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Legal notice:

The courtesy translations provided in the following have been done by best knowledge. Nevertheless it shall be noticed that the translation is not legally binding: The official documents must be in Italian by law.

If you should need any kind of clarification please refer to the Responsabile Unico del Procedimento (RUP) according the procedures provided in the call for tender document.

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Laboratory for Underground
Nuclear Astrophysics

LUNA MV

Restricted procedure for the supply and installation of a single stage electrostatic accelerator for the LUNA MV project at Laboratori Nazionali del Gran Sasso (L.N.G.S.) of Istituto Nazionale di Fisica Nucleare (I.N.F.N.)

SPECIAL TENDER SPECIFICATIONS

SPECIAL TENDER SPECIFICATIONS

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ART. 1 DESCRIPTION OF THE PLACE OF INSTALLATION

Laboratori Nazionali del Gran Sasso (L.N.G.S.), located between the cities of L'Aquila and Teramo, about 120 km from Rome, consist of the external laboratories, which house the management centre and support facilities - such as offices, various services, library and canteen -, and the underground laboratories, where the experimental equipment is located (www.lngs.infn.it).

The underground laboratories, 1000 m above sea level and covered by 1400 metres of rock, consist of three experimental Halls (A, B, and C), each with a length of 100 m, a width of 20 m, and a height of approximately 18 m, in addition to the service tunnel. The underground laboratories can be reached, subject to authorisation, also by trucks from the A24 motorway that links Teramo to Rome. Both the external and the underground facilities are within the Gran Sasso National Park and the Lega Mountain area.

The underground laboratories are also subjected to the requirements of Legislative Decree no. 334/99 and subsequent amendments and integrations, which acknowledges the Seveso Ter European Directive. Therefore, L.N.G.S. have adopted and implemented a Safety Management System in accordance with such Decree. For further information visit the website of the Contracting Authority, spp.lngs.infn.it.

The equipment object of the tender shall be installed inside dedicated facilities, located in "Hall C" of the underground laboratories, as shown in the attached drawings. The temperature of “Hall C” is 20 ± 4 °C, with relative humidity of 50 ± 5 %. Inside “Hall C” there are two bridge cranes, each with a load capacity of 20 tonnes. The access for trucks is in the south area of "Hall C”, in a location served by a bridge crane.

The structure serving the equipment object of the tender is split into an Accelerator Room and a Control Room. The installation arrangements are shown in the attached drawings (Figure1). In these areas, the temperature will be 21 ± 3 °C, with relative humidity of 50 ± 5 %. The Accelerator Room will be accessible through two shielding cement doors, which will be kept closed during the beam operation of the equipment object of the tender. Inside the Accelerator Room, a bridge crane with a 1000 kg loading capacity will be available. An indicative arrangement of the equipment object of the tender is shown in Figure2, which also shows the reference measurements of the Accelerator Room and the Control Room. In view of the particular features of the location of installation of the supply, in addition to viewing the attachments describing the areas, and the general conduct regulations of the Contracting Authority, a visit to the underground laboratories, to be agreed with the RUP, is also recommended.

The points of connection for the equipment object of the tender to the electricity and LAN network will be in the Control Room. The points of connection to the compressed air and cooling water systems will be in the Accelerator Room.

The electric control boards of the equipment object of the tender will be located in the Accelerator Room, with the exception, if the case, for the boards servicing the control system.

It must be noted that L.N.G.S. have introduced an Environmental Management System in accordance with ISO 14001 standards, and that the activities carried out inside L.N.G.S. (both in the underground and the external facilities) are regulated by an

Environmental Management Manual, and by specific management procedures and operating instructions. The Contractor shall, as far as their framework of responsibilities, comply with such procedures and instructions, and with any other operating instructions aimed at ensuring compliance with the Environmental Policy of L.N.G.S., and the set procedures/instructions.

ART. 2 OBJECT OF THE SUPPLY

The equipment object of the tender consists of the single stage electrostatic accelerator, the beam transport line, and all the necessary systems required for the operation of the whole system. The Contractor shall be responsible for the construction - at its own facilities -, the transport, insurance, installation, and alignment of the equipment object of the tender.

The Contractor shall therefore be fully responsible for the design, the construction, and the installation.

The Contractor shall also take charge of the accelerator and the beam transport line operating tests. He shall supply all the pieces of equipment, materials and instruments required to produce and test the accelerator and the beam transport line.

2.a **Accelerator** The high voltage power supply unit of the single stage electrostatic accelerator shall supply a voltage equal to 3.5 MV at the terminal. The Contractor shall be free to select the high voltage generation system and the high voltage stabilisation system. If not already provided for, the power supply must allow to subsequently activate the stabilisation through a “slit feed back system”. The acceleration tube must contain features that reduce the production of X rays during the beam acceleration stage. The accelerator must be equipped with a “shortening rod”.

Terminal, high voltage supply unit, and acceleration tube, are installed inside a pressure tank containing SF_6 insulation gas. The tank must be built in such a way that it is easy to move during installation and during maintenance activities. In order to minimise X ray emissions, a lead shield must also be included.

The terminal of the accelerator consists of the ion source, the beam extraction system, the “terminal magnet”, and other optical components that may be required to adapt the optical properties of the source to those of the acceleration column. Three "gas systems" will have to be installed on the terminal, serving the ion source. The ion source must be capable of supplying all the types of beams indicated in the minimum specifications described at the end of this section. The “terminal magnet” must have a mass resolution sufficient to separate H^+ and H_2^+ beams extracted from the ion source. Any changes in the parameters of the beam extraction system shall not change the energy of the beam on the target.

The system must be supplied ready for the future installation of a “beam profile monitor” and a Faraday cup on the terminal, even if these are not supplied within the scope of this tender.

