European Organization for Nuclear Research
Organisation européenne pour la recherche nucléaire

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The LWPU Project

IT-4041/TE/LWPU

Invitation to Tender

Technical Specification
Supply of a new control system and ancillary equipment for a Hydraulic Welding Press

Abstract

This technical specification concerns the design, manufacture, installation on the CERN site, programming and commissioning of a new hydraulic control system and ancillary equipment for a hydraulic welding press in use for welding superconductive magnets. This supply shall include an analysis of the existing control and hydraulic system, the required modifications to the hydraulic system in form of a new automated sectoring as well as the training of CERN personnel.

The contract is expected to be awarded in Q3-2015 and deliveries are foreseen over a six months period from placement of the contract.

May 2015

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List of acronyms

LHC	Large Hadron Collider
MSC	Magnets, Superconductors and Cryostats
LMF	Large Magnet Facility
TE	Technology Department
LWP	Large Welding Press
UI	User Interface
MIP	Maintenance and Inspection Plan
PdP	Prevention Plan

1. INTRODUCTION

1.1 Introduction to CERN

CERN, the European Organization for Nuclear Research, is an intergovernmental organisation with 21 Member States[1].

Its seat is in Geneva but its premises are located on both sides of the French-Swiss border (http://cern.ch/fplinks/map.html).

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 11 000 scientific users from research institutes all over the world are using CERN's installations for their experiments.

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) as presented below:

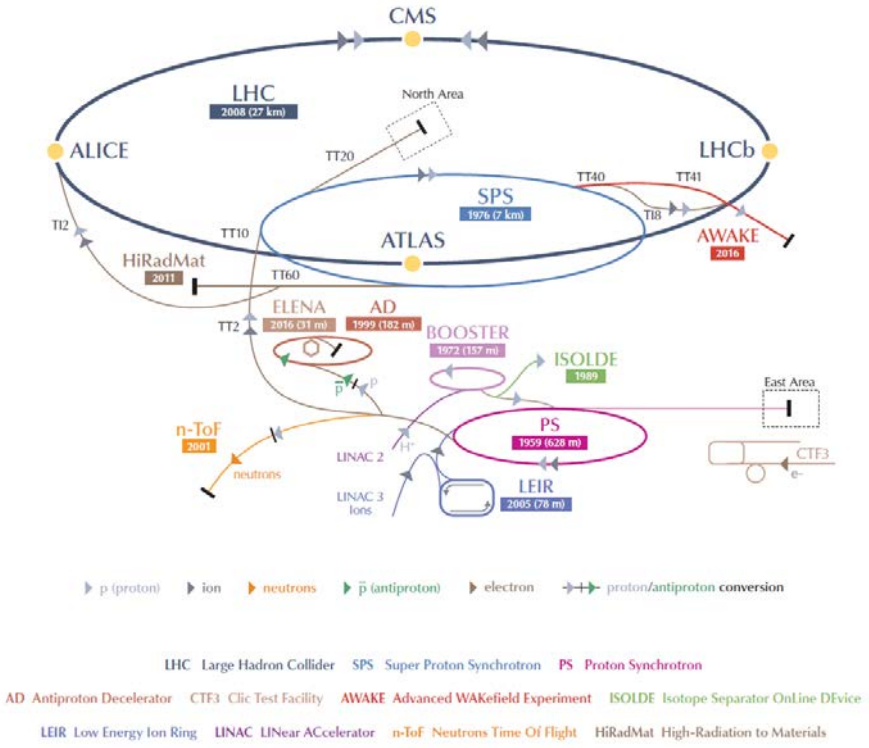

Figure 1: CERN Accelerator Complex

Further information is available on the CERN website: http://cern.ch

[1] The CERN Member States are currently Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Israel, Italy, Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom. In addition: Serbia and Turkey are Associate Member States and Romania is Candidate for Accession.

1.2 Introduction to the Technology Department

The Technology (TE) department is responsible for technologies which are specific to existing particle accelerators, facilities and future projects. The main domains of activities cover: magnets (superconducting, normal conducting, fast pulsed, electrostatic and magnetic septa magnets), their integration in the accelerators, their protection; power converters; cryogenics, high and ultra-high vacuum systems; coatings and surface treatments.

1.3 Introduction to the Magnets, Superconductors and Cryostats group

Within the TE department, the Magnets, Superconductors and Cryostat (MSC) group is amongst other tasks in charge of the design, construction and measurements of superconducting and normal conducting magnets for the CERN accelerator complex. Additionally, it is in charge of the superconducting magnet integration in the CERN accelerator complex, magnet cryostats and magnet quality controls, the support to the operation of the accelerators for magnets, magnet performance, devices (current leads) as well as the development of associated technologies, namely superconductors, insulation and polymers, superconducting electrical devices and magnetic measurements for present and future accelerators.

1.4 Introduction to the Large Magnet Facility section

Within the MSC group, the Large Magnet Facility (LMF) section is responsible, amongst other tasks, for CERN-wide support for engineering, manufacturing and maintenance of superconducting accelerators. Further information is available on the LMF website: http://te-dep.web.cern.ch/te-dep/structure/MSC/LMF/index.html

1.5 Introduction to the Large Welding Press upgrade project

The Large Welding Press (LWP) is the designation of the existing hydraulic welding press. Three presses of this type were used for the construction of about 1,300 15-m long superconducting dipole magnets for the LHC project during the years 1999 - 2008.

The magnets are designed as a twin-aperture structure, using superconducting cables and operate in superfluid helium at a temperature of 1.9 K at fields varying between 0.58 T and 11 T. The magnets consist of two sets of superconducting coils, non-magnetic force-supporting components called collars, an iron yoke split in two halves and assembled around the collared coils and a shrinking cylinder. The latter is composed of two austenitic 316 LN stainless steel half-shells assembled around the yoke and welded together longitudinally within the LWP. This cylinder has the mechanical functions of prestressing the entire assembly to maintain contact between the collared coils and the yoke during cool down from 300 K to 1.9 K and to withstand the high electromagnetic forces which occur during magnet operation. In addition, it serves as a pressure vessel (20 bar) for liquid helium. The above described assembly is hereafter referred to as the *cold mass*.

The LWP is required to impart the required geometry and prestress the cold mass whilst welding together longitudinally the two half-shells and simultaneously on both sides. The scope of the LWP upgrade (LWPU) project is the replacement of the existing and now obsolete control system, which is currently used to control and to allow exchange of information between the automated welding, hydraulic and safety control systems and devices and additional ancillary. With this upgrade, CERN is aiming for a simplified control system by separating the welding and hydraulic control systems. In

addition to this, CERN simplifies the pressing technique by inverting the layout of the pressing cylinders. The cold mass is currently pressed from the bottom against upper top cradles. Inverting the technique shall enable pressing from the top and simplifying the process as the current approach sequence will no longer be required.

