The Large Hadron Collider Project

SUPPLY AND INSTALLATION OF AN AIR CONDITIONING PLANT FOR THE SR1 ASSEMBLY AREA

TECHNICAL SPECIFICATION

Abstract

This Technical Specification concerns the supply and installation of an air conditioning plant for the heating, ventilation, cooling, dehumidification, humidification and smoke extraction, including the ductwork, metal supports, power and control electric cubicles, instrumentation, regulation and commands, necessary for a new assembly area for physics detectors. The location of the plant shall be in building SR1, at point 1 of the LHC, in Meyrin, Switzerland.

The date of delivery shall be July 2002.
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List of Documents

The complete list of the documents annexed to this Invitation to Tender is given in the covering letter. This list comprises the documents set out below, but lists also relevant documents to this Invitation to Tender.

- This Technical Specification
- Annex 1 Technical requirements
- Annex 2 Tender drawings
- Annex 3 Theoretical diagrams with their symbol identification system
- Annex 4 Reference detail drawings
- Annex 5 Provisional schedule
- Annex 6 CERN drawings archiving
- The Description and Quantity Estimate (DQE)
- The Technical Questionnaire (TQ)
- The Tender Form (TF)
- One CD–ROM containing drawings and DQE
- One CD–ROM containing CERN standards
Organisation of the Documents

This Technical Specification covers the qualitative description of the requirements set out in the Invitation to Tender.

All the equipment supplied by the Contractor and the commissioning thereof shall comply with the requirements set out in Annex 1.

Annex 2 shows the principles for the installation of the equipment in the building.

Annex 3 contains theoretical diagrams showing, for each circuit, how the installations operate. The used identification system is also described in.

The supplies that are similar or recurrent in the Invitation to Tender shall comply with the detail drawings in Annex 4.

The Contractor shall undertake to comply with the provisional schedule set out in Annex 5.

Annex 6 describes the procedures to be followed by the Contractor to archive drawings in CERN Drawing Directory (CDD).

The main components of each type of standard air–handling unit (AHU) are given in Section 2 of this specification. The technical parameters specific to each AHU are given in the Description Quantity Estimates (DQE) and in the Technical Questionnaire (TQ).

The Description and Quantity Estimate (DQE) covers the quantitative description of the requirements included in the Invitation to Tender. Bidders are also asked to supply a list of unit prices which will be applied for the calculation of cost overruns and under-spending during the project, in case of amendments to the contract.
## Terms and Definitions

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<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td>AHU</td>
<td>Air Handling Unit</td>
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<td>CDD</td>
<td>CERN Drawing Directory</td>
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<tr>
<td>CIT</td>
<td>&quot;Power Supply Cubicle Intelligent Control&quot;</td>
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<tr>
<td>DQE</td>
<td>Description and Quantities Estimate</td>
</tr>
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<td>EDMS</td>
<td>Engineering Data Management System</td>
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<td>EJP</td>
<td>Reduced power operation mode</td>
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<td>FMECA</td>
<td>Failure Mode Effects and Criticality Analysis</td>
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<td>HPGL</td>
<td>Hewlett Packard Graphics Language</td>
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<td>ISO</td>
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<td>PDF</td>
<td>Portable Document File</td>
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<tr>
<td>PLC</td>
<td>Programmable Logic Controller</td>
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<td>QAP</td>
<td>Quality Assurance Plan</td>
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<tr>
<td>TCP/IP</td>
<td>Transmission Control Protocol / Internet Protocol</td>
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<tr>
<td>TCR</td>
<td>Technical Control Room</td>
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<td>TF</td>
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<td>TQ</td>
<td>Technical Questionnaire</td>
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<tr>
<td>UIAC</td>
<td>Electric power cubicle «Normal Power»</td>
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<tr>
<td>UIAO</td>
<td>Electric control cubicle «Normal Power»</td>
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<tr>
<td>UICN</td>
<td>Firemen control cubicle</td>
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<tr>
<td>VSD</td>
<td>Variable speed drive</td>
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1.GENERAL

1.1INTRODUCTION

1.1.1Introduction to CERN

The European Organisation for Nuclear Research (CERN) is an intergovernmental organisation with 20 Member States*. It has its seat in Geneva but straddles the Swiss–French border. Its objective is to provide for collaboration among European States in the field of high energy particle physics research and to this end it designs, constructs and runs the necessary particle accelerators and the associated experimental areas.

At present more than 5000 physicists from research institutes world–wide use the CERN installations for their experiments.

1.1.2Introduction to the LHC Project

The Large Hadron Collider (LHC) is the next accelerator being constructed on the CERN site. The LHC machine will accelerate and collide 7 TeV proton beams but also heavier ions up to lead. It will be installed in the existing 27 km circumference tunnel, about 100 m underground, presently housing the Large Electron Positron Collider (LEP). The LHC design is based on superconducting twin–aperture magnets which operate in a superfluid helium bath at 1.9 K. This machine is scheduled to come into operation in the year 2005.

1.2SCOPE OF THE INVITATION TO TENDER

1.2.1Introduction to the Project

This Invitation to Tender concerns the supply, assembly, installation, testing and commissioning of an air conditioning plant for the heating, ventilation, cooling, dehumidification, humidification and smoke extraction, including the ducting, the metal structures for supports, the electric power and control cubicles, the electric power and control connections, regulation by programmable logic controllers, and the possibilities for a local monitoring system and a central one from CERN’s Technical Control Room (TCR), necessary for a new assembly area for physics detectors.

The location of the plant shall be in building SR1, at point 1 of the LHC, in Meyrin, Switzerland. The date of delivery shall be December 2001.

The existing heating is by air handling units with hot water coil at 80/60°C. The heating in new units will be by electric coils. The cooling and dehumidification will be by chilled water units at 6/12°C, the humidification by steam injection system. Smoke will be removed via an existing mechanical extraction system (400°C/ 2 hours) in the existing ventilation room. The installations will be regulated by programmable logic controllers (PLCs). The new installation shall be remote controlled from a console operator and both the existing and new ones shall be monitored via the web from a computer in the control room and centrally monitored from CERN’s Technical Control Room (TCR) on CERN’s Meyrin site.

* CERN Member States are: Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, The Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland and the United Kingdom.
1.2.2 Presentation of the Project

The existing SR1 building is a large hall of about 1500m², located in Meyrin, Switzerland at the point 1 of the LHC. The building and its installations were erected in 1985. Building SR1 consists of a cladded metal structure and has two ventilation technical rooms, located on either end of the building and housing the HVAC equipment providing the heating, ventilation and cooling needs of the hall. The refurbishment of the SR1 building will comprise the erection of different areas to assemble electronic equipment for a physics detector. This technical description concerns the definition of air conditioning plant necessary for the future use of the assembly areas, comprising the adaptation of the existing HVAC systems to the new requirements.

1.2.2.1 Existing principle of air conditioning in the hall

In the present configuration, the SR1 hall consisted of one main air volume, treated by two ventilation rooms for the heating, ventilation, cooling and smoke extraction. The two existing ventilation rooms (CERN reference CV1–125 and CV1–126) were working in independent modes. One can secure the second or complete the function in case of a large requirement. Each room was supplying the treated air in a common underground technical gallery. This treated air was transferred from the gallery to the hall via manual dampers located all along the gallery and via openings in the false floor of the hall. The return air was extract from the hall via a return air grille with motorised damper up to each ventilation room. Each ventilation room is composed by a fresh air grille, with pre filters, winding filters, a hot water coil, a chilled water coil, a drop eliminator, a supply fan, and also a second fan for the recirculation and for the extraction. The extraction fan can be used also for smoke extraction via a manual command from a "firemen command cubicle", located outside and close to the main door.

1.2.2.2 New principle of air conditioning in the hall

This Invitation to Tender concerns the modification of one of the two existing ventilation rooms and also the supply and installation of two new air conditioning plants for the needs of new rooms that will be erected in the hall.

Four rooms (a laser room, a test area, an assembly area and a control room), will be erected in double skinned metals panels with insulation, on the existing false floor of the hall. Their roofs will stand four meter high over the ground floor reference level of the hall. An electronic racks area will be arranged in the open air of the hall volume. As an option, a clean room will be erected in the assembly area with mobile partitions.

The existing ventilation room CV1–125 will be used for the pre–treatment of the air of a part of the hall. The air flow rates will be modified using new variable speed drives. The underground technical gallery will be separated in two parts, one part for each existing ventilation room. In the hall, the laser room, the test area and the control room will be post–treated via their own air handling units. These three new units (see drawings in Annex 2) will be installed in the false floor plenum of the building. Parts of the structure shall be modified to that end by CERN. The racks area will be cooled using the existing air handling unit via the false floor. The new assembly area and the clean room will be treated via their own air handling units. These two new units will be placed open air on a concrete slab behind the building.

The heating is at present done via hot water coils at 80/60°C. The heating in new AHUs shall be done with electric units. Cooling and dehumidification shall be done with chilled water coils at 6/12°C and a humidifier (steam injection system) shall provide humidification.

The air will be delivered via double skinned galvanised steel ducts, with textile ducts and air displacement terminals at the ends of the ductwork.

Cold water pipes necessary for the humidifier shall be installed by the Contractor from an existing valve.
Power and control electric cubicles, including cables and cable trays, instrumentation and connection shall be also part of the supply. The existing PLC shall be replaced with a new one.

The new plants CV1–127 and CV1–128 shall be controlled remotely from a local console operator. The local monitoring might be possible in the future from a local computer via the Ethernet protocol. The central monitoring for alarms might be also possible in the future from the Technical Control Room (TCR), located in Meyrin site of CERN, via the Ethernet protocol

1.2.2.3 Options
As options, the Bidder shall quote two additional lots:

Option 1: the Contractor shall refurbish a part of the existing ventilation room (replacement of the two existing electric cubicles by new ones, separating control and command components, replacement of the PLC, replacement of the filters, ?).

Option 2: CERN will erect a clean room in the assembly area. To this end, the Contractor shall provide an additional air handling unit to treat this room.

Option 3: the Contractor shall supply a humidifier to reduce the humidity level to 40% in the test area.

Option 4: the Contractor shall supply an extraction system for gas mixture in the test area.
1.2.3 Scope of services

The Bidders shall include the following services, supplies and assembly work in their tender:

1.2.3.1 Metal structures

- Needed fixings for the proper installation of all the components,
- double door with incorporated manual dampers in the technical gallery for air sealing purpose,
- sealing for all the service passages through walls, roofs and floors,
- hot deep galvanised steel structure to support open air AHU’s.

1.2.3.2 Air handling

- New AHUs (heating, ventilation, air–conditioning),
- over pressurise the technical gallery and the conditioned areas,
- double–skinned ducting with sandwich insulation and securing systems suited to the various cross–sections and lengths,
- one textile duct and one in standby for the washing operations,
- water collection from the systems to the drainage traps,
- transfer and return air grilles, air displacement terminals, manual and motorised dampers,
- pre–filters and the filters in the existing AHU (option),
- humidification system by steam injection (option).

1.2.3.3 Acoustics

- Acoustic grilles, baffles, flexible sleeves, sound traps and acoustic insulation,
- anti–vibration mounts.

1.2.3.4 Electrical power

- Modification of the existing electric power distribution cubicle (option),
- electric power distribution cubicles,
- frequency–type speed selectors,
- thyristor cubicles for the regulation of electrical heaters,
- cables and cable trays from the electric power cubicles to the various components: thyristor boxes, electric coils, fans, valves, including connections and connection tests,
- protection against the freeze of the part of the hydraulic pipes that are installed outside,
- equipotential links and the earthing of all equipment.

1.2.3.5 Electricity for control and regulation

- Control and command cubicles in which the programmable automatic units will be installed,
• programmable logic controllers, air–powered and hydraulic sensors and actuators, connected with the controls and servo–systems of the installations, including connections and connection tests,

• cables and connecting cables from the control and command cubicles to the various components: thyristor boxes, electric coils, fans, sensors and actuators, including connections and connection tests,

• modification of an existing manual fireman’s command cubicles, close to the entrance,

• procedural flow charts, function and misfunction analysis,

• software and programming of the automatic units,

• regulation, control and command of the installations, in compliance with the operating principles which will be supplied by CERN at the beginning of the works.

1.2.3.6 Hydraulic pipes

• Water supply for the humidifier (option),

• Drainage of equipment to floor traps.

1.2.3.7 Monitoring system

• Communication between PLCs,

• local monitoring systems, including console operator,

• preparation of the data in PLC for the future remote monitoring and supervision in the TCR, on Meyrin’s site. The communication between the local monitoring system and the TCR supervision will be made by CERN via the TCP/IP Ethernet services network.

1.2.3.8 Tests and commissioning

• Factory tests of the various AHUs and the control cubicles,

• tuning, adjusting, preliminary testing and testing,

• test records, commissioning, all the tuning and adjustments,

• necessary noise measurement campaigns,

• acceptance tests.

1.2.3.9 Miscellaneous

• Washing the existing AHU and the dampers in the technical gallery,

• regular cleaning, and cleaning upon completion of the work, of the premises and all the components,

• study, design, calculations and design memoranda for the planned installations,

• any necessary adjustment of existing installations to adapt them to the new requirements, including dismantling of the components of the equipment that shall not be used again,

• drilling holes in walls and floors for the passage of cables and cable trays,

• sealing the holes made in the walls and floors for the passage of equipment.

• drawings and schematic diagrams,
• labelling and panel signs of the systems and equipment in compliance with CERN standards,
• fitting of anchoring needed for handling purposes,
• hoisting and handling gear,
• protecting the roofs in the areas during the works,
• removal of rubbish in separate pre–sorted containers,
• providing documents for approval by CERN, before the execution of the works and their updating in compliance with the work performed before provisional acceptance,
• presentation of samples,
• training of CERN’s staff for operation.

The Contractor shall be responsible for carrying out the work and for the commissioning of the various installations. CERN will check the conformity of the supply with respect to the Technical Specification and approve the factory and acceptance tests.
1.2.4 Limit of services with respect to those of other contractors

1.2.4.1 Civil engineering

The civil engineering work needed for the various installations will be performed by CERN (partition walls inside SR1 hall for the new rooms and areas, openings and pockets, concrete slab to support open air AHU’s, as shown on Tender drawings). The connections among the Contractor’s equipment on the roofs and the sealing of all through-holes shall be under the Contractor’s responsibility. The sleeves, ducts and other components for the passage of ventilation equipment through walls, roofs and floors shall be under the Contractor’s responsibility. The civil engineering structures will be delivered in a finished state when the Contractor takes over the premises. He shall protect the above mentioned structures for all the length of his work and shall repair any damage that may occur.

