European Organization for Nuclear Research
Organisation européenne pour la recherche nucléaire

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Invitation to Tender

Technical Specification

Replacement of the Electrical Overhead Travelling Crane in TCC8

Abstract

This Technical Specification concerns the replacement of the 30 tonnes Electrical Overhead Travelling crane in the TCC8 tunnel, in France.
The delivery is foreseen over 14 months from notification of award of the Contract.

February 2025

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Table of Acronyms

Acronym	Definition
CERN	European Organization for Nuclear Research (Conseil Européen pour la Recherche Nucléaire)
CMU	Safe Working Load (Charge Maximale d'Utilisation)
DDF	Detailed Design File
EN	Engineering Department
EOT cranes	Electrical Overhead Travelling cranes
FAT	Factory Acceptance Tests
FEM	European Materials Handling Federation (*Fédération Européenne de la Manutention*)
HB	Brinell hardness scale
HE	Handling Engineering Group
HMI	Human-Machine Interface
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
LHC	Large Hadron Collider
PCR	Qualified radioprotection expert (*Personne compétente en radioprotection*)
PLC	Programmable Logic Controller
PoE	Power over Ethernet
PP	Prevention Plan (*Plan de Prévention*)
RFID	Radio-Frequency IDentification
SAT	Site Acceptance Tests

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1. INTRODUCTION

The Contract will be performed in accordance with the General Conditions of CERN Contracts (CERN/FC/6674-II). However, this Technical Specification prevails over the General Conditions of CERN Contracts with regard to the particular provisions specified in this document, and this without prejudice to any other provision in the General Conditions of CERN Contracts.

Capitalised terms in the body text are defined either in the General Conditions of CERN Contracts or in the present document.

1.1 Introduction to CERN

CERN, the European Organization for Nuclear Research, is an intergovernmental organization with over 30 Member States[1]. Its seat is in Geneva but its premises are located on both sides of the French-Swiss border (https://maps.web.cern.ch/). CERN's mission is to enable international collaboration in the field of high-energy particle physics research and to this end it designs, builds and operates particle accelerators and the associated experimental areas. At present, more than 10 000 scientific users from research institutes all over the world are using CERN's installations for their experiments. Further information is available on the CERN website: http://cern.ch.

The accelerator complex at CERN is a succession of machines with increasingly higher energies. Each machine injects the beam into the next one, which takes over to bring the beam to an even higher energy, and so on. The flagship of this complex is the Large Hadron Collider (LHC) (see Figure 1).

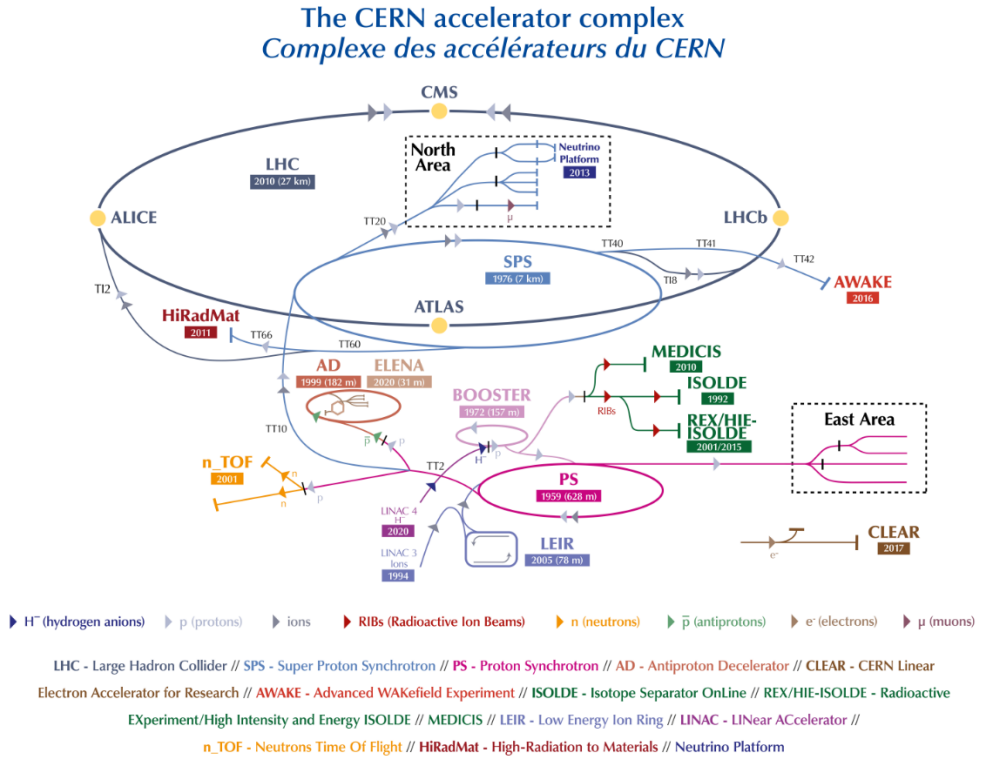

Figure 1: CERN Accelerator Complex

[1] http://home.web.cern.ch/about/member-states

1.2 Introduction to the Engineering Department and the Handling Engineering Group

The Engineering Department (EN) provides CERN with the Engineering Competences, Infrastructure Systems and Technical Coordination required for the design, installation, operation, maintenance and dismantling phases of the CERN accelerator complex and its experimental facilities.

The mandate of the Handling Engineering (HE) Group is to provide transport and handling services for the technical infrastructure of CERN, accelerators and experiments. This includes the design, the tendering/procurement, the installation, the commissioning, the operation, the maintenance and the decommissioning of standard industrial and custom-built transport and handling equipment.

2. SCOPE OF THE SUPPLY

CERN intends to place a contract (the "Contract") for the dismantling of an Electrical Overhead Travelling (EOT) crane and the design, manufacturing, supply, installation and commissioning of a new one (in whole or in part, the "Supply").

The Supply shall also include the preventive and corrective maintenance during the warranty period as well as the training of the operators in the use of the EOT crane and of the maintenance personnel on how to perform maintenance activities after the end of the warranty period.

The successful bidder (the "Contractor") shall provide the Supply as defined in this Technical Specification, including its annexes.

2.1 General Description

A 30 tonnes EOT crane is currently installed in the TCC8 tunnel, an experimental area on the CERN site of Prévessin (FR). As part of a new physics experiment, the new crane will be used to handle particle accelerator components and shielding blocks which will become radioactive during the experiment's lifetime (see § 3.1.3).

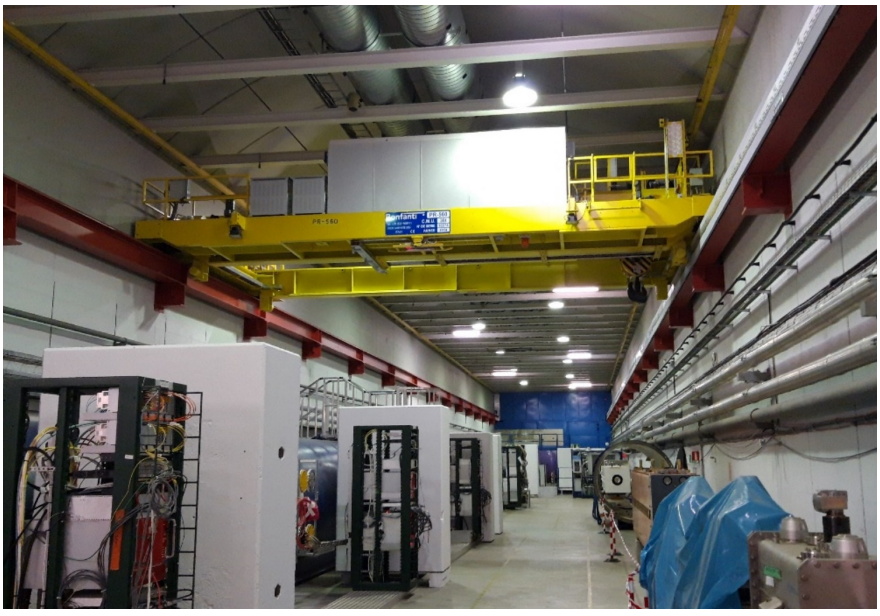

Figure 2 – The crane currently installed in TCC8

The characteristics of the existing crane do not meet the criteria required for this type of handling operations and it shall therefore be replaced by a new one.

Figure 3 shows a schematic plan view of the area with the main components of the new crane.

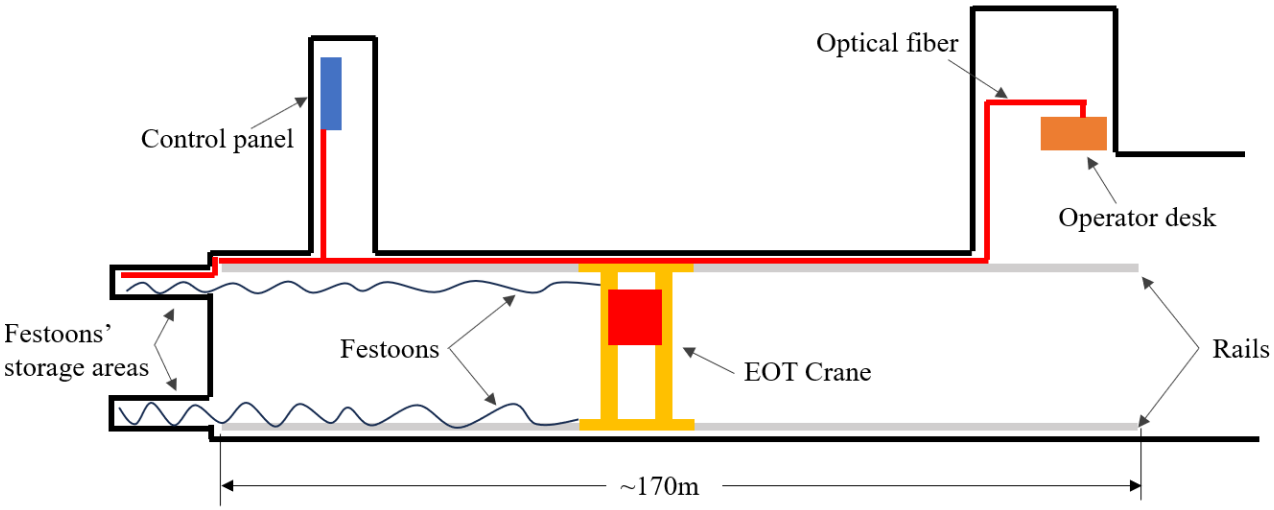

Figure 3 - Schematic plan view of the new crane in the TCC8 tunnel

2.2 Content of the Supply

The Supply shall include:

- *Technical deliverables* as specified in § 3:
  - EOT crane;
  - Radio remote controls (§ 3.2.1);
  - Control panel;
  - Camera system including optical fibres;
  - Electrical cables between the crane and the control panel

- *Activities* as specified in § 4:
  - On the Contractor's site:
    - Design (§ 4.1.1);
    - Testing (§ 4.3.1);
    - Packing, and shipping if requested (§ 4.1.2);
    - Remote service (§ 4.4.2).
  - On the CERN site:
    - Inspection visits (§ 4.2.2);
    - Dismantling (§ 4.2.3);
    - Installation (§ 4.2.4);
    - Testing (§ 4.3.2);
    - Maintenance (§ 4.4);
    - Training of CERN personnel (§ 4.5).

- *Documentation* as specified in § 5:
  - Detailed Design File (§ 5.1.1);

- Factory Acceptance Test report (§ 5.1.2);
- Technical and PLC documentation (§§ 5.1.3 and 5.1.4);
- Maintenance documentation (§ 5.1.5);
- Safety Documentation (§§ 5.1.1 and 7.4.2.1).

2.3 Equipment, Materials and Facilities Provided by CERN

CERN will provide the following equipment, materials and facilities for the purpose of the performance of the Contract:

- Rails and mechanical end-stops (see Table 1);
- Festoons' rails (§ 3.5.3);
- Operating Time Counter (§ 3.3.4);
- Electrical power supply;
- Containers for disposal of waste;
- Loads needed for the SAT.

3. SPECIFICATION OF THE TECHNICAL DELIVERABLES

The Supply shall include the technical deliverables as specified in the present section.