2. SCOPE OF THE SUPPLY

The successful bidder (hereinafter referred to as the "contractor") shall design, manufacture, programme, install and commission a new hydraulic sectoring and control system for the existing large hydraulic welding press for welding superconductive magnets (hereinafter referred to, in whole or in part, as the "supply"). This requires a complete analysis of the existing control and hydraulic system. The contractor shall also implement required modifications to the hydraulic system in form of a new automated sectoring to the new press layout supplied by CERN. This supply shall be delivered to, installed, commissioned and tested on the French part of the Swiss CERN site and shall also include the training of CERN personnel.

The supply shall originate from CERN Member States, and under certain conditions, from Associate Member States or Candidates for Accession (as specified in the tender form).

2.1 Deliverables Included in the Supply

The supply shall include a conceptual and a detailed design file as specified in § 3.8 as well as:

2.1.1 Hydraulic system

- A proposal for suitable components (piping, valves, pumps) to modify the sectoring as defined in § 3 as part of the conceptual and detailed design files;
- Manufacture, installation, commissioning and testing of new sectoring components;
- Complete documentation and certificates including user manuals in English, drawings and circuit/wiring diagrams (see §3.8).

2.1.2 Control system

- A proposal for the design of a new control system as defined in § 3 as part of the conceptual and detailed design file;
- Design, manufacture, installation, commissioning and testing of the new hydraulic control system and ancillary equipment;
- Complete documentation of installed equipment including user manuals in English (e.g. operational manual, operating instructions), drawings, updated hydraulic circuit and wiring diagrams and hydraulic control system source files (if applicable). The contractor shall specify the required services (e.g. electrical cabling) on the installation site, which will be made available by CERN.

2.1.3 Hydraulic system and control system

- Preparation of a Maintenance and Inspection Plan (MIP) for the complete upgrade as part of the detailed design file;
- Technical support and maintenance during the warranty period;

- Training of CERN personnel;
- Packing and if applicable, shipping to the CERN site.

2.2 Activities at the Contractor's Premises

The contractor shall perform the following activities at his premises:

- Comprehensive analysis of the current hard and software (hydraulic system and control system);
- Preparation of a proposal for the following:
  - Suitable components to perform sectoring as defined in § 3;
  - Design of the new control system and its User Interface (UI) as defined in § 3.
- Manufacture of the new sectoring components;
- Design and manufacture of the new hydraulic control system and ancillary equipment;
- Preparation of a complete documentation of installed equipment;
- Preparation of a MIP for the complete upgrade;
- Preparation of a schedule for preventive maintenance (cf. § 4.9.1) if applicable;
- Preparation of a list of spare parts (cf. § 4.9.3);
- Packing, and if requested, shipping to the CERN site (see § 4.5).

2.3 Activities on the CERN Site

The contractor shall carry out the following activities on the CERN site in France:

- Dismantling of obsolete hydraulic equipment and control system;
- Installation, commissioning and testing of the following:
  - new sectoring components;
  - new hydraulic control system.
- Training of CERN personnel;
- Technical support during the warranty period;
- Preventive and corrective maintenance.

2.4 Items and Services provided by CERN

CERN will provide the following items and services:

- The contractor shall specify the required services (e.g. electrical cabling) on the installation site, which will be made available by CERN after agreement and under the responsibility of the supplier;
- Hoisting devices, e.g. overhead crane and slings for the installation at CERN under the contractors responsibility;
- Electrical interface connections in the installation hall.

3. TECHNICAL REQUIREMENTS

3.1 General Description

The supply shall include and be compliant with the following parameters and conditions:

3.1.1 Automated Sectoring

The superconducting magnets to be welded at the LWP will have different lengths from 4.7 m to 15 m. The existing hydraulic system allows the modification of the number of connected cylinders down to a length of 4.7 m. However, this modification is based on a manual closure of valves and manifolds, i.e. a manual disconnection of cylinders from the hydraulic circuit (see Fig. 2 and Annex 1).

Moreover, the outer eight rows of cylinders at both ends are operable on a different pressure. In four-cylinder blocks, they are connected to manifolds and enabled to use a second hydraulic pump. By reconnecting these manifolds to other cylinders, this feature can be shifted in case of shorter magnets. A different pressure is crucial in order to not jeopardise the sensitive magnet ends.

The new automated sectoring shall replace this manual procedure. Each of the 48 pressing cylinders shall be controllable on a set pressure. If a cylinder is not needed, it shall be cut off from the hydraulic supply by the hydraulic control system. The pressure shall be predefined by the operator at the control panel but also be modifiable during operation. The contractor shall provide a solution of how to carry out sectoring, taking the following into account:

- The implementation of the sectoring shall use a minimum of three hydraulic pumps, i.e. one for each cylinder row (24 per side) and one for the auxiliary circuit as well as pressing cylinders in combination with shuttle valves and blocking valves. Manifolds, situated closely to the four-cylinder blocks, would reduce the volume of required pipes;
- The contractor shall also provide an analysis as to whether it is advisable or not to use valves along with hand levers, automated solenoid controlled valves or a combination of both.

The contractor shall submit a proposal of how to carry out sectoring, taking the following into account:

- The pressing shall be accomplished by using two different pressures at the pressing cylinders: one pressure for the main sector and one for the auxiliary sector (cf. Figure 2);
- Disconnection of unused pressing cylinders from the hydraulic circuit shall be possible through the UI;
- The operator shall be enabled to connect and disconnect pressing cylinders, block or change valve’s direction from the control panel;
- With regard to the magnet length, the additional sectors shall be added or disconnected via the control panel (cf. Figure 2);
- The auxiliary sector shall comprise the outer two cylinders for every magnet length;
- Side A and Side B of the pressing cylinders shall function independently from each other and be actuated by different hydraulic pumps (cf. Figure 2).
- The intermediate beam speed shall be 5 m/min until contacting the first end-switch, which shall reduce the speed to 2 m/min. The second end-switch shall stop the movement.