1.2.4.2 Minor metalwork and joinery

The openings in partition walls, floors and roofs for the way passage of equipment will be done by CERN, according to what shown on drawings given in annex 2. All additional openings shall be done by the Contractor. The air transfer grilles and the self–adjusting apertures shall be supplied and fitted by the Contractor. The Contractor shall provide a double door with frame and incorporated manual dampers for the air sealing in the cross section of the technical gallery. The air sealing for the way passage of equipment through walls, floors and roofs shall be provided by the Contractor. The Contractor shall supply the steel structure to support outside AHU’s.

1.2.4.3 Electric power

The interior lighting of the buildings and ventilation rooms will be under CERN’s responsibility. The interior lighting of the AHUs shall be under the Contractor’s responsibility.

The existing UIAC 125 power distribution cubicle shall be adapted to the new requirement by the Contractor. The new UIAC 127 and UIAC 128 power distribution cubicles and the associated power supplies shall be provided by the Contractor. These cubicles will be powered supplied by CERN. The Contractor shall be responsible for the connections from these cubicles to his own equipment (motors, batteries, control cubicles, electric components, etc.) and the associated protections.

1.2.4.4 Electricity for the control and command cubicles

The electric control cubicles including the PLCs shall be supplied, fitted and powered by the Contractor from the electric power cubicles. The Contractor shall be responsible for the relay of signals and commands from all new electric power cubicles to the local monitoring system, as well as for the linking of signals by buses and the linking of commands by cables to PLC. The Contractor shall be responsible for the modification of the manual firemen command cubicle and for the emergency stops of his equipment. The Contractor shall be responsible for transforming from the 400 V or 230 V to the 230 V, 48 V and 24 V.

1.2.4.5 Fire detection

Where areas are fitted with fire detection equipment by CERN, the Contractor shall be responsible for the supply and fitting of the connecting cables relaying fire detection data from a floating contact supplied by CERN to the PLC for controlling the various operating modes of the installations. The Contractor shall also be responsible for the detection of smoke in his AHUs downstream of the electric heaters, which shall cause the ventilation system to be shut down.
1.2.4.6 Hydraulic pipes

The Contractor shall provide the water supply of his humidification systems from an existing cold water valve located in the false floor close to the new ventilation room. He shall also provide the drainage of his systems to existing drainage floor traps.

The supply and installation of the pipes for the distribution of chilled, the piping and the connections will be under the responsibility of other contractors. The chilled water coils shall be supplied and fitted by the Contractor with caps on the drain and bleed cocks, flanges for screwing and counter flanges for welding on stand–by on the connections to the units. All the hydraulic connections shall be outside the enclosure of the air handling units. When submitting the working drawings, the Contractor shall provide the following technical characteristics for each air handling unit:

- chilled water coil (all the connection diameters, pressure losses at the rated flow rate, etc.),
- three–way valves and control valves (make, type, technical characteristics, kV, connections, servo–motor, complete documentation, etc.),
- control parts and sensors (make, type, technical characteristics and documentation, etc.).

The three–way valves (in both cases with their connection and counter flanges) and the control parts (sensors and actuators) shall be supplied by the Contractor with flanges and counter flanges. This equipment will be fitted by other contractors in compliance with the general project schedule. The Contractor shall be responsible for the electrical connection of this equipment. The Contractor shall be responsible for connecting the condensed water pipes from the cooling coils to the drainage system, including pipes, traps, branches, supports, etc. It should be noted that any items of equipment which have been omitted or not provided on time by the Contractor according to the planning, and any equipment whose technical characteristics he has omitted or not provided on time, shall be supplied and fitted by the Contractor at his expense.

1.2.4.7 Local monitoring

The Contractor shall be responsible for all the services needed for the local monitoring systems, including console operator and programmes, supply and fitting of the fieldbuses for the communication with the electrical power supply boards. The physical Ethernet connection needed for the remote monitoring and supervision will be supplied by CERN. Dialogue according to the TCP/IP protocol within CERN’s network will be under CERN’s responsibility. CERN will provide Ethernet TCP/IP sockets in front of each PLC.

1.2.4.8 Overhead travelling cranes

The SR1 building is fitted with an overhead travelling crane (may be used by the Contractor under very specific conditions). The Bidder shall include all cost generated by shipping, lifting discharget and installation of all the equipment.

The Contractor shall therefore take every necessary precaution to ensure that his equipment does not interfere with this crane (rails, consoles, access ladders, etc.). It must not hamper the travel of the cranes. The Contractor shall provide all handing methods for the installation of his equipment.

Technical Specification
1.3 GENERAL CONDITIONS FOR TENDERING AND CONTRACTORS

Please refer to the commercial bidding documents for more complete information. Tender will only be considered from Contractors having been selected as qualified bidders by CERN, as a result of the Market Survey ref. MS–2937/ST/ATLAS. CERN reserves the right to disqualify any bidder whose reply to this Market Survey is found to have been incorrect.

1.3.1 Bidders’ conferences

Before Tender are submitted, CERN will give bidders notice to attend one compulsory one–day joint information meeting at CERN, at which they will be given additional information on technical matters and specific work–related details. In the case of consortia, at least one person from each consortium partner but not more than five persons per consortium must attend the bidders’ conference. Each bidder must be represented by at least one technical manager and one commercial manager.

The following subjects will be covered in the course of this meeting:
• Information from the CERN Purchasing Service,
• relations with the Host States,
• safety criteria,
• specifications specific to this Invitation to Tender,
• visit to the CERN site,
• questions and answers.

Bidders will be invited, wherever possible, to send in their questions by letter or fax in advance so as to reach CERN before the compulsory bidders’ conference. A summary of questions raised and answers given during the conference will be forwarded to all participants without mentioning names.

NB: Tenders submitted by bidders failing to attend this conference will not be taken into consideration.

1.3.2 Options

Some of the work lots may include options. These options shall be quoted separately and shall not form part of the adjudication price.

1.3.3 Subcontracting

Please refer to the Tender Form for specific conditions concerning the subcontracting. CERN reserves the right to accept or reject the sub–contractors selected. In any event, the Contractor shall remain solely responsible to CERN for the proper performance of the work.

1.3.4 Documents to be submitted with the Tender

The Bidder’s Tender shall contain the following documents duly completed in duplicate:
• The Technical Questionnaire (TQ), completed in full,
the originals of the technical descriptions and documentation issued from the manufacturers for all the proposed equipment, clearly showing the results of the selection as per the list of technical documentation requested in the TQ,

- a description of the working methods and protective measures that will be implemented for safety purposes, as well as the equipment and manpower that will be used,

- a detailed schedule for the various phases of the work for each work lot,

- a brief although sufficiently complete and clear description of the hoisting and handling gear the Contractor has at his disposal to perform the installation work specified in the safe manner, as per paragraph 1.9 of this specification,

- the Description and Quantity Estimate (DQE), completed in full,

- the Tender Form, completed in full.

These documents shall be send together in one package bearing the reference number of the Invitation to Tender and the Bidder’s name and address.

The Bidder shall submit with his tender any observations or suggestions he may consider useful concerning the requirements and the estimates given in the DQE or the drawings.

The costs associated with drawing up the tender shall be met entirely by the Bidder. CERN will not contribute in any way to the expenses incurred by bidders in connection with the tendering procedure.

**1.3.5 Presentation of the tender**

The Bidder may be required to make a formal presentation of his tender at CERN at his own expense. He shall be ready to do so within a week of notification.

**1.3.6 Country of origin**

Please refer to the Tender Form for specific conditions concerning the country of origin of the equipment or services to be supplied.

**1.3.7 Inclusive lump–sum price**

The price for the supply as defined in this Invitation to Tender including all the accessory supplies and work, whether or not specifically mentioned, shall be an inclusive lump–sum price.

By submitting his tender, the Bidder confirms that he is fully conversant with all the conditions associated with the performance of the obligations incumbent upon him as a Bidder and incumbent upon him as a contractor, as the case may be, under the Invitation to Tender and that the Tender price is sufficient to meet these obligations.

The Bidder shall be liable for all information he provides in his tender.

CERN provides no express nor implied warranties of any kind with regard to the information contained in the invitation to tender and accepts no liability with regard thereto. In particular, the information given in the Invitation to Tender documents regarding the layout of other contractors’ structures and which may influence or have a bearing on the Contractor’s own structures may under no circumstances be considered exhaustive.

**1.3.8 Evaluation of the tenders**

CERN will evaluate tenders in the light of the requirements set out in the Invitation to Tender documents and will reject tenders which do not fully meet the specified requirements, or are incomplete.
Alternative options from the Bidder who has made the lowest conforming bid may be taken into consideration by CERN. The contract will be awarded on the basis of either the basic tender or the alternative option, at CERN’s discretion. Bidders must therefore be prepared to enter into a contract with CERN on the basis of either their conforming bid or any alternative that they may have proposed.

The evaluation of the tenders and the decision taken with respect to the award of a contract shall be at the sole discretion of CERN, and no appeal by the bidder against the decision shall be considered.

1.4 CONTRACT EXECUTION

1.4.1 Responsibility for the design, the equipment and its performance
The Contractor shall be responsible for the correct performance and working order of all items supplied, irrespective of whether they have been chosen by the Contractor or suggested by CERN. The contractor shall be liable for any information prepared by him or on his behalf, and shall apply professional standards in using any information provided to him under the contract.

Where the contractor seeks any approval or agreement by CERN or any other party, the giving of such approval or agreement shall not release him from his obligations or liabilities under the contract.

1.4.2 Contract follow-up

1.4.2.1 Representative: contract engineer
The Contractor shall within two weeks from the notification of the contract notify CERN in writing of the person appointed to represent him for the daily follow up of the work on the CERN site.

He shall give CERN prior notification in writing of any change of that person.

1.4.2.2 Progress reports
The Contractor shall supply, within one month of notification of the Contract, a written programme detailing the manufacturing and testing schedules. The programme shall include preliminary dates for inspections and tests. A written progress report shall be sent to CERN every month until completion of the Contract.

1.4.2.3 Approval of projects and manufacture
The detailed design shall be submitted to CERN for approval. CERN will give its approval or refusal, in writing, within one month. Component ordering and equipment manufacture shall not start without CERN’s written prior agreement. Production of the series must not start before CERN has given its formal approval of the pre−series in writing.

1.4.2.4 Construction of the AHUs
Series production must be preceded by the construction of a full size prototype. Series production must not commence before CERN has approved the prototype in writing.

1.4.2.5 Deviations from this specification
The Contractor shall not implement any deviations from this Invitation to Tender without CERN’s prior written approval which it can give or withhold at its sole discretion.
CERN reserves the right to modify the conditions set out in this Invitation to Tender including but not limited to the Technical Specification during execution of the Contract. The consequences of such modifications shall be mutually agreed between CERN and the Contractor it being understood that any additional costs shall be calculated on the basis of the unit prices quoted in the DQE.

All amendments to the contract shall be in writing.

1.4.3 Factory access

During the Contract period CERN and its representatives shall have free access during normal working hours to the Contractor’s manufacturing or assembly sites, including any subcontractor’s premises. The place of manufacture, as stated in the TQ, may only be changed after written approval by CERN.

1.4.4 Packaging, transport and handling of the equipment

The Contractor shall be responsible for and shall include in his tender all the transport, off–loading and installation of the supply.

1.4.5 Site organisation

1.4.5.1 Site installation

Depending on availability thereof, CERN may allocate to the Contractor some working space on the CERN site. Notwithstanding this possibility the Bidder shall make provisions for the installation of a work site outside CERN’s premises.

Before installing his own facilities on the site which may be allocated to him by CERN hereunder, the Contractor shall submit to CERN, for approval, drawings of his site installations, and also drawings showing any modifications which may be made as the work progresses.

Any space which may be required by the Contractor’s subcontractors shall be made available by the latter from the space allocated to him by CERN.

The Contractor shall in particular ensure that he complies with CERN’s instructions relating to lining–up, materials depots, time limits for the use of roadways, lighting, special conditions relating to scaffolding, fencing, etc.

No site huts will be provided by CERN.

1.4.5.2 Cleanliness of the site

The Contractor shall ensure that his installations and work site are kept clean; in particular, he shall make sure that all materials used for installation work are stored in a suitable manner. As the work progresses, the Contractor shall remove, at his own expense, all waste and unused materials.

1.4.5.3 Supply of electricity and fluids

The Contractor shall make provision for the supply of electricity and fluids to his work sites. He shall be responsible for any connections made either for his or for his sub–contractors’ use. Where the constructions are close to CERN’s supply points, he may negotiate for the connections of his installations to them, provided that these installations are compatible with those of CERN.

1.4.5.4 Contractor’s liable for equipment, installations and constructions

Whether they’re on the CERN site or not, the Contractor shall be responsible and liable for any supplies and any equipment or materials owned by him in accordance with the Contract. He shall take all necessary action to protect them against damage or loss.
1.4.5 Site safety and inspection

The Contractor shall at all times comply with all regulations and in particular safety regulations applicable on the CERN site.

In case the Contractor fails to comply with such regulations and that such non compliance presents a risk for third parties CERN reserves the right to take conservatory measures at the Contractor’s expense it being understood that such measures shall not release the Contractor from his liability hereunder.

Where the Contractor uses on the CERN site plant and equipment, such as scaffolding, cranes, transporters, etc., shall provide CERN with evidence that such equipment has been inspected and tested in accordance with the regulations applicable on the work site.

Before any electrical machinery is commissioned, the Contractor shall inform the CERN representative, who will carry out a verification prior connection to the power supply. A second inspection shall be done by the Office of Controls and Inspections appointed by CERN for electrical installations. CERN reserves the right to have temporary electrical connections modified to ensure that they comply with the applicable standards. The cost of such modifications shall be borne by the Contractor.

1.4.6 Working sequence

For /In case of approval process of Contractor’s documents, deviations of the specification, action to perform following meetings, schedule modifications, etc, CERN shall issue a work order.

The work orders shall state:

- the completion period and the date of commencement of the work (if this date is not specifically given, it shall be deemed to be the day after the issue of the work order) and the completion period.

- the definition of the work or construction to be done (descriptions any working drawings or sketches).

The Contractor shall not carry out any work which is not covered by a work order.

In case Contractor considers that the instructions in a work order go beyond his obligations under the Contract he shall state his case in writing within eight calendar days dating from the day after the notification of the work order. This claim shall in no way suspend the execution of the work order, unless otherwise decided by CERN.

1.4.7 Work surveillance

During the Contract, the Contractor shall provide access to the work site to all CERN representatives appointed to supervise the work. He shall appoint a representative on the worksite who supervises the personnel, equipment and the execution of the work. This representative shall be in a position to provide CERN with all the information it needs to monitor the work. He shall speak English or French.

1.4.8 Manpower and tooling

Contractor’s personnel: Prior to the start of the work the Contractor shall provide a list of all his personnel working on the CERN site and their qualifications which he shall update as necessary.

He shall be responsible for any specific training required for the work at CERN and shall submit the corresponding certificates if so required by CERN.
He shall be solely responsible and liable for obtaining, from the competent national or local authorities, all authorisations required to enable him to fulfil his obligations under the Contract. (ex. Working permits).

