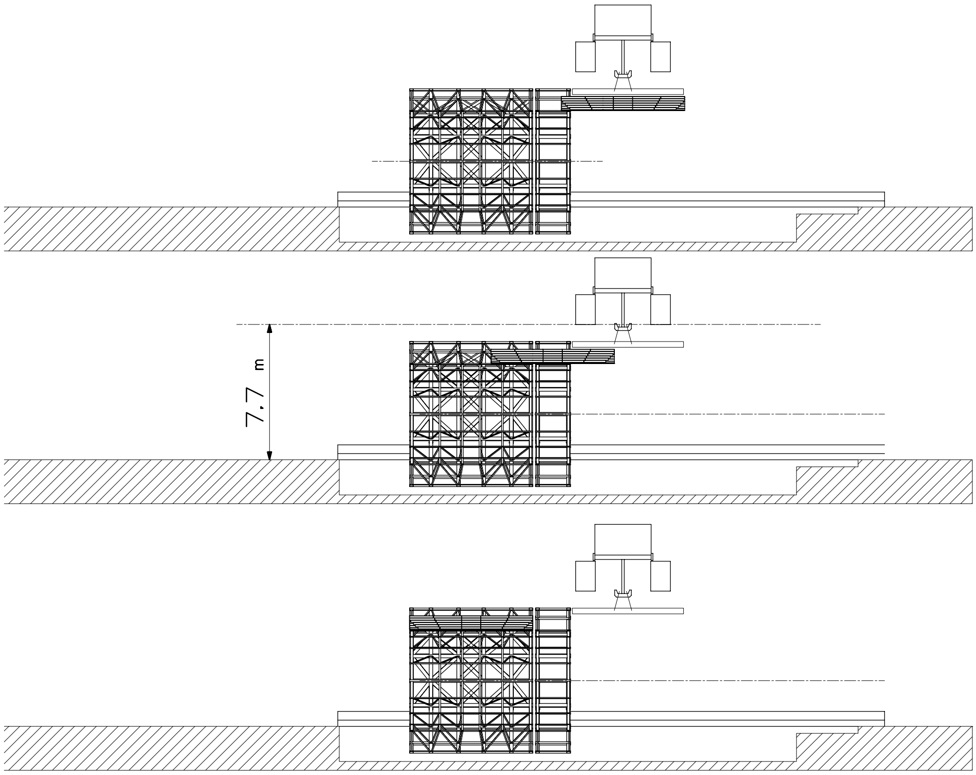

Figure 16.4: Pre-assembly of the TRD modules in the SXL assembly hall at Point 2. The figure shows the installation of a supermodule, using the transport jig and the baby space frame.

of the supermodules inside the experimental area (see Fig. 16.5). The space frame and the baby space frame will first be lowered down into the experimental area and placed on temporary support beams outside the L3 magnet. In this position the TDR modules can be relatively conveniently inserted into the space frame and some preparation of services can be made. The space frame is thereafter moved into the final position inside the L3 magnet. Alternatively, the TRD modules can also be inserted directly into the space frame in the final position inside the L3 magnet, however, this would be more restrictive and time consuming. This possibility is important for maintenance a possible staged installation.

16.3 Access, maintenance and services

16.3.1 Access for maintenance and repair

Access for maintenance to the various parts of the TRD detector is relatively straightforward. All services are concentrated to the side of the baby space frame and are easily accessible from platforms placed at several levels.

16.3.2 Services

The TRD services have been described in a previous chapter (Chapter 9). All services will have to pass through the narrow chicane shaped clearance (100 mm) between the magnet doors and the door frames (as shown in Fig. 16.2). In order to install the services the door will have to be opened, which prohibits any further service installations on the absorber side, once the Muon spectrometer is installed. The baby space frame will serve as a support for the services and allow a convenient distribution of cables, gas tubes and cooling tubes to the different sectors (see Fig. 16.6). It is estimated that the total weight of the services for the TRD detector is about 20 t.