2.b **Transport of the beam** The section “Upstream” of the beam line connects the accelerator to the analysis magnet. It consists of a stainless steel vacuum chamber, containing vertical and horizontal electrostatic “steerers”, any optical elements, a Faraday cup, and a “gate valve” connected to the output of the line itself. The vacuum system must be based on turbo pumps, and oil free primary pumps, and must be supplied complete with a vacuum measurement system. It is also required to allow for a “drift” without any components inside, in order to be able to build a shielding wall of a minimum thickness of 1.5 m between the tank and the analysis magnet. All the flanges of the beam transport section must have copper gaskets. If not already contemplated, the construction of the section “Upstream” of the beam line must allow for the future addition of a “beam profile monitor”, and a “slit feed back” system, required for the stabilisation of the high voltage supply unit.
The line section must be connected to the analysis magnet through a bellow. The product between the value of the mass and the energy of the beam (M*E), must be higher than 45 amu MeV. The corresponding vacuum chamber must have outputs at 35° and 0°, with flanges with copper gaskets, and a port for the alignment of the line at 35°. A "beam dump" must also be installed on the 0° output, capable of absorbing for long periods the maximum obtainable beam intensity. The power supply of the magnet must not exceed 30 V. Together with the magnet itself, the Contractor shall also provide a mapping of the calculated magnetic field.
The “Downstream” beam transport line section connects the analysis magnet to the target indicated in the attached drawings. The line section must consist of a stainless steel vacuum chamber containing vertical and horizontal electrostatic “steerers”, optical elements, the Faraday cup, and a “gate valve” connected to the output of the line itself. The vacuum system must be based on turbo pumps and oil free primary pumps, and shall be supplied complete with a vacuum measurement system. All the flanges of the beam transport section must have copper gaskets. If not already contemplated, the construction of the section “Downstream” of the beam line must allow for the future addition of a “beam profile monitor”, and the “slit feed back” system, required for the stabilisation of the high voltage supply unit. The line section must be connected to the analysis magnet through a bellow.
The “Target” position is shown in the attached drawings (Figure 2). It must be at least three metres after the last focusing element, and at no less than two metres from the internal walls of the Accelerator Room.

2.c **Equipment** All the equipment required for the generation of the ion beam must be monitored and controlled from the Control Room. After start-up by an operator, the equipment object of the tender must be capable of delivering the ion beam on the “Target” for at least 23 hours without human intervention.
The equipment object of the tender must be fitted with all the necessary interlocks and controls to prevent damage to people and property. In addition, in

case of unexpected faults, or in case of mistakes by an operator, such systems must bring the equipment object of the tender back to a safe state, that shall be maintained for at least 8 hours without further damage.
No automatic restart shall be permitted.

The management and the control of the whole equipment object of the tender takes place inside the Control Room, through a supervision and control system. This system is the only tool for the supervision and the control of the equipment object of the tender, and must enable the operator to completely display and handle all the parameters and tools required for the generation and the transport of the beam, and for ascertaining its quality. The system must provide the operator with the reset tools after unwanted and emergency interruptions.
The supervision and control system must allow the reading of the ion currents of the openings, slits and Faraday cups in a range between 10 nA and 1mA. A current integrator with 1% integration precision on the total of the integrated charge shall be included in the supply. For each current and voltage power supply unit, both the current and the voltage values read on the field must be listed.
Access to the supervision and control system must be protected by Username and Password. The supervision and the management of the parameters of the beam must be possible through the LAN network of L.N.G.S.
In addition to the parameters from the equipment object of the tender, the supervision and control system must give the possibility of acquiring and displaying a limited number of external parameters, including the status of the controlled access doors, the exceeding of the permitted radiation limit, and the alarms generated by the supervision system of the underground laboratories. It must also allow to use these parameters to generate interlocks for the operations of the equipment object of the tender. For this purpose, a minimum number of 8 low voltage digital inputs and 8 analogue inputs must be included. It must be mentioned that the use of these ports must be freely configurable by the Customer, also after the delivery of the equipment object of this tender.
The supervision and control system must also allow to transfer a limited number of parameters of the equipment object of the tender to external systems, including the supervision system of the underground laboratories and the LUNA-MV project data acquisition system. For this purpose, at least 8 low voltage digital outputs and 8 analogue outputs are required. The use of these ports must be freely configurable by the Customer, also after the delivery of the equipment object of this tender. The use of a “client server” structure allowing the exchange of data with other control systems will be the object of an assessment (Art. 7).
The supervision system must allow the operator to independently configure charts containing the time development of at least four parameters selected by the operator. These charts must be automatically updated by the supervision system at least once every second, and must cover a period of time of at least one hour.
The control system must also include a long-term log with storage of the machine parameters at intervals of at least one minute. Routines must be

supplied for chart data display, and for the automatic weekly creation of backup data copies on mass storage units. The mass storage units shall be part of the supply. All the data must be accessible by the operators also outside the environments of the control system, in widely used data formats.
Licences for the use and modification of any commercial programs used must be supplied as part of the tender.
All the elements of the equipment object of the tender must be made of components that are widely available on the market, and which are expected to be still available on the market for a minimum period of 10 years. For the realisation of the equipment object of the supply, the Contractor shall use cables and tubes, and in general plastic materials without halogens.
The temperature inside the cabinets must not exceed 50 °C during continuous operation at full power.
The water cooling system found at L.N.G.S. is of the closed type. All the elements must therefore be compatible with this system. No cooling liquids other than water shall be permitted.