**Working period**: The Contractor’s personnel shall work between 6 o’clock and 20 o’clock during week days. It shall not work on week-ends, except if it is expressly requested by CERN.

**Replacement of personnel**: CERN reserves the right to request at any time the immediate replacement of any of the Contractor’s personnel whose actions or administrative situation are likely to be prejudicial to CERN or any third party working on the CERN site.

**Special tooling and equipment**: the Contractor shall equip his personnel with all the necessary individual tooling and any special equipment such as: scaffolding, ladders and special hoisting gear as the fulfilment by such personnel of his obligations under the Contract. may require. All such tooling or equipment shall comply with applicable laws.

1.4.9 Assembly

The assembly work shall be done in accordance with the suppliers’ instructions and with good trade practice.

1.4.10 Air distribution via ducting

The principles governing the ducting runs are given on the tender drawings as a guide. The Bidder shall include in his tender a working design study for each ducting network after taking measurements on the site and shall adjust his networks to the as-built civil engineering structures. He shall also take account of any new information which CERN may give him during the work as a result of the technical co-ordination with the other tradesmen involved and shall adjust his drawings accordingly. Furthermore, on the tender drawings, the ducting shall be shown with constant cross-section ducts. In certain cases, the Contractor may reduce the cross-section of his ducts as the air-flow in these is reduced after take-offs.

1.4.11 Waste disposal

CERN will install a series of rubbish containers on the work site, the number of which shall vary according to the different types of waste to be removed. The Contractor shall carefully sort and place all the waste arising from the dismantling of existing installations or new construction work in the appropriate containers. In case he does not comply with his obligations hereunder CERN may sort and/or remove the waste on the Contractor’s behalf and charge him with the related costs.

1.4.12 Cleaning

The Contractor shall be responsible for cleaning his work site on a daily basis. Prior to acceptance, all the structures and all the equipment (AHUs, ducting, cubicles, etc.) shall be carefully cleaned ready for use.

Furthermore, the Contractor may not store any material, such as combustible packaging, inside CERN buildings.

1.4.13 Training of CERN’s operating staff

The Contractor shall train the CERN staff to correctly operate the installations and structures to be supplied hereunder. Training shall take place at CERN. The cost of training shall be included in the Tender.
1.4.14 Internet

With a view to optimising the exchange of information, the Contractor shall have Internet access. He shall in particular use Internet for:

- Exchanging e-mails and files,
- archiving documents on CERN’s Intranet system,
- consulting CERN’s databases to monitor progress with the work.
1.5 APPLICABLE DOCUMENTS

The term ‘applicable laws’ shall mean all rules and regulations laid down by CERN and all laws, treaties, rules, regulations or orders of any local, national and other authority having jurisdiction over the contractor or the performance of his obligations under the contract.

The contractor shall comply with applicable laws, and shall hold CERN free and harmless from and indemnify CERN for any loss or damage, including legal costs, resulting from their infringement by the contractor. The contractor shall forthwith notify CERN in writing of any discrepancy between applicable laws and his obligations under the contract.

In particular the Contractor shall comply with the documents or standards listed below.

The supplies and assembly work shall comply with international (ISO) or European (EN and Eurovent) standards or, where these do not exist, the most recent standards in force in the country where the installation is to be located.

1.5.1 CERN regulations

The following CERN regulations, which are also applicable to the performance of the contract, are included in the CD–ROM "Safety and Quality Assurance Documents" joined to the Invitation to Tender.

- The safety regulations applicable , ref. CERN/TIS/GS/98–10, dated May 1998,
- Safety code A3 Rev., 1992, relating to safety colours and safety signs,
- Safety code A8, 1993, relating to noise protection,
- Electrical Safety Code C1, 1990 edition,
- Safety Code D1 Rev., 1997 edition, relating to hoisting gear,
- Safety code D2 (Rev.2, 1999) relating to pressure equipment,
- Safety code E (Rev., 1995) relating to the fire protection,
- Safety instruction IS5 relating to emergency stops,
- Safety instruction IS23 Rev. 2 relating to criteria and standard test methods for the selection of electric cables and equipment from the point of view of fire safety and radiation resistance (1993),
- Safety instruction IS24 covering regulations applicable to electrical installations (1993),
- Safety instruction IS37 Rev. 2 covering regulations applicable to alarms and alarm systems (1998),
- Safety instruction IS41, 1995, relating to the use of plastics and other non–metallic materials at CERN from the point of view of fire safety and radiation resistance,
- Recommendations for on–site installation of welded pressurised pipelines, ref. TIS/TE/MI/CM00–14, 2000,
- PGCO: Specification concerning the construction of low–voltage sub–distribution boxes and units (ST/IE, December 1994),
- PG: General requirements (ST/IE, December 1994),
- PGN: CERN standards (ST/IE, December 1994),
Further information on the safety regulations applicable at CERN may be obtained from the TIS–GS, TIS–TE and ST–CV groups.

1.5.2 International regulations

- PD 6611 concerning symbols and terminology of ventilation for buildings,
- EN 779 concerning air filters,
- EN 1505 concerning air ducts with rectangular cross section,
- EN 1506 concerning air ducts with circular cross section,
- EN 1886 concerning air handling units,
- EN 61131–2 for information on the CIT system modules of the cubicles supplied by CERN,
- EN 1131–3 concerning programming representation,
- EN 50136 concerning alarm systems and alarm transmission systems and equipment,
- ISO 100005 concerning the guidelines for quality plan,
- ISO 3258 concerning air distribution vocabulary,
- ISO 9660 CD concerning the writing of information on CD ROM,
- ISO 10628 concerning flow diagram for process plants – general rules,
- ISO 11546 concerning sound insulation,
- IEE 802.3 concerning Ethernet,
- DIN 1946 concerning air dampers,

The electrical components shall also comply with the following documents:

- IEC 17–13 concerning control characteristics,
- IEC 127 concerning cartridges for miniature fuses,
- IEC 157 concerning low–voltage switchgear and control gear, circuit–breakers,
- IEC 158 concerning low–voltage control gear, contactors: AC3,
- IEC 185 concerning current transformers,
- IEC 186 concerning voltage transformers,
- IEC 255 concerning electric relays,
- IEC 297 concerning dimensions of switchboards and racks,
- IEC 439 concerning factory–built low–voltage switchgear and control gear assemblies,
- IEC 529 concerning classification of degrees of protection provided by enclosures,
- IEC 536 concerning classification of electric and electronic equipment,
- IEC 685 concerning connecting devices,
- IEC 715 concerning dimensions of low voltage switchgear and control gear, mounting on rails for mechanical support,
• IEC 742 concerning circuit separation transformers and safety transformers,
• IEC 947–4–1 concerning contact switches and motor starters,
• IEC 61508 concerning functional safety of electrical/electronic/programmable electronic safety related systems.

1.5.3 French National regulations
For the sake of rationalisation CERN wishes the following French National Regulations to be used for Swiss and French both sites.
• Standard NF C 15–100: standard used by the Office of Controls and Inspections prior to acceptance,
• Standard NF S 31–010 concerning the characterisation and measurement of noise,
• Decree of 23 January 1997 concerning neighbourhood noise,
• Articles R48.4 and R48.5 of the public health code,
• Standard NF X 60–200 concerning technical documentation,
• Standard NF X 60–300 concerning maintenance,
• Standard NF E 85–010 of October 1988 concerning fixed metal ladders with or without caged ladder,
• Standard NF E 85–031 of September 1989 concerning metal stairs,
• Standard NF E 85–101 of October 1988 concerning metallic rails,
• Standard FD X 07–021 concerning measurements and application of statistics,
• Decree of February 15th 1995 concerning mechanical smoke extraction installations.

1.5.4 Other documents
• The assembly and maintenance instructions provided by the manufacturers.
1.6 DOCUMENTS TO BE PROVIDED

1.6.1 Before starting work

After the contract has been awarded, CERN will send the Contractor a complete list of the documents to be provided and the associated deadlines. In particular, the Contractor shall send CERN, for approval, two paper copies and one electronic copy of the documents listed below for each structure (list not exhaustive):

1.6.1.1 Method

- A flow–chart of the staff seconded to execute the contract covered by this Invitation to Tender,
- the procurement program for the raw materials and sub–contracted equipment,
- a detailed schedule of the submission of documents, manufacturing, factory tests, deliveries, assembly, tests, commissioning and acceptance, according to annex 5,
- the request for approval of sub–contractors, where applicable,
- the methods for installing and assembling the components of the installations,
- the Contractor’s part of the Risk Prevention Plan.

1.6.1.2 Drawings, diagrams, design memoranda

- The working drawings, manufacturing drawings, general and detail drawings of the planned installations,
- the complete technical documentation of the proposed equipment,
- the weight and dimensions of each assembly, sub–assembly and the components of all the supplies,
- a copy of the approval certificates, the fire resistance certificates of the materials and equipment to which such formalities apply,
- the design memoranda drawn up by the Contractor. It should be noted that the power, flow rates and the diameters of pipework and ducting shown on the drawings are provided only as a guide and that the Contractor is required to supply all the design memoranda needed for installation,
- the presentation of the samples and materials certificates to be approved by CERN,
- the electric power, water and various fluid requirements,
- the technical drawings of the acoustic equipment, accompanied by the design memoranda showing the maximum guaranteed noise reduction levels; details of the precautions taken to prevent noise from being transmitted around baffles shall also be given,
- the theoretical air–handling, hydraulic, electrical, control and regulation, management and monitoring drawings,
- the control and regulation flow–charts,
- the electrical wiring and regulation diagrams,
• the function and misfunction analyses,

The Contractor shall supply the working drawings in the form of AutoCAD 14 or EUCLID files so that CERN may check that there is no interference with the work of the other trades involved.

1.6.2 Approval of documents

Unless specified otherwise, the Contractor shall submit to CERN two paper copies and one electronic copy of all documents required in accordance with the contract. CERN will be responsible for co–ordinating the documents provided by the Contractor from the point of view of interference with the other trades. CERN will inform the Contractor within five weeks whether there’re any amendments needed.

The Contractor shall not start manufacturing and installation on site before approval by CERN of the documents concerned. The Contractor shall use only documents with stamped “approved” and signed by the CERN engineer in charge.

1.6.3 Prior to acceptance

For each structure, the Contractor shall send CERN, three weeks prior to acceptance, three paper copies and two electronic copies of the following amended as–built documents:

• The updated versions of the above–mentioned documents,
• the results of the tests, performance tests, checks (unit pressure, AHUs, etc.),
• the materials certificates of the various equipment,
• the commissioning report, including all the regulation parameters,
• the list of equipment, including the reference numbers of the spare parts and suppliers’ addresses,
• the operating, maintenance, emergency repair and preventive and systematic maintenance instructions,
• the Contractor shall enter the technical parameters of the installations’ components on Excel–type templates supplied by CERN for CERN’s Computer Aided Maintenance Management (Camm) software in accordance with the coding system of CERN’s quality assurance plan,
• all the software and programmes, source and object files, fully documented and detailed (comments in the programs, with documentation and licences, in accordance with the state of programming when in service),
• for each item of software and program installed, a glossary, with comments, of all the variables,
• for each control cubicle, all the documents showing how the automatic unit and the input/output modules are organised, reference to the various functional sub–units, the type of signals used, the various power supplies and associated protective devices.

For each cubicle, a folder containing the documents relating to all the cubicle’s components, the diagrams and the cabling guide, shall be placed in a special watertight box. This box may be fixed on the inside of one of the cubicle doors.

A laminated diagram in the conventional colour code stuck on a rigid board shall be fixed on each control cubicle, pinpointing all the components to facilitate understanding of the installation’s operating handbook.
1.6.4 On completion of the work (withdrawal of reservations)

The contractor shall submit five paper copies and two electronic copies of the following final documents:

- the updated versions of the above-mentioned documents with all the regulation parameters,
- the last test records,
- operating instructions specifying the various settings, the operations to be performed, the timing and type of maintenance inspections and all the information needed to manage the installation,
- copies of the manufacturers’ guarantee certificates.

1.6.5 Archiving of drawings and internal approval on the CDD

The drawings shall be submitted to CERN for archiving in duplicate, in addition to the paper copies, in the form of printer files (HPGL) and source files (DWG and DXF) on CD–ROM. Following an initial check by CERN, the Contractor shall archive his drawings in CERN’s CDD via Internet (directions for the archiving are given in Annex 6). To this end, the Contractor shall be put in contact with CERN’s CDD technical support team in order to obtain rights of access to the CDD Web server (registration of the Contractor, obtaining of a user name and password, etc.). For each drawing, the Contractor shall enter all the information relating to his drawing in the relevant fields on the site’s Web pages from his own Internet browser. He shall then download the files (source files and HPGL) of the drawing in question onto a directory of the CDD server via Internet. An automatic procedure generated by the CERN server will check the drawing entries and will send all the correctly formatted drawings for approval to the various CERN services concerned. Every person receiving a drawing will be able to accept or reject it and will make comments in textual format. The Contractor may consult the CDD via Internet on his own initiative in order to check the approval or rejection status of his documents. He must take account of any comments made, amend his drawings accordingly, index them and put them back in the system until all his drawings have been fully approved. This procedure shall apply to all the drawings submitted for approval prior to the start of the work and to the as–built drawings submitted prior to provisional acceptance for final archiving.

1.6.6 Document format

All the text, instructions and notes appearing on the drawings and in the documents shall be in English or bilingual French and English. All the abbreviations and codes used shall comply with CERN’s coding systems. All the documents drawn up by the Contractor shall be sent to CERN in both paper and electronic format. The contractor must draw up his design memoranda using preferably Microsoft Word or Microsoft Excel and his schedules using Microsoft Project. He shall provide CERN with a source version (DOC, XLS, MPP, etc.).

The Contractor shall supply a paper copy, a DWG drawing source file and an HPGL plotter type file for each drawing. The drawings shall comply with the QAP document, ref. LHC–PM–QA–306.00, Drawing Process External Drawings. The electrical wiring diagrams shall be made on a software imposed by CERN (SEE 300 software developed by IGE–XAO, TRACE ELEC, or another similar software). The sheets shall be supplied as source files and printer files (DWG, associated files, and HPGL). The other documents (qualifications, technical documentation, etc.) not available on the above-mentioned software shall be scanned by the Contractor and supplied in PDF format. As a general rule, the various documents, drawings and diagrams shall be sent to CERN in both paper copy and electronic format.
The support medium for the electronic versions shall be CD–ROM. Each CD–ROM supplied shall be accompanied by a delivery slip and shall also comprise a Word–type file indicating the contents of the files and directories of the information contained in them.
1.7 CONTRACTOR'S OBLIGATIONS

The contents of all the documents referred to in this section shall be applicable throughout the execution of the contract.