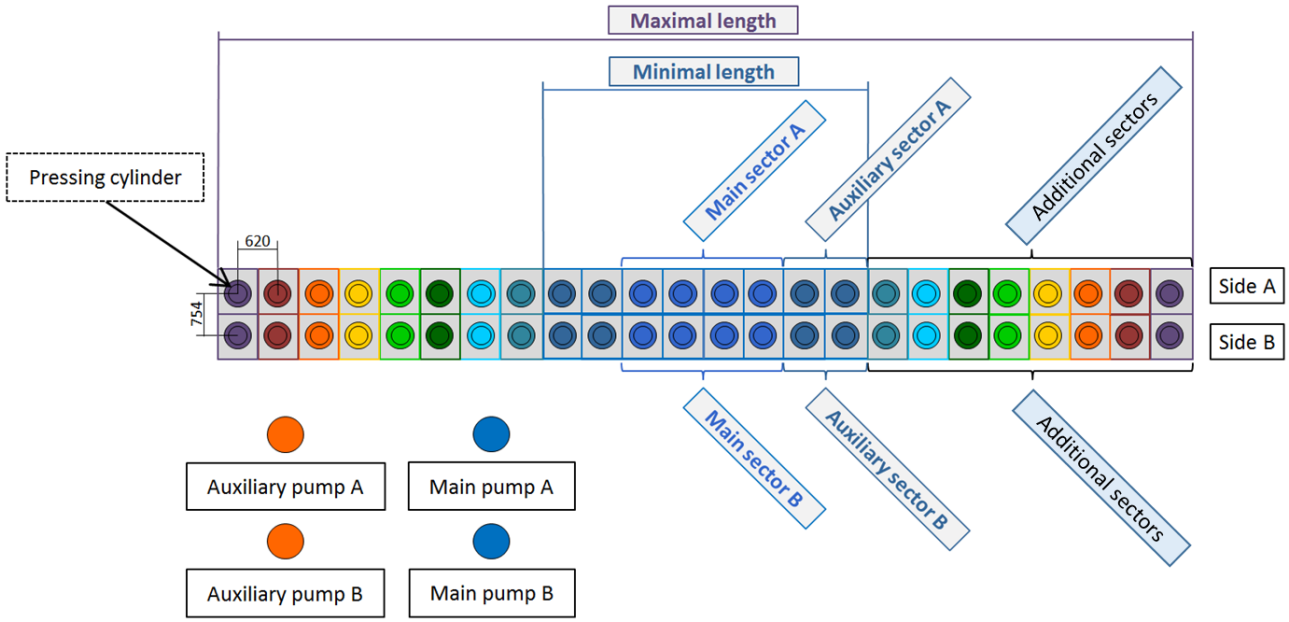

Figure 2: Sectoring

3.1.2 Control System User Interface

The control system shall control the entire hydraulic circuit and hydraulic related operation steps. It shall also control hydraulic related safety devices and functions and be based on Siemens SIMATIC S7 and WinCC® visualization. The UI design shall be submitted to CERN for approval according to prior agreement with CERN. It shall include the following sections:

3.1.2.1 Overview (cf. Figure 3):

- The *Overview* section of the menu shall illustrate the press layout by means of a side- and top-view of the press;
- Active components with feedback shall be shown with respect to their feedback availability in green or red background colour;
- A chart shall show the set and actual pressure of the pressing cylinders. The respective field shall provide a direct link button to the respective *Pressing* screen of the menu. In addition the pressure values shall be stored in a data file at least once per minute;
- A status window (cf. Figure 3 and Figure 4) shall provide a quick overview about the press status. In case of an error, it shall show the respective position on the overview screen of the menu (e.g. defective sensor marked with red background colour) and give a short explanation in the status window (here with red background colour). A mouse-click or touch screen input on this explanation shall directly link to the equivalent section of the menu. If the error cannot be marked on the overview section screen, the window shall only provide a quick link. During operation the status window shall show the current and following operation step (cf. Figure 4). This status window shall also provide an overview on precondition prior launching a pressure cycle. E.g. it shall indicate if all components are well operational. In addition it shall provide the status of end switch positions and safety equipment.

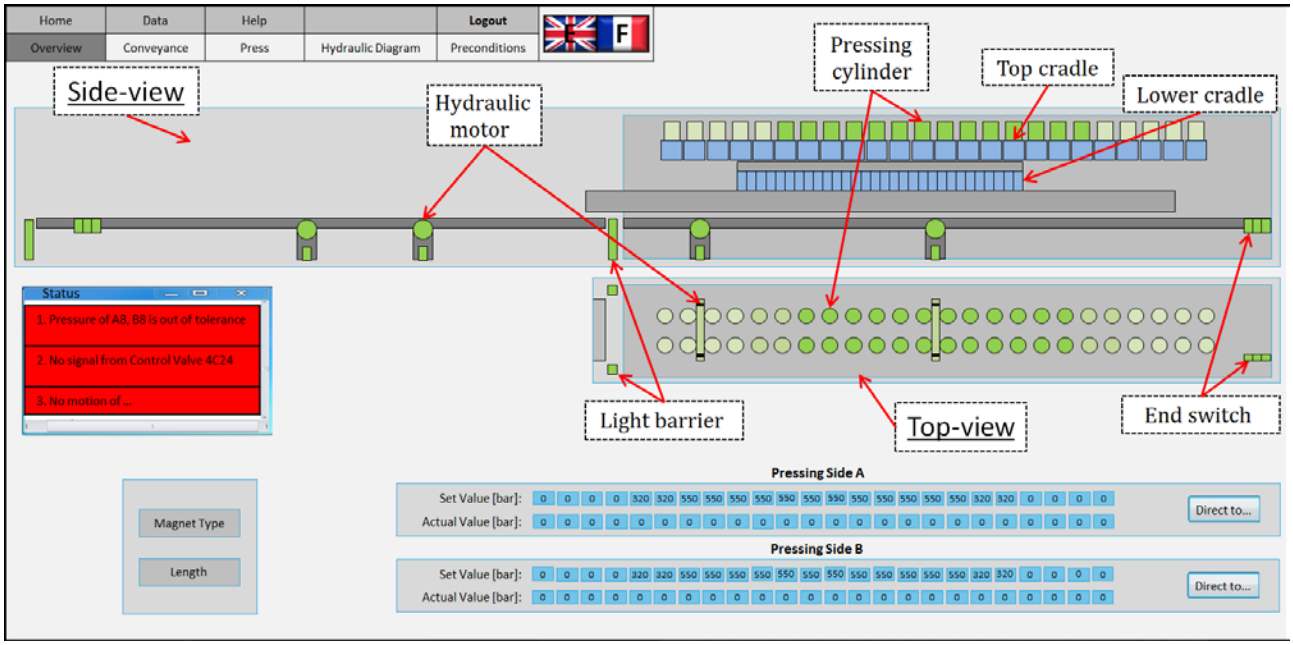

Figure 3: Overview

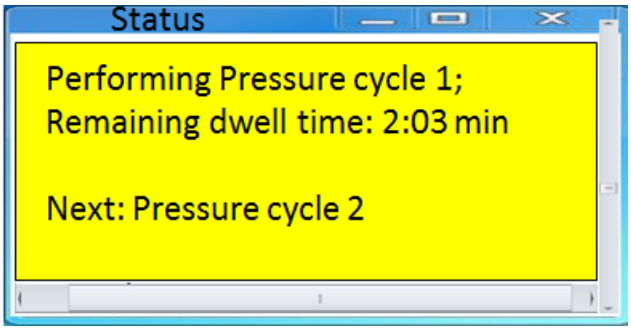

Figure 4: Status window during operation without error

3.1.2.2 Conveyance (cf. Figure 5):

- The *Conveyance* section of the menu shall illustrate the introduction and extraction part;
- This section shall also show a side-view of the press;
- Necessary components to be included are: hydraulic motors, end switches and light barriers;
- The operator shall be enabled to switch between automatic and manual mode, the manual mode allows debugging in case of major errors on the hydraulic system. Therefore the manual mode shall have priority over the automatic mode.