Minimum supply specifications

Below are the minimum mandatory specifications for the equipment object of the supply.

a) Maximum terminal voltage TV applicable to all the accelerated ions	3.5 M.V
b) Accelerated ions	H^+, $^4He^+$, $^{12}C^+$ and $^{12}C^{2+}$
c) Ripple with the maximum extracted beam intensity for TV > 0.3MV	± 0.01% of TV
d) Precision of the voltage reading at the terminal	350 V
e) Repeatability of the beam energy with maximum beam current, irrespective of the species of the beam	± 0.01% of TV
f) Variation of the beam energy after one hour of operation	< 0.001% of TV
g) Variation of the beam energy after one minute of operation	< 0.001% of TV
h) Variation of the beam intensity after one hour of operation	1 % of the actual current
i) Variation of the beam intensity during one minute of operation	10% of the actual current

j)	Minimum value of the vacuum at the output of the accelerator, with accelerator off (including ion source)	10^{-7} mbar
k)	Minimum value of the vacuum at the output of the accelerator with beam at maximum power	10^{-5} mbar
l)	Time required to change the species of beam for a maximum number of 3 species of beam	< 2 h
m)	Time of continuous operation of the beam at maximum intensity without local or remote operator intervention	> 23 h
n)	Time of interruption of the beam after reaching the maximum continuous operation time	< 1h
o)	Time of continuous operation at maximum beam intensity without opening the tank	> 700 h
p)	Time of annual operation with maximum beam intensity	> 7400 h
q)	Beam line height	1600mm

ART. 3 AMOUNT OF THE SUPPLY

The amount of the supply as described in Art. 2 is equal to Euro 3,156,000.00 + VAT, custom cleared and free delivered at L.N.G.S. ("Delivery Duty Paid", DDP, following the rules of the International Chamber of Commerce 2010). The amount includes Euro 5,000.00 to be used in case of interferences during the installation at L.N.G.S.

ART. 4 PROFESSIONAL FIGURES DURING THE REALISATION STAGE

The Contracting Authority shall appoint the Director for the Execution of the Contract (DEC – Direttore per l'Esecuzione del Contratto) - who shall be responsible for the coordination, the management, the technical and the accounting control of the execution, pursuant to art. 301 of Presidential Decree no. 207/2010 -, and the Conformity Inspection Officer (IVC - Incaricato della Verifica di Conformità) - who shall operate pursuant to art. 317, 318, 321 and 322 of Presidential Decree no. 207/2010,

and subsequent amendments and integrations -.
The Contractor shall appoint an experienced specialist technician ("senior specialist") as Technical Manager for the whole Production (RTP – Responsabile Tecnico per l'intera Produzione).
The RTP shall be the referent of the project and shall be responsible towards the Contracting Authority for all the aspects of this Contract, for the whole Contract period. In particular, the RTP shall:

- Organise regular meetings with the Designer and the DEC;
- Provide updates at two-week intervals on the progress of the design and manufacturing;
- Regularly supply an updated and detailed calendar for the procurement of materials and equipment, for the construction and the tests;
- Organise written meeting and progress reports, with a copy to be forwarded to the Contracting Authority within 5 days.

The Contractor shall also appoint an Installation Manager (RI – Responsabile dell'Installazione) with previous experience in the installation of similar equipment, in charge for coordinating and supervising the installation of the equipment object of the tender at the underground laboratories of L.N.G.S., until completion of the conformity assessment activities. The RI shall also be responsible for the training of personnel pursuant to Art. 8.
The appointments of the RTP and RI shall be forwarded to the Contracting Authority for approval. The Contracting Authority shall be entitled to demand the immediate replacement of the RTP and/or the RI appointed by the company, should L.N.G.S. consider them, to their unquestionable judgement, to behave unacceptably, and/or to be unable to ensure the appropriate completion of the supply in accordance with the terms of the Contract. No indemnity or compensation shall be due to the Contractor by L.N.G.S. for such replacement.

ART. 5 SUPPLY EXECUTION STAGES

5.1 **Design** Following the awarding of the Contract, the Contractor shall appoint the RTP and shall produce the technical project, which shall be checked and approved by the DEC during the technical meeting summoned by the DEC.
The documentation supplied by the Contractor shall include:

i) Technical/executive supply project, containing the executive designs, together with a full list of the components, and the electrical and hydraulic drawings.
ii) All the information useful for the production of the "Single Document for the Assessment of the Risks from Interferences" (DUVRI - Documento Unico di

Valutazione dei Rischi da Interferenze), containing the procedures for the unloading, transport, positioning, alignment and assembly of the equipment itself. This document shall be issued and updated in collaboration between the Contracting Authority and the Contractor.

iii) "Training Plan" following the requirements of Art. 8. The "Training Plan" shall be approved by the DEC.

iv) "Inspection Plan" containing a final list of all the mechanical and electrical checks that will be carried out on the components of the equipment object of the tender. The same document shall also include checks aimed at ascertaining what described in Art. 6 that follows. The "Inspection Plan" shall be approved by the DEC and the IVC.

5.2 **Execution at the Contractor's facilities** During the execution and the assembly of the supply, the DEC shall be entitled to carry out inspections at the Contractor's facilities, and at any sub-suppliers, subject to preliminary agreement.

During this stage, the Contractor shall regularly provide information on the advancement of the works, and forward copies of all the acceptance and conformity tests for each component realised or acquired from third parties.

Inspection visits during the different installation stages, for the control of the activities carried out on all the apparatuses installed, and the conformity of the same in relation to the documentation forwarded during the agreement of the Contract, shall be agreed and carried out by the Conformity Inspection Officer, in the presence of the DEC and in collaboration with the RTP. These inspection visits may be attended by additional DEC appointed personnel. Each inspection shall be the object of a report. Any discrepancies found between the original project and/or the final technical documentation delivered, and/or the execution and installation, shall be resolved by the Contractor.

All the works and the provisions required for the correct installation and the perfect operation of the equipment, as well as for the inspection and testing activities, shall be at the expenses of the Contractor.