1.7.1 General

In addition to meeting the requirements set out in this specification the supplies shall be in good working order, perform properly and be compatible with the equipment to which they will be connected.

The design memoranda and bills of quantity mentioned in the Invitation to Tender documents and any characteristics and dimensions shown on the drawings or in the texts are provided only as a guide. All the working documents shall be drawn up by the Contractor.

1.7.2 "Traveller" File

The procurement of raw materials, the manufacture of components, the assembly and testing of each sub–unit shall be recorded and monitored in a specific file entitled the "Traveller". These procedures shall comply with those defined in the QAP document, ref. LHC–PM–QA–309.00, "Fabrication and Inspection of Purchased Equipment".

1.7.3 Location of the Contractor’s Premises

The volume of the work being done for the LHC Project requires that the Contractor sets up an organisational structure able to guarantee that the installations are properly completed in terms of quality, cost and schedule. In this context, the Contractor shall set up an administrative and technical support structure near CERN, which shall remain effective for the entire duration of the work.

1.7.4 Schedule

The Contractor shall comply with the provisional schedule set out in Annex 5. CERN reserves the right to amend the schedule before the start of the work, especially for reasons connected with the work of other firms on the same premises or because of the actual date of the contract’s adjudication. This could result in changes in the order in which work on the various air–handling structures is performed and the Contractor shall undertake to adapt himself in accordance with them. This will not justify a price increase.

The time allowed for the whole of the work and certain intermediate time limits shall be set out in the Contract. The other intermediate time limits shall be stipulated in work orders during the performance of the Contract.

The schedule set out in the Contract is provisional. The schedule is composed of different phases, with start date and finish date for each phase. CERN reserves the right to change the start date of each phase three months before the start of the corresponding work without any price increase. Then CERN will confirm the definitive date in work orders two weeks before the start of the work.

In certain phases, as stipulated in the provisional schedule, the Contractor shall work simultaneously with others Contractors.

At the beginning of the Contract and before the start of the work, the Contractor shall submit for CERN’s approval a schedule showing 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.
The schedule shall make provision for CERN official holidays and take into account whether and other conditions related to the execution of the work.

Where the equipment has to be installed in structures, the supply and assembly operations shall be included in the work schedule.

The schedule of the various items of work relating to the contract shall comply with the procedures defined in the QAP document, ref. LHC–PM–QA–301.01, "Planning and Scheduling Requirements".

1.7.5 Checking of data provided by CERN

At the time of drawing up this Invitation to Tender, some of the buildings referred to have yet to be finished, and a small number of parameters have yet to be confirmed by the future users of the premises. Before any work begins, the Contractor shall satisfy himself of the correctness of the dimensions and information shown on the drawings provided by CERN for information, failing which he shall bear sole responsibility for the consequences. This shall also apply to the civil engineering structures.

1.7.6 Missing CERN documents

The Contractor shall request in writing, and sufficiently far in advance, any drawings, written instructions or documentation needed to execute the work that CERN may not have provided.

1.7.7 Working and other documents

The Contractor shall be responsible for all necessary measurements on the site. The greatest care shall be taken in entering the dimensions and measurements on the working drawings, and a clear distinction shall be drawn between the structural components (various grades of metal, equipment to be erected and all structural materials). In the case of metal structures, the measurements shall define fully the shapes of components, all their parts, and their assembly. The weight calculations for the various metal components shall be attached.

1.7.8 CERN approval and performance of the work

Work may begin only when CERN has approved the entire project in writing on the basis of the requested documents. Any structure with references other than those referred to in the Invitation to Tender documents and which have not obtained CERN’s approval prior to performance of the work may be refused.

1.7.9 Protection of equipment

The Contractor shall be required to make provision for all the protective devices needed to prevent damage to the installations made by other tradesmen and his own installations, tooling and equipment.

In particular, he shall take every precaution to prevent any indentation of the roof covering when the equipment is being installed (temporary platform for walking on and for storage shall be compulsory).

1.7.10 Type of materials

All the materials installed shall be new, free of any flaw or alteration (by oxidisation or otherwise), fire–resistant and halogen–free (see Safety Instruction IS41 and shall have been manufactured in one of CERN’s Member States. The Contractor shall, at his own expense, replace any item of equipment or part of the installation that does not comply with the contract including this Technical Specification.
1.7.11 Guarantee of the installations

The contractor shall guarantee the supplies hereunder including their design and layout, as well as the dimensions given in his own drawings in accordance with the provisions set out hereunder and the applicable provisions of the General Conditions of CERN Contracts.

1.7.12 Guarantee periods

During the guarantee period the Contractor shall agree to carry out, on request by CERN, maintenance/repair on the supplies for maintenance/repairs which CERN deems outside the scope of the guarantee as stipulated in the previous article.

1.7.13 Faults or structural defects

If so required by CERN in writing, and upon its instruction, the Contractor shall investigate the causes of any bad performance or other non compliance of the supplies and in particular a structural defect.
1.8 SAFETY

1.8.1 Introduction
The term "Safety" includes safety, health, working conditions and environmental protection. Concerning safety the Contractor shall in particular comply with the following document: Safety Regulations Applicable to the Work of Contractors at CERN, Reference CERN/TIS–GS/98–10 of May 1998 and the provisions below.

1.8.2 Safety Co–ordination
In accordance with the Safety Regulations, Appendix 3 – Table 2, these works will be the object of a safety co–ordination for the 2nd category of work; this means that before the beginning of work:

• A Joint Inspection of the work site will be organised by the CERN ST–CV group, in which the Contractor, as well as its possible subcontractors, will take part.
• A Risk Prevention Plan will be established (Safety Regulations, Appendix 3.5); this plan will include, in particular, an analysis of the risks from the Contractor, the description of the procedures and means of prevention to be implemented.

Specific recommendations
All safety precautions and measures must be taken, considering:

• Organisational measures described in the present technical specification.
• The environmental conditions of the existing structures and their particular hazards
• The work to be done by the contractor in order to protect people from injuries or illnesses, installations and equipment from damages and environment from pollution and to avoid interference’s with possible other work in the vicinity.
• The existing travelling crane may be used under the approval from CERN ST/HM and TIS/TE groups. The Contractor’s staff shall follow the due certification training before works commences, at the Contractor’s expense.
• The crane shall be locked if the Contractor uses scaffolding or gondola systems in order to work in high position.
• The openings in floors shall be suitable protected.
• The Contractor shall take all precautions before accessing the roof of inside rooms because of their fragility.
• All handling methods from the Contractor shall be first checked by CERN. The Contractor’s staff shall be trained and certificated.
• The Contractor shall guarantee safe access to working stations in the false floor and in the technical gallery.
• The Contractor shall install all the necessary site signs and fences (fixed, height 1.5 m),
• The Contractor shall install premises for the staff and the work site switchboards with 30 mA differential protection,
• The Contractor shall clearly define the hoisting and handling means and methods,
• The Contractor shall install all the necessary safety devices for work performed at a height, in particular for access to roofs, etc.
Concerning the personnel, the contractor will guarantee the presence of at least one rescuer–first-aid worker for every 10 workers on the work site.

**1.8.4 Further instructions**

In support of their offers, the bidders will provide a brief, but sufficiently, complete and clear description of their working methods and the means of protection which they will implement, as well as the installation of the work site and the hardware and the manpower which will be employed. They will also specify the provisions planned for the workers’ hygiene (toilets, cloakrooms,...). A calendar for the execution of the various phases of work will also be joined. These important elements will be taken into account in the analysis of the offers and will have to be specified in detail by the Contractor in the Risk Prevention Plan before the beginning of the work. CERN is looking for companies that attach great importance to complying with the safety requirements to which they are subjugated and that will implement all essential measures to avoid accidents and occupational illnesses amongst the personnel, as well as deterioration in hardware and environment pollution. Without exception, they must take all this into account in their offers. All additional information concerning the safety requirements applicable at CERN can be obtained from CERN ST/CV group and CERN TIS/GS Safety Group.
1.9 QUALITY ASSURANCE PLAN

The Contractor must plan, establish, implement and adhere to a documented quality assurance program that fulfils all the requirements described in this Technical Specification and drawn up according to the Quality Assurance Plan for the project.

The Quality Assurance Plan book shall be specific for this contract. The Contractor shall submit to CERN’s approval, a specific list of procedures in accordance to the context of the project, that he will describe in the QAP. This list shall be updated for all the period of the contract until the end of the guarantee period.

The list of relevant topics covered by the LHC Quality Assurance Plan, together with the corresponding documents, is given in below. This list is not restrictive. These documents can be found on the CD-ROM "Safety and Quality Assurance Documents" joined to the present Invitation to Tender.

Table 1 – Sections and documents of the LHC QAP

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<td></td>
<td>Design Process and Control</td>
<td>LHC–PM–QA–307.00</td>
</tr>
<tr>
<td></td>
<td>Drawing Management and Control</td>
<td>LHC–PM–QA–305.00</td>
</tr>
<tr>
<td></td>
<td>Drawing Process–External Drawings</td>
<td>LHC–PM–QA–306.00</td>
</tr>
<tr>
<td><strong>Change Control</strong></td>
<td>Configuration Management – Change Process And</td>
<td>LHC–PM–QA–304.00</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td></td>
</tr>
<tr>
<td><strong>Manufacturing and</strong></td>
<td>Manufacturing and Inspection of Equipment</td>
<td>LHC–PM–QA–309.00</td>
</tr>
<tr>
<td><strong>Inspection</strong></td>
<td>Handling of Non–conforming Equipment</td>
<td>LHC–PM–QA–310.00</td>
</tr>
<tr>
<td></td>
<td>LHC Part Identification</td>
<td>LHC–PM–QA–206.00</td>
</tr>
</tbody>
</table>
1.10 TESTS, INSPECTIONS AND COMMISSIONING

Following CERN’s written approval of the documents submitted by the Contractor, the latter may begin manufacture of the system components. The cost of all tests, inspections, commissioning, measurement campaigns, acceptance, the necessary instrumentation, its use and fitting–out, the supervision, the specialist manpower and the services of the official bodies needed to meet these requirements shall be included in the tender. The Contractor shall provide all the calibration certificates for his equipment.

1.10.1 Factory tests

The preparation of the factory tests shall be the subject of a document to be submitted to CERN for approval. This document shall set out in detail the procedure for the tests, their nature and all the operations to be performed. A factory test shall be performed, in the presence of a CERN representative, on the first unit of each standard AHU series, with a fan fitted with a suitable speed selector and electric power cubicle. CERN will supply a detailed list of the tests at the time of the work. They shall include:

- A visual check of the mechanical assembly (type of equipment, construction method, compliance with specifications),
- a check of the operating performances of the fan, by means of simulating the head loss of the ducting on both sides of the AHU, at different speeds, in relation to the automatic variable speed drive unit,
- a check of the enclosure’s air–tightness in relation to the operating pressure (see criteria Annex 1),
- measurement of the electricity consumed,
- measurement of the noise output of the fan section of each class of AHU,
- a check of the water exchangers’ resistance to hydraulic pressure (1.5 times the nominal pressure).

The UIAC power cubicles (to be supplied by the Contractor), and the UIAO control cubicles containing the programmable logic controllers (PLCs), the local monitoring systems shall also be factory–tested in the presence of CERN’s representatives. These tests shall be made on a simulator reproducing the on–site operating conditions. Each functionality shall be checked, and each control loop tested independently. The communication tests shall be done by simulating the system. The control loops shall be simulation–tested and the significant parameters recorded (control values, values to be set, interference levels). These inspections shall take place at least four weeks before the date on which the equipment is shipped to CERN. All costs entailed by these tests (supply, manpower, apparatus, instrumentation, etc.) shall be borne by the Contractor and shall form an integral part of his tender. The Contractor shall set out the results of all the tests in a document, which must be approved by CERN before installation on the site. The Contractor shall propose a date for delivery to the site.

1.10.2 Tests performed on the Contractor’s premises

CERN reserves the right to be present or to be represented by an organisation of its choice at all the tests performed on the Contractor’s premises or those of his sub–contractors. To this end, the Contractor shall keep CERN informed of progress with the manufacture and of the programmed test schedules. CERN shall provide at least ten working days’ notice of the date of such tests.
1.10.3 Inspections performed by the Contractor

Throughout the execution of the work the Contractor himself shall be required to monitor all his installations for both the quality of workmanship and operation. As soon as the installation has been assembled on the CERN site, the Contractor shall check the following and carry out the necessary corrective measures if required:

- The mechanical assembly of the systems (construction method, type of material, modularity, etc.),
- all the documentation,
- the identification labels (each AHU component, air circuits and air flow indication arrows, electrical components and regulation devices, graduated segments for viewing the settings of dampers and servo–motors, etc.),
- the command components, the protections of the electrical equipment, the safety devices, the remote controls, the transfers of the signals and alarms,
- all the cables, without exception, and their marking,
- the measurement of the insulation of the power systems between phases, neutral and earth,
- phase balance and the equipotential links.

All the tests and inspections shall be entered on a test certificate appended to the general work completion file.

The work–site (buildings, approaches and storage areas) shall be cleaned up and all rejects, trimmings and materials unused by the Contractor shall be removed.

Once the above requirements have been fulfilled the Contractor and CERN shall make a joint inspection to verify that the assembly work has been duly completed.

1.10.4 Testing by the Contractor

A detailed programme of tests will be drawn up by CERN in collaboration with the Contractor. All the measurements taken will be reported in test reports to be annexed to the technical file for submission to CERN. The tests will be carried out in the presence of a CERN representative. They will cover the following main items:

- Measurement of the air flow rates,
- measurement of the air–tightness of the ducting systems in accordance with the criteria set out in Annex 1,
- noise measurements,
- measurement of the electric current and power consumed in the various operating modes,
- measurement of the rotational speeds of the fans in the various operating modes,
- check of the quality and quantity of the materials,
- check of the assembly work: positions, directions, quality of connections, accessibility, securing, finishing, insulation, marking, compliance with the working drawings,
- safety inspections: Electrical circuits, belt guards for fans, etc.,
- checking of compliance between markings, drawings, diagrams and descriptions,
- checking of control and command functions,
• checking of dynamic behaviour: checking that the regulation process of the AHUs takes less than 5 minutes to stabilise after start-up; testing the stability of the automatic settings, etc.,
• checking the operating and maintenance instruction manual and the other documents.
• checking the class of the rooms,
• checking the operating and maintenance instruction manual and the other documents.

The operating points for the different settings referred to above will be shown on the characteristic curves for the fans and annexed to the test reports. The intensity and power consumption values measured shall be compared with the ratings given on the motor identification plates.