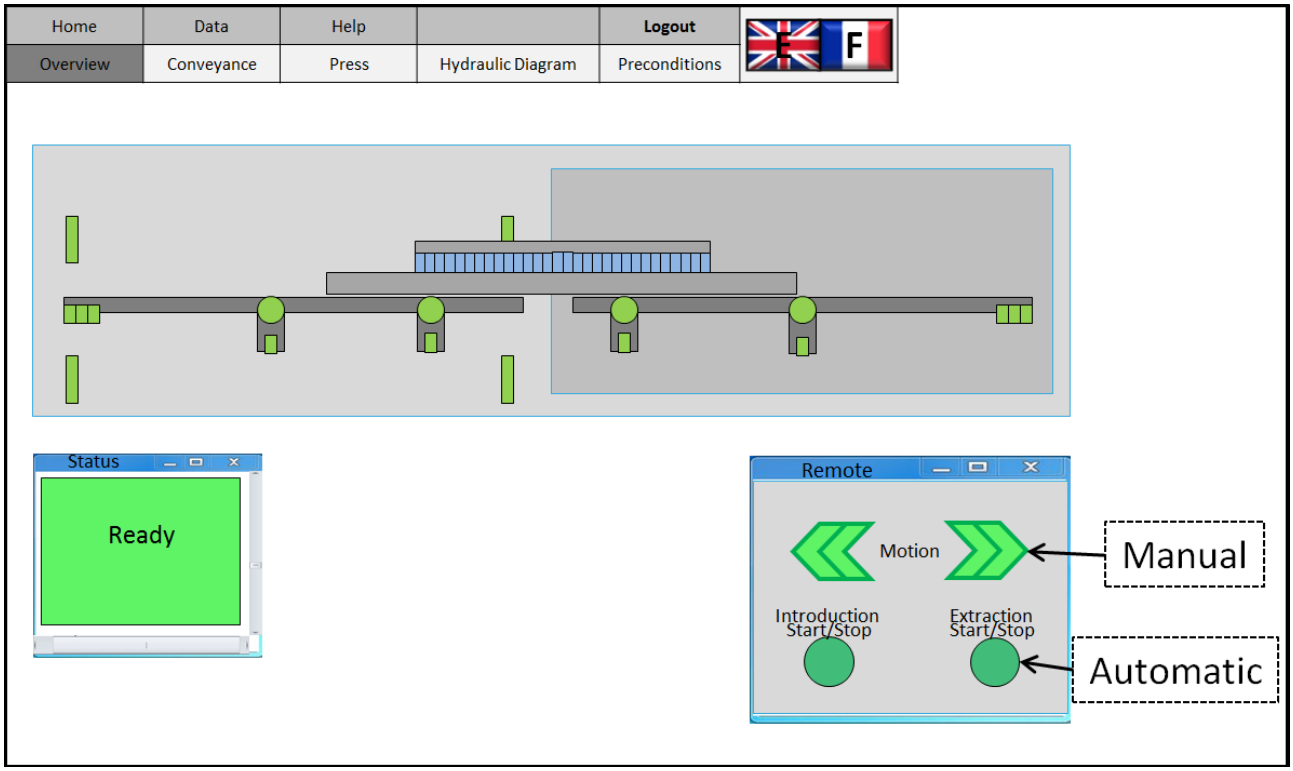

Figure 5: Conveyance graph

3.1.2.3 Press (cf. Figure 6):

- The *Pressing* section of the menu shall illustrate the pressure in the individual zones and allow to access the programming of the automatic pressure cycle;
- A side-view at the top shall highlight the magnet, lower cradles and the intermediate beam along with pressing cylinders and information about their feedback. Green background colour confirms proper functionality. Red announces faults on the level of hydraulic valves resulting in imbalanced pressure between the pressure zones;
- A field shall provide a short note about the magnet's type and length;
- A status window shall provide the information about the press status;
- The system shall allow storing of the pressure cycles used for the different magnet types;
- The system shall memorize the pressure of each cylinder during the automated pressure cycle, the system shall memorize the actual pressure value throughout a cycle at least once per minute.
- A graph shall display the set pressure along with the actual pressure respectively;
- *Current Sequence* provides the user about the current sequence according to the status window;
- *Select sequence* links to the sequence settings;
- The recorded data shall be converted into a transferable and presentable format including the option for graphical representation;
- The recorded data shall be printable;
- A USB interface shall allow the transfer of recorded data;
- A control panel shall enable the operator to control the approach process. This panel shall provide the features: Start, Pause, Un-/Lock, Depressurise.

Start shall initiate the pressing cycle;

Pause shall interrupt the pressure increase;

Un-/Lock shall interlock the pressing status in order to enable or disable the usability of *Conveyance* or the welding operation;

Depressurise shall initiate lowering of the pressing cylinders.