The Contractor shall supply, without additional charges, any parts not described and not accounted for in the overall offer, or not contemplated during the design stages, which however may prove necessary for ensuring that the specifications guaranteed by the Contractor are met.

5.3 **Packaging and Despatch** The delivery of the equipment object of the tender is subjected to the activities inside the underground laboratories. Therefore, despatch and delivery shall be coordinated together with L.N.G.S., taking into account the indications of the DUVRI.

The Contractor shall proceed to the packaging and the despatch of the

equipment object of the supply only after successful completion of the inspections indicated in Art. 6. The Contractor is responsible for packaging and despatching all the components, including for the organisation and the authorisation of the transport. The packaging and the despatch to L.N.G.S. shall be at the expense of the Contractor. Any damage to the equipment occurring during transport shall be the responsibility of the Contractor.

The Contractor shall deliver the supply to Hall C of the underground laboratories, to an area accessible by trucks, and served by bridge crane. Any expenses related to the further movement from the unloading area to the LUNA-MV site shall be the responsibility of the Contractor, subject to coordination with the DEC (see Plan in Figure2).

5.4 Installation at L.N.G.S.

Before being able to operate inside the underground laboratories, the personnel of the Contractor shall attend a safety course organised by the Prevention and Protection Service of the Contracting Authority. During this course, the Environmental Management System of the laboratories will also be introduced, together with the corresponding management procedures, and the operating instructions, in compliance with ISO 14001 standards.

The Contractor shall also be required to comply with all the provisions and measures implemented in order to ensure the safety of internal and third party personnel, in accordance with the requirements of Legislative Decree no. 81/2008 and subsequent amendments and integrations, and to avoid damage to public and private property, with indemnity to be paid in case of default.

The Contractor shall comply with the corresponding legal requirements and with the specific indications supplied for any waste resulting from the activities carried out at L.N.G.S.

The installation of the equipment object of the tender shall be completed under the supervision of the RI. The connection of the equipment object of the tender to the electricity network, the LAN network, the compressed air system, and the cooling water system, shall be the responsibility of the Contractor, subject to the indications of the DEC.

During the installation activities, the personnel of the Contractor shall comply with the provisions of the DUVRI. Should situations inside the underground laboratories require it, and following request of the appointed offices of the Contracting Authority, the DEC shall be authorised to order the suspension of the installation activities.

On completion of the installation at L.N.G.S., the RI shall formally declare completion of the installation and of the whole activity, and forward the final technical documentation to the Contracting Authority. From the date of

notification of completion of the installation and of the whole activity, and after checking the completeness of the supply documentation, the Contracting Authority shall plan the conformity inspection for the whole intervention, in accordance with the provisions of Art. 6.

The installation shall not be considered as complete until the following documents have been supplied:

a) description of the mode of operation and detailed circuit diagrams of all the systems and subsystems of the equipment;
b) complete list of the parts of the accelerator, the beam transport lines, and the sub-systems or equipment;
c) complete set of mechanical drawings, detailed wiring and interconnection diagrams, diagrams and circuits of all the electronic and electro technical components, list of the parts and their technical specifications, pneumatic and hydraulic system diagrams;
d) user manual describing the operating principles of the various pieces of equipment and their regulation, the procedures for adjusting the operating parameters of such equipment, the user instructions for the installation, the operation, and the maintenance of all the supply, and the instructions for the use and the management of the whole control system;
e) user manual describing the control system, as well as the corresponding communication protocol;
f) optical parameters of all the components of the system for the generation, acceleration, and transport of the beam;
g) report confirming the completion of the training in accordance with the requirements of Art. 8;
h) certificate of conformity for the electric system installed and conformity certificates for the instruments supplied;
i) user manuals of all the instruments supplied, preferably with an extra copy in electronic format (e.g. pdf.);
j) technical report highlighting the connections between the masses of the fixed instruments installed and the corresponding equipotential nodes of the electric control board, as well as any procedure for access to such masses for the execution of the regular checks on fixed equipment.

The entire documentation shall correspond to the actual construction of the equipment (“as-built”).

ART. 6 CONFORMITY INSPECTION

Conformity inspections shall be carried out in order to assess the correct execution in relation to the conditions and the terms of the Contract. In view of the nature and the complexity of the supply, the Contracting Authority considers it appropriate to carry out conformity inspections during the execution of the Contract.

In specific, conformity inspections shall be carried out both at the premises of the Contractor and at Laboratori Nazionali del Gran Sasso.

All logistic and repair costs, as well any costs for the despatch of materials to and from the factory, shall be the responsibility of the Contractor.

6.1 Conformity tests at the Contractor's facilities

The conformity inspection officer shall, in the presence of the RTP and the DEC, ascertain the correct operation of the accelerator at the Contractor's facilities. The following tests shall be completed:

i. Accelerator tests without ion beam

(1) Vacuum quality check;
(2) Testing of all the cooling circuits, to ascertain the operating pressure and temperature values, and the operation of the automatic locking devices;
(3) Testing of all the cooling circuits to ensure that the increase in temperature of the input and output water is as indicated in the project specifications;
(4) Checking of all the control, measurement, safety and consensus signals for the interlocks;

ii. Preliminary beam acceptance tests

The intensity, stability, and transmission of the beam at different energies shall be checked by completing the tests listed below, taking into account the values offered by the Contractor.

1) Check to ascertain the achievement of the quality of the H^+, $^4He^+$, $^{12}C^+$ and $^{12}C^{++}$ beams with voltage at the terminal of 3.5 MV. After a stabilisation period, for each species the system shall work for 4 hours without any operator intervention. The checks shall be carried out in accordance with the technical specifications of the offer.
2) The H^+, $^4He^+$, $^{12}C^+$ and $^{12}C^{++}$ beams shall be accelerated and extracted at

terminal voltages of 0.3, 1 and 2 MV, to ascertain that the characteristics offered have been reached. After a stabilisation period, for each species the system shall work for 30 minutes without any operator intervention. The checks shall be carried out in accordance with the technical specifications of the offer.