1.10.5 Checks by CERN

All the test reports will be checked by CERN in the Contractor’s presence. The following additional checks will be performed:

• Verification of the quality and quantity of the materials,
• verification of compliance of the installations with the documents and regulations in force and with normal trade practice,
• verification of compliance of the installations with the design memoranda and the working drawings,
• verification by the technical control office (Office of Controls and Inspections appointed by CERN for electrical installations). Changes to the installations as a function of the comments by the Office of Controls and Inspections shall be under the Contractor’s responsibility,
• verification and control of the accuracy and speed of response of the measuring equipment,
• verification that the monitoring PLC parameters are available from the web via Ethernet TCP/IP access,
• verification of the noise measurements.

1.10.6 Noise measurement campaigns

CERN attaches particular importance to reducing the noise pollution from its equipment in the outside environment to the minimum. Checks on noise damping shall therefore include various kinds of noise measurement. The noise measuring instruments and their completion certificate shall be provided by the Contractor. The measurements taken shall be appended to the test reports. The noise level measurements shall be taken by the Contractor in the presence of CERN’s Acoustics Service and in accordance with its instructions. They shall be carried out on each structure in different locations and at different phases of the work. The measurement campaigns shall comprise the following stages:

• Measurement of the background noise spectra (before work, equipment switched off), which shall be used as reference values,
• measurement of the noise limits of the ventilation system alone (fans operating at maximum flow rates),
measurement of the noise limits of the ventilation system and all the machines such as compressors, transformers, etc. in the nominal operating conditions (determination of the capacity of the ventilation system and its acoustic equipment to reduce to a minimum the transmission of noise from the machines to the outside environment),

- night–time and daytime measurements.

The noise limits shall be measured at the following locations:

- Inside the buildings and on the different floors,
- inside the structures by the work stations (normal operation of the installations),
- inside and outside the buildings by the air inlets, smoke extraction units, roof exhausts and extraction outlets (verification of the attenuation specified by the Contractor),
- on the boundary of the CERN site,
- on the boundary of the neighbouring property, if necessary.

1.10.7 Commissioning

Once the Contractor has completed his own tests, he may inform CERN that the installation is ready for commissioning. CERN shall send him confirmation of the date of commissioning.

The commissioning procedure shall consist of several phases:

- commissioning of all the safety devices,
- commissioning of the electrical systems (operation),
- commissioning of the hydraulic systems,
- commissioning of the air–handling systems,
- commissioning of the control system,
- commissioning of the monitoring systems.

1.10.8 Acceptances

Acceptances shall be granted in accordance with the contract documents. Comments and reservations made by one of the parties shall be entered in the acceptance reports. At acceptance, test checks shall be made on the basis of the test reports (listing the measured and rated characteristics) supplied by the Contractor. The necessary resources for all these tests and acceptances (instruments like thermometers, anemometers, noise level meters, hygrometers, etc., plus the staff) shall be supplied by the Contractor, together with calibration certificates issued by an approved body. If recordings of the installation need to be made, the Contractor shall provide the recording devices.

1.10.9 Provisional acceptance

As soon as the work is complete and has successfully undergone any prescribed tests and as soon as the Contractor considers that he has fulfilled all his obligations, he may request CERN to draw up a certificate of provisional acceptance in accordance with the provisions hereunder and the applicable provisions of the General Conditions of CERN contracts.

It is understood that CERN may issue such a certificate for part of the work defined if it can be considered as a separate deliverable.

CERN may:
• refuse to draw up this certificate if it considers that the Contractor has not fulfilled all his obligations, including the making good of the premises and land;
• issue the certificate with reservations.

In case CERN refuses to draw up the provisional acceptance certificate, CERN shall so advise the contractor in writing stating the reason for such refusal and the contractor shall forthwith at his own expense take all such corrective action as may be necessary.

Corrective action may imply the demolition of the non conforming supplies at the expense and risk of the Contractor. In such a case the Contractor shall then be required to rebuild such supplies in accordance with the contract including this technical specification within the overall schedule.

1.10.10 Reservations

If, on provisional acceptance, CERN has made reservations, the Contractor shall take all necessary corrective action, within the specified time.

In case such corrective action is not taken within the specified time limit CERN shall be entitled to have the corrective action carried out by a third party at the contractor’s expense.

Once the corrective action has been taken the acceptance procedure set out hereunder shall apply as appropriate.

1.10.11 Final acceptance

The certificate of final acceptance drawn up in accordance with the provisions hereunder and the applicable provisions of the General Conditions of CERN contracts shall be issued following the date of expiry of the guarantee period (or the last expiry date in the case of different periods corresponding to partial provisional acceptances), or, where appropriate, the date of proper completion of maintenance/repairs or replacement of supplies under the guarantee.
2. BASIC DATA

2.1 PRESENTATION OF THE SR1 BUILDING

Building SR1 (CERN reference 2175) is located in Switzerland opposite the entrance to CERN’s Meyrin site, at Point 1 of the LHC (440 m altitude). The enclosure comprises a steel structure with cladding and accessible roof with water proofing. Building SR1 is composed by a large hall (1500 m²), a false floor (two meter high, floors tiles on a steel suspension system), and a longitudinal underground technical gallery. Two ventilation rooms, located on either end of the hall are housing HVAC equipment providing the heating, ventilation, cooling and smoke extraction needs of the hall.

Until present, SR1 hall was housing electronic racks and electric cubicles, which were cooled from the false floor. The following specific equipment is already existing:

- One travelling crane,
- floor drainage traps in the false floor,
- rain water drainage all along the façades,
- one opening in the floor and a ladder for the access to the false floor,
- manual dampers along the technical gallery.

All the dimensions and positions of the pockets shown on the drawings shall be checked by the Contractor, who shall be responsible for any additional civil engineering work.

2.2 PRESENTATION OF NEW CONDITIONED AREAS IN SR1

THE SR1 building will be converted to an experiment assembly area. CERN will erect new areas inside a part of the hall, made of steel partitions: a laser room, a test room, an assembly area, a control room and a rack area. The rest of the hall will not be modified. For the need of this project, CERN will provide:

- one new opening in the floor for the access to the false floor,
- one concrete slab outside to support new open air AHU’s,
- one cold water supply in the false floor.

2.2.1 Laser room

The laser room will house a laser machine and 1 person during the tuning. The enclosure will comprise partition walls and roof, made of sandwich double steel panels with rockwool insulation between them, thickness 100 mm. The laser, 6 kW electric power, will be also cooled with water by another contractor.

2.2.2 Test area

The test area will house 2 electric racks, 1 kW each, one X–ray machine of 6 kW and 5 people. The enclosure will comprise of partition walls and roof, made of sandwich double steel panels with rockwool insulation between them, thickness 60 mm in walls and 100 mm in roof.
2.2.3 Control room

The control room will house 3 electric racks, 6 kW each, 8 computers, printers and 10 people. The enclosure will comprise partition walls and roof, made of sandwich double steel panels with rockwool insulation between them, thickness 60 mm in walls and 100 mm in roof.

2.2.4 Assembly area

The assembly area will house 3 electric racks, 6 kW each, 6 computers, printers and 25 people. The enclosure will comprise partition walls and roof, made of sandwich double steel panels with rockwool insulation between them, thickness 60 mm in walls and 100 mm in roof. The access to the assembly area shall be done via a lock.

2.2.5 Clean room (as an option)

The clean room, located in the assembly area, will house electric racks, computers, printers and 12 people. The enclosure will comprise partition walls and roof, made of sandwich double steel panels with rockwool insulation between them, thickness 60 mm in walls and 100 mm in roof. The partitions will be mobile to provide four different possible areas.

2.2.6 Rack area

The open air rack area will house 65 electric racks, 5 kW each, and passage people. The enclosure will comprise no partitions. All the dimensions and positions of the pockets shown on the drawings shall be checked by the Contractor, who shall be responsible for any additional civil engineering work.

2.2.7 Summary of conditioned areas

<table>
<thead>
<tr>
<th>Area</th>
<th>Surface area at floor level m²</th>
<th>Volume m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventilation room CV1–125</td>
<td>40</td>
<td>300</td>
</tr>
<tr>
<td>New ventilation room CV1–127</td>
<td>120</td>
<td>250</td>
</tr>
<tr>
<td>Laser room</td>
<td>20</td>
<td>80</td>
</tr>
<tr>
<td>Test area</td>
<td>100</td>
<td>395</td>
</tr>
<tr>
<td>Control room</td>
<td>48</td>
<td>190</td>
</tr>
<tr>
<td>Racks area</td>
<td>168</td>
<td>665</td>
</tr>
<tr>
<td>Assembly area</td>
<td>604 to 365</td>
<td>2386 to 1426</td>
</tr>
<tr>
<td>Clean room</td>
<td>105 to 240</td>
<td>420 to 960</td>
</tr>
<tr>
<td>LHC machine area</td>
<td>570</td>
<td>3535</td>
</tr>
<tr>
<td>Handling area</td>
<td>50</td>
<td>310</td>
</tr>
</tbody>
</table>
2.3 DESIGN OUTDOOR CONDITIONS

Summer: 32° dry bulb temperature
40% relative humidity

Winter: −10 °C dry bulb temperature
90% relative humidity

These are average values provided for the purposes of calculations. Higher or lower absolute values may be occur.

2.4 REQUIRED INDOOR CONDITIONS

Table 2 – Required indoor conditions

<table>
<thead>
<tr>
<th>Room</th>
<th>Temperature °C</th>
<th>Humidity %</th>
<th>Internal Heat load estimate (sensible) KW*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser room</td>
<td>22 ± 2</td>
<td>50 max</td>
<td>4</td>
</tr>
<tr>
<td>Test area</td>
<td>22 ± 2</td>
<td>50 max</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40 ± 10 (option)</td>
<td></td>
</tr>
<tr>
<td>Control room</td>
<td>22 ± 2</td>
<td>50 max</td>
<td>15</td>
</tr>
<tr>
<td>Assembly area</td>
<td>22 ± 2</td>
<td>50 max</td>
<td>40</td>
</tr>
<tr>
<td>Clean room</td>
<td>22 ± 2</td>
<td>50 max</td>
<td>20</td>
</tr>
<tr>
<td>Racks area</td>
<td>26 max</td>
<td>–</td>
<td>70</td>
</tr>
</tbody>
</table>

* Internal heat load includes sensible heat only for the specific equipment inside the areas (load for lighting, people, fresh air and partitions are not included).
Lighting: 20 W/m²

Table 3 – Cleanliness class

<table>
<thead>
<tr>
<th>Room</th>
<th>Class* 209E (US)</th>
<th>Vol/ h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser room</td>
<td>M7</td>
<td>30</td>
</tr>
<tr>
<td>Test area</td>
<td>M7</td>
<td>25</td>
</tr>
<tr>
<td>Control room</td>
<td>M7</td>
<td>20</td>
</tr>
<tr>
<td>Assembly area</td>
<td>&lt;M6</td>
<td>12 to 20</td>
</tr>
<tr>
<td>Clean room</td>
<td>&lt;M6</td>
<td>30</td>
</tr>
</tbody>
</table>
2.5 AIR HANDLING UNITS

The air-handling units for this project are identified into various types, the main components of which are shown below, in accordance with the coding scheme in Annex 3.

2.5.1 Configuration of the AHUs

2.5.1.1 Existing ventilation room CV1–125, located up to the SR1 hall

![Ventilation room CV1–125 diagram](image-url)
2.5.1.2 New ventilation room CV1–127, located in the false floor of the SR1 hall

2.5.1.3 New steel structure, located open air behind the SR1 hall

Technical Specification
2.5.1.4 Gas mixture extractor, located in the Test Area

2.5.2 Summary of the AHUs

<table>
<thead>
<tr>
<th>AHU Type</th>
<th>Function</th>
<th>Flow–rate (m³/h)</th>
<th>Fan type</th>
<th>Motor type</th>
<th>Elec. power of Motor for fan (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CV1–125</td>
<td>Air supply for the hall SR1</td>
<td>80 000</td>
<td>UUDC</td>
<td>UMFV</td>
<td>30</td>
</tr>
<tr>
<td>CV1–125</td>
<td>Air extraction for the hall SR1</td>
<td>80 000</td>
<td>UUDC</td>
<td>UMFV</td>
<td>30</td>
</tr>
<tr>
<td>CV1–130</td>
<td>Air supply for laser room</td>
<td>2 500</td>
<td>UUDC</td>
<td>UMF2</td>
<td>2.2</td>
</tr>
<tr>
<td>CV1–131</td>
<td>Air supply for test area</td>
<td>10 000</td>
<td>UUDC</td>
<td>UMF2</td>
<td>11</td>
</tr>
<tr>
<td>CV–132</td>
<td>Air supply for control room</td>
<td>4 000</td>
<td>UUDC</td>
<td>UMF2</td>
<td>4</td>
</tr>
<tr>
<td>CV1–133</td>
<td>Air supply for clean room</td>
<td>30 000</td>
<td>UUDC</td>
<td>UMFV</td>
<td>22</td>
</tr>
<tr>
<td>option</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CV1–134</td>
<td>Air supply for assembly area</td>
<td>30 000</td>
<td>UUDC</td>
<td>UMFV</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humidifier option</td>
<td></td>
<td>10 000</td>
<td>–</td>
<td>–</td>
<td>40</td>
</tr>
<tr>
<td>option</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CV1–135</td>
<td>Gas extractor for test area</td>
<td>2 000</td>
<td>UUZC</td>
<td>UMF1</td>
<td>5</td>
</tr>
</tbody>
</table>

NB: The nominal flow–rates defined in m³/h refer to an air temperature of 15°C and an atmospheric pressure of 1013 mbar, with a margin of 5%. The air density shall be taken as 1.226 kg/m³.

The electric powers of motors for fans and humidification systems are given by CERN by means of indication only. These powers shall be confirmed by the Contractor at the beginning of the works.
2.6 NOISE LEVEL LIMITS

CERN places particular emphasis on the environment of its installations, and in particular acoustic aspects both during the construction phase and once the installations are operating. The implementation of the equipment supplied by the Contractor (air intakes, outlets, roof units, exhausts etc.) shall not affect the thermal and acoustic insulation of the buildings. The Contractor shall take every precaution to prevent the transmission of noise from the inside to the outside.

2.6.1 Surrounding area

The maximum permissible noise levels shall be those laid down by the French Decree of 23 January 1997, namely: (all other trades in operation too)

<table>
<thead>
<tr>
<th>In residential areas:</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 dB(A) of continuous excess in daytime (7.00 to 22.00)</td>
</tr>
<tr>
<td>3 dB(A) of continuous excess at night (22.00 to 7.00)</td>
</tr>
<tr>
<td>and</td>
</tr>
<tr>
<td>on the boundary of the CERN site:</td>
</tr>
<tr>
<td>70 dB(A) during the day (7.00 to 22.00)</td>
</tr>
<tr>
<td>60 dB(A) at night (22.00 to 7.00)</td>
</tr>
</tbody>
</table>

Measurements at 1.2 m above ground level.

2.6.2 Technical premises

The maximum permissible noise levels in the new ventilation room shall be:

| 70 dB(A) |

Measurements at a distance of 1 m from each AHU and at 1.2 m above the finished floor level.