3.1 Technical Requirements for the EOT crane

3.1.1 Main Characteristics

Table 1 - Main characteristics of the new EOT crane

Main hoist working load limit [ton]	30
Auxiliary hoist working load limit [ton]	5
Span S [mm]	9400
Main hoist range of lift [mm]	7000
Auxiliary hoist range of lift [mm]	7400
Crane displacement [m]	170
Position of control panel	Remote position, approximately 250m cable length between crane and control panel
Operation	Via radio remote control; it shall be able to operate the crane remotely from an operator desk at about 200m from the control panel
Main hoist speed [m/min]	0.4 – 4 / variable speed range with frequency converter
Main hoist travel speed [m/min]	0.8 – 8 / variable speed range with frequency converter
Long travel speed [m/min]	1 – 20 / variable speed range with frequency converter

Auxiliary hoist speed [m/min]	1 – 8 / variable speed range with frequency converter
Auxiliary hoist travel speed [m/min]	1 – 10 / variable speed range with frequency converter
Main hook side approach (minimum hook-rail distance) [mm]	1000
Auxiliary hook side approach (minimum hook-rail distance) [mm]	700
Clearance between main hook and TCC8 floor [mm]	5000
Clearance between auxiliary hook and TCC8 floor [mm]	5400
Clearance under girder from TCC8 floor [mm]	5400
Height of rail above TCC8 floor [mm]	5500
Maximum crane height from top of rail [mm]	1700
Type and size of rail	Burback A-65
Max static vertical reaction per wheel [kN]	238
Max static horizontal transverse reaction per wheel [kN]	17
Max static horizontal longitudinal reaction per rail [kN]	33

3.1.2 Lifetime

The design lifetime of the steel structure and the mechanisms of the EOT crane shall be 25 years; the design lifetime of the control system components shall be 20 years.

3.1.3 Crane Use and Radiation Levels

The crane will be used to handle the different components of the target station (Figure 4) during the whole lifetime of the facility. The estimated radiation levels in the different phases are provided below:

- Installation phase: the crane will be used to handle objects which are weakly activated or not activated at all. The radiation level will be in the range 1-10 μSv/h;
- Operation phase: the crane will not be used and the radiation level in the parking area will be in the range 1-10 μSv/h;
- Maintenance and final dismantling of the target station: the crane will be used to remove the shielding blocks and handle objects, such as the target, which could reach a radiation level up to 100 Sv/hour. The handling for maintenance purpose will be carried out once per year.

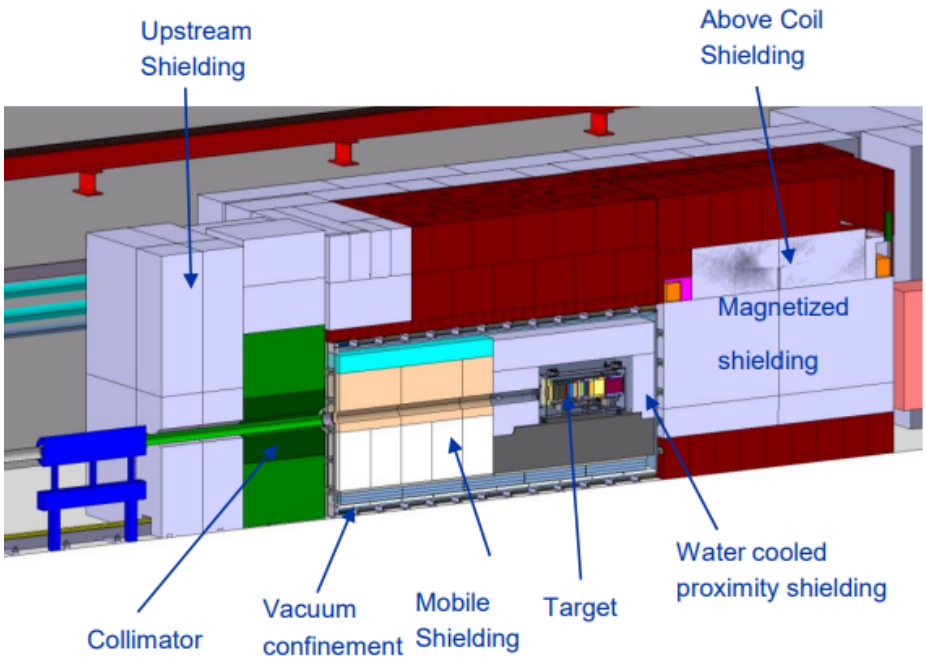

Figure 4 – Target station

3.1.4 Classification

Structures and mechanisms classification according to FEM 1.001 shall be as follows:

- Structures: A4;
- Cross-travel mechanisms, long-travel mechanisms, auxiliary hoist mechanisms and main hook: M4;
- Mechanisms of the main hoist (with exception of the hook): M8.

3.1.5 Rails

The existing rails and mechanical end-stops shall be reused; the Contractor shall validate their conditions and alignment before the crane replacement.

During the design phase, based on its own measurements, the Contractor shall confirm in writing the conformity of the rails, including their alignment and technical conditions.

3.1.6 Design Ambient Temperature

The design ambient temperature range for the installed crane shall be 0 / +50 °C.

3.1.7 Electronic Components

Because of the radiation level to which the EOT crane will be exposed during its lifetime, all the electronic components shall be located in the control panel installed remotely.

The only exception shall be the load measuring device (see § 3.3.12).

3.1.8 Maintainability

Design shall guarantee that the minimum time interval between two periodic preventive maintenance interventions is 30 hours of hoist operation or one year.

3.1.9 Interchangeability of Components

Selection of components (brakes, sensors, switches, contactors, electronic cards) shall be made with a view to reducing as much as possible the number of different spare parts.

3.1.10 Lifting Points

The main crane parts shall be equipped with dedicated lifting points to allow their handling during the installation and the maintenance phases.

3.1.11 Overhanging Crane Components

The crane design and installation shall prevent overhanging crane components (e.g. motors, casings) from falling due to mechanical failure.

3.1.12 Sharp Edges

Design shall avoid sharp edges and corners or, where this is not possible, mechanical protections shall be provided to avoid direct contact.

3.1.13 Lighting

The crane shall be equipped with floodlights to illuminate the area underneath the crane according to FEM 1.001 3rd edition 1998 book 5; they shall be easily accessible from the crane's walkway.

3.1.14 Earthing

All metallic parts shall be grounded; multi-stranded flexible copper braids shall be used to provide the electrical interconnection between the various steel components. Metallic sections of cable trays shall be interconnected electrically by earth straps. A green-yellow earth conductor shall be included in both the crane and the trolley feeding line.

3.1.15 Emergency Buttons

Emergency buttons to cut off any crane movement shall be installed on the crane at a distance of 1.5 m maximum from the maintenance areas.

3.1.16 Specific Tooling

Specific tooling needed for maintenance, both preventive and corrective, shall be provided by the Contactor with the crane before its acceptance and shall be included in its price.

3.1.17 Acoustic Noise

When the crane is operated with the maximum load and with the three movements (hoisting, long and cross travel) engaged at slow or fast speed, the absolute maximum sound pressure level index shall be 65 dB(A) measured underneath the crane, at 1 m from the floor level.

3.1.18 Marking of the EOT Crane

Markings of the EOT crane shall comply with Directive 2006/42/EC; they shall be positioned on both sides of the crane and be visible from the hall floor.

Rated capacity shall be indicated, as per EN 15011 § 7.4, by the marking « C.M.U. ..... t».

The markings shall also include the CERN identification number “PR-xxx”.

3.1.19 Marking of Electrical Components

All operating components, such as motors, sensors, end stops, distributors, junction boxes and their connections shall be marked in a durable manner in accordance with the electrical drawings. The values of any adjustable settings (for example thermal cut-outs) shall also be marked on the component.

Each electrical cubicle shall be clearly labelled with a warning sign indicating the electrical risk.

3.1.20 Access for EOT Crane Maintenance

The EOT crane shall be equipped with personnel access means and catwalks necessary to perform all preventive and corrective maintenance tasks under safe working conditions; access to the crane shall meet the requirements of NF EN 13586.

Gates shall be installed at all entry points; an electrical switch shall stop all movements of the crane if a gate is not properly closed.

Personnel shall be able to access the crane in its parking position through a door located at the rail level.

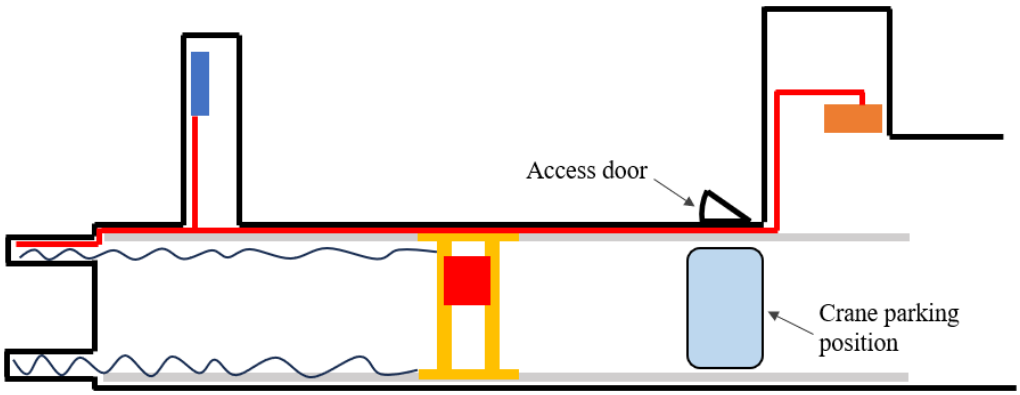

Figure 5 – Schematic position of the crane parking position and the access door

3.1.21 Gearing

Gears shall be encased in a sealed gearbox. Open gears transmission systems are forbidden.

Figure 6 - Example of forbidden transmission system

3.1.22 Electric Motors

All motors shall be of insulation class F155 (IEC 60085) minimum, protection degree IP44 (IEC 60529) and be suitable for being driven by frequency converters (e.g. insulated bearings). The motors shall be equipped with a forced ventilation system.

3.1.23 Electrical Cables

All the electrical cables on-board of the crane shall comply with the requirements of § 3.5.1.

3.1.24 Trolley Feeding Line

The electrical cables between the trolley and the bridge shall be collected in a cable chain.

3.1.25 Brakes

Brakes shall be protected from the ingress of any substances from the environment.

All brakes shall be equipped with sensors that detect the correct brake's opening; in case the brake is not opening within a predefined time interval, the motor start-up command shall be interrupted.

3.1.26 Hydraulic Installations

Rigid pipes shall be used whenever possible in hydraulic installations (e.g. pipes between brakes and a hydraulic unit); use of flexible hoses shall be limited to the extreme sections of the circuit.

3.1.27 Lubrication

3.1.27.1 General

Lubricating oil and greases shall be radiation resistant.

The crane shall be able to operate for at least 30 hours or three months without need of lubrication checks.

The crane documentation shall include a lubrication chart showing all the lubrication points with the characteristics of the lubricant to be used, the oil capacity of the casings and the topping-up and oil-changing intervals expressed in the number of hours of operation.

Every greasing point, lubricant distributor or oil filler aperture shall be clearly marked and be easily accessible for oil replacing.

Before the equipment is commissioned, all components shall be properly lubricated.

3.1.27.2 Casings

Every casing shall be fitted with a simple means of checking that the oil level is correct.

It shall be possible to fill and top up the casings easily and without any spillage. The drainage piping shall be accessible, oil tight and of generous proportions to allow the oil to drain away quickly. The drainage recipients shall be accessible; they shall be fitted with a drain-cock and a safety plug downstream of the cock.

3.1.27.3 Oil Leakage and Retention

The crane design shall ensure that no oil or grease can drip from the crane.

Retention bins shall be installed underneath the gear boxes and underneath all places where oil or grease dripping may occur.

3.1.28 Paintwork

3.1.28.1 Paint type

All paints shall be lead-free.

3.1.28.2 Protection Against Corrosion

Before assembly, the metal components shall be de-rusted by sand or shot blasting, quality class Sa 2 1/2 according to DIN 18364 or equivalent, and immediately given a coat of anti-rust paint to a minimum finished thickness after drying of 40 µm.

Surfaces which are bolted together shall be protected from rust before assembly. All parts which are hidden after assembly shall be given a second coat of anti-rust paint, applied in the workshop. The first coat of anti-rust shall be completely dried before applying the second one. Final thickness after drying shall be minimum 80 µm.

Only primers compatible with the paint used for the topcoat and two-component paints shall be used.

Structures shall be given two coats of paint, with the second coat applied after the first one has completely dried. The required minimum total thickness of the coats of paint, i.e. one primer coat and two topcoats, shall be of 150 µm.

Before SAT, weld seams and bolts shall be painted and any damage made to the paint during transport assembly and commissioning shall be repaired.