3) Check that the "ripple" parameters can be reached with the maximum beam intensity.
4) The stability and reproducibility of the energy of the beam shall be assessed through nuclear reactions. The details of the procedure shall be agreed between the parties, and documented when issuing the "Inspection Plan". The instrumentation exclusively required for these tests shall be provided by the Contractor. The details regarding the instrumentation required, the times and the procedures through which they are made available, shall be indicated in the "Inspection Plan" before the start of the construction.

Upon successful result of the tests, an appropriate report shall be issued, and forwarded to the RUP, in accordance with the requirements of art. 317 of Presidential Decree no. 207/2010.

6.2 **Technical tests at L.N.G.S.** During the installation period and upon completion of the whole installation, the Contracting Authority shall carry out conformity inspections and checks through the DEC and IVC. These inspections may be attended by additional DEC appointed personnel. For this purpose, the RI shall preliminarily disclose and communicate, with an acceptable level of notice, the main expected installation activities, and promptly notify the completion of the intervention. The assessment of the correct operation of the accelerator shall be completed through the same tests and procedures described at points i and ii of section 6.1.

ART. 7 AWARDING

The technical offer shall include every single detail required to ascertain that the technical specifications can be met. The Contract shall be awarded following the criteria of the most economically advantageous offer, pursuant to art. 83 of Legislative Decree no. 163/06, art. 283, paragraphs 1, 2, and 3 of Presidential Decree no. 207/2010 and subsequent amendments and integrations, as well as attachment P, no. II) letter a), item 4 of Presidential Decree no. 207/2010 and

subsequent amendments and integrations, based on the following elements, listed in decreasing order of importance:

1. **maximum 50 points for the economic offer:**

2. **maximum 50 points for the technical offer, split as follows:**

a. Quality of the supply **max. 33 points**

1. Beam intensity max. 12 points

the following beam intensities correspond to a score of 6:

H^+	
0.5 < E ≤ 3.5 MeV	600 eμA
0.3 ≤ E ≤ 0.5 MeV	500 eμA
$^4He^+$	
0.5 < E ≤ 3.5 MeV	400 eμA
0.3 ≤ E ≤ 0.5 MeV	300 eμA
$^{12}C^+$	
0.5 < E ≤ 3.5 MeV	150 eμA
0.3 ≤ E ≤ 0.5 MeV	100 eμA
$^{12}C^{++}$	
1 < E ≤ 7MeV	80 eμA

ii. Stability of the beam energy max. 8 points
iii. Operating times max. 6 points
iv. Quality of the components max. 3 points
v. Radiation level max. 2 points
vi. Quality of the control system max. 2 points

b. Maintenance and management costs **max. 9 points**

i. Regular maintenance program: consumables necessary for the equipment maintenance. max. 4.5 points

ii. Table indicating the electric consumption and the quantity and quality of the cooling water necessary for the equipment operation. max. 4.5 points

ii.

c. Improvements **max. 8 points**

i. Supply of beam diagnostic on the terminal, additional to what requested in the Technical Specifications max. 2 points

ii. Supply of beam diagnostic in the beam line, additional to what requested in the Technical max. 2 points

Specifications max. 2 points

iii. Supply of auxiliary equipment in support of maintenance on the equipment object of the tender max. 2 points

iv. Extension of the warranty over the 12 month period and supply of spare parts

ART. 8 PERSONNEL TRAINING

The Contractor shall be responsible for the training of no. 3 L.N.G.S. employees, nominated by the Contracting Authority, on the management, the prompt intervention support, the maintenance, and the repair of the whole system object of the tender, starting from the putting into operation of the same. This training shall also include the mentoring for the three individuals during installation at L.N.G.S.

Before the start of the construction of the equipment object of the tender, the Contractor shall suggest a "Training Plan", indicating the program, the required hours of training and the way the training will be given. This training plan shall result in the ability of L.N.G.S. personnel to independently manage the equipment. The company shall agree the training activities with the involved personnel, and release attendance certificates.

ART. 9 MAINTENANCE AND RUNNING

The company shall supply the following documentation:

- Regular maintenance program for the first 10 years of operation of the equipment object of the tender.
- Operation plan for accelerator consumptions

ART. 10 IMPROVEMENTS

In the tender offer, the Contractor may suggest possible improvements for the equipment object of the tender. Such improvements shall be evaluated during the assessment of the technical offers, in accordance with the indications of Art. 7 and the invitation letter.

In particular, the following shall be evaluated:

i. Supply of beam diagnostic on the terminal, additional to what requested in the Special Tender Specifications.

ii. Supply of beam diagnostic on the beam line, additional to what requested in the Special Tender Specifications.
iii. Supply of auxiliary equipment in support of the maintenance of the equipment object of the tender.
iv. Extension of the warranty over the 12 month period, and supply of spare parts.

ART. 11 PAYMENTS

Payments shall me made as follows, subject to the issuing of the corresponding invoices:

1. Upon presentation and approval of the documentation pursuant art. 5.1 of this Special Tender Specifications.	20%
2. On completion of the construction of the equipment object of the tender at the Contractor's facilities, certified by the report of the DEC.	30%
3. On completion of the tests on the accelerator at the Contractor's facilities, confirmed by the successful results of the conformity inspections carried out.	20%
4. On completion of the final conformity inspection at L.N.G.S.	30%

It must be noted that the payment indicated at item 1 of this section is subjected to the issuing by the company of a bank or insurance guarantee for an amount equal to the payable amount.

