IT-4464 Bidders' Conference Technical Annexes

19th-20th February 2019

Introduction

- Technical Annex 1: «General Requirements for Electrical Overhead and Gantry Cranes»
- Technical Annex 2: «Radio Remote Controls Requirements»
- Technical Annexes 3A-3I: «Questionnaires»
- Technica Annex 4: «PLC Programming and Documentation Requirements»

Annex 1 - introduction

- Sections 1 to 7 contain requirements to be respected for the calculation of supply of new cranes and are always applicable
- Requirements in section 8 are the basis for pricing the additional options in the UPL; they will be applicable only when explicitly stated in the data sheet

Annex 1 – mandatory requirements

3.1.1 ***Lifetime***

New cranes and new components shall be designed for a lifetime of a minimum of 25 years; in case of revamping, existing structures shall be validated for a residual life of 25 years too.

3.1.2 ***Classification***

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

- Structures: A4;
- Mechanisms: M4.

3.1.3 ***Design Temperature***

In case of outdoor installation, the crane shall be designed to operate in the temperature range −20 / +50 °C.

In case of indoor installation, the design temperature range shall be 0 / +50 °C.

3.1.4 ***Space Restrictions and Clearances***

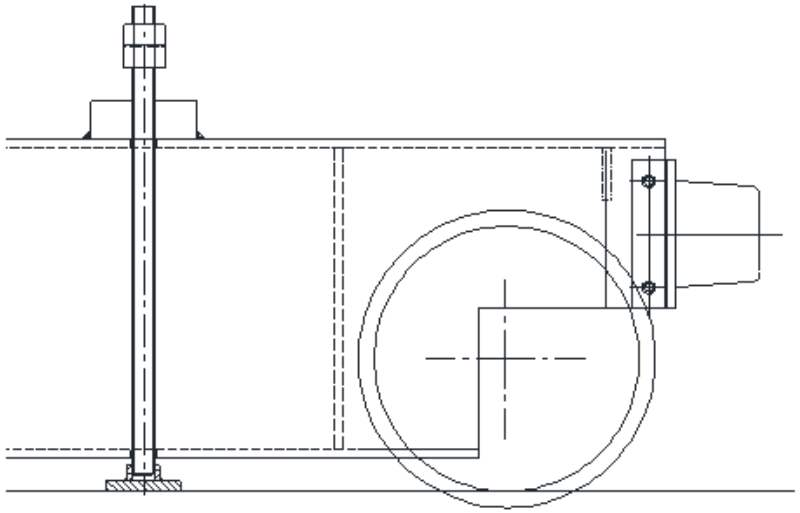
The minimum vertical clearance between the crane and any fixed obstacle such as the ceiling or ventilation ducts shall be at least 500 mm.

Annex 1 – mandatory requirements

3.3.2 New Structure

In case of supply and installation of a new bridge, the following requirements have to be taken into account:

- Drainage apertures shall be provided in all places where water and oil may accumulate;
- The vertical deflection of the girder when the hoist is located 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, may be removed horizontally after the end carriages have been lifted by about 20 mm. When crane capacity is lower or equal to 10 tons, design of the end carriage shall include a built-in jack to lift the end carriage by acting on a threaded bar. Figure 4 below provides an example of this system:



Annex 1 – mandatory requirements

When crane capacity is bigger than 10 tons, it shall be possible to fit easily 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 200 mm;
- Proper bumpers shall be placed at the end carriages extremities to reduce the energy transmitted to the structures in case of impact;
- End-carriages shall be equipped with proper means to avoid derailment of the bridge;
- The minimum hardness of wheels rolling surface shall be 300 HB up to a depth of 5 mm.

Annex 1 – mandatory requirements

3.7 Hoist

3.7.1 General

- In case of double-girder EOT cranes, the hoist shall be of open-type design;
- Hoist design shall assure that, during lifting and lowering operations, the hook remains centered below the rope drum without neither horizontal drift (i.e. true vertical lift) nor rotation about a vertical axis;
- Rope fleet angle shall not exceed 2,5 degrees;
- Design shall foresee the possibility to lift the maximum load for the whole lifting height at low speed.