3.1.28.3 Protection of Unpainted Parts

All the mechanical parts which cannot be painted for functional reasons shall be protected against corrosion during transport and storage.

3.1.28.4 Colours

The topcoat paint shall be RAL 1021. No requirement is given for the topcoat colour of the mechanism components (motors, reduction gears, etc.) and the electrical cubicles.

The pulley-blocks shall be painted with 30mm-wide oblique black stripes on a yellow (RAL 1021) background.

3.1.29 Redundancy of all Motors

All gearboxes, except for those of the auxiliary hoist, shall be equipped with a differential unit and two independent electric motors:

- a main motor to be used in normal operations;
- a second motor to be used either in case of fault of the first one or to perform precise operations.

Selection of the motor shall be possible through a toggle switch on the remote-control transmitter; if changeover happens when a motor is operating, the system shall stop the motion before activating the other motor.

The speed of operation with the second motor shall be between 10 and 20% of the speed of operation with the main motor.

Emergency motors shall be driven by a dedicated frequency converter.

3.1.30 Bridge Structure

The following requirements shall be met:

- Drainage apertures shall be installed in all places where water may accumulate;
- The vertical deflection of the girder when the hoist is in the middle with a load equal to 110% of nominal capacity shall not exceed 1/1000th of the span;
- The end-carriages shall be designed so that the wheel-axle assembly, with the bearings, can be removed horizontally after the end-carriages have been lifted by about 20 mm;
- It shall be possible to easily fit hydraulic jacks between the carriage and the rail or girder to facilitate lifting them for wheel removal; the clearance to be provided for fitting the jacks shall be at least 200 mm;
- Bumpers shall be placed at the end-carriages' extremities to protect the structures in case of impact;
- End-carriages shall be designed to avoid derailment of the bridge;
- The minimum hardness of the wheels' rolling surface shall be 300 HB up to a depth of 5 mm;
- The girder shall be equipped with a metallic ruler, covering its whole length, that will be used to retrieve the position of the trolley with respect to the girder (§ 3.4.1). The ruler shall have a resolution of 10 mm; Figure 7 and Figure 8 show, as an example, the existing ruler installed on the railway.

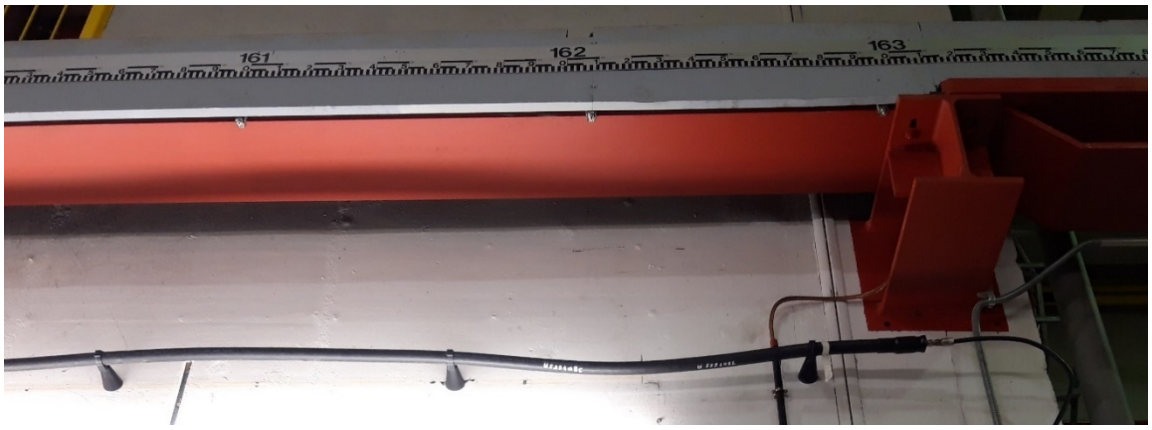

Figure 7 – Example ruler installed on the railway

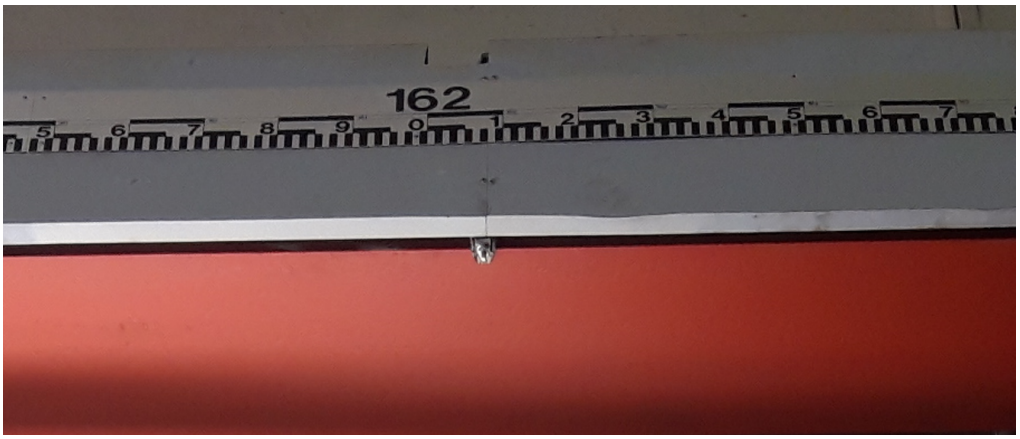

Figure 8 – Ruler detail

3.1.31 Trolley Structure

The following requirements shall be met:

- The trolley shall be equipped with personnel access means and catwalks necessary to perform all preventive and corrective maintenance tasks on the trolley equipment under safe working conditions;
- The end-carriages shall be designed so that the wheel-axle assembly, with the bearings, may be removed horizontally after the end carriages have been lifted about 20 mm by hydraulic jacks to be fitted easily between the carriage and the rail or girder. The clearance to be provided for fitting the jacks shall be at least 200 mm;
- Bumpers shall be placed at the end-carriages' extremities to protect the structures in case of impact;
- End-carriages shall be designed to avoid derailment of the trolley;
- The minimum hardness of the wheels' rolling surface shall be 300 HB up to a depth of 5 mm.

3.1.32 Main Hoist

3.1.32.1 General

- The hoist shall be of open-type design;
- The hoist design shall ensure that, during lifting and lowering operations, the hook remains centred below the rope drum without either horizontal drift (i.e. true vertical lift) or rotation around a vertical axis;
- The rope fleet angle shall not exceed 2.5 degrees;
- The hoist shall be able to lift the maximum load for the whole lifting height at low speed.

3.1.32.2 Rope Drum

- The rope drum shall be able to store in one single layer all the rope necessary to obtain the full hook height;
- A minimum of three wraps of rope (for any rope) shall remain on the drum when the hook is in its lowest position;
- The design shall include a device which, in case of bad winding of the ropes, stops the lifting movement allowing lowering only at slow speed.

3.1.32.3 Ropes

- The rope wires shall comply with ISO 2232;
- Two ropes shall be installed, one of them shall be right-lay and the other one left-lay.

3.1.32.4 Balancing Beam (Equaliser)

The ropes' terminations shall be fixed, through a wire rope socket, to a balancing beam (or equaliser) which shall recover the differences in lengths of the two ropes and shall guarantee an equal load distribution between the rope falls.

The ropes' fixing points and the beam pivot point shall be aligned (see Figure 9 below).

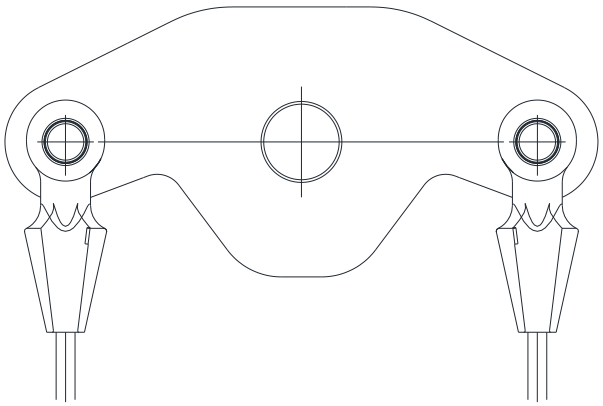

Figure 9 – Balancing beam with fixing points and pivot point aligned

A rotation of the beam up to 45° without interference with the steel structure shall be ensured; if the rotation exceeds 45°, e.g. in case of failure of a rope, it shall be detected by a limit switch.

3.1.32.5 Hook – Pulley block

- The hook shall be of the ramshorn type, size 16 according to EN 13001-3-5;
- The hook shall be equipped with safety latches;
- The design shall ensure the possibility to replace the ropes without special tools;
- The pulley block shall be painted with oblique black stripes on a yellow background;
- The design shall include the possibility to manually lock the hook at any position, without tooling, to avoid any rotation of it around the vertical axis.

3.1.32.6 Emergency Brake

The crane shall be equipped with a hydraulic-type brake, acting on the rope drum, that is activated as soon as one of the following conditions is met:

- The rope drum rotation speed exceeds 110% of its nominal value (over speed condition);
- The difference between the actual and the nominal motor-rope drum speed ratios exceeds 5% of the nominal ratio. This control shall be done for any hoisting motor.

Under any other condition, the emergency brake shall close only once the hoist motor is stopped, thus limiting the stress induced on the structure and mechanisms.

The braking system (number and size of the brakes, disc diameter and control system) shall be designed so that the deceleration with a nominal load does not exceed 5 m/s^2 and the distance covered by the hook from the over speed detection to its arrest is less than 200 mm.

Resetting shall require an intervention on the control panel by rearming a spring-return key switch within the electrical cubicles.

A spring-return key switch inside the cubicle shall give the possibility to open the service brake; this will allow testing the correct functioning of the emergency brake during periodical inspections.

It shall be possible to manually open the emergency brake, after its intervention, with a lever located on the hoist, and to lower the load.

The calculation notes (§ 5.1.3) shall include a complete rigid-body model of the hoist (hook block, rope drum, gearbox, motors, brakes, couplings) under dynamic conditions, proving that the requirements above are respected and that any component is able to withstand the efforts resulting from a brake intervention with and without load.

The control system of this safety function shall reach at least performance level "d" according to ISO 13849.

The design of the trolley structure shall avoid any contact between the brake pads and the disc following the crane's deformation under load.

3.1.32.7 Cable reel

A cable reel shall be installed on the trolley to provide electrical power and signals to the handling accessories that will be attached to the hook. The following wires and cables shall be included:

- A cable (single phase and earth) to power a 230 V AC 10A device;
- Ten 2,5 mm^2 wires;
- A category 6 Ethernet cable.

A Harting® plug shall be installed at the cable end for a quick connection with the handling accessory.

3.1.33 Auxiliary hoist

The crane shall be equipped with a wire-rope auxiliary hoist; the hoist shall be installed on a monorail on the side of the main girder.

The pulley block shall be painted with oblique black stripes on a yellow background.

3.2 Technical Requirements for the Radio Remote Control

3.2.1 Manufacturer and Model

For standardisation reasons, "HBC Radiomatic" remote control systems shall be supplied; the transmitter shall be of the "Spectrum" series.

Two complete sets, i.e. two transmitters and two receivers shall be supplied.

3.2.2 Requirements

The radio remote controls shall have the following characteristics:

- It shall be possible to operate the EOT crane from the operator desk and from any position in the TCC8 tunnel;
- They shall comply with the current European Legislation and Standards and be supplied with CE certification and documentation;
- The power supply of the receiver shall be 24 V DC;

- On-off switch using a key (two keys shall be provided);
- The remote receiver unit shall be connected via the specified HARTING®-type plug (or equivalent) to the control panel to enable a rapid exchange in case of a failure;
- Remote control start-up shall be done via Radio-Frequency Identification (RFID) modules.
  Four transponders shall be supplied to allow the operator to start-up the remote controls from these locations:
  - Operator desk;
  - Control panel;
  - Crane walkway;
  - TCC8 tunnel.
- Sound warning horn indicating successful crane start-up (adjusted to 80 dB(A) at 1 m from emitter);
- Two-position switch for the selection of speed characteristics (slow speed and normal speed);
- Emergency stop push-button;
- Bypass functions activated with a hold-to-run selector;
- Charger and spare battery delivered with each remote-control unit;
- Time relay function shutting down the crane if no control movements are made over a certain period of time (adjustable 1-15 minutes, pre-adjusted to 10 minutes);
- The transmitter equipped with a “zero-g” and “inclination switch”, shutting down the crane in case of an operator fall;
- The transmitter equipped with an exchangeable “iLOG”;
- The labelling on the transmitter in French;
- The symbols on remote control units corresponding for all movements to the symbols on the crane structure (shapes, colours and directions).