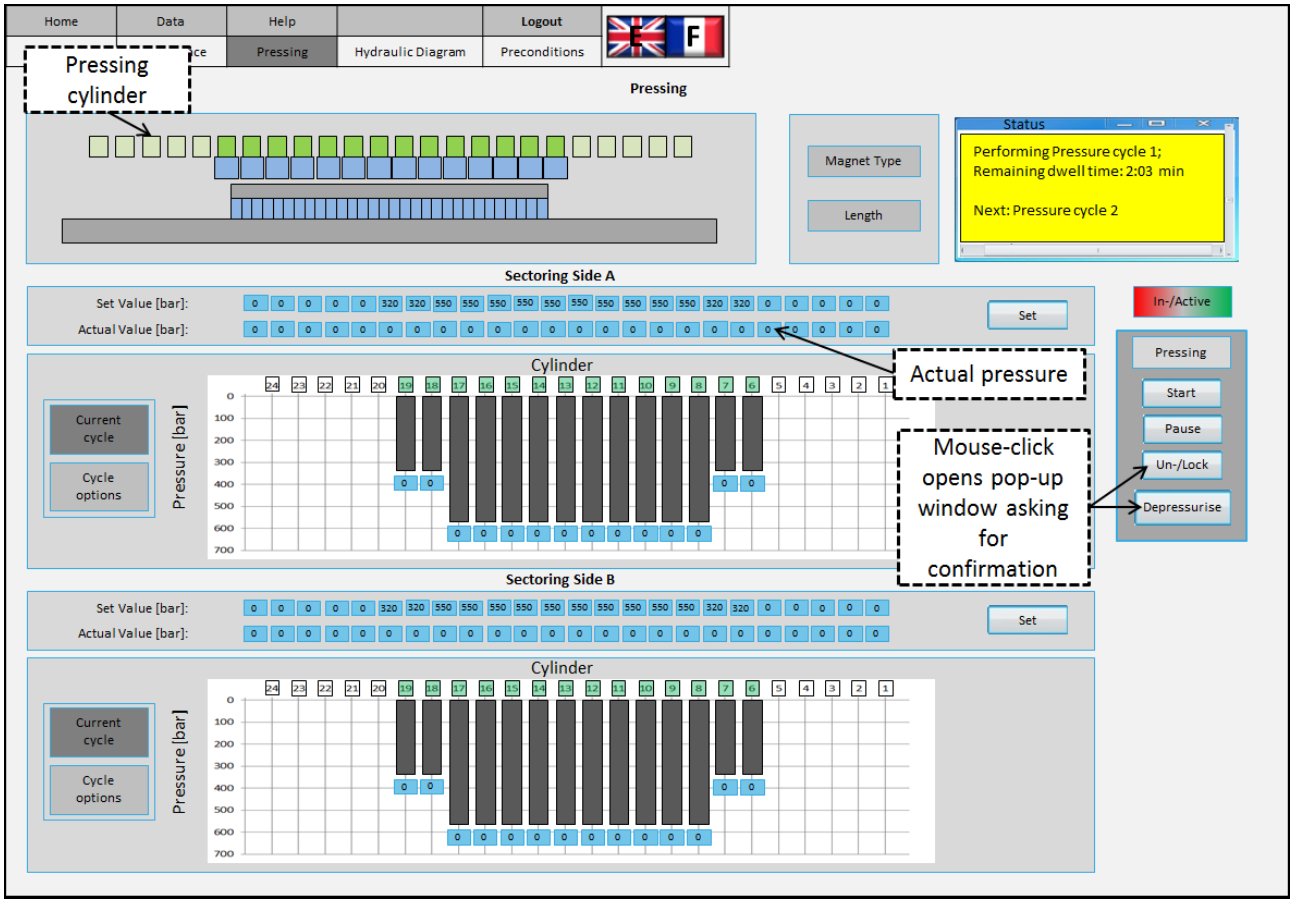

Figure 6: Pressing overview

The pressing overview shall provide the status of pressing cylinders, information about object inside the press and two separate windows: one which indicates operating pressure and other which allows the operator to modify the pressing parameters.

Pressing – Sequences (cf. Figure 7):

- A top-view shall highlight the pressing cylinders and information about their feedback. Green background colour confirms proper functionality. Red announces improper functionality. The colour code scheme shall be proposed by the supplier.
- A field shall provide a short note about the magnet's type and length along with a table listing modifiable information about the number of sequences, dwell time and hydraulic pressure tolerance;
- A chart for sides A and B shall inform about the actual hydraulic pressure for each pressing cylinder;
- Another chart shall show modifiable pressure values for the selected number of sequences;

- A *Save*-button shall save new input and overwrite former input;
- A *Reset*-button shall reset any input to the last saved;
- A *Back*-button shall link to the previous *Pressing* screen.

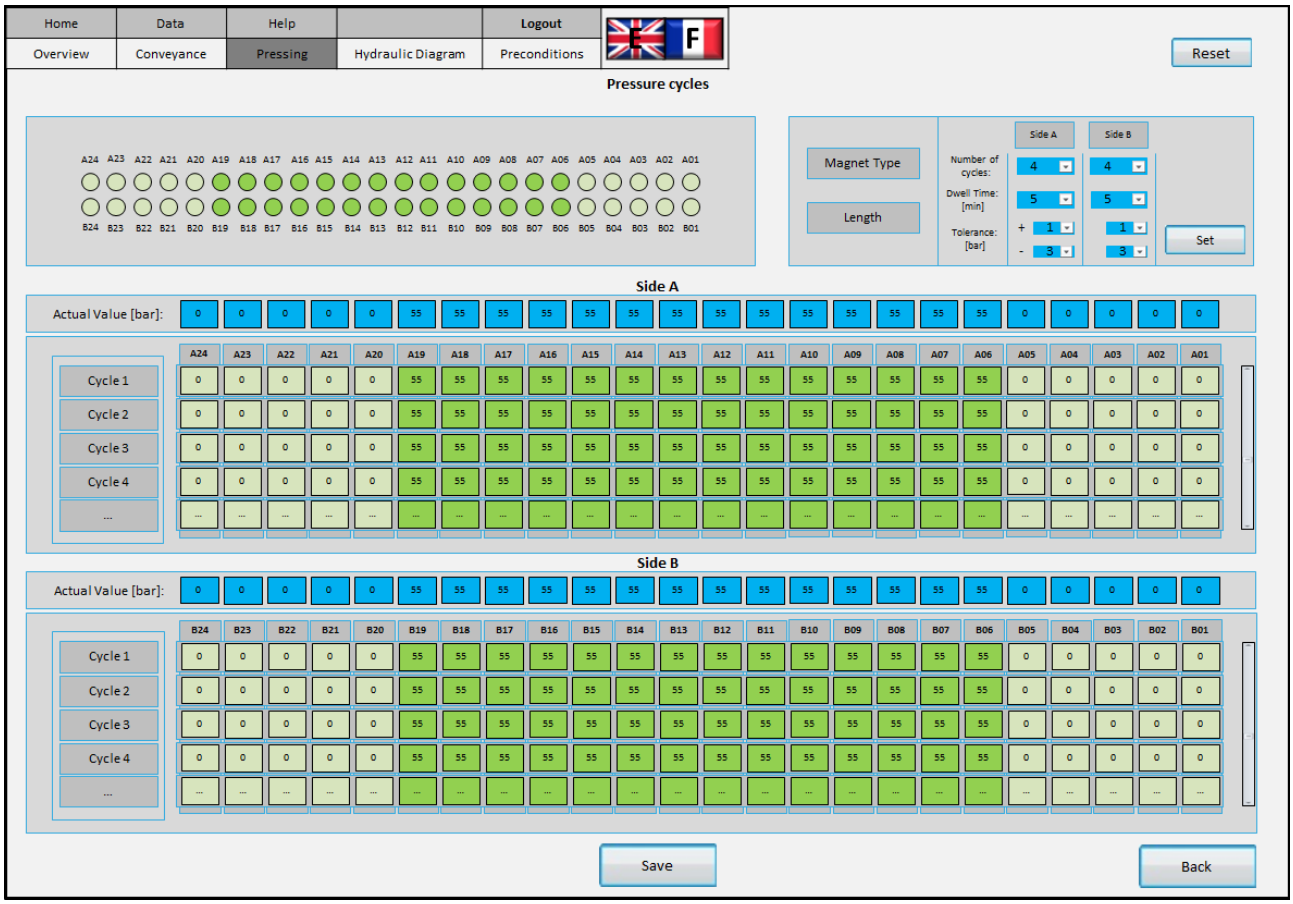

Figure 7: Pressing – Sequences

3.1.2.4 Hydraulic Diagram:

The *Hydraulic Diagram*-screen shall show the entire hydraulic circuit. This diagram shall include all valves and allow the operation of the press in a pure manual mode, e.g. selecting of valves shall allow to manipulate directional valves, operate pumps, changing flow rates in control valves. In addition the manual operation based on a visualized hydraulic diagram shall allow conveyance of magnets, pressurizing and depressurizing during any unforeseen circumstances like hydraulic leaks, blocked valves.

Therefore the operator shall have the possibility to switch between hydraulic diagrams showing specific circuits only, e.g. conveyance circuit or pressing circuit. The *Hydraulic Diagram*-button of the menu shall expand and show all possible views based on both touch screen and mouse clicking i.e. entire hydraulic circuit, conveyance circuit or pressing circuit.