3.7.2 Rope Drum

- The rope drum shall be able to store all the rope necessary to obtain the full hook height in one single layer;
- Three wraps of rope (for any rope) shall remain on the drum when the hook is in its lowest position;
- Two spare grooves (for any rope) shall remain available on the drum when the hook is at its highest position;
- Design shall include proper devices which either prevent the bad winding of the ropes (rope guides) or, in case this occur, stop the lifting movement allowing lowering only at slow speed; the data sheet will specify which type of device shall be installed.

Annex 1 – mandatory requirements

3.7.3 Ropes

- 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.

3.7.4 Balancing Beam

The ropes' extremities shall be fixed to a balancing beam which recovers the differences in lengths of the two ropes and guarantees an equal loads distribution between the rope falls; design shall allow a rotation of the beam up to 45° without interference with the steelwork.

A beam rotation beyond 45°, e.g. in case of failure of a rope, shall be detected by a limit switch.

3.7.5 Hook – Pulley block

- Hook shall be endowed with safety latch;
- Design shall assure the possibility to quickly replace the ropes;
- The pulley-block shall be painted with oblique black stripes on a yellow background (see § 7.3);
- The design shall include the possibility to manually lock the hook every 90° without tooling to avoid any rotation of it around the vertical axis;
- When a motorized below-the-hook accessory is requested, the electrical connection shall be made with a plug-socket system on both sides of the cable.

3.7.6 Hoist service brake

In case of non-self-braking motor, a disc-type service brake shall be installed.

Annex 1 – mandatory requirements

4. ELECTRICAL CONTROL AND INSTRUMENT REQUIREMENTS

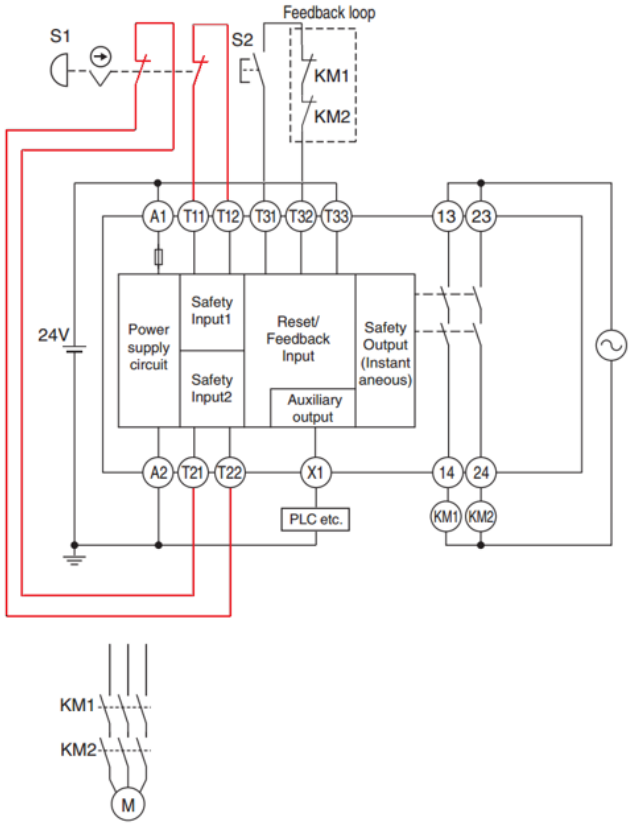
4.1 General

- The electrical installations shall comply with the CERN Electrical Safety Code C1 (1990) that calls for compliance with the most recent IEC & CENELEC Standards, CERN Safety Instructions IS23 (criteria for electric cables and wires in low voltage applications) and IS24 (criteria for electrical installations); CERN Safety Instructions are available at the following link: http://cern.ch/safety-rules;
- The electrical power feed shall comply with CERN's 50 Hz - 400 V +/- 10% network; see document *Main Parameters of the LHC 400/230 V Distribution System* (available at the link https://edms.cern.ch/document/113154/2);
- The crane shall comply with *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 with the exception of the emergency brake control (see § 8.3);
- For maintenance reason, the control equipment shall be standard industrial products of Siemens or Schneider; the equipment shall be the latest version in the market at the time of the crane manufacturing;
- The overall circuit diagram for the crane shall be laid out in accordance with, and follow