3.2.3 Storage Cubicle

A storage cubicle, suitable to accommodate the transmitter with its battery charger, shall be supplied and installed close to the operator desk; it shall be fitted with a 230 V AC 10 A socket (Swiss standard) protected by a 30 mA differential circuit breaker. The cubicle shall be equipped with a Ronis 455 key.

3.2.4 Interchangeability with CERN’s Remote Control

CERN is equipped with a Spectrum-type (serial number 737 - 1801419) universal remote-control set (receiver and transmitter).

The remote-control sets supplied by the Contractor shall be fully compatible with the universal one: in case of fault, it shall be sufficient to plug the universal remote-control to the crane to restore the crane operability and all its functions.

3.3 Technical Requirements for the Control Panel

3.3.1 General

- The control panel shall be located in the connection tunnel TA851, at a distance of about 20 m from the intersection with the TCC8 tunnel (Figure 10 and Figure 11);
- The design shall comply with CERN's –3-phase 400 V AC +/- 10% 50 Hz network and with the requirements of the *IEC 61000-2-4 Electromagnetic compatibility — Part 2-4: Environment - Compatibility levels in industrial plants for low-frequency conducted disturbances*;
- The control system shall reach at least performance level "c" according to ISO 13849 except for the emergency brake control (see § 3.1.32.6);
- For maintenance reason, the control equipment shall be standard industrial products of Siemens or Schneider; the equipment shall be the latest version available at the time of the crane manufacturing;
- The overall circuit diagram for the crane shall be laid out in accordance with and shall follow the basic principles of the schematic layout in Figure 12. The component references, for example "QF100A" which appear in Figure 12, shall correspond to the names used in the schematic layout; the terminals and terminal blocks shall be marked on the diagram;
- Components and wires' identification codes shall contain the diagram page number in which the component or the wire is represented (see Figure 12).

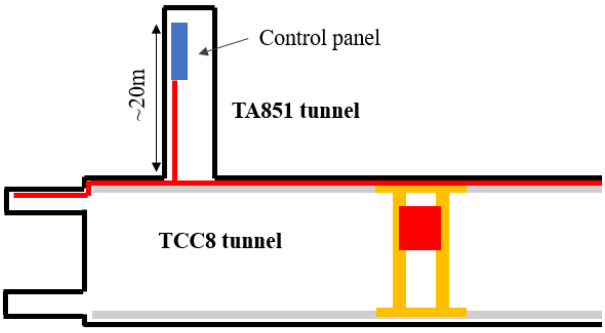

Figure 10 – Schematic position of the control panel

Figure 11 – Pictures of the TA851 tunnel with the designated position of the control panel

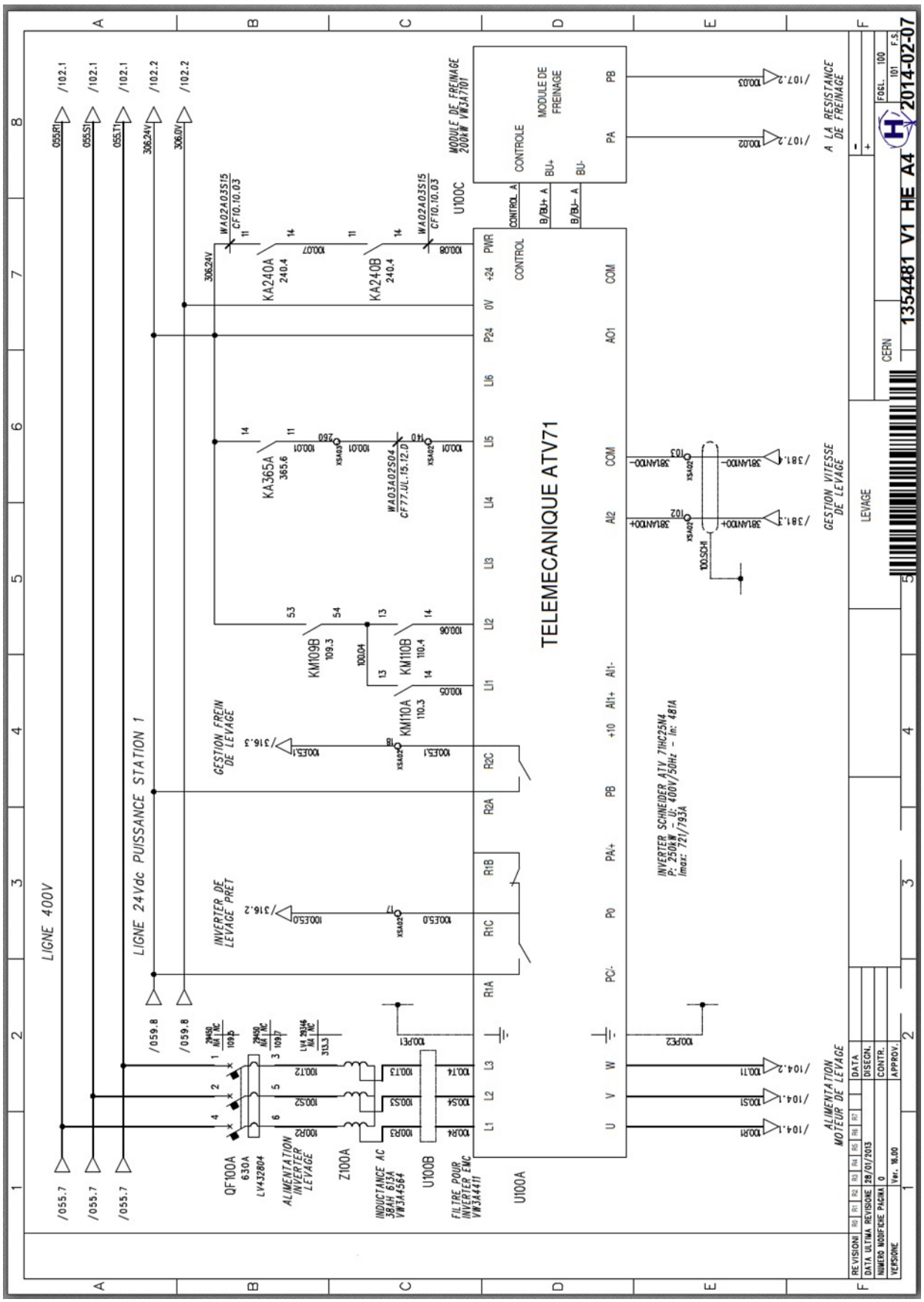

Figure 12 - Example of a schematic layout

3.3.2 Electrical Cubicles

- The electrical cubicles shall fulfil the European Directive 2014/35/EU on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits; they shall have the CE marking and be accompanied by the EC declaration of conformity;
- An isolating switch shall be fitted on the outside of the electrical cubicle. It shall be possible to lock this device mechanically in "Off" position by means of three padlocks;
- If there are several cubicles, the switchgears shall be grouped according to their function and identified by labels on the doors, for example: "Power-Cubicle", "Trolley-Cubicle", "Bridge-Cubicle", "Lifting-Cubicle" and "Controls-Cubicle";
- Power and control components related to the same function (e.g. hoisting movement) shall be grouped together;
- The doors shall be held closed by one or more handles of which at least one shall be fitted with a key lock (RONIS 2132A - standard key used at CERN). Only side-opening doors may be installed; the doors shall be capable of opening fully in all circumstances;
- The cabinet shall have a protection factor IP44 and shall fulfil the electromagnetic compatibility requirements stated by directive 2014/30/EU;
- A 20% of spare room shall be foreseen inside each cubicle;
- The cubicles shall be equipped with internal floodlights and a 230 V AC 10 A socket (Swiss standard) protected by a 30 mA differential circuit breaker;
- All the cables entering the cubicles and distribution boxes shall be connected via easily accessible interconnection terminals grouped on a DIN section rail. All terminals and wires shall be marked and identified in the electrical drawings; every terminal input shall be fitted with insulating caps for protection. The equipment shall be installed vertically, top entry, bottom exit;
- All cables entering electrical cubicles shall end independently at terminal blocks;
- Cage-clamp connection terminals shall be used.

3.3.3 Frequency Converters

The frequency converters shall:

- Always remain powered even when the crane is not in operation. It shall be possible to reset the frequency converter by continuously pushing for five seconds the start-up button on the remote control;
- Be equipped with all the necessary components to ensure the electromagnetic compatibility;
- Be equipped with a forced ventilation system;
- Be fitted with a manual override, which permits full speed operation in case the frequency converter fails. Alternatively, a redundant frequency converter shall be supplied;
- Be delivered with all the equipment necessary for their set up.

3.3.4 Operating Time Counter

The Contractor shall foresee the possibility to integrate a battery-powered device which will be used to register the operating time of the crane hoist. The module will be supplied by CERN and the Contractor shall install it. In particular, the design shall include an output contact which closes as

soon as any hoist motor starts up; indicative dimensions of the module are 100 mm x 100 mm x 50 mm.

3.3.5 Control Circuit

- The control circuit shall be powered with 24 V DC;
- It shall be possible to isolate each movement of the crane. Each motor output shall therefore comprise:
  - A circuit breaker to protect electrical circuit against electrical hazards;
  - Two mechanically and electrically interlocked contactors;
  - An overload protective device, using either properly rated thermal relays or thermal probes incorporated in the stator. A memory relay shall continue to give the fault signal and may be reset only by an operation inside the electrical cubicle.
- The controls shall be interlocked by a device monitoring the presence and correct rotation of the three phases, under and overvoltage: the threshold of the device shall be adjustable.

3.3.6 Programmable Logic Controller (PLC) Hardware Design

During the design phase, the Contractor shall respect the following hardware selection criteria:

- All PLC modules or PLC-related components shall be of SIEMENS® or SCHNEIDER ELECTRIC®;
- Two Human-Machine Interface (HMI) screens, from the same manufacturer as the PLC, shall be supplied. Their size shall be 12”. One shall be installed on the door of the control panel and the other one on the operator desk (§ 3.4.2);
- Resolvers shall be supplied to continuously measure the three coordinates of the main hook position;
- A remote connection module (cellular network or Wi-Fi) shall be supplied; it shall allow the Contractor and CERN to diagnose remotely the cause of crane faults and to modify the crane settings;
- Components shall be of latest range of products.

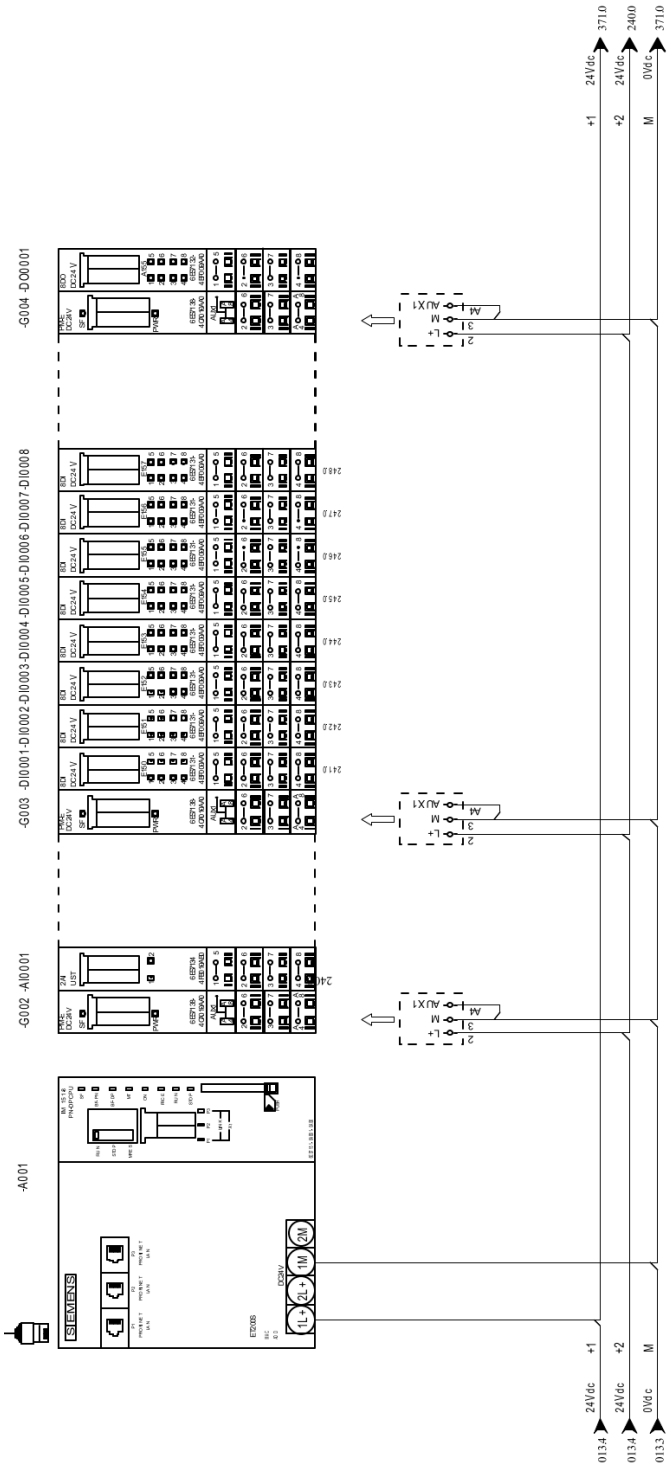

Figure 13 - Example of PLC Hardware Configuration

3.3.7 PLC Program Design

The PLC program design shall start with a graphic functional description of the PLC program; the complete system control logic and equipment behaviour shall be described in detail. A partial example of such graphic functional description is shown in Figure 14.

