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Technical specification for the construction of the corrector magnets C5 and C6

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1 Introduction

1.1 ESS

The European Spallation Source (ESS in the following), that is being built in Lund - Sweden, will be a multi-disciplinary research center based on the world's most powerful neutron source. This new facility will be up to 100 times brighter than today's leading facilities, enabling new opportunities for researchers in the fields of life sciences, energy, environmental technology, cultural heritage and fundamental physics. A linear accelerator (Linac) creates protons at the ion source, accelerates and steers them onto a rotating tungsten target creating neutrons via the spallation process.

The construction of this center will be managed by European Spallation Source ERIC (European Research Infrastructure Consortium).

Italy is one of the founding Countries of ESS ERIC and will participate to ESS realization by means of In-Kind Contribution (IKC). Three Italian Entities are involved: Istituto Nazionale di Fisica Nucleare (INFN), Elettra Sincrotrone Trieste (Elettra) and Consiglio Nazionale delle Ricerche (CNR).

1.2 INFN

The National Institute for Nuclear Physics (INFN) is the Italian research agency dedicated to the study of the fundamental constituents of matter and the laws that govern them, under the supervision of the Ministry of Education, Universities and Research (MIUR). It conducts theoretical and experimental research in the fields of sub-nuclear, nuclear and astro-particle physics and it contributes to the development of the knowledge on the particle accelerators and detectors technology. All of the INFN's research activities are undertaken within a framework of international competition, in close collaboration with Italian universities on the basis of solid academic partnerships spanning decades. Fundamental research in these areas requires the use of cutting-edge technology and instruments, developed by the INFN at its own laboratories and in collaboration with industries.

INFN has been appointed by the Italian Government as the Representing Entity for Italy in ESS-ERIC. In accordance with art. 9, paragraph 4, of the European Regulation n. 723/2009 and the Statute of ESS-ERIC, the Representing Entity is entitled to exercise the rights and fulfillment of obligations deriving from Italy's participation in ESS-ERIC.

According to the Agreement signed between INFN, Elettra and CNR on 13 July 2015, it was agreed that INFN, as an entity admitted to tax exemptions for transactions related to the Italian participation in the ESS project, will take over the financial responsibility for the implementation of in-kind contributions of Italy, including the conduct of public procedures that may be necessary.

1.3 Elettra – Sincrotrone Trieste S.C.p.A

Elettra – Sincrotrone Trieste (Elettra in the following) is a multidisciplinary international research center of excellence, specialized in generating high quality synchrotron and free-electron laser light and applying it in materials and life sciences. This center is located in Trieste - Italy. The main assets of the research center are two advanced light sources, the

electron storage ring Elettra and the free-electron laser (FEL) FERMI supplying light of the selected "colour" and quality to more than 30 experimental stations.

During the four-year period 2010-2014, Elettra has proposed and preliminary agreed with ESS, according to their respective technological and scientific-technical skills, the construction of the magnets for the LINAC of ESS as an in-kind contribution to the ESS project.

The magnets described in the present documents are indeed part of the Trilateral In-Kind Contribution Agreement signed between European Spallation Source ERIC, INFN and Elettra, regarding the magnets for the ESS Linac.

1.4 Scope of this document

The In-kind Contribution for the magnets for ESS includes the supply of dipole (D1), quadrupole (Q5, Q6, Q7 and Q8) and corrector magnets (C5, C6 and C8) according to the following scheme:

Item	Q5	**C5**	Q6	**C6**	Q7	D1	Q8	C8
Quantity	26	**13**	95	**55**	12	2	6	4

Tab. 1 – Name and quantity of the magnets to be supplied.

This document lists and defines the technical specification for the construction of the corrector magnets **C5** and **C6**. The total number of magnets to be built includes one additional magnet for each group (called the 1st magnet of the series or the 1st off magnet). So the total number of magnets to be built in the frame of this contract will be:

- C5: 14 magnets
- C6: 56 magnets

1.5 General conditions

This document summarizes all the technical specifications and operating parameters concerning the goods to be supplied. Wherever "shall" is being used, this means that the good must strictly conform to the specified technical requirement and/or operating parameter.