Annex 1 – mandatory requirements

4.4 Main Contactors

For safety reasons two main contactors shall be installed on the crane. A safety relay (type PREVENTA of Schneider Electric or equivalent) shall stop the machine movement on receipt of a stop instruction (e.g. emergency button) from the operator, or on detection of an anomaly in the safety circuit itself as shown in Figure 7 below:



Annex 1 – mandatory requirements

4.6 Motors and Control System

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- Motors and their control systems shall be capable of operating under intensive use conditions. The motor duty factor shall be 60 %. All motors shall be of insulation class F155 (IEC 60085) minimum and protection degree IP44 (IEC 60529) and be suitable for being driven by frequency converters (e.g. insulated bearings);
- Motor control drives shall have CE marking and be accompanied by EC declaration of conformity; they should be equipped with all the necessary components to reduce the electro-magnetic disturbance;
- Frequency converters shall be equipped with a forced ventilation system and be fitted with a manual override, which permits full speed operation using the normal operation control;
- Motor driven by frequency converters shall be equipped with a forced ventilation system with monitored airflow to allow continuous use at low speed;
- All the equipment necessary to set up and program variable speed motor controls and any programmable logic controllers used shall be part of the supply.

Annex 1 – mandatory requirements

4.11 Cables, Cabling and Sliding Contact Conductors

- CERN requires (see CERN safety instruction IS23) all cables and sliding contact conductor system insulation to have acceptable characteristics in terms of fire propagation, smoke density, corrosivity and toxicity (halogen and sulphur free) of fire gases;
- Flexible cables shall be used for the external fixed connections. Highly flexible cables shall be used for external movable connections (e.g. festoon cables);

4.15 Time Counter

The crane shall be equipped with two working time counters:

- The first counter shall register the total hours of operation of the crane (sum of the three movements but only when it is in motion);
- The second counter shall register the total operation hours of the hoist.

Annex 1 – mandatory requirements

4.17 Safety Zones Controlled by Switches

The crane shall be equipped so that it will be possible to define two rectangular areas, located in any part of the building, where the hook cannot access.

All the needed components shall be supplied and installed so that, when needed, definition and activation of a zone could be done by simply installing the switches' actuators.

It shall be possible to bypass this function through a hold-to-run selector or button on the remote control.

5.3 Oil Leakage and Retention

The crane design shall ensure that no oil or grease can drip from the crane. Retention bins shall be installed under gear boxes and under all places where oil or grease dripping may occur.

Annex 1 – requirements for options

8.15 Load Measurement and Display

A load cell shall be installed on the crane allowing measuring the weight of the load attached to the hook with a precision of +/- 1% of the crane capacity.

A display showing the load value shall be installed on the crane in a position visible to the operator; characters shall be minimum 300 mm high. Fixing of the display shall allow display rotation around its horizontal axis. If there is a PLC installed, the load limiter shall be from the same manufacturer as the PLC.

8.16 Life calculation module

The module shall be capable to provide the information needed to calculate the actual life of the crane. Considering a cycle as the entire sequence of operations starting from the moment the load is hoisted and ending when the load is laid on the floor, the module shall 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.

It shall be possible to export this information through a USB key; data shall be collected in a Microsoft Excel® compatible file.

Annex 1 – requirements for options

8.17 Electronic safety barriers

Safety device that detects the presence of personnel on the crane walkway and stops any crane movement; device shall be multi-beam type with a width of 1m and capable of covering the whole walkway length. Supply shall include the cables and the control equipment.

Transmitter and receiver supports shall allow the possibility to adjust the beam height with respect to the walkway and shall be rigid enough to avoid malfunctioning due to vibrations induced by the crane movement.