Invoices shall be addressed to the attention of the Project Manager (RUP – Responsabile Unico del Procedimento), and headed as follows:

Laboratori Nazionali del Gran Sasso dell'Istituto Nazionale di Fisica Nucleare
Via G. Acitelli, 22
67100 Assergi (AQ)

Payments shall be made by bank transfer within 30 days from the date of receipt of the invoice, subject to successful assessment of the regular progression of the supply, and successful ascertainment of the contributory and tax compliance of the company, ascertained through the Single Insurance Contribution Payment (in Italy D.U.R.C. -

Documento Unico di Regolarità Contributiva).

ART. 12 PREDISPOSITION FOR FUTURE DEVELOPMENTS

After putting into operation the equipment object of this tender, the Contracting Authority might consider the possibility of a second downstream beam line in the area indicated in the drawings attached. This line section will consist of a further analysis magnet, vacuum systems and beam diagnostic. The achievable characteristics of the beam shall be comparable to those of the beam line object of this tender. The Contractor shall take into account these possible developments, with particular attention to the optics of the beam. In addition, the technical equipment supplied within the scope of this tender shall be designed to allow the integration of the components serving the beam section that will be built in the future.

ART. 13 TIMETABLE

The delivery of the equipment object of this tender is subjected to the works for the preparation of the LUNA-MV site inside the underground laboratories. The Contracting Authority expects these works to be completed by December 2017. Therefore, delivery of the equipment object of the tender to L.N.G.S. will not be possible before January 2018.

The provisional timetable for the completion of the equipment object of the tender is included in the executive Table. The executive timetable shall be agreed between the parties during the design of the equipment object of the tender. The completion of the works for the preparation of the installation site might be delayed for a maximum of 6 months in relation to the timetable. The final timetable will be issued 12 months before the installation date. This delivery date shall be respected by both parties. In any case, the last date for the conclusion of the "commissioning" and conformity inspection stage shall necessarily be not later than July 2019.

	Provisional executive timetable	**MONTHS**
1	Undersigning of the Contract	0
2	Approval of the documentation pursuant to art. 5.1 of these Special Tender Specifications, and start of construction at the Contractor's facilities	3
3	Completion of the equipment object of the tender at the Contractor's facilities	22

4	Completion of the conformity inspections on the accelerator at the Contractor's facilities	23
5	Start of the installation works at L.N.G.S.	24
6	End of the installation works at L.N.G.S. and start of "commissioning" and of the conformity inspections	29
7	End of "commissioning" and final conformity inspection	30

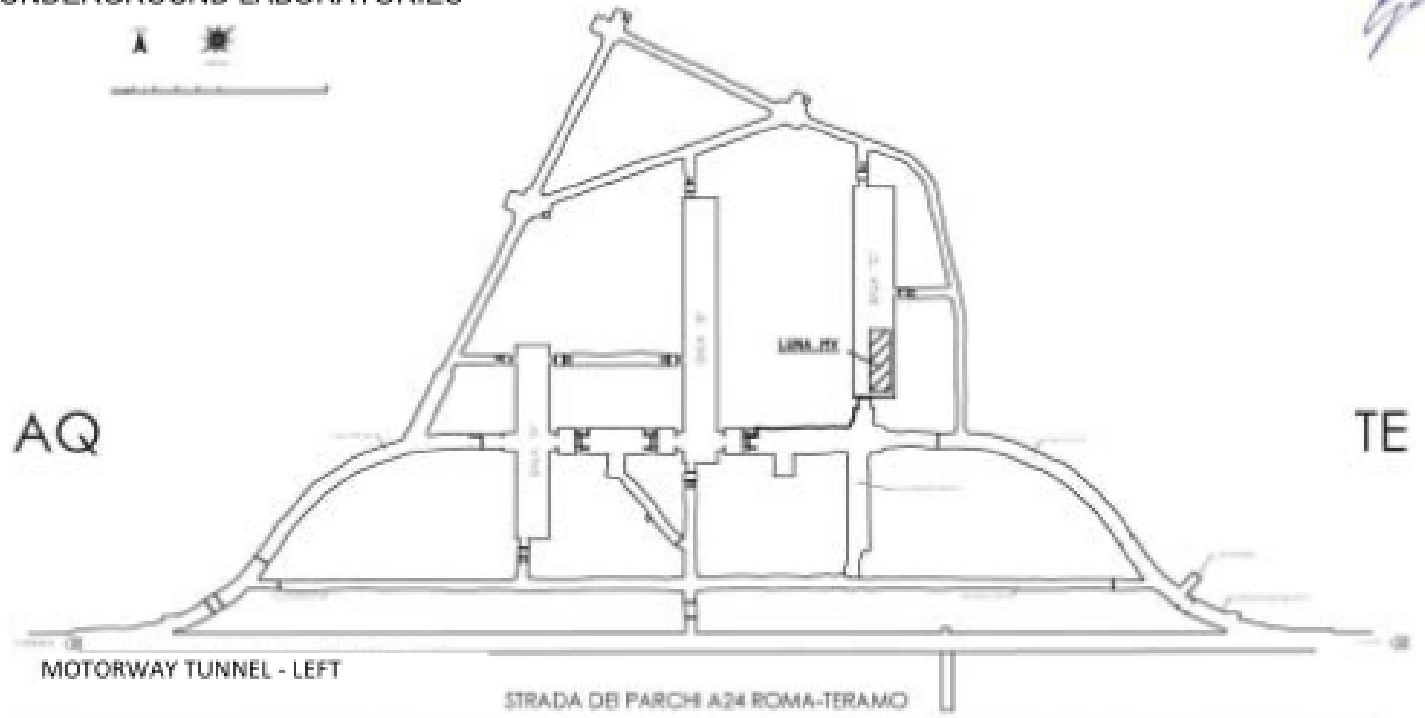
Table: Provisional executive timetable for the realisation of the equipment object of the tender

LIST OF ATTACHMENT

- **Figure 1:** Schematics of the L.N.G.S. underground laboratories, also indicating the position of installation of the equipment object of the tender.
- **Figure 2:** Schematics of the LUNA-MV installation site, including the adjoining service area, which can be reached by a truck , served by a bridge crane. It shows the Control Room and the Accelerator Room. An indicative arrangement of the equipment object of the tender is also shown:
  a. accelerator tank in the closed position;
  b. "downstream" section of the beam line;
  c. analysis magnet;
  d. "upstream" section of the beam line;
  e. target.