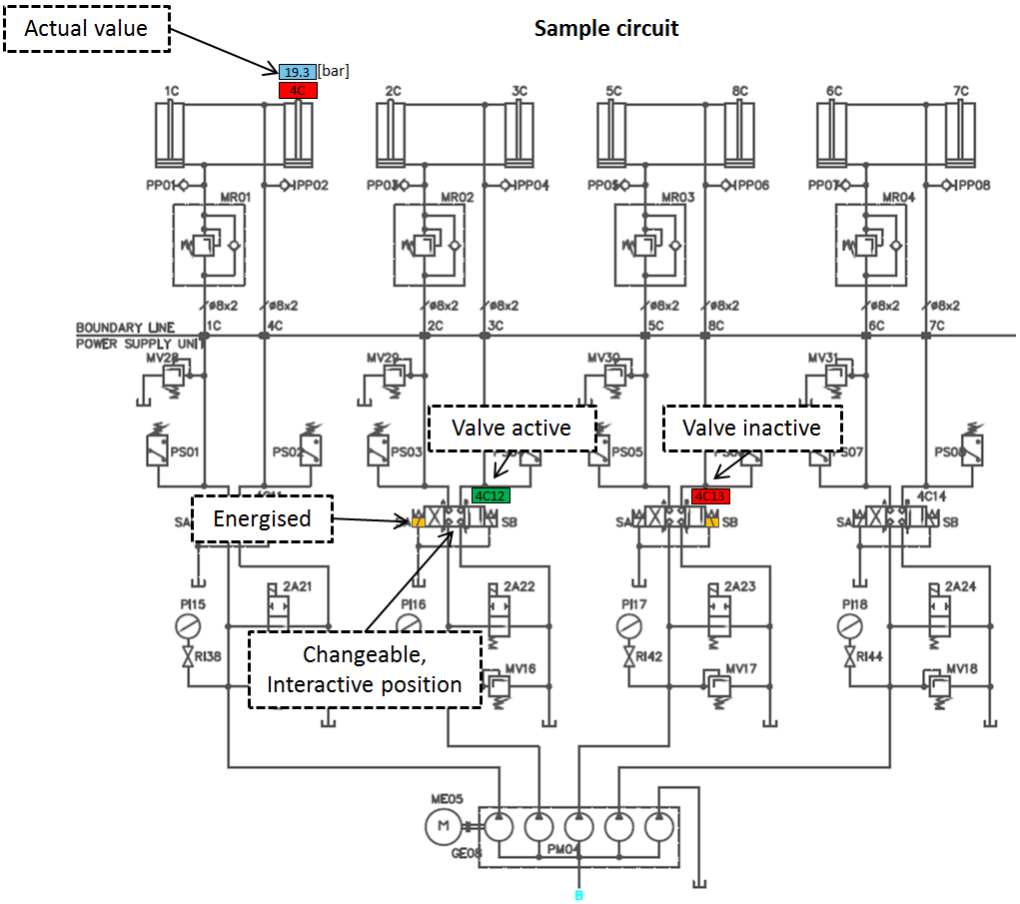

Figure 8: Sample circuit

3.1.2.5 Preconditions screen:

The preconditions screen shall provide a complete overview of preconditions for allowing automated operation. This shall indicate eventual errors on valves, pumps, cooling devices or soft- and hardware related issues. In contrast to the status window which in this respect, lists only outstanding preconditions, this shall cover all preconditions in general, no matter if they are enabled or not.

The UI shall provide an observation mode and an operator mode. The latter shall be accessible after entering an access password. Only the operator is allowed to operate the system; this includes any executable action (e.g. printing protocols). The following Figures 9 and 10 shall illustrate the intention. At least three different passwords are required:

- A system service administrator shall be allowed to have access to the entire software hierarchy and be allowed to program and modify pressure cycles;
- The main operator shall be allowed to open predefined pressure cycles and launch/stop the conveyance and operation cycles. In addition it shall allow the opening of hydraulic diagram for the manual operation;
- The operator access shall allow users to enter the system with a pure visualization or read only mode for process visualization;
- Only one operator can be logged in at a given time;
- After login, the operator may create a new file or open an already existing file. A file will be created for each magnet type in the course of time. After operation, the operator will save the file in order to enable the use of last saved settings at the following operation.

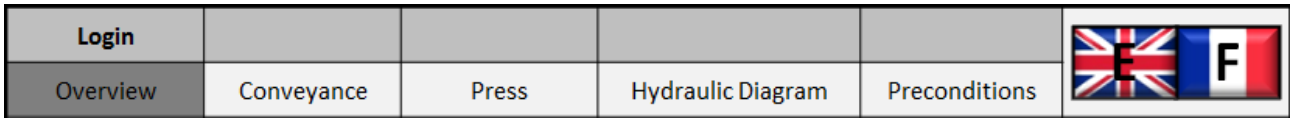

Figure 9: Observing mode

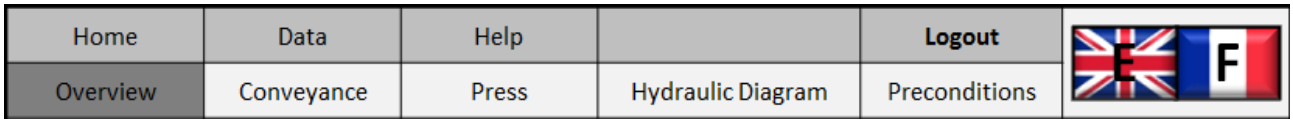

Figure 10: Operator mode

3.2 Applicable Standards, Rules and Regulations

The supply shall comply with all relevant professional, EU and CERN standards and codes including, but not limited to:

- European directive 2006/42/EC on machinery;
- European directive 97/23/EC on pressure equipment;
- CERN Safety Regulation SR-M on mechanical equipment;
- Quality management system ISO 9001:2008.

3.3 Dimensions and Tolerances

The implementation of the control system shall be compatible with the available space indicated in the press layout (see annex 1).

3.4 Manufacturing and Tooling

The contractor shall have available all the necessary tooling and material for the proper execution of the contract. Any materials and tooling required for the execution of the contract on the CERN site shall be in compliance with the European legislations and the CERN Safety rules.

3.5 Safety Design Requirements

The supply shall comply with CERN Safety rules (available at the link: http://cern.ch/safety-rules), that are based on French and European legislation.

The LWP construction is based on 24 mounting frames. During welding operation, the welding operator requires closed access to the welding zone which is only possible by entering the zone between each of the 24 mounting frames. Only limited space is available in between two mounting frames and therefore safety aspects are stringent and have priority over the welding operation. To avoid any kind of collision between welding chariot and welding personal the welding chariot and the teach pendant are equipped with emergency stops.