Annex 2 - introduction

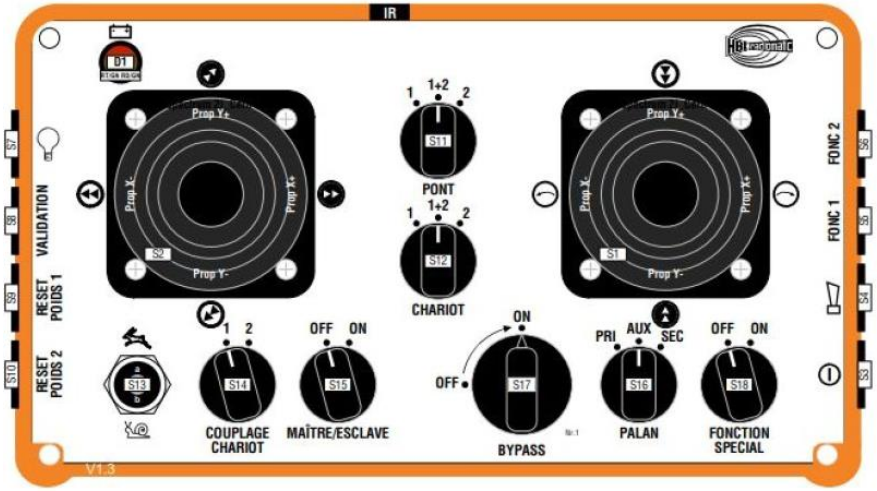
- Objectives:
  - ✓ define a standard user interface for all radio controls at CERN
  - ✓ Reduce the number of different models / configurations to allow quick replacement with CERN universal radio controls
- Two HBC Radiomatic models are considered:
  - ✓ Spectrum 1
  - ✓ Micron 5

Annex 2

Specific requirements:

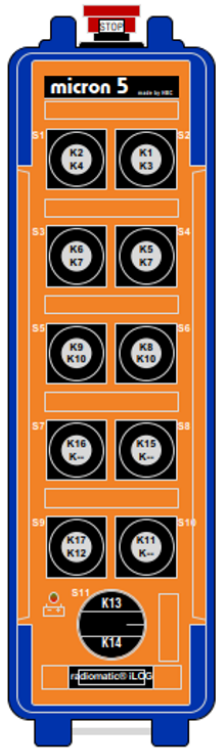
- Infra-red start up with two receivers on the crane
- Emergency stop push-button
- Removable «iLOG»
- Zero-g sensor and inclination switch (Spectrum 1 only)
- Receiver connected to the cubicle with Harting plug
- Storage cubicle with protected battery charger socket included

Annex 2



Spectrum

Micron 5



- CERN is equipped with a Spectrum and a Micron5 universal radio control sets
- Radio control receivers and Harting plugs shall be configured so that, in case of fault, they can be quickly replaced with the universal RC set

Annex 4 - introduction

- Covers the following aspects of PLC programming:
  - ✓ Design requirements
  - ✓ Interface with users
  - ✓ Software protection
  - ✓ Documentation