This graphic functional description shall be provided as part of the detailed design file.

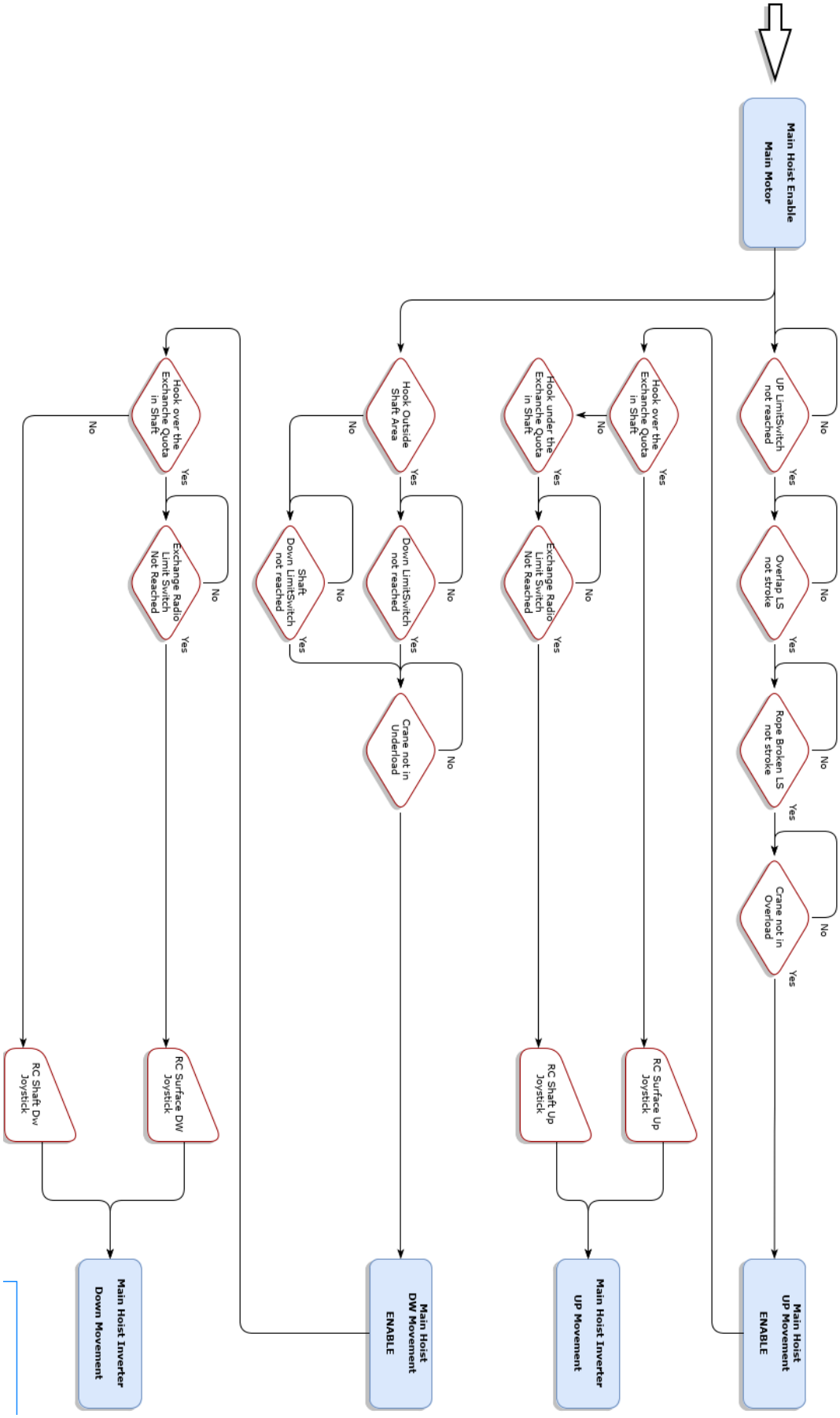

Figure 14 – Example of graphic functional description

The Contractor shall respect the following requirements:

- If using a Siemens PLC, the Contractor shall use the latest version of TIA–Portal for creating the program (TIA Step 7 Professional V13.0 SP2 or newer);
- If using a Schneider PLC, the Contractor shall use the latest version of "Unity Pro" (V12.0 or newer) for creating the program;
- Naming and versioning:
    - The project name shall read as follows: "PRXXX_VERSION"[2];
    - The files of the program shall be saved in a specific folder. The name of this specific folder shall be read as follow: "PLC_PRXXX_VERSION"[2];
    - If there are more than one CPU/PLC in a project, it shall be easy to identify the function of each of them. For example, in a master/slave application, one PLC/CPU shall have the name "PRXXX_MASTER_VERSION" and the other one "PRXXX_SLAVE_VERSION".
- The programming language for the PLC installed shall be by default Function Block Diagram (FBD). If the original program is not created on this graphical language, the Contractor shall deliver a "translated" version of the program on FBD containing all the information that is part of the original program;
- All unused variables, symbols, functions, function blocks, data blocks, timers, counters etc. shall be deleted from the program;
- Names chosen for inputs, outputs, variables, etc. shall be coherent and understandable. In addition to the names, there shall be a comment explaining more about their function. (e.g., why there is a NO-Contact or a NC-Contact);
- All the comments and variable names, symbols, etc. used in the program shall be in English or French;
- The program structure shall be built to easily allow CERN maintenance personnel to set-up autonomously the following tasks:
    - Creation, reset and parameterization of the crane working "zones", if any, following a procedure given by the Contractor to calculate the different limit points;
    - Speed range for each motion, if managed by the PLC;
    - Working load limit and in general the system of load monitoring which may have to be reset after some usage period.
- The HMI supplied, shall allow the following:
    - Fault diagnosis of the PLC system, permitting fault tracking and storage of the last 1000 faults. It shall be possible to visualize the last faults and distinguish the active faults from the ones previously stored in the system memory. Whenever a fault is triggered, the system shall memorize its fault code number, its description, the identification of the defective component(s), the pages of the electrical scheme where these components are located and the current date and time. The system shall automatically store recognized faults in chronological order; the oldest stored faults shall be overwritten when the system memory reaches its full capacity. Disconnection from electrical power shall not affect fault registration and storage;

[2] XXX is a variable for the specific crane (e.g. PR205).

    - In case of any failure of the diagnosis system, the crane shall still be functional;
    - Reading of all time counters;
    - Reading of the status of all start up conditions;
    - Reading of the status of all safety devices;
    - Reading and reset of the PLC status regarding possible errors;
    - Visualization of a map of the crane showing the location of all the installed electrical equipment; display size shall guarantee a good visualization;
    - Reading and modification of the speed values for the crane movements (e.g. adjustment of the maximum and minimum speeds);
    - Reading of the main hook (30 tonnes) coordinates;
    - Reading of the actual load attached to the main hook;
    - Setting and modification of 50 tridimensional exclusion zones, i.e. zones where the crane hook cannot access;
    - Setting and modification of 50 pre-defined points for the semi-automatic positioning (§ 3.3.11);
    - Reset of the resolvers;
    - Reset of the load monitoring system.
- The modification of values in the HMI shall be protected by password. The password to be used will be communicated by CERN and shall not be written in the operator and maintenance manuals. CERN shall be able to change this password after commissioning. The following HMI functions shall be protected by password:
    - Modifications of safety zones;
    - Modification of range values for all movement;
    - Activation or deactivation of safety functions;
    - Reset of the load monitoring system;
    - Reset of the resolvers;
    - Export of the life calculation data (§ 3.3.15).
- The PLC program access shall be protected from modification, upload and download. The password to be used will be communicated by CERN and shall not be written in the operator and maintenance manuals; CERN shall be able to change this password after commissioning.
- Safety PLC functions shall be protected by password. The password giving access to the safety-related parts of the software shall be supplied to CERN. The password to be used shall be defined by the Contractor and shall not be written in the operator and maintenance manuals.

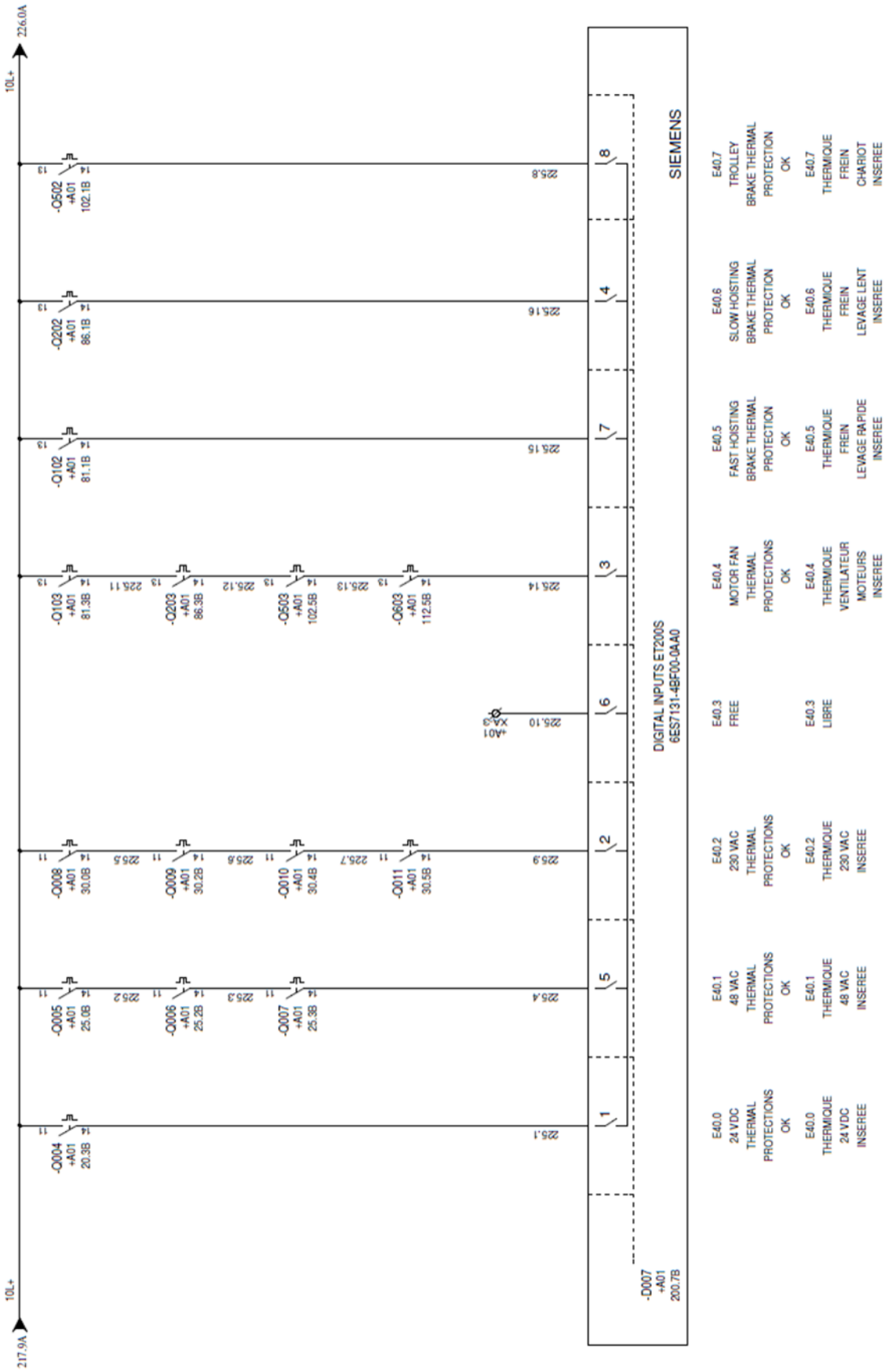

Figure 15 - Example of PLC Wiring Scheme

3.3.8 Normal / Test Functionality

For safety reasons, functionality tests for the control circuits shall enable checking of all control circuits without powering up the motors. The modes Normal / Test shall be activated by a key switch (Ronis 455 – as standard key at CERN for switches) inside the electrical cubicles.