  The dashed area is for possible future developments as described in the specifications. Also shown are the reference measurements of the Accelerator Room and Control Room.
- **Figure 3:** Section A-A
- **Figure 4:** Section B-B
- Single Document for the Assessment of the Risks from Interferences (DUVRI).
- Information folder.

UNDERGROUND LABORATORIES



LUNA-MV

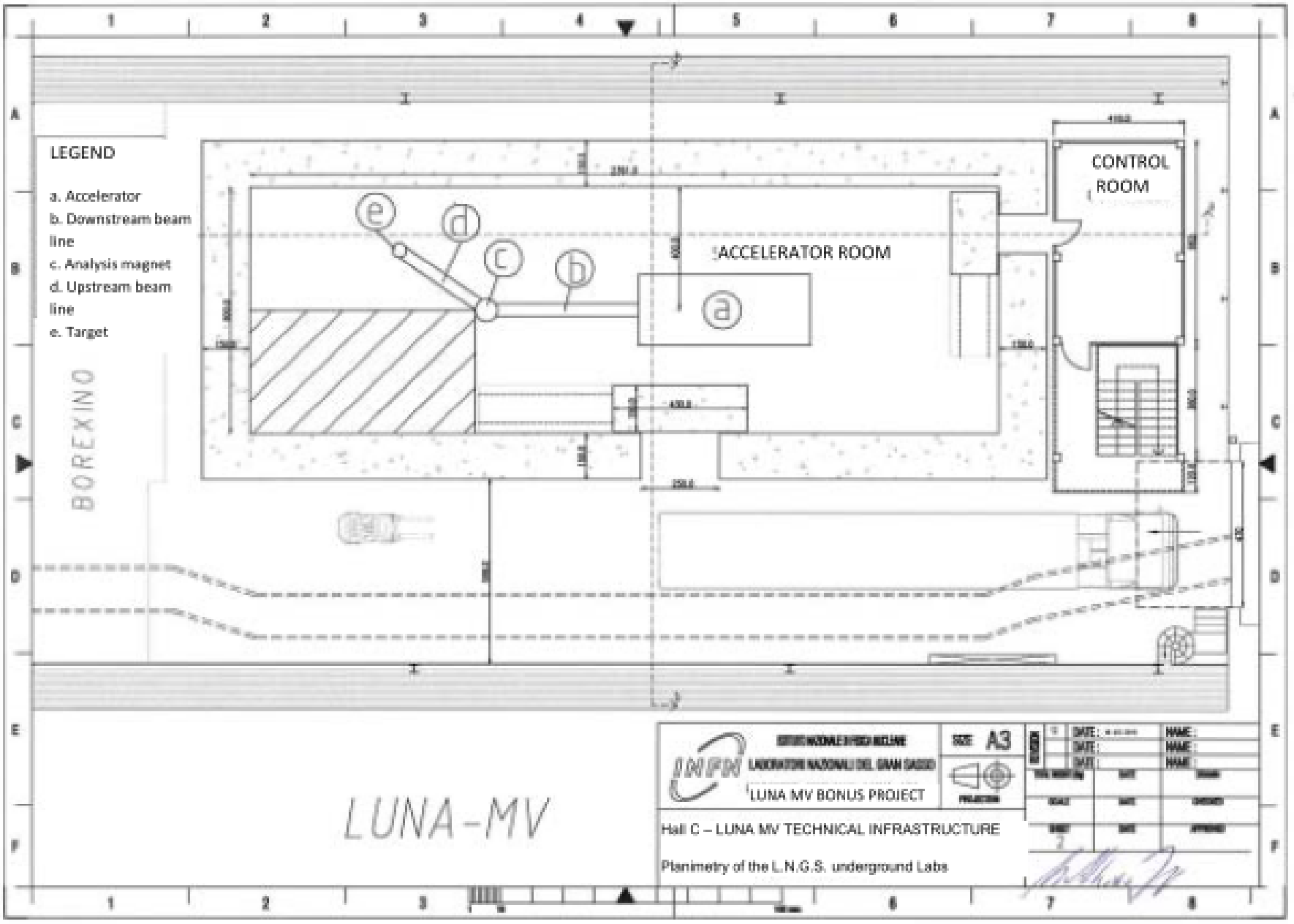
INFN LABORATORI NAZIONALI DEL GRAN SASSO