Annex 4

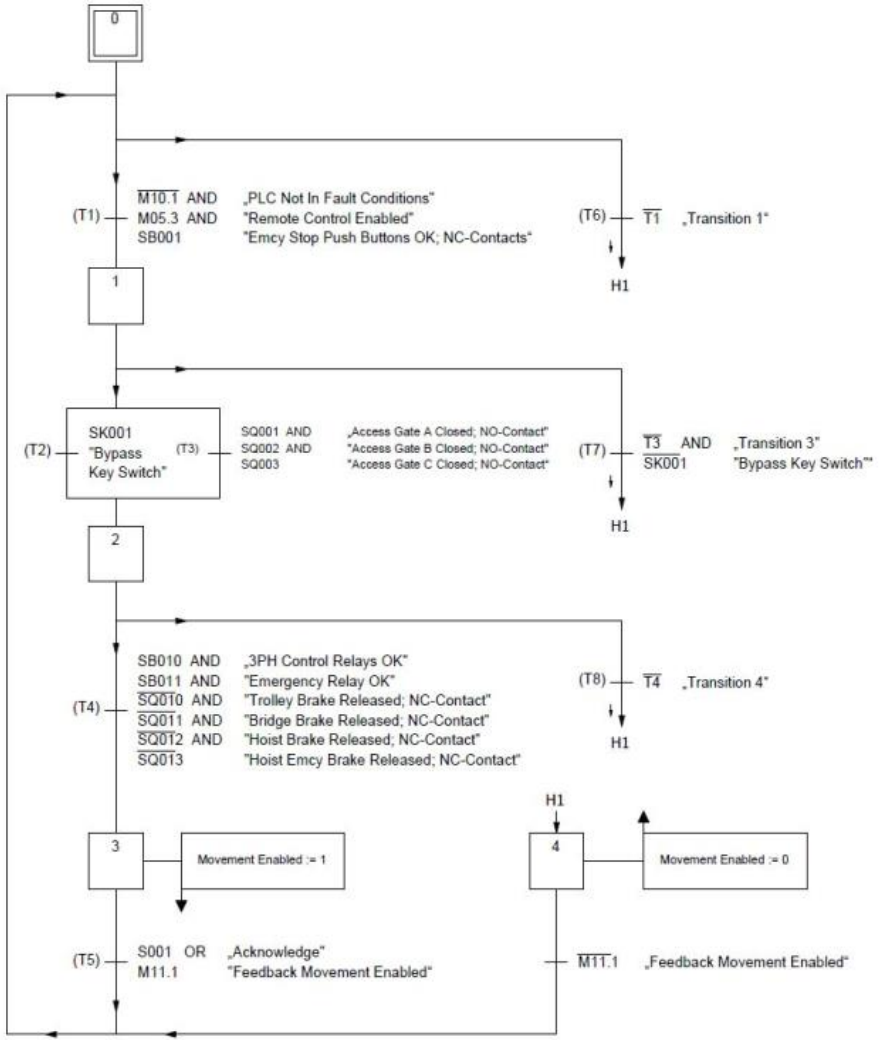
1. PLC PROGRAM FUNCTIONAL DESCRIPTION

Any design phase of a PLC based control system shall start with a graphic functional description of the PLC program.

GRAFCET symbols shall be used in the development of this functional description.

The complete system control logic and equipment behaviour shall be described in detail. A simple partial example of such graphic functional description can be assessed in § 6.

This graphic functional description shall be provided as part of the documentation set for design approval.



Annex 4

d) The programming language for the PLC(s) installed on CERN overhead cranes shall be by default Function Block Diagram (FBD). If the original program is not created on this graphical language the supplier shall deliver a "translated" version of the program on FBD containing all the information that is part of the original program;

e) All unused variables, symbols, functions, function blocks, data blocks, timers, counters etc. shall be deleted from the program;

f) 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 its function. (e.g., why there is a NO-Contact or a NC-Contact);

g) All the comments and variable names, symbols, etc. used in the program shall be in English or French;

3. PLC HARDWARE DESIGN

During the design phase the bidders shall respect the following hardware selection criteria:

- All PLC modules or PLC(s) related components shall be of SIEMENS or SCHNEIDER ELECTRIC latest range of products;
- Components or modules for which the production suspension is announced by the manufacturer until the technical project approval by CERN, shall not be used. If such situation happens during the design phase, the PLC hardware, the program and all related documents shall be updated with no extra-cost for CERN;
- Whenever an HMI is used, it shall be from the same manufacturer as the PLC. Its minimum size should be 9".

Annex 4

5. PLC DOCUMENTATION

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

a) A functional copy of the program with the latest parameters (after completion of the crane commissioning) in digital format. Whenever changes are performed in the equipment, the supplier shall update the related documents.

b) A document with the following content about the PLC/HMI program(s):

- Identification of the crane, project reference, commissioning date;
- Identification of company and the PLC system designer;
- Version of the PLC(s) and/or HMI program(s) installed;
- Details about the software that was used to programming the device
  i. Exact name of used software (including all needed add on or extensions)
  ii. Exact version of the used software (including all needed add on 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.

This document shall be updated whenever a change of the PLC and/or HMI program is made. 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.

Annex 4

c) A document for each hardware device and system interfacing with the PLC (e.g. WIFI devices, 3G/LTE devices) with the following content:
   - Identification of the crane, project reference, commissioning date;
   - Identification of company 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.

d) The final version of the graphic functional description of the program, as requested in §1;

e) A plant/drawing of the crane with the location of all the electrical equipment;

f) A clear list of all PLC inputs and outputs, with comments on the usage of each;

g) A list of the PLC input/output cards identifying all the sensors/actuators wired to those cards.

h) A drawing showing the complete data BUS system with all peripherals;

i) Documentation for all data BUS peripherals containing, 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).