3.3.9 Motion Limits Control

- The control system shall include switches so that all the crane motions (hoisting, cross travel, long travel) are slowed down in proximity of the permitted extreme positions and stop once the limit is reached;
- The reverse motion, i.e. moving away from the extreme position, shall always be possible at the nominal speed;
- Crossed-rods lever switches shall be used for cross and long travel motions; the switches shall be activated by adjustable actuator plates and be fitted in such a way that they are not damaged in case of over-travel. Steel plates shall guarantee a mechanical protection against accidental contact during routine maintenance;
- Geared cam limit switches shall control the hoisting motions; their characteristics (e.g. the hysteresis) shall be suitable for the hook lifting height;
- An additional safety limiter (ultimate upper limit switch) shall be fitted for the highest position of the hook and comply with the following requirements:
  - It shall be actuated by a mechanical device, independent from the one activating the limit switch, and shall operate by directly detecting the position of the hook pulley block;
  - It shall operate directly on the main power supply of the crane by cutting off the power at the line contactor (see the schematic layout example in Figure 12);
  - It shall be impossible to reset this additional safety limiter from the operator's controls. Resetting shall require an intervention on the control panel by rearming a key activated switch (Ronis 455 as CERN standard key); after resetting, all movements of the crane, except lifting upwards, shall be allowed.

3.3.10 Anticollision System

The crane shall be equipped with a system that avoids any risk of collision with the other crane operating in the same area (see drawing "TCC8 tunnel – General Drawing"); the travel motion shall slow down and stop as soon as the minimum allowed relative distance is reached.

3.3.11 Semi-automatic positioning

The control system shall include the possibility to operate the crane in semi-automatic mode; the operator shall be able to position the bridge and the trolley in a pre-defined point by repeating the following procedure:

- Rotate a selector on the radio control transmitter on the "semi-automatic" position;
- Select the destination point in a dedicated page of the HMI (§ 3.3.7);
- Push a hold-to-run button on the transmitter;
- The hook moves up to the top position;
- The bridge and the trolley move and bring the hook in the designated position.

It shall be possible to start the cycle from any position of the hook inside the building. The crane shall stop as soon as the button is released and re-start when it is pushed again.

3.3.12 Load Measurement and Overload Functions

The hoisting movement of the crane shall be fitted with a load cell and associated electronic board measuring the weight attached to the hook with a precision of +/- 1 % of the crane capacity; the load cell shall be from the same manufacturer as the PLC.

The device shall prevent the crane from hoisting a weight above the safe maximum load, taking the dynamic effect into account and shall be set to 105 % of the crane capacity. Once the overload condition is detected, no lifting movement shall be allowed while lowering shall be possible only at low speed. The acoustic signal (§ 3.3.14) shall be activated anytime the operator gives the lifting command.

The load cell shall also detect the no-load condition (e.g hook laying over an object); once the measured load value falls below a defined threshold, the lowering movement shall be stopped.

It shall be possible for the operator to set to zero the system via the remote-control transmitter.

The crane operator shall be able to identify the actual load attached to the hook via the HMI.

An additional electromechanical overload detection system shall be installed on the hoist; it shall be set to 110 % of the crane capacity and intervene in case the primary system fails.

3.3.13 Interlock between main hoist and auxiliary hoist

An interlock shall ensure that a hook can operate only if the other hook is raised in the slow-down zone.

This condition shall be signalled by a green light installed below the crane.

3.3.14 Visual and acoustic signalling

The table below summarizes the visual and acoustic signals for the operator that the EOT crane shall produce upon reaching certain conditions.

Table 2 – Visual and acoustic signalling

Condition	Visual signal	Acoustic signal
EOT crane start-up	Continuous orange flashing light	Three second horn
Access gate open	Red light	
Ultimate upper limit switch triggered (§ 3.3.9)	Red light	
Overload triggered (§ 3.3.10)	Red light	Three second horn
All the hooks raised in the slow-down zone (§ 3.3.13)	Green light 1	
Emergency brake intervention (§ 3.1.32.6)	Red light	

Explanatory text in French shall be included next to each signalling light and visible from the floor.

3.3.15 Life Calculation

The EOT crane shall be capable to provide the information needed to calculate their actual life; it shall therefore measure and record the following data for each cycle:

- Date and time of the cycle;
- Actual load value;
- Operating time of each motor during the cycle;
- Cumulated number of cycles;
- Cumulated operating time of each motor.

The crane shall be able to store data up to 250.000 cycles; a cycle is understood as the entire sequence of operations starting from the moment the load is hoisted and ending when the load is laid on the floor.

It shall be possible to export this information through a USB key on a Microsoft Excel® compatible file.

3.4 Technical Requirements for the Camera System

The Supply shall include a camera system allowing the operator to carry out the handling operations from a remote location.

It shall comprise:

3.4.1 Cameras

The crane shall be equipped with six Power over Ethernet (PoE) cameras.

Four cameras shall be installed on the bottom of the bridge and the trolley to provide a view on the hook and the operating area; they shall have the following characteristics:

- Pan, tilting and zoom (min. 26x optical) functions;
- Colour video quality.

Two cameras will be used to retrieve the position of the trolley with respect to the girder and of the bridge with respect to the TCC8 tunnel; to do so, they shall be positioned respectively on the trolley and on the bridge and provide a view on the rulers installed on the girder (§ 3.1.30) and the railway.

The existing ruler on the railway shall be reused.

These two cameras shall have the following characteristics:

- Zoom (min. 26x optical) functions;
- Colour video quality.

All cameras shall be mounted on mechanical supports requiring no tool for their installation and removal.

3.4.2 Operator Desk

The operator desk shall be located in the connection tunnel TA852 (Figure 16 and Figure 17), at a distance of about 15 m from the crane operating area.

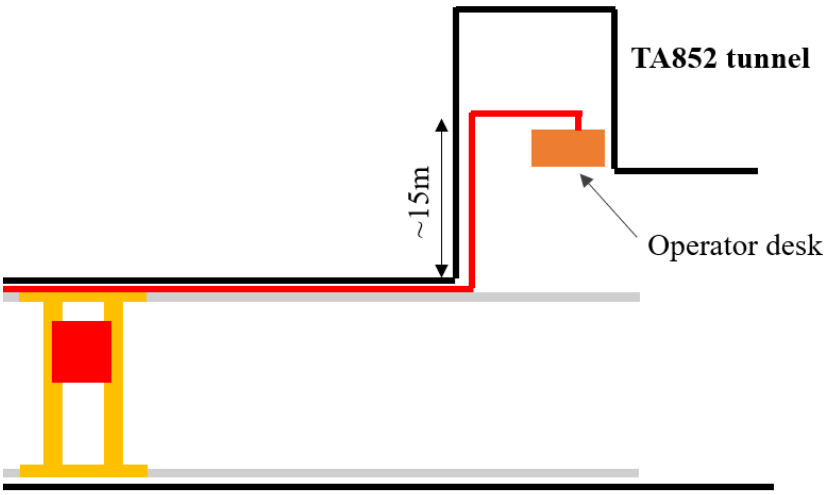

Figure 16 - Schematic position of the operator desk

Figure 17 - Pictures of the TA852 tunnel with the designated position of the operator desk

The operator desk shall be equipped with the following components:

- Four 21” monitors;
- A 12” HMI screen;
- A PC to control the cameras via an IP address; no specific software shall be needed to control the cameras. The PC shall have a Wi-Fi network card;
- An Uninterruptible Power Supply (UPS).

Figure 18 provides an example of the operator desk layout.

Figure 18 – Example of operator desk

3.4.3 Network

The cameras, the control panel and the operator desk shall be connected via a network made of:

- Mineral optical fibres with protective sheath between the control panel and the operator desk and between the crane and the operator desk. Cable trays shall be installed to mechanically protect the fibres in the fixed installation sections;
- Ethernet cables on-board of the crane;
- A PoE converter on the crane.

3.5 Technical Requirements for the Electrical Cables between the Crane and the Control Panel

3.5.1 General requirements for the electrical cables

- Cables, cable trays and conduits shall respect the requirements of the CERN safety instructions IS41, IS48 and SSI-FS-2-1, in particular:
  - All constituent materials of cable insulation and sheathing, including tapes and fillers, shall be halogen-free and sulphur-free;
  - Cables shall meet the fire performance requirements for “High-risk installation” areas;
  - The insulation and sheathing materials shall achieve a radiation index of 7.0.
- The minimum conductor cross section shall be 1.5 mm^2 (except for BUS cables). All multicore cables installed on the crane shall include 10 % in quantity of free cores;
- Power and control cables shall be kept separated and dividers shall be foreseen if they are routed in the same cable tray;
- Shielded cables shall be used to connect electric motors to frequency converters; to prevent electromagnetic disturbance, shields shall be grounded without being damaged and with 360

degrees contact and no twisted ends. Whenever possible, shielded cables shall not be interrupted, otherwise proper connectors shall be used;
- Conductor colours and position order, from the master switch up to the fused isolating switch for each motion (Q04, Q06, …), shall comply with the standard identification colours specified in EN 60204-32.

3.5.2 Cables in fixed installation

- Cables in fixed installation shall be mechanically protected by a cable tray; where possible, the existing cable trays shall be reused;
- Dividers shall be used to separate the power and the signal cables.

3.5.3 Cables in mobile installation

- The cables in mobile installation shall be split in two festoons;
- Highly flexible multi-stranded round cables shall be used;
- Festoons shall be supported by proper cable trolleys;
- The existing festoon rails shall be reused (Figure 19);
- Each festoon shall include a steel wire or a chain to connect the trolleys and avoid an excessive pull on the cables;
- Festoons shall be stored in the existing areas at the extremity of the TCC8 tunnel (Figure 19);
- The festoons design shall consider that a removable wall will be installed between the festoons' storage areas and the crane operating area (Figure 20). An opening in the wall will be created to allow the festoon passage.
  In case the wall is removed, it shall be possible to operate the crane in the whole TCC8 area by simply releasing a cable trolley;
- Cables in fixed installation and cables in mobile installation shall be connected by a junction box with a minimum rating IP44.

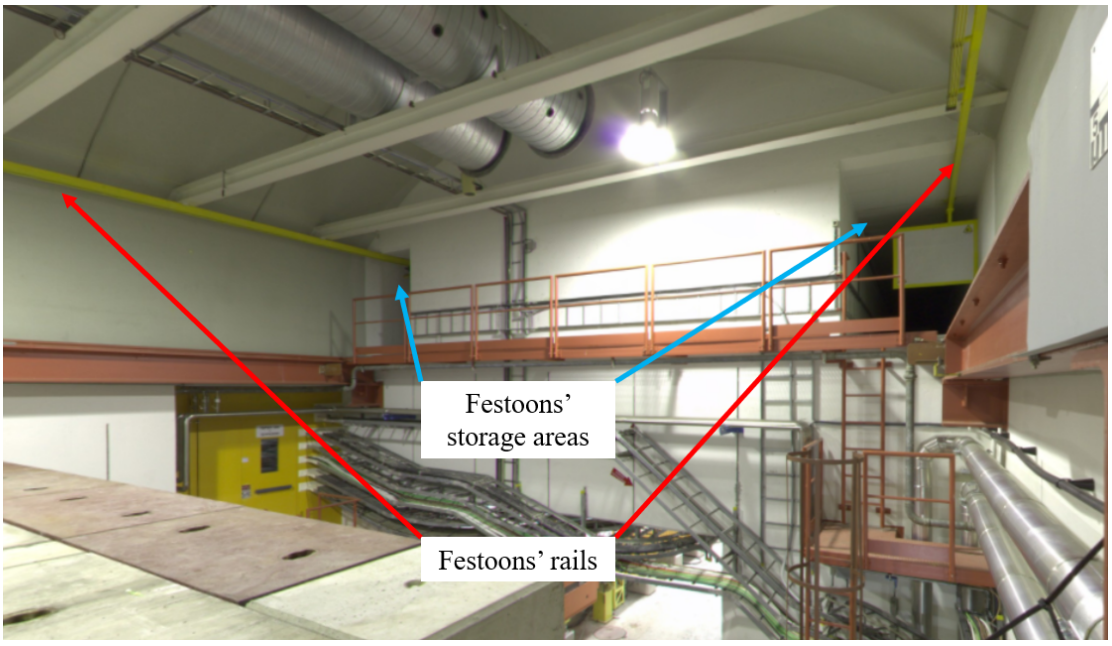

Figure 19 – Festoons' rails and storage areas

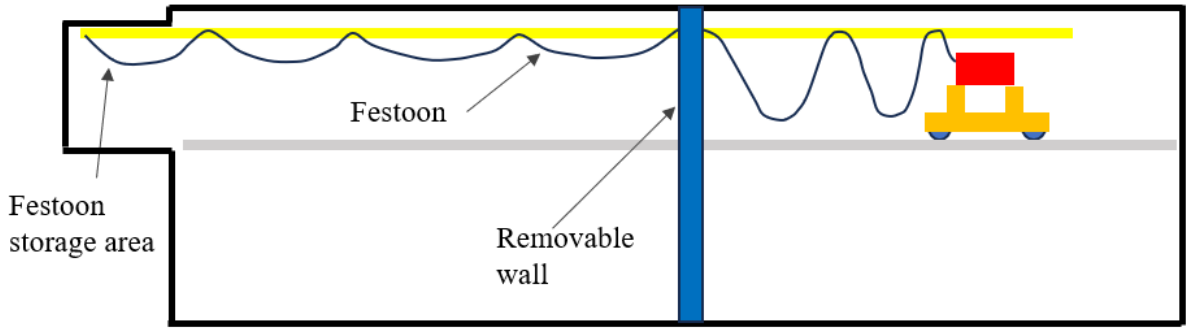

Figure 20 - Schematic longitudinal view of the TCC8 tunnel with the removable wall