The permissible noise level limits in all ground floor areas when the ventilation facilities in the ventilation rooms be in operation, shall be:

| 40 dB(A) |

Measurements at 1.2 m above the finished floor level.
2.6.3 Factory testing of the fans and ventilators
The maximum permissible noise level of the fan section of each AHU shall be:

\[ < 65 \text{ dB(A)} \]

Measurements just at external side of the casing.

2.6.4 During the construction phase
During the construction phase the Contractor shall:

- Comply with the working hours notified in writing and approved by CERN,
- use equipment complying with the regulations.

The noise levels during construction shall not exceed the following limits:

<table>
<thead>
<tr>
<th>In residential areas:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5 dB(A) of continuous excess in daytime (7.00 to 22.00)</td>
<td></td>
</tr>
<tr>
<td>3 dB(A) of continuous excess at night (22.00 to 7.00)</td>
<td></td>
</tr>
</tbody>
</table>

and

on the boundary of the CERN site:

| 70 dB(A) during the day (7.00 to 22.00) |
| 60 dB(A) at night (22.00 to 7.00) |

Measurements at 1.2 m above ground level.
2.7 REFERENCE DRAWINGS AND SCHEMATICS

All the supply shall be in compliance with the following documents.

2.7.1 Annex 2: Tender drawings

- LHCU−2175−0011: Existing building SR1
- LHCU−2175−0012: New ventilation room
- LHCU−2175−0015: New building SR1
- LHCU−2175−0020: Openings and pockets
- LHCU−2175−0018: Laser room circuit
- LHCU−2175−0016: Test area circuit
- LHCU−2175−0017: Control room circuit
- LHCU−2175−0019: Assembly area and clean room circuits
- LHCU−2175−0021: Gas extraction circuit in Test area (option)

2.7.2 Annex 3: Principle schematics

- LHCU−2175−1001: Existing installation
- LHCU−2175−1002: Project installation for laser room, test area, control room and rack area
- LHCU−2175−1003: Project installation for assembly area and clean room
- LHCU−2175−1004: Regulation
- LHCU−2175−1005: Gas mixture extraction in test area (option)

2.7.3 Annex 4: Detail drawings
3.DESCRIPTION OF THE WORKS

3.1 INTRODUCTION

3.1.1 Work lots
The works are broken down into different work lots, one work lot for each treated room, one for the electrical power part, one for the control and regulation, one for the monitoring, and one for each option.

3.1.2 Existing principle
The existing CV1–125 ventilation room is composed by two AHUs, CV1–125–1 for treated air supply and CV1–125–2 for recirculation and extraction, for the heating, ventilation, cooling and smoke extraction of the SR1 hall. The treated air is supplied to the hall via a technical gallery with grilles and manual dampers, and then via the false floor with openings under electronic racks. The exhaust is done by a grille located in the upper part of the hall with motorised damper. The two fans, maximum 80 000 m$^3$/h air flow rate each, are commanded from the same variable speed drive system (the two fans are working simultaneously at the same rate).

3.1.3 New principle for the laser room, the test area, the control room and the racks area
The new principle is quite the same as the previous: the existing AHU will be used for the air conditioning of the rack area via the technical gallery and for the supply of pre treated air in the technical gallery. This treated air will be post treated by three new air handling units, installed in the new CV1–127 ventilation room, located in the false floor of the building. The extraction of the hall will done as previous, via a main extraction grille. The technical gallery will be separated in two volumes, one to treat the racks and to pre treat the new rooms, and second to treat the rest of the building according to the existing principle.

The maximum forced air flow rate will be 80 000 m$^3$/h, with a minimum fresh air flow rate of 2000 m$^3$/h (extreme conditions), that will be maximised to cool racks by outside air.

3.1.4 New principle for the assembly area and the clean room
The assembly area shall be treated via its own air handling unit, located open air behind the SR1 building. When the clean room will be erected in the assembly area, a second unit shall treat this new volume. An assembly of dampers in a peripheral ductwork shall permit the selection of the devices for the supply in one or in the other room.

3.1.5 References
Annex 2 Tender drawings LHCU21750011, LHCU21750015
Annex 3 Principle schematics LHCU21751001, LHCU21751002, LHCU21751003

Technical Specification
3.2 WORK LOT 1: FITTING THE CV1–127 VENTILATION ROOM

Work lot 1 concerns the static ventilation and the acoustic insulation of the new ventilation room CV1–127, located in the false floor of the SR1 hall. This room will house three new post treatment AHUs of the project. CERN will provide partitions, door and lighting of this room.

3.2.1 Required conditions of the supply air in the technical gallery

The existing CV1–125 AHU will be configured by CERN for the new requirement in terms of air flow rate, and operating points to obtain the following conditions in summer:

<table>
<thead>
<tr>
<th>Room</th>
<th>Dew point °C</th>
<th>Dry bulb temperature °C</th>
<th>Water ratio G / kg dry air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical gallery</td>
<td>10</td>
<td>&lt; 12</td>
<td>≤ 8</td>
</tr>
</tbody>
</table>

3.2.2 Ventilation

The Contractor shall provide two acoustic grilles with manual damper, for the high–level and low level ventilation of the room.

One of the existing dampers in the technical gallery may be open to increase the ventilation of this room if needed.

3.2.3 Acoustic insulation

The Contractor shall provide the inside acoustic insulation of the room, made of two steel sheets, one perforated with rockwool between them.

3.2.4 Air duct protections

The Contractor shall provide air duct protections, located on the top of the ducts and also some existing pipes that will be lay down on the false floor, for keeping people from walking on them. These protections will consist of a steel sheet, thickness 900 mm, covering the top of duct, supporting 150 kg. Their position will be given by CERN during the works.

3.2.5 Sealing

The Contractor shall provide the sealing in all passage ways trough walls, partitions, roofs, and floors.

The Contractor shall install a sealing door in the technical gallery, composed by a metal frame, manual dampers mounted on a door with handle and lock, to separate the volume of the gallery in two parts. The position of this door is shown on drawings.

The Contractor shall seal also the holes in technical gallery, with galvanised panels and insulation, in particular where the pipes are crossing through a wall and the cable trays the roof of the gallery. He shall also adapt existing dampers to the inlets of the new AHU’s.

3.2.6 References

Annex 1  Technical Requirements
Annex 2  Tender drawings LHCU21750012, LHCU21750015
Annex 3  Principle schematics LHCU21751001, LHCU21751002, LHCU21751003
3.3 WORK LOT 2: AIR CONDITIONING FOR LASER ROOM

Work lot 2 concerns the air conditioning of the laser room, consisting of the supply and installation of an air handling unit, ductworks and sealing works.

3.3.1 Principle

A new post treatment AHU will supply secondary air for heating, cooling and dehumidification to the laser room. The return air will be done via air duct to CV1–130 and the extraction via jalousie overpressure damper to the volume of the hall. The laser room shall be maintained at positive pressure.

3.3.2 Required indoor conditions

<table>
<thead>
<tr>
<th>Room</th>
<th>Temperature °C</th>
<th>Humidity %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser room</td>
<td>22 ± 2</td>
<td>50 ± 10</td>
</tr>
</tbody>
</table>

3.3.3 AHU: CERN reference CV1–130

The air handling unit shall be of modular–design with dimensions compatible with the service rooms. It will be built according to the requirements of annex 1 and the characteristics given in chapter 2 of the Technical Specification. CV1–130 unit will be designed to post treat air from the technical gallery and will be composed by a motorised damper section, a mixing box with a motorised damper and access, a filter section, a chilled water coil section, an access section with incorporated measuring section, an electric heating coil section, a measuring section, a fan section and all access doors. The fan shall be designed to operate at two speeds.

3.3.4 Air distribution

A connection air duct shall be adapted from the opening and a damper in the technical gallery to the AHU. The supply ductwork shall comprise a double–skin galvanised steel sheet duct insulated with rockwool 25 mm, running in the false floor from the AHU to the openings into the SR1 floor and wall. The return air ductwork shall be made of double–skin ducts with same insulation. The air supply in the room will be made by a textile duct 400 mm diameter, one second textile duct in standby for the washing period. The return air shall be by a single–deflection grille with damper, position as per drawings. The extraction shall be made in the volume of the hall via a jalousie overpressure damper. The duct supports shall be secured by damping (welding prohibited) to the metal frames of the false floor.

3.3.5 Sealing

The Contractor shall provide the sealing in the connection point with the technical gallery, and in all passage ways trough walls, partitions, roofs, and floors.

3.3.6 References

Annex 1 Technical Requirements
Annex 2 Tender drawings LHCU21750012, LHCU21750015, LHCU21750020, LHCU21750018
Annex 3 Principle schematics LHCU21751002, LHCU21751004
3.4 WORK LOT 3: AIR CONDITIONING FOR TEST AREA

Work lot 3 concerns the air conditioning of the test area, consisting of the supply and installation of an air handling unit, ductworks and sealing works.

3.4.1 Principle

A new post treatment AHU will supply secondary air for heating, cooling, dehumidification to the test area. The return air will be done via air duct to CV1–131 and the extraction via jalousie overpressure damper to the volume of the hall. The test area shall be maintained at positive pressure.

3.4.2 Required indoor conditions

<table>
<thead>
<tr>
<th>Room</th>
<th>Temperature</th>
<th>Humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test area</td>
<td>22 ± 2</td>
<td>50 ± 10</td>
</tr>
</tbody>
</table>

3.4.3 AHU: CERN reference CV1–131

The air handling unit shall be of modular–design with dimensions compatible with the service rooms. It will be built according to the requirements of annex 1 and the characteristics given in chapter 2 of the Technical Specification. CV1–131 unit will be designed to post treat air from the technical gallery and will be composed by a motorised damper section, a mixing box with a motorised damper and access, a filter section, a chilled water coil section, an access section with incorporated measuring section, an electric heating coil section, a measuring section, a fan section and all access doors. The fan shall be designed to operate at two speeds.

3.4.4 Air distribution

A connection air duct shall be adapted from the opening and a damper in the technical gallery to the AHU. The supply ductwork shall comprise a double–skin galvanised steel sheet duct insulated with rockwool 25 mm, running in the false floor from the AHU to the openings into the SR1 floor and inside walls. The return air ductwork shall be made of double–skin ducts with same insulation. The extraction shall be made by jalousie overpressure damper. The air supply in the room will be made by air displacement terminals and the return air by single–deflection with dampers, positions as per drawings. The duct supports shall be secured by damping (welding prohibited) to the metal frames of the false floor.

3.4.5 Sealing

The Contractor shall provide the sealing in the connection point with the technical gallery, and in all passage ways through walls, partitions, roofs, and floors.

3.4.6 References

Annex 1  Technical Requirements
Annex 2  Tender drawings  LHCU21750012, LHCU21750015, LHCU21750020, LHCU21750016
Annex 3  Principle schematics  LHCU21751002, LHCU21751004
3.5 WORK LOT 4: AIR CONDITIONING FOR CONTROL ROOM

Work lot 4 concerns the air conditioning of the control room, consisting of the supply and installation of an air handling unit, ductworks and sealing works.

3.5.1 Principle

A new post treatment AHU will supply secondary air for heating, cooling and dehumidification to the control room. The return air will be done via air duct to CV1–132 and the extraction via jalousie overpressure damper to the volume of the hall. The control room shall be maintained at positive pressure.

3.5.2 Required indoor conditions

<table>
<thead>
<tr>
<th>Room</th>
<th>Temperature</th>
<th>Humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control room</td>
<td>22 ± 2</td>
<td>50 max</td>
</tr>
</tbody>
</table>

3.5.3 AHU: CERN reference CV1–132

The air handling unit shall be of modular–design with dimensions compatible with the service rooms. It will be built according to the requirements of annex 1 and the characteristics given in chapter 2 of the Technical Specification. CV1–132 unit will be designed to post treat air from the technical gallery and will be composed by a motorised damper section, a mixing box with a motorised damper and access, a filter section, a chilled water coil section, an access section with incorporated measuring section, an electric heating coil section, a measuring section, a fan section and all access doors. The fan shall be designed to operate at two speeds.

3.5.4 Air distribution

A connection air duct shall be adapted from the opening and a damper in the technical gallery to the AHU. The supply ductwork shall comprise a double–skin galvanised steel sheet duct insulated with rockwool 25 mm, running in the false floor from the AHU to the openings into the SR1 floor and inside walls. The extraction ductwork shall be made of double–skin ducts with same insulation. The air supply in the room will be made by air displacement terminals and the return air by single–deflection grilles with dampers, positions as per drawings. The duct supports shall be secured by damping (welding prohibited) to the metal frames of the false floor.

3.5.5 Sealing

The Contractor shall provide the sealing in the connection point with the technical gallery, and in all passage ways trough walls, partitions, roofs, and floors.

3.5.6 References

Annex 1  Technical Requirements
Annex 2  Tender drawings  LHCU21750012, LHCU21750015, LHCU21750020, LHCU21750017
Annex 3  Principle schematics  LHCU21751002, LHCU21751004
3.6 WORK LOT 5: AIR CONDITIONING FOR ASSEMBLY AREA

Work lot 5 concerns the air conditioning of the test area, consisting of the supply and installation of an air handling unit, ductworks and sealing works.

3.6.1 Principle

A new AHU will supply air for heating, cooling and dehumidification to the assembly area. The return air will be done via air duct to CV1–134 and the extraction via jalousie overpressure damper to the volume of the hall. The assembly area shall be maintained at positive pressure.

3.6.2 Required indoor conditions

<table>
<thead>
<tr>
<th>Room</th>
<th>Temperature °C</th>
<th>Humidity %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assembly area</td>
<td>22 ± 2</td>
<td>50 max</td>
</tr>
</tbody>
</table>

3.6.3 AHU: CERN reference CV1–134

The air handling unit shall be of modular–design for open air location with dimensions compatible with the outside concrete slab and pockets in the wall. It will be built according to outside conditions, to the requirements of annex 1 and the characteristics given in chapter 2 of the Technical Specification. CV1–134 unit will be designed to treat air from return air ducts and outside fresh air and will be composed by a fresh air grille with a motorised damper section, a pre filter section, a mixing box with damper section, an access section, a filter section, an electric heating coil section, a chilled water unit section, an access section with drain pan and incorporated measuring section, a second electric heating coil section, a second measuring section and a fan section and all access doors. The fan shall be designed to operate at variable speeds.

The outside part of the chilled water pipes will be protected by autoregulant heating cables, under the responsibility of another Contractor.

The manifolds and their three way valves will be installed inside the building, on the concrete slab for unloading.