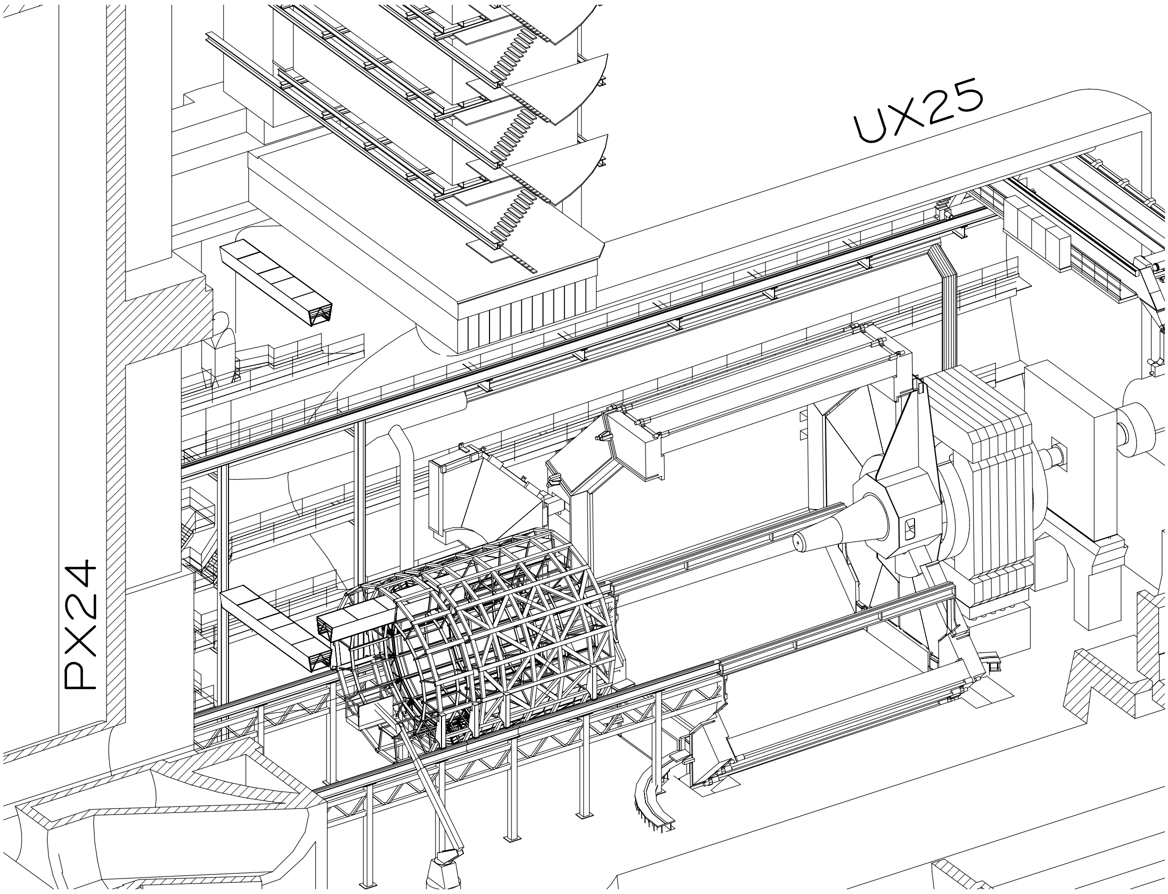

Figure 16.5: Installation of the TRD modules into the space frame inside the ALICE experimental area.

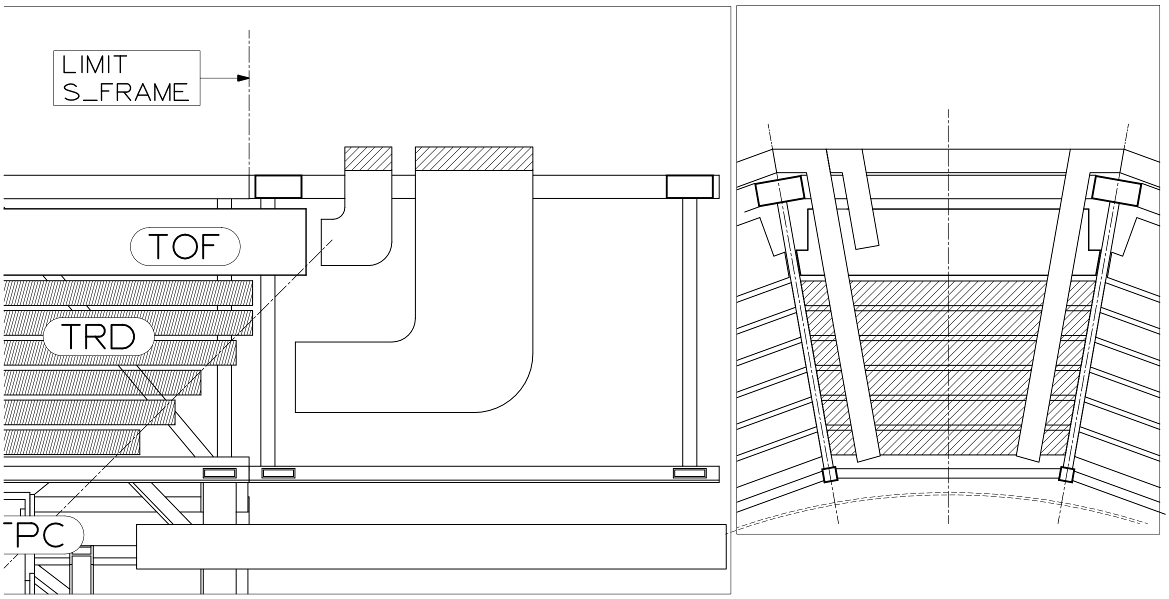

Figure 16.6: Conceptual routing of services. The services are attached to the outside of the support frame and distributed to the 18 supermodules.

The gas supply will come from the existing surface building, and the distribution units will be located on the shielding plug in PX24. In order to keep the losses and cost of cable installation as low as possible the racks for the power supplies will be installed as close as possible to the L3 magnet. They will be located at both sides of the L3 magnet at floor level. In the event of a removing a TRD module all services will have to be disconnected. This is facilitated by installing ‘patch-panels’ on the baby space frame.

16.4 Safety aspects

The TRD detector has been the subject of a recent Initial Safety Discussion (Ref. [2]). The outcome of this ISD was that the concept of the TRD detector did not include any major safety risks. The TRD detector uses non-flammable gas mixtures and the absence of toxic, corrosive, or flammable components makes the TRD an intrinsically safe detector. Apart from the initial construction period the handling of the TRD will always rely on the mechanical stability of the space frame, which will reduce the probability of any mechanical failure. The closed volume inside the dipole magnet and the part of the Muon spectrometer that penetrates into the L3 magnet will be separately monitored for both flammable gas and oxygen deficiency. The access to the inside of the L3 magnet will be restricted and regarded as a confined space. All construction materials and electronics printed circuit boards will conform to the CERN safety Instruction TIS IS41 and IS 23 concerning the use of plastic and other non-metallic materials at CERN with respect to fire safety and radiation resistance.