4. SPECIFICATION OF THE ACTIVITIES

The Supply shall include the activities listed in the present section. These activities shall comply with the requirements specified below.

4.1 Activities at the Contractor's Premises

During the Contract, CERN shall have free access, during normal working hours, to the Contractor's premises, including manufacturing and assembly sites and Subcontractor's premises. The change of manufacturing place is subject to prior written approval by CERN.

4.1.1 Design Activities

Before starting any design activity, the Contractor shall verify the dimensions and data shown on the layout drawings and other information made available by CERN as part of this Technical Specification.

4.1.2 Packing and Shipping

The Contractor shall be responsible for the packing and, if requested by CERN, for the transport to CERN. In this case, the Contractor shall take up a dedicated all-risk transport insurance for the Supply concerned in accordance with the provisions of DAP Incoterms 2020 conditions, CERN Prévessin (FR).

In all cases, the Contractor shall comply with the packing and shipping instructions available under: https://procurement.web.cern.ch/system/files/document/packing-and-shipping-instructions_0.pdf and, in particular, ensure that the Supply is packed in a way that guarantees the absence of any contamination and that no damage or any possible deterioration in performance due to transport conditions can occur.

4.2 Activities on the CERN site

The Contractor shall perform its activities on the CERN site in accordance with the provisions of § 7.4.

4.2.1 General

During all the activities on the CERN site, the Contractor's personnel shall comply with all procedures and safety measures defined in the Contractor's installation method statement (see § 5.1.1) and the Safety documentation (see § 7.4.2). It is the Contractor's responsibility to ensure that its personnel is trained and authorised to perform the activities concerned.

The facility is equipped with the following handling equipment that can be used for the handling operations:

- A 45 tonnes overhead crane at the extremity of the TCC8 tunnel;
- A 45 tonnes overhead crane at the top of the shaft to handle material between the surface and the underground;
- A motorized transfer table to handle material between the bottom of the shaft and the TCC8 tunnel.

The Contractor shall provide any other handling and personnel access equipment, such as forklifts and elevating working platforms, that are necessary for the activities.

CERN will be responsible for the handling operations of the equipment owned by CERN; the Contractor shall provide the necessary information, i.e. drawings of the components to be handled, position of the centre of gravity, weight, handling accessories and procedure.

The Contractor shall be responsible for the execution of all the handling manoeuvres with the equipment provided by him.

It shall be the Contractor's responsibility to fence the worksite with barriers and protect the equipment in the worksite with fire-resistant covers and dust-tight covers.

During the dismantling and installation activities at CERN, the Contractor shall report at least every day to the CERN work supervisor on activities' progress and any issue that may affect the execution, quality or progress of the project.

4.2.2 Inspection Visits

Before starting the design phase, the Contractor shall perform on the CERN Site all the measurements and inspections required for the design study phase, paying specific attention to the mechanical interfaces and the available space above, below and on the sides of the EOT crane. Inspections shall also take into consideration all installation aspects, buildings restrictions and specific access conditions.

The Contractor shall notify CERN of anything to its knowledge that may impact the installation and commissioning of the Supply.

4.2.3 Dismantling

The dismantling activities shall include:

- Dismounting of the existing EOT crane. The EOT crane shall be disassembled in parts so that they can pass through the shaft between the surface and the TCC8 tunnel which has a clear passage area of 8 m x 4 m;
- Dismounting of the electrical feeding line;

- Cutting of the brackets supporting the electrical feeding line (see drawing "EOT crane in TCC8 – Layout Drawing").

Any destructive work shall respect the requirements listed in § 7.4.2.3.

4.2.4 Installation

The installation activities shall include:

- Installation of the EOT crane;
- Installation of the control panel;
- Installation of the operator desk;
- Installation of the festoons;
- Installation of the cables, optical fibres and cable trays between the EOT crane, the control panel and the operator desk.

4.2.5 Waste Sorting

Waste shall be handled in accordance with Laws including provisions concerning the traceability of the waste. CERN will, on Contractor's written request, make available containers for the disposal of waste that shall be sorted by the Contractor in accordance with CERN procedures and instructions indicated in the *Working on the CERN Site* (WOCS) document. The Contractor shall cut into pieces the parts according to the containers' size.

The Contractor shall lower on the TCC8 tunnel floor the main parts of the dismantled EOT crane (girders, end-carriages, trolley, electric cubicles, walkway) which will remain CERN's property and will be removed by CERN.

The Contractor shall remove the oil from the EOT crane parts dismounted during their activities and store the oil in tanks provided by CERN.

4.3 Tests

The Contractor shall carry out the tests as specified below.

4.3.1 Factory Acceptance Tests (FAT)

CERN, or a representative of its choice, may attend the FAT; the Contractor shall notify CERN in writing at least ten working days before the proposed date for these tests.

The crane shall be fully assembled, and the electrical cables (both festoon and fixed cables) and the optical fibres wired to the crane, the control panel and the operator desk.

The tests shall include:

- Visual inspection:
    - Verification of conformity with the approved mechanical design;
    - Visual inspection of the control panel (wiring, labelling) and insulation tests;
    - Verification of correct installation of the electrical components;
    - Verification of correct wiring and earthing.
- Verification of the key dimensions and geometry;
- Functional tests without load:
    - EOT crane start-up;

- Verification of motions and limit switches;
- Speed checks;
- Test of the semi-automatic functioning;
- Test of the safety functions;
- Test of the emergency stops;
- Test of the camera system;
- Test of the HMI screen.

The Contractor shall indicatively consider three days for the FAT.

The Contractor shall submit the test results, recorded and compiled in a report to CERN for its written acceptance. Prior to shipment of the Supply, the Contractor shall correct any non-conformity identified by CERN during the FAT.

4.3.2 Site Acceptance Tests (SAT)

Site Acceptance Tests (SAT) of the Supply will be carried out by CERN who will provide the loads needed for the tests; the Contractor's representative shall be attending the SAT.

SAT will include:

- Visual and functional tests to assess the conformity of the Supply to this Technical Specification and its annexes; the same functional tests carried out during the FAT will be repeated in the real installation conditions;
- Static and dynamic tests and check of all the safety functions; the CERN Safety Instruction SSI-M-1-2 will be used as a basis.

The Contractor shall indicatively consider one week for the SAT.

The Contractor shall notify CERN in writing at least ten working days before the proposed date for these tests.

Any non-conformity shall be remedied by the Contractor within two weeks from its notification by CERN.

4.4 Maintenance

The preventive and corrective maintenance shall be performed as specified in the sections below.

4.4.1 Preventive Maintenance

The Contractor shall perform on-site preventive maintenance interventions every 30 hours of hoist operation or at least once every year during the warranty period.

4.4.2 Remote Service

The Supply shall include, during the warranty period, a remote service allowing the Contractor to diagnose remotely the cause of the crane faults, to modify the crane settings and re-program the components.

The Contractor shall provide assistance remotely within 24 hours from CERN's written request.

4.4.3 First-line Intervention by CERN

Without prejudice to the warranty conditions, the Contractor shall authorise CERN, after adequate training, to perform first-line corrective maintenance interventions on the Supply in accordance with the maintenance manual.

4.4.4 Corrective Maintenance

In case of major breakdowns and during the warranty period, the Contractor shall intervene on the CERN site for diagnostic interventions and repair proposals within five days from CERN's written request. The Contractor shall then perform the corrective maintenance including the procurement of spare and repaired parts.

4.5 Training of CERN Personnel.

The Contractor shall train CERN's personnel, at CERN, as follows.

4.5.1 Training of CERN's Technical Maintenance Personnel

The Contractor shall provide a one-day training in English or in French for CERN's personnel. The Contractor shall explain the content of the maintenance manual and train CERN's personnel in carrying out preventive and corrective maintenance services including fault diagnostics and recovery procedures.

4.5.2 Training of CERN's Operators

The Contractor shall provide a one-day training in English or French for CERN's operators. During the training, the operators shall become familiar with all the controls and functionalities of the EOT crane.

5. SPECIFICATION OF THE DOCUMENTATION

The documentation related to the Supply shall comply with the requirements specified below.

5.1 Documentation Related to the Supply

The documentation related to the Supply shall include:

- Detailed Design File (DDF) (see § 5.1.1);
- Factory Acceptance Test (FAT) report (see § 5.1.2);
- Technical Documentation (see § 5.1.3 and § 5.1.4);
- Maintenance Documentation (see § 5.1.5).

5.1.1 Detailed Design File (DDF)

Before starting any manufacturing activity, the Contractor shall submit a DDF to CERN for its written acceptance including:

- Mechanical layout drawing showing the following information: EOT crane overall dimension, hook in its extreme positions in the three directions, minimum gap between the crane and the fixed obstacles, speed values, installed power, loads transmitted from the wheels to the rails;

- EOT crane 3D model showing:
  - Definitive design of steel structures and mechanisms;
  - Access means to the EOT crane and to its components and details of the areas dedicated to maintenance;
  - Location of the electrical components (switches, cable chain, cameras etc.) and cable trays.
- Electrical circuit diagrams and electrical cubicle layout drawings;
- Layout of operator controls;
- Graphic functional description of the control system (see § 3.3.7);
- Layout of the HMI pages;
- Project schedule showing the following phases:
  - Design;
  - Procurement of commercial parts;
  - Manufacturing;
  - FAT;
  - Delivery;
  - Dismantling and installation;
  - SAT.
- Installation method statement (in English and French) containing the list of equipment to be used, installation procedure, time schedule, risk analysis, description and drawings of difficult handling operations, space requirements with an estimation of time for which the space will be needed. The document shall also include the information required in § 7.4.2.3.

5.1.2 Factory Acceptance Test report

The Contractor shall submit a FAT report in accordance with the schedule defined in § 7.1, including:
- All tests performed;
- All test results;
- All non-conformities;
- All modifications performed.

5.1.3 Technical Documentation

The Contractor shall submit technical documentation to CERN for its written acceptance including:
- EC declaration of conformity;
- Technical file as defined by the European Directive 2006/42/EC. The calculation notes shall clearly describe the assumptions made and the formulas shall be explicitly expressed;
- Final 3-D model of the crane;
- As-built versions of all the mechanical and electrical design documents;
- Conformity certificates of commercial parts;
- Bill of materials which shall include the following information: manufacturer, manufacturer's model, serial number and any important ordering detail; the Contractor shall highlight the recommended spare parts;
- List of bearings which shall include all bearings installed on the crane (including those which are contained in commercial parts) and provide the following details: manufacturer, code, location (e.g. long-travel wheel axle);

- List of electrical cables.

The technical documentation shall be provided in electronic format; a paper copy of the documents needed for the corrective maintenance shall be delivered and stored in the operator desk.