Figure 11: Emergency trip wires

- Pulling the trip wire shall stop the electrical power (cf. Figure 11) at any moment. Those wires shall keep their function and interrupt the welding operation or conveyance. This safety override function shall be linked to the hydraulic control system. If activated during welding operation, the hydraulic cylinders shall still be pressurised to avoid any damage due to imbalanced pressure on the magnet. In the event of conveyance, the motors shall immediately stop any movement. The operator shall be able to confirm the resumption of operation from the control panel after having cleared the related emergency stop;
- The control panel shall contain one emergency shutdown in order to stop any operation of the welding carriages. It shall also stop any movement of the conveyor. If activated during operation, the hydraulic cylinders shall still be pressurised. The hydraulic pumps, however, shall keep the plateau at the current pressure. The operator shall then confirm the resumption of operation at the control panel;
- Light barriers are installed on both sides of the external conveyor and shall be connected to the hydraulic control system. If interfered during conveyance, the motors shall immediately stop any movement. The operator shall then confirm the continuance of operation at the control panel.

3.6 Operational Conditions

The supply shall operate at a maximal hydraulic pressure of 700 bar. It shall also operate with a hydraulic temperature during operation between 40°C and 60°C. Nominal pressure in all circuits shall be achieved within 15 min resulting in a ramping rate of 50 bar/min. The maximal pressure difference within a hydraulic sector shall not exceed 3%.

3.7 Environmental Conditions

The supply shall be able to operate in an ambient temperature of 10 to 35°C.

3.8 Information and Documentation

3.8.1 Conceptual design file

The conceptual design file shall include:

- List of components to modify the sectoring;

- List of components to modify the sectoring;
- Description of the hydraulic system and required modifications to the existing hydraulic system;
- Layout of hydraulic circuit, including amount of pumps and valves;
- Engineering drawings including the pipe routing, positions and dimensions;
- Description of control system, including procedure for conveyance and hydraulic sectoring.

3.8.2 Detailed design file

The detailed design file shall include:

- P&ID, including routing of pressure sensors, overpressure sensors, oil temperature sensors, electrical cabling, hydraulic connections;
- Preparation of a Manufacturing and Inspection Plan (MIP) for the complete upgrade as part of the detailed design file;
- Maximum electrical power requirement and consumption diagram in function of operating process;
- Industrial control layout including implementation of existing safety equipment (see § 3.5);
- Layout of user interface and detailed description of control system;
- Description of hardware interfaces for safety related equipment (see § 3.5).

3.8.3 Preventive maintenance plan

This file shall include:

- Preventive maintenance plan including a descriptive title for each maintenance task to be performed;
- Frequency assigned for performing of each maintenance task;
- Condition required for performance of the task (i.e. running or shut down);
- Estimated time to perform the task;
- Special tools, materials and equipment required to perform the task.

3.8.4 Technical documentation

At the end of the tests carried out at the contractor's premises (cf. § 4.3.1), a technical file shall be supplied to CERN for approval, upon which CERN will give the agreement for shipment. The technical file shall contain at least:

- EC declaration of conformity;
- Electrical wiring diagram;
- Periodic inspections and maintenance manuals;
- List of spare parts;
- Records of non-conformities and changes relative to the design file;
- Acceptance test results and measurements including graphs of hydraulic pressure as function of time (cf. § 4.3);
- Records of all acceptance tests;
- Material certificates (cf. § 3.5);
- Inspection schedules and instructions;

- Complete documentation of installed equipment including user manuals in English (e.g. operational manual, operating instructions), drawings, updated hydraulic circuit and wiring diagrams and hydraulic control system source files (if applicable).

3.9 Documentation Handling, Quality Control and Quality Assurance

The contractor shall plan, establish, implement and adhere to a documented quality assurance program that fulfils all the requirements described in this technical specification.

In addition to the requirements of § 3, the contractor may propose any internationally recognised design standard, subject to prior written approval by CERN. The contractor shall state his intended method of design including applicable codes as part of his bid. CERN reserves the right to veto the use of certain codes or norms, if it is considered that their application will not ensure compliance with this technical specification.

The contractor shall submit all documents produced in electronic format:

- Drawings in CATIA®, AUTOCAD® and/or HP-GL® format;
- Text documents in Microsoft Word® and/or PDF® format;
- Equipment lists in Microsoft Excel® format;
- Schedule in Microsoft Project® format.

The contractor shall comply with professional and CERN’s standards in matters of document editing, design/drawing process, design reviews and approval, naming conventions and tagging, quality assurance/control.

4. PERFORMANCE OF THE CONTRACT

Unless specifically mentioned otherwise, the contractor shall apply the most restrictive clause in case of ambiguity between the clauses of the contract, including its annexes.

All deliverables and activities that are not explicitly mentioned in the technical specification but are essential for the execution of the contract shall be considered an integral part of the technical specification and therefore subject to clause 3.1 of General Conditions of CERN Contracts.

4.1 Delivery Schedule

Once the contractor is notified of the award of the contract, he shall deliver the supply within six months from the date of notification of the contract.

CERN reserves the right to amend this delivery schedule before the start of the installation works. In such case, CERN will inform the contractor in writing about the definitive date to start the on-site installation two weeks before such date.

The contractor shall supply, within three weeks from the start of the contract, a conceptual design file and the detailed schedule (cf. § 3.8.1). In addition and prior material procurement, the contractor shall submit for CERN's approval a detailed schedule defining the processes and methods which he intends to implement. At CERN's request, he shall provide for information, in writing, a detailed account of the arrangements which he intends to make, and the equipment and installations to be provided (see §3.8). Eight weeks after the signature of the contract the detailed design file shall be delivered to CERN (cf. 3.8.2).

CERN and its representatives shall have free access during normal working hours to the manufacturing or assembly sites, including any subcontractor's premises, during the contract period. The place of manufacture may only be changed after written approval by CERN.

The schedule shall make provision for CERN's official holidays.

The program shall include preliminary dates for inspections and tests.

The milestones are listed in Table 1:

Milestone	Date
Notification of the contract	T0
Supply of the conceptual design file and detailed schedule	T0 + 3 weeks
Supply of the detailed design and the MIP (cf. § 3.8)	T0 + 8 weeks
Final acceptance tests at the contractor's premises (cf. § 4.3.1)	T0 + 20 weeks
Delivery of the supply to CERN	T0 + 22 weeks
Installation of the supply	T0 + 25 weeks
Commissioning of the supply	T0 + 28 weeks
Supply of all documentation	T0 + 29 weeks
Training of operators and final acceptance	T0 + 29 weeks
Final acceptance tests at the CERN site	T0 + 29 weeks

Table 1: Milestones

4.2 Working on the CERN Site

4.2.1 General Requirements

Any contractor working on the CERN site shall take into account and implement the rules and provisions defined in document entitled *Working on the CERN Site*: https://edms.cern.ch/file/1155899/

Moreover, any contractor shall inform, in writing, his employees concerned and his potential sub-contractors about working on the CERN site rules and provisions. He must also take the necessary measures so that his sub-contractors also inform their employees about working on CERN site rules. The activities performed by the contractor shall be performed on the French part of the Swiss CERN site in building 180. However, the contractor shall take note that he has to enter the CERN site in Switzerland.