3.6.4 Air distribution

The fresh air shall be taken open air from the inlet of the AHU. The supply ductwork shall comprise a double–skin galvanised steel sheet duct insulated with rockwool 25 mm, running in the false floor from the AHU to the openings into the SR1 floor and inside walls. The return air ductwork shall be made of double–skin ducts with same insulation. The air supply in the room will be made by air displacement terminals and the return air by single–deflection grilles with dampers, positions as per drawings. The duct supports shall be secured by damping (welding prohibited) to the metal frames of the false floor.

3.6.5 Steel structures

The Contractor shall provide the supporting structure of the AHU’s, design for two units (the second AHU is asked as an option). The structure shall be done in hot deep galvanised steel and will be located on the outside concrete slab. This slab will be provided by CERN.
3.6.6 Sealing

The Contractor shall provide the sealing in the external wall, and in all passage ways through walls, partitions, roofs, and floors.

3.6.7 References

Annex 1  Technical Requirements
Annex 2  Tender drawings, LHCU21750015, LHCU21750020, LHCU21750019
Annex 3  Principle schematics LHCU21751003, LHCU21751004
3.7 WORK LOT 6: AIR CONDITIONING FOR RACK AREA

Work lot 6 concerns the air conditioning of the rack area, consisting of the supply and installation of new sensor in the ambience and sealing.

3.7.1 Principle

The electronic racks will be cooled with primary air from the existing CV1–125 ventilation room via the technical gallery and the false floor. The treated air will cross the racks from the bottom to the top and will be mixed after to the air volume of the SR1 hall. The extraction shall be done from the existing CV1–125–2 unit via a return air grille with motorised damper.

3.7.2 Required indoor conditions

<table>
<thead>
<tr>
<th>Room</th>
<th>Temperature °C</th>
<th>Humidity %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Racks area</td>
<td>26 max</td>
<td>No control</td>
</tr>
</tbody>
</table>

3.7.3 AHU

No additional AHU is required.

3.7.4 Air distribution

The extraction in the room shall be made by the existing extraction grille with motorised damper, position as per drawings.

3.7.5 Sealing

The Contractor shall provide the sealing in 4 passage ways in the roof of technical gallery.

3.7.6 References

- Annex 1  Technical Requirements
- Annex 2  Tender drawings LHCU21750011, LHCU21750015, LHCU21750020
- Annex 3  Principle schematics LHCU21751001, LHCU21751002
3.8 WORK LOT 7: ELECTRICAL POWER SYSTEMS

Work lot 7 concerns the electrical power systems necessary for the previous work lots. CERN gives, by means of indication only, the power supply list for cubicles. The Contractor shall confirm, the commencement of the works, the items and power ratings of these components.

3.8.1 Inside AHUs lighting

The Contractor shall be responsible for the AHU internal lighting by connection boxes, according to Annex 1.

3.8.2 New UIAC 127 power cubicle – normal power (Contractor supply)

UIAC 127 will be supplied by the Contractor and powered by CERN. It will be located in the new underground CV1–127 ventilation room. The Contractor shall be responsible for supplying power to all the electrical power components of his equipment from the feeders, the estimated power values of which are given in the table below. The protection devices on these feeders are also under the responsibility of the Contractor. It shall conform to paragraph 7.2.2 of Annex 1.

Table 3 – UIAC 127 – (CV1–127 ventilation room)

<table>
<thead>
<tr>
<th>Reference UIAC</th>
<th>P* (kW)</th>
<th>Component</th>
<th>Reference AHU</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIAC 127</td>
<td>2.2</td>
<td>Fan motor UMF2</td>
<td>CV1–130</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>Fan motor UMF2</td>
<td>CV1–131</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Fan motor UMF2</td>
<td>CV1–132</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Electric heating coil</td>
<td>CV1–130</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Electric heating coil</td>
<td>CV1–131</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Electric heating coil</td>
<td>CV1–132</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>Humidifier (option)</td>
<td>CV1–130</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Gas extractor (option)</td>
<td>CV1–135</td>
</tr>
<tr>
<td></td>
<td>–</td>
<td>Internal lighting</td>
<td>CV1–130, CV1–131, CV1–132</td>
</tr>
<tr>
<td></td>
<td>–</td>
<td>Control cubicle with PLC</td>
<td>UIAO 127</td>
</tr>
</tbody>
</table>

*P is the CERN estimated electric power in kW of the component that has been sized by the Contractor

3.8.3 New UIAC 128 power cubicle – normal power (CERN supply)

UIAC 128 will be supplied by the Contractor and powered by CERN. It will be located on the existing concrete slab used for unloading. The Contractor shall be responsible for supplying power to all the electrical power components of his equipment from the feeders, the estimated power values of which are given in the table below. The protection devices on these feeders are also under the responsibility of the Contractor. It shall conform to paragraph 7.2.2 of Annex 1.
Table 4 – UIAC 128 – concrete slab for unloading

<table>
<thead>
<tr>
<th>Reference UIAC</th>
<th>P* (kW)</th>
<th>Component</th>
<th>Reference AHU</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIAC 128</td>
<td>15</td>
<td>Fan motor UMFV</td>
<td>CV1–133</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>Fan motor UMFV (option)</td>
<td>CV1–134</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>Electric heater</td>
<td>CV1–133</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>Electric heater</td>
<td>CV1–133</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>Electric heater (option)</td>
<td>CV1–134</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>Electric heater (option)</td>
<td>CV1–134</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Heaters of the outside pipes</td>
<td>CV1–133, CV1–134</td>
</tr>
<tr>
<td></td>
<td>–</td>
<td>Internal lighting</td>
<td>CV1–133, CV1–134</td>
</tr>
<tr>
<td></td>
<td>–</td>
<td>Control cubicle</td>
<td>UIAO 128</td>
</tr>
</tbody>
</table>

*P is the CERN estimated electric power in kW of the component that has been sized by the Contractor

3.8.4 UIMV Variable speed drives (Contractor supply)

The variable speed drives shall be installed next to the UIAC 128 cubicle. They shall conform to paragraph 7.2.5 of Annex I.

3.8.5 UIMG thyristor cubicles (Contractor supply)

The thyristor cubicles shall be installed next to the AHUs corresponding to the supplied electric heating coils. They shall conform to paragraph 7.2.4 of Annex I.

Table 5 – Thyristor cubicles

<table>
<thead>
<tr>
<th>Reference AHU</th>
<th>Reference UIMG</th>
</tr>
</thead>
<tbody>
<tr>
<td>CV–130</td>
<td>UIMG–130</td>
</tr>
<tr>
<td>CV–131</td>
<td>UIMG–131</td>
</tr>
<tr>
<td>CV–132</td>
<td>UIMG–132</td>
</tr>
<tr>
<td>CV–133 (option)</td>
<td>UIMG–133</td>
</tr>
<tr>
<td>CV–134</td>
<td>UIMG–134</td>
</tr>
</tbody>
</table>

3.8.6 Cables and cable trays

The Contractor shall be responsible for all the cables and cable trays down line the power cubicles. Outside cable trays shall be hot deep galvanised.

Safety–related installations as well as their remote controls (power supplies, remote control and indications) shall be connected by fire–resistant cable. These cables shall be installed in red non–combustible cable trays. The installations supplied by secured power shall be:

• firemen control cubicle link.

3.8.7 Earthing

All metal parts shall be earthed by the Contractor at the connectors provided by CERN.
3.8.8 Connections

The Contractor shall be responsible for all the power, control and monitoring connections of the AHUs and their sensors and actuators.

Local shut–down switches shall be provided for the AHUs not visible from the electrical cubicle. All the local and remote controls and the control connections shall be provided by the Contractor. All safety installations shall have manual override from the fire brigade control cubicles. After local shut–down, the indication of the presence of the power supply voltage for the supply fans shall be transferred to the local monitoring system.

3.8.9 Warning

AHUs shall be protected from normal power interruptions, in particular with electric coils.

3.8.10 References

Annex 1  Technical Requirements
Annex 2  Tender drawings  LHCU21750012,  LHCU21750015, LHCU21750020
Annex 3  Principle schematics  LHCU21751002,  LHCU21751003, LHCU21751004
3.9 WORK LOT 8: CONTROL AND REGULATION

Work lot 8 concerns the control and regulation systems necessary for the previous work lots.

3.9.1 Principle

The ventilation shall be continuous. The Contractor shall be responsible for supplying and installing all the equipment necessary for the regulation, monitoring and control of the installations.

Regulation shall be digital. It shall be designed for connection to a communication bus with addressing, so as to provide the possibility of changing set points remotely and supervising the states of each unit (temperature, humidity, heating, cooling, humidification, dehumidification, motors operation hours, electrical consumption, peak electrical power, histograms, etc.).

3.9.2 Operating modes

- EJP: reduced consumption period,
- heating or/and air conditioning,
- free cooling in mid–season and summer,
- smoke extraction mode,
- slow down mode,
- automatic mode and manual mode.

3.9.3 CERN rules

Some general principles on the regulation of these installations are given here. This list is not exhaustive. During the work phase, the Contractor shall provide CERN with the function and malfunction analyses and the detailed function flow–charts for each circuit’s regulation loop programs. These flow–charts shall be based on this Technical Specification and on any further detailed information CERN may provide the Contractor during the work.

Electric coils shall be supplied by circuit breakers controlled by the PLCs, the power supply from the UIAC board being done via thyristors commanded by 0–10 voltage signals. The coils shall be protected against undesired temperature rise by means of thermostats and temperature sensors. CERN requires two UBTT thermostats installed per each heating element (NFC 15–100), whereas manufacturers usually supply just one. The powering of the electric heaters shall be slaved to the operation of the fan.

During the EJP mode (reduced power consumption periods) the AHUs shall operate on all–return air (fresh air damper closed), the electrical heaters powered, but the room temperature set point being lowered.

Three–way valves shall be foreseen with position indication signal.

AHUs containing electrical coils shall be fitted UBFY smoke detectors which shall stop the AHU upon detection (indication: "smoke detection supply duct" on the monitoring system, fault origin: "presents of smoke in return ducts", action: "stop of the installation", acknowledgement: logical and mechanical).

In all the conditioned spaces high and low temperature thresholds on the ambient air temperature sensor shall be set, allowing to set–off an alarm in case of high/low temperature.

The measurements from sensors installed in a plenum serving several AHUs shall be transmitted to all the PLCs linked to those AHUs.

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All the operations that can be controlled automatically shall also be capable of being controlled or performed manually. In general, the manual controls shall have priority. They shall be transmitted to the monitoring system. The automatic control installation shall be configured so that simultaneous action of the automatic system commands and the manual controls is impossible.

The Contractor shall size the number and sizing of feeders in the UIAO cubicles, and the number of PLCs per cubicle.

3.9.4 Specific regulation concepts
Operating points in existing CV1–125 AHU will modified by CERN. If the heat load in racks area is low, the air flow rates will be reduced.
Over pressure shall be maintained the in new areas.
The CV1–127 air conditioning plant shall stop if CV1–125 stops.
For each new area, the AHU’s shall stop in case of fire detection in the considered area.
Dampers shall also self–close automatically in case or power interruption.
The fan–motors of the new AHUs located in CV1–127 will work by default on the small speed. The second speed shall be selected if the heat load in occupied zone is higher.

3.9.5 Emergency stops
The contractor shall provide emergency stops:
• One in front panel of UIAO 127,
• One in front panel of UIAO 128,
• One in front panel of CV1–133,
• One in front panel of CV1–134 (option),
• Two in front panel of UICN 125.

3.9.6 Controller programming
The contractor will be in charge of the programming of the PLCs, the design and the implementation of the control application programmes, including the calculation, simulation, tuning and validation of the control parameters for each regulation loop, the communication between the PLCs, and the monitoring system. Each PLC will be able to inform the monitoring system and the other PLCs about its availability/unavailability status, which has to be periodically self–tested and reported by event.

3.9.7 UIAO 127 control cubicle (Contractor supply)
UIAO 127 will be located in CV1–127 room and shall conform to paragraph 7.2.3 of Annex 1; it shall be supplied from UIAC 127 cubicle by the Contractor. UIAO 127 shall also incorporate its own PLC, according to paragraph 9.1 of annex 1, for monitoring, control and regulation of the new AHUs including sensors and actuators related to the process.
Table 6 – UIAO 127 control cubicle in new ventilation room

<table>
<thead>
<tr>
<th>Reference UIAO (cubicle)</th>
<th>Reference UOWC (PLC)</th>
<th>Reference AHU</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIAO 127</td>
<td>UOWC 127</td>
<td>CV–130</td>
</tr>
<tr>
<td></td>
<td>UOWC 127</td>
<td>CV–131</td>
</tr>
<tr>
<td></td>
<td>UOWC 127</td>
<td>CV–132</td>
</tr>
<tr>
<td></td>
<td>UOWC 127</td>
<td>CV–135</td>
</tr>
<tr>
<td></td>
<td>UOWC 127</td>
<td>humidifier</td>
</tr>
<tr>
<td></td>
<td>UOWC 127</td>
<td>All instruments and actuators</td>
</tr>
<tr>
<td></td>
<td>UOWC 127</td>
<td>Ethernet links</td>
</tr>
<tr>
<td></td>
<td>UOWC 127</td>
<td>Console operator</td>
</tr>
</tbody>
</table>

3.9.8 UIAO 128 control cubicle (Contractor supply)

UIAO 128 will be located on the concrete slab for unloading and shall conform to paragraph 7.2.3 of Annex 1; it shall be supplied from UIAC 128 cubicle by the Contractor. UIAO 128 shall also incorporate its own PLC, according to paragraph 9.1 of annex 1, for monitoring, control and regulation of the new AHUs including sensors and actuators related to the process.

Table 7 – UIAO 128 control cubicle on the concrete slab for unloading

<table>
<thead>
<tr>
<th>Reference UIAO (cubicle)</th>
<th>Reference UOWC (PLC)</th>
<th>Reference AHU</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIAO 128</td>
<td>UOWC 128</td>
<td>CV–133</td>
</tr>
<tr>
<td></td>
<td>UOWC 128</td>
<td>CV–134</td>
</tr>
<tr>
<td></td>
<td>UOWC 128</td>
<td>All instruments and actuators</td>
</tr>
<tr>
<td></td>
<td>UOWC 128</td>
<td>Ethernet links</td>
</tr>
<tr>
<td></td>
<td>UOWC 128</td>
<td>Console operator</td>
</tr>
</tbody>
</table>

3.9.9 UICN 125: manual fire brigade command cubicle (to be modified by the Contractor)

The Contractor shall also provide a new FELLER switch to stop CV1–127 plant and one to stop CV1–128 plant, including connecting cables and connections. Indication shall be provided by 4 additional LED. Each command shall be transmitted to the monitoring system. All the modifications made on the UICN 125 shall not modify the existing performances.