5.1.4 PLC Documentation

The Contractor shall use a separate folder for all PLC and HMI related documentation. In particular, the Contractor shall deliver the following:

- The source code of the program with the latest parameters (after completion of the crane SAT) in digital format. Whenever changes are performed on the equipment, the Contractor shall update the related documents;
- A document with the following content about the PLC/HMI program(s):
  - Identification of the crane, project reference, commissioning date;
  - Identification of the Contractor and the PLC system designer;
  - Version of the PLC(s) and/or HMI program(s) installed;
  - Details about the software used to program the device:
    - Exact name of used software (including all needed add on or extensions);
    - Exact version of the software used (including all needed add-ons or extensions):
      - e.g. TIA Portal – Version V13 SP1 Update 9;
      - e.g. STEP 7 Professional - Version V13 SP1 Update 9;
      - e.g. STEP 7 Safety - Version V13 SP1 Update 5;
      - e.g. WinCC Advanced – Version V13 SP1 Update 9;
      - e.g. Unity Pro XL - V11.0.
- The Contractor shall update this document if a change to the PLC and/or HMI program occurs before the end of the warranty period. The document shall contain the history of changes in which the programmer shall describe in detail all the modifications made in each version of the program.
- A document for each hardware device and system interfacing with the PLC (e.g. Wi-Fi devices, 4G devices) with the following content:
  - Identification of the crane, project reference, commissioning date;
  - Identification of the Contractor and the responsible system designer;
  - Possible access information (except the password);
  - Details about the software that was used to initialize and parametrize the device, including exact name of used software and exact version of the used software.
- A drawing of the crane with the location of all the electrical equipment;
- An exhaustive list of the PLC inputs and outputs, with comments on the usage of each;
- A list of the PLC input/output cards identifying all the sensors/actuators wired to those cards;
- A drawing showing the complete data BUS system with all peripherals;
- Documentation for all data BUS peripherals shall contain the identification of the device, the manufacturer, the order number, schema position, bus address, name of the specific bus system, and additional description (e.g. master/slave).

5.1.5 Maintenance Documentation

The Contractor shall submit maintenance documentation including:

- Operating and maintenance manual of the crane and its commercial parts; in case of lack of information, the Contractor shall provide, during the warranty period, complementary operating and maintenance instructions at no additional cost;
- A separate manual, to be used by the crane's operator, in English or French, including all the important crane characteristics and use instructions (start-up procedure, working area, functions).

5.2 Creation, Updating and Control of Documents

The Contractor shall apply professional standards and codes in matters of document editing, design/drawing process, design reviews and approval, naming conventions and tagging, quality assurance/control.

The full documentation supplied in the framework of the Contract (including all drawings and schematics) shall be in English except where explicitly stated differently.

The Contractor shall submit all documents produced exclusively in the following electronic formats:

- 3D models in STEP format;
- Drawings in AUTOCAD® format;
- Text documents in PDF® format;
- Schedules in PDF® format.

6. APPLICABLE RULES, NORMS AND STANDARDS

The Supply shall comply with Laws. For the purpose of the Contract, Laws shall include all relevant rules, norms and standards and, and in particular:

6.1 Rules

- CERN Safety rules, available under: http://cern.ch/safety-rules, in particular:
    - SR-M - *Mechanical equipment*;
    - SSI-M-1-2 - *Cranes, bridges cranes, gantry cranes and power driven hoists*;
    - SSI-FS-2-1 - *Fire safety and radiation resistance requirements for cables*;
    - IS 41 - *The use of plastic and other non-metallic materials at CERN with respect to fire safety and radiation resistance*;
    - IS 48 - *Fire prevention for cables, cable trays and conduits*;
    - Safety Code F: *Radiation Protection;*
    - SR-SO - *Responsibilities and organizational structure in matters of Safety at CERN*;
    - SR-WS - *Works and services*;
    - GSI-WS-1 - *Safety coordination for works and services*.
- Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery;
- Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility;
- Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits.

6.2 Norms and Standards

- EN 15011, *Cranes – Bridge and gantry cranes*;
- EN 13001-1, *Cranes – General design – Part 1: General principles and requirements*;
- EN 13001-2, *Crane safety – General design – Part 2: Load actions;*
- NF EN 13586, *Cranes – Access;*
- EN 1090-2, *Execution of steel structures and aluminium structures – Part 2: Technical requirements for steel structures;*
- EN 60204- 32, *Safety of machinery – Electrical equipment of machines – Part 32: Requirements for hoisting machines;*
- ISO 12100, *Safety of Machinery – General principles for design – Risk assessment and risk reduction;*
- ISO 13849-1, *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design;*
- IEC 61000-2-4, *Electromagnetic compatibility – Part 2-4: Environment – Compatibility levels in industrial plants for low-frequency conducted disturbances;*
- NF C18-510, *Operations on electrical network and installations in an electrical environment - Electrical risk prevention*.

7. PERFORMANCE OF THE CONTRACT

7.1 Schedule

The Contractor shall deliver the Supply in accordance with the following schedule, starting from the date of notification of award of the Contract to the Contractor:

Table 2: Schedule

	Milestones	Weeks	Indicative Date
T_0	Notification of award of the Contract to the Contractor		01/07/2025
	Delivery of the project schedule (§ 5.1.1)	T_0 + 4	31/07/2025
	Delivery of the mechanical layout and the 3D model (§ 5.1.1)	T_0 + 13	30/09/2025
	Delivery of the electrical circuit diagrams, electrical cubicle layout drawings, layout of operator controls, graphic functional description of the control system and HMI pages (§ 5.1.1)	T_0 + 16	24/10/2025
T_1	Written acceptance by CERN of the above-mentioned documentation (§ 7.5.1)	T_0 + 20	21/11/2025
	Delivery of the installation method statement (§ 5.1.1) and the Safety documentation (§ 7.4.2)	T_1 + 32	01/07/2026

	Milestones	Weeks	Indicative Date
	Factory Acceptance Tests (§ 4.3.1)	$T_1 + 37$	03/08/2026
	Delivery of FAT report (§ 5.1.2) for written acceptance by CERN	$T_1 + 38$	10/08/2026
T_2	Written acceptance by CERN of the above-mentioned documentation (§ 7.5.2) and authorisation by CERN to proceed with delivery of the Supply	$T_1 + 39$	17/08/2026
	Delivery of the EOT crane components to CERN and start of installation	$T_2 + 2$	31/08/2026
T_3	Written acceptance of the Supply by CERN (§ 7.5.3)	$T_2 + 14$	27/11/2026

7.2 Contractor's Personnel

The Contractor shall assign an appropriate number of qualified personnel for the performance of the Contract. The personnel assigned by the Contractor shall at all times remain under the sole direction and responsibility of the Contractor.

The Contractor shall forthwith replace, if so requested by CERN, any member of its personnel assigned to the Contract whose conduct or whose administrative situation affects or threatens to affect the proper performance of the Contract or any other activities on the CERN site.

The Contractor shall, at its own expense, ensure that its personnel assigned to the Contract has suitable training to comply with the requirements of the Contract.

Furthermore, before the start of the Contractor's activities on the CERN site (see § 7.4), the Contractor shall ensure that its personnel has completed the specific training CERN deems necessary. The CERN site specific training will be provided by CERN.

7.3 Contract Follow-Up and Progress Monitoring

The Contractor shall assign a person in charge of the technical execution of the Contract and its follow-up, as well as a person in charge of the commercial follow-up, during the whole duration of the Contract. These persons shall be able to communicate in at least one of the official languages of CERN (English or French).

The Contractor shall attend online or in-person regular meetings, organised and scheduled by CERN, to monitor the performance of the Contract. If CERN deems necessary, the meeting shall be in-person on the CERN site.

During the dismantling, installation and commissioning works on the CERN site, the Contractor shall submit to CERN a written progress report every week.

7.4 Working on the CERN Site

For any intervention on the CERN site, the Contractor shall take into account and implement the rules and provisions defined in the document *Working on the CERN Site* available under: https://procurement.web.cern.ch/document-category/key-reference-documents

7.4.1 Location of the Activities

The Contract will be performed on the French part only of the CERN site.

7.4.2 Safety Requirements related to Activities on the CERN Site

7.4.2.1 Safety coordination

The activities performed by the Contractor on the CERN site will be classified as category 2 worksite. CERN will prepare, with the collaboration of the Contractor, a Prevention Plan (PP), in French, summarizing the safety issues to be followed before and during the dismantling, installation, commissioning and maintenance works.

The Contractor (and the Subcontractor, if any) shall:

- Collaborate with CERN, providing information about the activities, the workers involved, an assessment of the inherent risks and the risks generated, the preventive and protection measures to be taken;
- Take part in all joint inspections, if necessary;
- Inform his personnel and his potential Subcontractors about the provisions, and take the necessary measures so that his Subcontractors inform their personnel;
- Inform CERN of changes in the potential risks as and when they arise and vice versa.

During the performance of the Contract, the PP shall be updated as the risks evolve and at least annually.

7.4.2.2 Presence of pollutants: lead and asbestos

Paints and undercoats of the crane structure (girders, end-carriages, trolley, walkways, feeding line brackets) contain lead. The Contractor shall apply the relevant procedures for any destructive work on these parts as well as for the management of the resulting waste.

The crane is free of materials containing asbestos.

7.4.2.3 Specific Safety requirements

The activities performed by the Contractor will be carried out in radiation and underground areas. The estimated radiation dose rate in the areas where the dismantling and installation activities will take place is in the range 1-10 µSv/h.

The Contractor shall respect the following additional requirements:

- Follow a specific two-day training, provided by CERN;
- Use only electrical tools and equipment;
- Integrate the installation method statement (§ 5.1.1) with detailed information about the activities:
  - Duration and precise location of each sub-activity;
  - Number of people involved;

- Work method;
- Estimation of the waste volume, weight and type.

- Respect the following measures for destructive works:
  - Perform any cutting operation with reciprocating saw (angle grinders are not allowed);
  - Use of a specific vacuum cleaner provided by CERN.

7.4.2.4 Safety correspondents

In accordance with § 7 of the Safety regulation CERN SR – SO "*Responsibilities and Organisational Structure in Matters of Safety at CERN*"[3], the Contractor shall appoint a Safety Correspondent who shall act as its representative at CERN in matters of Safety.

The Contractor shall also designate a qualified radioprotection expert (PCR) to assure that all the Contractor's obligations in terms of radiation protection are met (see § 3.13 of the document "*Working on the CERN site*").

7.5 Acceptance of the Supply by CERN

7.5.1 Acceptance of the Detailed Design File

The Contractor shall submit to CERN for acceptance the DDF as specified in § 5.1.1 and according to the schedule defined in § 7.1.

CERN will verify the conformity of the DDF in accordance with clause 22 of the General Conditions of CERN Contracts.

The ordering of components and start of manufacturing shall not commence prior to CERN's written acceptance of the DDF.

7.5.2 Acceptance of the FAT report

The Contractor shall submit to CERN for acceptance the FAT report as specified in § 5.1.2.

CERN will verify the conformity of the FAT report in accordance with clause 22 of the General Conditions of CERN Contracts.

The delivery to CERN of the Supply shall not commence prior to CERN's written acceptance of the FAT report.

7.5.3 Acceptance of the Supply

Acceptance of the Supply will be subject to:

- Successful completion of the FAT and SAT (§ 4.3);
- Compliance of the Supply with this document and its annexes;
- Conformity of the technical and maintenance documentation (§ 5.1.3, § 5.1.4 and § 5.1.5);
- Completion of the training of CERN personnel (§ 4.5).

[3] Available at https://www.cern.ch/safety-rules.

8. CERN REPRESENTATIVES

All commercial and technical correspondence concerning the Invitation to Tender shall be communicated to the CERN procurement officer and in copy to the technical officer. Any communication by or to any other person than the CERN Procurement Service shall not be valid and have no effect.

Procurement Officer	**Tel**	**Email**
Mr Floris Bonthond	Tel: +41 22 767 3143	floris.bonthond@cern.ch
In case of absence:		
Mr Alvaro Lecinana Soldevilla	Tel: +41 22 766 7433	alvaro.lecinana.soldevilla@cern.ch
Technical Officer	**Tel**	**Email**
Mr Roberto Rinaldesi	Tel: +41 22 767 0280	roberto.rinaldesi@cern.ch
In case of absence:		
Ms Caterina Bertone	Tel: +41 22 767 2494	caterina.bertone@cern.ch

9. ANNEXES

9.1 Drawings

Table 3 - List of applicable drawings

Description	**Drawing number**
TCC8 tunnel – General Drawing	EDMS 1427211
EOT crane in TCC8 – Layout Drawing	EDMS 1427212