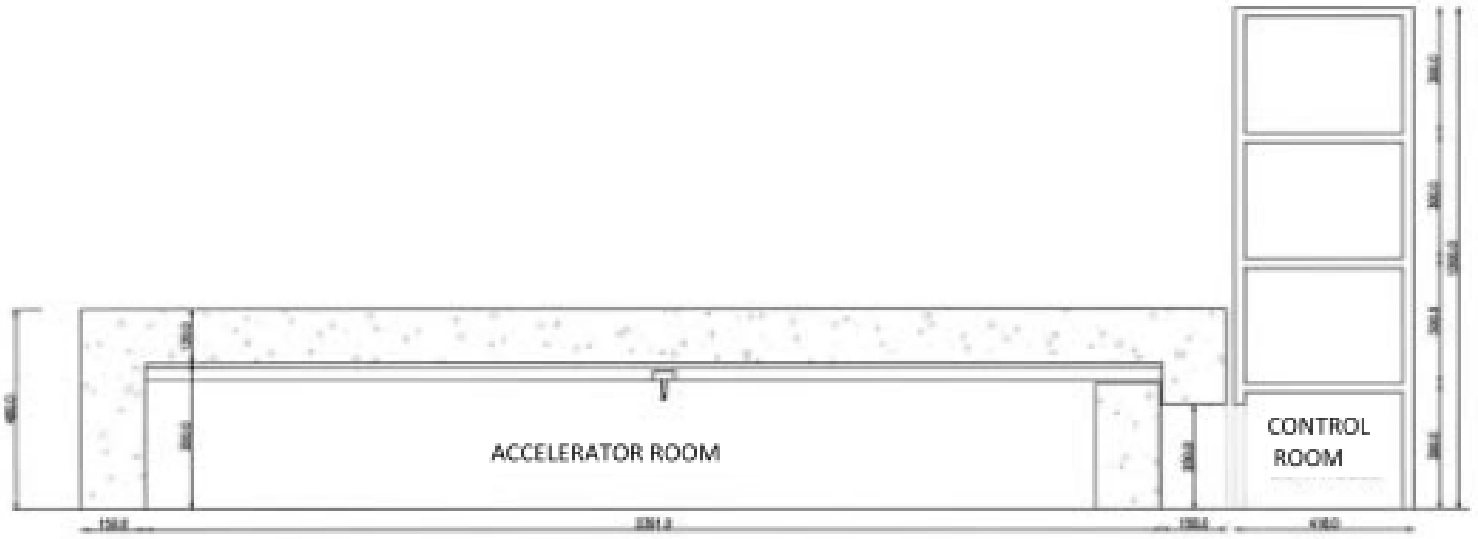
SIZE A3

LUNA MV BONUS PROJECT

Hall C – LUNA MV TECHNICAL INFRASTRUCTURE

Planimetry of the L.N.G.S. underground Labs


LEGEND
a. Accelerator
b. Downstream beam line
c. Analysis magnet
d. Upstream beam line
e. Target
ACCELERATOR ROOM
CONTROL ROOM
BOREXINO
LUNA-MV
INFN
LUNA MV BONUS PROJECT
SIZE A3
Hall C – LUNA MV TECHNICAL INFRASTRUCTURE
Planimetry of the L.N.G.S. underground Labs



LUNA-MV

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Hall C – LUNA MV TECHNICAL INFRASTRUCTURE

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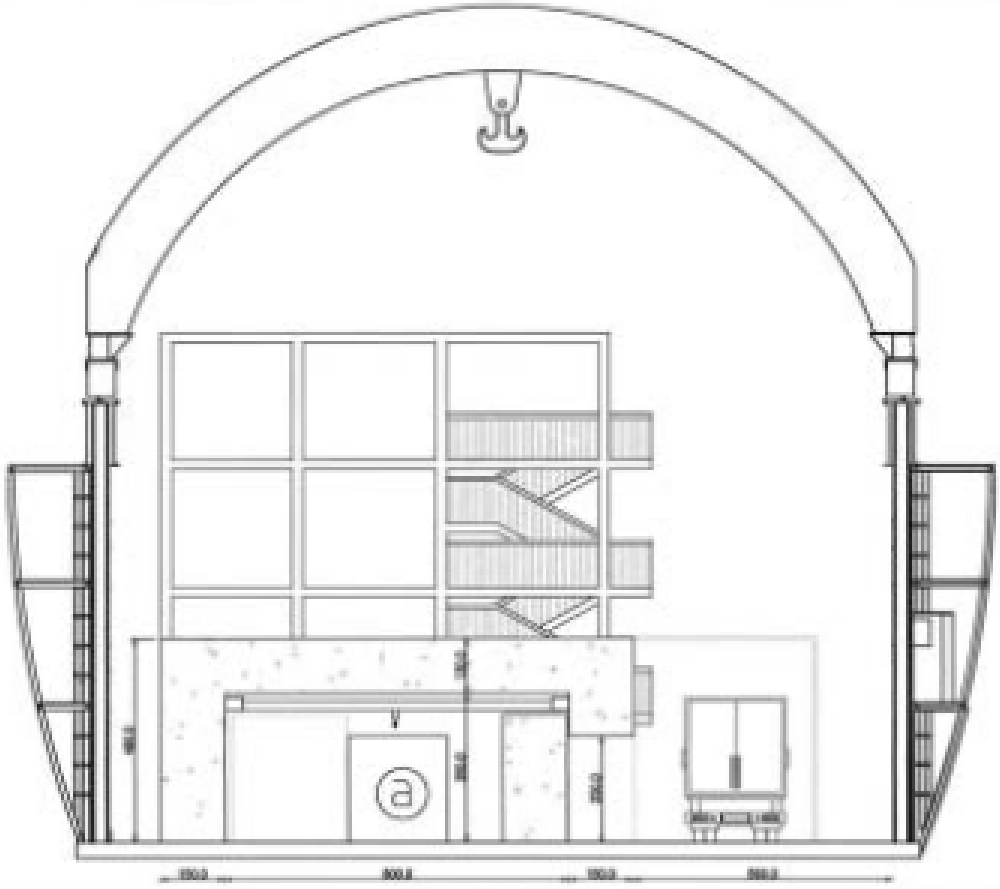
REVISION

DATE :

NAME :



LUNA-MV

INFN LABORATORI NAZIONALI DEL GRAN SASSO

LUNA MV BONUS PROJECT

SIZE: A3

Hall C – LUNA MV TECHNICAL INFRASTRUCTURE

Planimetry of the L.N.G.S. underground Labs