4.2.2 Safety coordination

The activities performed by the contractor on the CERN site will be classified as a "Category 2" worksite or activity.

CERN will prepare, with the collaboration of the contractor, a Prevention Plan (PdP), summarizing the main general safety issues to be followed before and during the works.

Before the beginning of the work, the contractor (and any subcontractor) shall:

- Collaborate with CERN to establish the PdP, providing a work description with presentation of the activities to be carried out, the workers involved in those activities, an assessment of the risks

inherent in the worksite and the risks generated by activity, the preventive and protection measures to be taken for each risk;

- Take part in all joint inspections;

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

The contractor and any subcontractor shall inform CERN of changes in the potential risks as and when they arise and vice versa.

4.2.3 Particular features of the CERN site

The following aspect of the CERN site should be taken into account the custom formalities since the installations straddles between the Swiss-French border.

4.2.4 Personnel

The contractor shall assign a sufficient number of qualified personnel for the provision of the supply and related services. The personnel assigned by the contractor to the contract 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 of the personnel assigned to the contract whose conduct or whose administrative situation could adversely affect or is adversely affecting the proper performance of the contract or any other activities on the CERN site.

4.2.5 Training

The contractor shall, at his own expense, ensure that his personnel assigned to the contract have suitable training to comply with the requirements of the present technical specification.

The contractor shall systematically evaluate the training of his personnel at the end of each training course and shall provide CERN with evidence that personnel have been successfully trained. CERN may also make its own evaluation by setting up a series of tests and refuse the assignment of a member of the contractor’s personnel who has not been trained successfully. Furthermore, before the start of the contractor’s activities on the CERN site, the contractor shall provide his personnel with the specific training CERN deems necessary. This CERN site specific training will be provided by CERN.

4.3 Tests

4.3.1 Tests Carried Out at the Contractor’s Premises

CERN reserves the right to be present, or to be represented by an organisation of its choice, to witness any acceptance tests carried out at the contractor's or his subcontractors' premises. The contractor shall give at least ten working days’ notice of the proposed date of any such tests.
The control system’s UI and as well as all its functionalities shall be demonstrated and validated by CERN prior to delivery.

4.3.2 Tests Carried Out at CERN

After completion of the installation and commissioning, the contractor shall demonstrate the proper functionality of the supply within a final acceptance test. To perform these tests CERN will provide a full size dummy mass or superconducting magnet. After the training (see §4.2.5) the sequences

indicated in table 2 are mandatory to achieve full acceptance. The tests will be performed with dummy masses and an LHC cold mass assembly in order to fully validate the pressing cycles and hydraulic sectoring in the following sequence:

- The conveyance sequence shall be tested in the fully automated mode to demonstrate that end switches and all safety relevant equipment are functional;
- All automated sectoring circuits shall be tested to show full functionality of all hydraulic hardware;
- Verification of the independence of both cylinder rows A and B (see Fig. 2);
- Test of ramping capability and hydraulic pressure stability. During this tests all operational conditions and requirements indicated in §3.6 shall be confirmed.
- Long duration test at the nominal pressure of 700 bars shall proof leak tightness and show the stability of both hard- and software. The test shall be finalized by an emergency pressure release.

Additional tests or the repetition of sequences which are required for final acceptance can be announced during the acceptance test without further notice.

	Sequence	**Ramp [bar/min]**	**Pressure [bar]**	**Time [min]**
1	Pressure test at nominal pressure	50	700	240
2	Sectoring test (Sectoring 4.7 m)	50	500	60
3	Sectoring test (Sectoring 8 m)	50	500	60
4	Sectoring test (Sectoring 15 m)	50	500	60
5	Ramping test 1	20	200	30
6	Ramping test 2	40	200	30
7	Test of conveyance sequence	-	-	-
8	Test of all safety equipment and end switches	-	-	-
9	Test of emergency pressure release (Sectoring 15 m)	50	700 to 0	-

Table 2: Acceptance test

4.4 Contract Follow-Up and Progress Monitoring

The contractor shall assign a person responsible for the technical execution of the contract and its follow-up, as well as a person responsible for the commercial follow-up, throughout the duration of

the contract. They shall be able to communicate in one of the official languages of CERN (English or French).
The contractor shall send a written progress report to CERN every month until completion of the contract. All communications shall be in English or French. All documents shall be in English.

This report shall include all the necessary information about the actual progress in comparison to scheduled progress.

In accordance with section 7 of the Safety regulation CERN SR – SO "Responsibilities and Organisational Structure in Matter of Safety at CERN" the contractor shall appoint a Safety Correspondent who shall act as his representative at CERN in matters of Safety.

4.5 Packing and Shipping

The contractor is responsible for the packing and, where specified by CERN (see tender form document), for the transport to CERN. In all cases, he shall ensure that the equipment is delivered to CERN without damage and any possible deterioration in performance due to transport conditions.

The contractor shall comply with professional and CERN's regulations in matter of packing and shipping.

4.6 Dismantling, Installation and Commissioning

The activities by the contractor shall be performed on the French part of the Swiss CERN site in Meyrin (see §4.2).

4.7 Training of press operators

After commissioning, the contractor shall provide training and support on the CERN site to a group of up to ten users. A detailed training programme on the press operation, including an overview of the inspection and maintenance procedures, shall be presented. The training shall not be performed later than one week after the final acceptance test.

4.8 Acceptance and Warranty

Acceptance of the supply shall be given by CERN only after the commissioned supply is deemed to be in conformity with the contract including documentation referred to in this technical specification, all tests specified have been successfully completed and all tests or other certificates have been submitted to CERN. In addition a 3rd party visit by a certified technical inspection association will be performed prior final acceptance.

The warranty shall be as defined in the tender form.

4.9 Maintenance and Spare Parts

The contractor shall provide preventive and corrective maintenance during the two year warranty period on the CERN site. In addition, the contractor shall provide any corrective maintenance with an expected intervention time of 48 h from notification by CERN.

The preventive and corrective maintenance shall be provided according to the provisions below.

4.9.1 Preventive Maintenance

The contractor shall supply as part of the detailed design file a complete preventive maintenance plan (if applicable) to be carried out during the warranty period. In addition, the contractor shall propose a complete preventive maintenance plan (if applicable) after the warranty period.

4.9.2 Corrective Maintenance

Corrective maintenance shall be performed with an expected intervention time of maximum 48 h from notification by CERN.

4.9.3 Spare Parts

The contractor shall provide a list of implemented items with indicative prices. He shall state wear parts, consumables and their respective time for delivery.

5. CERN CONTACT PERSONS

Persons to be contacted for technical matters:

Name/Department/Group	Telephone	Email
Mr Friedrich Lackner / TE-MSC	Tel: +41 22 76 79411	Friedrich.Lackner@cern.ch
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Persons to be contacted for commercial matters:

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Mr Floris Bonthond	Tel: +41 22 767 3143	Floris.Bonthond@cern.ch
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6. ANNEXES

- Annex 1: Labeled view of the LWP;
- Annex 2: Hydraulic diagram (up-to-date situation May 2015).