Table 8 – UICN 125 manual fire brigade command cubicle

<table>
<thead>
<tr>
<th>Ref.</th>
<th>AHUs</th>
<th>Switch</th>
<th>LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>UICN 125 existing</td>
<td>CV1–125 mode</td>
<td>1x3 (Run/Stop/Smoke extraction)</td>
<td>2 (Run/Stop)</td>
</tr>
<tr>
<td></td>
<td>CV1–126 mode</td>
<td>1x3 (Run/Stop/Smoke extraction)</td>
<td>2 (Run/Stop)</td>
</tr>
<tr>
<td></td>
<td>3 dampers CV1–125</td>
<td>–</td>
<td>2 (Open/closed)</td>
</tr>
<tr>
<td></td>
<td>3 dampers CV1–126</td>
<td>–</td>
<td>2 (Open/closed)</td>
</tr>
<tr>
<td>new</td>
<td>CV1–127</td>
<td>1 (Run/Stop)</td>
<td>2 (Run/Stop)</td>
</tr>
<tr>
<td>new</td>
<td>CV1–128</td>
<td>1 (Run/Stop)</td>
<td>2 (Run/Stop)</td>
</tr>
</tbody>
</table>
3.9.10 Instrumentation

The Contractor shall be responsible for supplying and installing the air and hydraulic system sensors and actuators, in accordance with the technical requirements in paragraph 8 of Annex 1. The instrumentation is indicated on the theoretical diagrams in Annex 3.

3.9.11 Cables and cable trays

The Contractor shall be responsible for supplying and installing all the cables, cable trays and telex–type rails necessary for wiring the sensors and actuators from the control cubicles, in accordance with the technical requirements of Annex 1. Outside cable trays shall be hot deep galvanised.

3.9.12 Earthing

All metal parts shall be earthed. The Contractor shall be responsible for earthing the controllers, boards, sensors, actuators and other equipment that require earthing.

3.9.13 Connections

The Contractor shall be responsible for all connections. The Contractor shall provide the connections of the electrical boxes and cubicles of his installations from the connectors provided, defined in the scope of the work. Local shut–down switches shall be provided for the AHUs not visible from the electrical cubicle.

3.9.14 References

<table>
<thead>
<tr>
<th>Annex</th>
<th>Description</th>
<th>LHCU21750012</th>
<th>LHCU21750015</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Tender drawings</td>
<td>LHCU21750020</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Principle schematics</td>
<td>LHCU21751002</td>
<td>LHCU21751003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LHCU21751004</td>
<td></td>
</tr>
</tbody>
</table>
3.10 WORK LOT 9: MONITORING SYSTEM

Work lot 9 concerns the monitoring systems necessary for the previous work lots.

3.10.1 Generalities

The local monitoring system control and communication architecture for these facilities will keep homogeneity with other local monitoring systems existing at CERN.

3.10.2 Monitoring system description

The two new PLCs shall be provided by the Contractor with incorporated Ethernet TCP/IP modules with memory. The report will be foreseen of all information, in real time –alarm, status, parameter, remote command,?– attached to the sensors, regulators, actuators and ventilators, to the monitoring system with definition of variables in the local database for each piece of information. The previous information shall be available from the HTML format.

The Contractor shall provide a console operator only in UIAO 127 and UIAO 128, composed with a keyboard and incorporated screen, to visualise parameters and modify them.

CERN will provide an Ethernet socket close to each PLC and the connection the PLC. The programming of the web mimic diagrams will be done by CERN.

The Contractor shall be responsible of the quality of information, defaults, alarms in the memory database of the PLC for web requests via Ethernet network. If needed, the Contractor shall modify the database of the PLC until the web monitoring will operate.

3.10.3 Monitoring modes for UIAO 127 and UIAO 128 systems

- Automatic,
- Manual mode from switch and emergency stops
- Local mode from the console operator connected to the PLC (visualisation of parameters, commands, operating point modification)
- Local mode from a CERN PC portable computer connected to a PLC socket (visualisation of parameters, commands, operating point modification, program modification)
- Distant mode from the TCR or a computer via the web (information only, no commands)

3.10.4 Communication between the PLCs and the electrical cubicles supplied by CERN

The UIAC 127 and UIAC 128 electrical power cubicles shall communicate with the PLC of UIAO 127 and UIAO 128, via cables. The physical link and the communication through these cables shall be done by the Contractor. The non-operational status of the electrical cubicle shall not disturb the operation of the PLC to which it is attached, nor the communication on the fieldbus. The protocol shall be in conformity with the industrial standard. It shall be documented and available for CERN, as well as the eventual updates. The network shall include all the features required to control the electrical cubicles from the PLC and the monitoring system.

3.10.5 CERN Ethernet TCP/IP Services network

The CERN Ethernet Services TCP/IP network, at 100 Mbit/s, allows the following communication:

- The dialogue between the different PLCs,
• the dialogue between the PLCs and the local monitoring system,
• the backup of the databases, in a daily basis on the CERN IT Ethernet, from each local monitoring system station towards the archiving station at Meyrin,
• the dialogue between the different local monitoring system stations,
• the communication between a central supervision station (real time: alarm and histogram–trend consultation, mimic diagrams visualisation, analysis, ?) and the different local monitoring system stations will be done by the principle client/server and the CERN IT Ethernet TCP/IP,
• the communication between the local monitoring stations, the TDS and the Technical Control Room supervision system, will be done by the Ethernet Services network.

The physical link, as well as the different CERN Ethernet Services TCP/IP, will be provided by CERN. The dialogues between the different equipment by means of this network is under CERN’s responsibility. Any intervention on this network must be authorised by CERN. The IP configuration parameters to connect computers on this network will be provided by CERN.

3.10.6 Function analysis

In the same way as for the function requirements, a misfunction analysis must precise and fully identify the behaviour of the processes after a restart caused by power failures or breakdowns in the various components. CERN facilities can be affected by power failures that are related to safety aspects. For this reason the monitoring system shall be capable of automatic restart after a power failure. The misfunction analyses shall contain, at least:

• Initialisation and general control phase,
• transient task identification,
• transient task sequencing.

3.10.7 References

Annex 1  Technical Requirements
Annex 2  Tender drawings  LHCU21750012, LHCU21750015
Annex 3  Principle schematics  LHCU21751004
3.11 OPTION 1: REFURBISHMENT OF THE EXISTING VENTILATION ROOM CV1–125

Option 1 concerns the expense price for the refurbishment of the existing CV1–125 ventilation room.

3.11.1 Cleaning and preventive maintenance

The existing ventilation room CV–125 will be cleaned, in particular the dampers, inside panels of the AHU, and also manual dampers in the technical gallery. The dust will be brushed, washed. The mechanical parts of air handling components will be tested, maintained with greasing, etc. A panel with the general working scheme of the installation shall replace the existing one located in CV1–125 room.

3.11.2 Replacement of the filters

The Contractor shall remove the existing winding filter of the unit CV1–125–1, and shall install a pre filter and also new filters as following:

- **Stainless steel pre filter UFPZ:** characteristics according to paragraph 1.7.2 of annex 1 and dimensions as per air flow of the fresh air grille.
- **Multi–V pleated filter UFFM (multidriedal):** characteristics according to paragraph 1.7.3 of annex 1 and dimensions as per air flow in the whole air supply section of the AHU.

- **UIAO 125 control cubicle (to be modified by the Contractor)**

The Contractor shall remove the existing PLC in UIAO 125 control cubicle and provide a new one according to paragraph 9.1 of annex 1.

Characteristics of the existing PLC:

- Make: LANDIS & GYR
- Type: VISIOGYR 04
- 230 V, 47–63 Hz, 40 W, T250 mA

The new PLC will be located, either in the existing cubicle if there is enough place, either in a separate cubicle. The I/O cables will be connected to the existing terminals blocks. It will also receive the new sensors and actuators of the new system.

3.11.4 Update of the regulation system

The existing PLC in UIAO 125 shall be replaced by a new one, according to annex 1, cabled from its new position to the existing terminal blocks. The Contractor shall provide all the instrumentation needed for the new requirement.

3.11.5 Required conditions of the supply air in the technical gallery

The existing AHU will be configured for the new requirement in terms of air flow rate, and operating points to obtain the following conditions:

<table>
<thead>
<tr>
<th>Room</th>
<th>Dew point °C</th>
<th>Dry bulb temperature °C</th>
<th>Water ratio G / kg dry air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical gallery</td>
<td>10</td>
<td>&lt; 12</td>
<td>≤ 8</td>
</tr>
</tbody>
</table>

Technical Specification
3.11.6 Modification of the extraction fan–motor transmission

The Contractor shall modify the extract air motor–fan transmission ratio on the basis above specification and guarantee the air flow rate to be attained in the new configuration.

3.11.7 Replacement of the existing the variable speed drive

The Contractor shall remove the existing variable speed drive and provide two new systems based on variable frequency principle, according to annex 1. The Contractor shall prevent the installation form harmonics by filters and all fittings. The old system is a GRADIVAR type VR1BH005, serial number 2T8545008.001 from TELEMECANIQUE, to be remove.

3.11.8 Replacement of the existing motors of fans

The motors of the fans will be replaced with new ones. Here are the technical characteristics of the existing fans and motors:

<table>
<thead>
<tr>
<th>Item</th>
<th>Supply air CV1–125–1</th>
<th>Extract air CV1–125–2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fans</td>
<td>Fan 1</td>
<td>Fan 2</td>
</tr>
<tr>
<td>Make</td>
<td>GEBHARDT</td>
<td>GEBHARDT</td>
</tr>
<tr>
<td>Type</td>
<td>RZR 13 – 1120 N2 RD 180</td>
<td>RZR 13 – 1120 N2 RD 270</td>
</tr>
<tr>
<td>Serial number</td>
<td>N° 8508/37208/3</td>
<td>N° 8508/37205/4</td>
</tr>
<tr>
<td>Bearings</td>
<td>22216CCK/C3 H316</td>
<td>22216CCK/C3 H316</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Supply air CV1–125–1</th>
<th>Extract air CV1–125–2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motors</td>
<td>Motor 1</td>
<td>Motor 2</td>
</tr>
<tr>
<td>Make</td>
<td>LEROUY SOMER</td>
<td>LEROUY SOMER</td>
</tr>
<tr>
<td>Type</td>
<td>PLS 6 225</td>
<td>PLS 6 180L</td>
</tr>
<tr>
<td>Speed</td>
<td>1400 rpm/mn</td>
<td>1400 rpm/mn</td>
</tr>
</tbody>
</table>

3.11.9 Existing UIAC 125 electric power cubicle modification (normal and secured networks)

Cubicle reference UIAC 125 exists in ventilation room CV1–125. This cubicle has a manual switch that can select the normal power supply, or the secured power in case of smoke extraction.

The Contractor shall remove all electric cubicles in this ventilation room, and provide new ones according to Annex 1, separating power and control electrical systems.
**Table 9 – UIAC 125 – CV1–125 ventilation room**

<table>
<thead>
<tr>
<th>Reference UIAC</th>
<th>P* (kW)</th>
<th>Component</th>
<th>Reference AHU</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIAC 125</td>
<td>30</td>
<td>Fan motor UMFV</td>
<td>CV1–125–1 supply</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>Fan motor UMIV</td>
<td>CV1–125–2 extraction</td>
</tr>
<tr>
<td></td>
<td>−</td>
<td>Internal lighting</td>
<td>CV1–125</td>
</tr>
<tr>
<td></td>
<td>−</td>
<td>Control cubicle</td>
<td>UIAO 125</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Instrumentation, valves</td>
<td>CV1–125</td>
</tr>
</tbody>
</table>

*P is the CERN estimated electric power in kW of the component that has been confirmed by the Contractor*
3.12 OPTION 2: ADDITIONAL AHU FOR THE CLEAN ROOM

Option 2 concerns the expense price to supply and install an additional AHU (CV1–133) if CERN decides to build the clean room.

3.12.1 Required indoor conditions

<table>
<thead>
<tr>
<th>Room</th>
<th>Temperature</th>
<th>Humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean room</td>
<td>22 ± 2</td>
<td>50 max</td>
</tr>
</tbody>
</table>

3.12.2 Description of the works

The clean room will have mobile partitions to provide different areas to the room. The Contractor shall provide the additional CV1–133 AHU, located on CV1–134, open air in the same steel structure. Dampers mounted in ducts shall permit the combination of the two AHU’s with the two ductworks. The Contractor shall supply 4 operating points available in the PLC in order to adapt the air flow rates to each configuration of the partitions.

3.12.3 References

Annex 1 Technical Requirements
Annex 2 Tender drawings LHCU21750015, LHCU21750020
Annex 3 Principle schematics LHCU21751003
3.13OPTION 3: ADDITIONAL HUMIDIFIER FOR THE TEST AREA
Option 3 concerns the expense price for the humidification of the test area.

3.13.1Required indoor conditions

<table>
<thead>
<tr>
<th>Room</th>
<th>Temperature</th>
<th>Humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test area</td>
<td>22 ± 2</td>
<td>40 ± 10</td>
</tr>
</tbody>
</table>

3.13.2Supplying and fitting a humidification system
The Contractor shall supply and install a humidification system in a long straight of the supply duct. The system shall be from the steam injection principle with easy maintenance type DENFENSOR MK5 from AXAIR or equivalent, comprising all fittings. The humidifier itself will be located in CV1–127 ventilation room. The Contractor shall install all the necessary equipment to that purpose, starting from an existing valve close to CV1–127 room for the water and from UIAC 127 for the electricity. The Contractor shall be responsible also for the drainage of the system to the existing floor drains in the false floor.

3.13.3References
Annex 1  Technical Requirements
Annex 2  Tender drawings  LHCU21750001,  LHCU21750012,  LHCU21750015
Annex 3  Principle schematics  LHCU21751002
3.14 OPTION 4: ADDITIONAL GAS EXTRACTION SYSTEM IN THE TEST AREA

Option 4 concerns the expense price for the extraction of gas mixture in the Test Area in case of leakage.

3.14.1 Principle
A mechanical system shall be installed to mechanically extract gas mixtures (with static air supply to the test area).

3.14.2 AHUs and air distribution
An extraction box CV1–135, which may be installed under the roof of the test area, shall provide an overall extraction flow rate of 2,000 m³/h.

This network shall be made of single–skin galvanised sheet steel, with return grills and dampers at low and high places, also one branch in the false floor. Plugged branches shall also be provided, with dampers, for future ad hoc extraction from the cavern.

3.14.3 Regulation
Extraction shall be done only when gas leakage is detected. Its operation shall be slaved to the area’s gas detection system.

If a gas leakage is detected in the area (signal obtained on a free–potential contact), the extraction unit shall switch to the nominal flow rate.

The Contractor shall supply all the regulation instruments, connect them electrically and carry out their programming and commissioning.

Operating modes:

• Automatic emergency mode: extraction at 2,000 m³/h,
• manual mode: manual command close to the test area entrance.

3.14.4 References
Annex 1 Technical Requirements
Annex 2 Tender drawings LHCU21750012, LHCU21750015
Annex 3 Principle schematics LHCU21751001, LHCU21751002, LHCU21751005