Wherever "can" is being used, this means that the Contractor has the possibility to propose or suggest, within the quotation framework, better technical solutions and/or procedures, according to his expertise, in order to achieve the required mechanical and electrical specifications.

For the whole duration of the contract the adopted language, for written and/or oral communications, shall be English and/or Italian.

For the whole duration of the following warranty and servicing periods the adopted language, for written and/or oral communications, shall be English.

2 Tender process

2.1 Scope of the tender process

Scope of the tender process is the assignment of the contract for the supply of:

- 14 (13 + 1) correctors C5
- 56 (55 + 1) correctors C6

2.2 Technical offer

The technical offer shall be written in English and shall include:

2.2.1. a Technical Proposal report (TP) outlining the technical features of the mentioned magnets (par. 2.1). The TP report shall include the elements of the evaluation criteria of the tender.

3 Supply's contract

3.1 Contractual responsibility

3.1.1. The Contractor shall be responsible

- for the construction, including all the necessary tools and instrumentation (both mechanical and electrical),
- for the dimensional and the electrical tests,
- for the packaging, the insurance and the delivery to Elettra of[1]
  - 14 (13 + 1) correctors C5
  - 56 (55 + 1) correctors C6

3.1.2. INFN, in agreement with Elettra, will provide only to the Contractor and after the signature of the contract the following documentation:

- All the 3D models (step files) of the magnets complete of all the components.
- A detailed list specifying the type of test to be performed during the various phases of the construction.

3.1.3. All the technical documentation provided by INFN, in agreement with Elettra, and attached to this specifications document shall be integral part of the specifications document itself.

3.1.4. The Contractor shall prepare all the technical documentation necessary for the construction phases. The documentation shall be in paper or digital format, in English.

3.1.5. All the technical documentation realized by the Contractor for the scope of the magnets construction shall be exclusive property of INFN.

3.1.6. After the technical documentation (parameters, technical drawings, etc.) has been approved by INFN, in agreement with Elettra, no changes will be permitted, unless following a written request by the Contractor that must be approved in writing by INFN, in agreement with Elettra.

3.1.7. The Contractor shall deliver the completed magnets only after written notification, by INFN, in agreement with Elettra, of acceptance of the positive results of the Factory Acceptance Tests (FAT).

3.1.8. In case of non-conformity detected during the FAT or during the tests at Elettra, with respect to the technical drawings and/or to the technical specifications

[1] The additional magnet shall be used as reference during the test and magnetic measurements performed at Elettra (see also Chap. 6)

described in this document, of any component of the magnets, the Contractor shall be responsible for the costs of repair or, in case it is necessary, for the substitution of the defective component itself.

3.1.9. Any kind of approval by INFN, in agreement with Elettra, shall not release the Contractor from his responsibility to realize the magnets complying with the mechanical and electrical parameters described in this specification.

3.1.10. Elettra has the right to be present at each inspection and/or test described in this document. For this purpose, INFN and Elettra shall be notified in advance of at least 2 (two) weeks to the execution date of the inspection and/or test. Free access to the manufacturing sites, both of the Contractor and of any sub-contractor, shall be granted to Elettra personnel during normal working time.

3.1.11. The Contractor shall provide

- The design and construction of all the equipment and/or tools, mechanical and/or electrical, necessary for the realization of the magnets.
- The set of construction drawings relating to the above mentioned equipment and/or tools; these drawings shall be included in the Technical File and shall be integral part of the delivery.
- The list of procedures to be adopted to perform the required verifications/tests and the FAT as well as the detailed list of the actions envisaged for each procedure. The above lists shall be included in the Technical File and shall be integral part of the supply.
- The construction of all the equipment, tools and accessories, necessary for the realization of the magnets.
- The assembly of the magnets.
- The execution of the FAT.
- All the certificate and data-sheets of the purchased materials.
- The insurance and shipping to Elettra of the assembled magnets

3.1.12. The Contractor is the sole responsible for the procurement of materials, construction, testing and delivery of the goods to Elettra.

3.1.13. The Contractor is the sole responsible for the full compliance of the goods with respect to this specification.

3.1.14. The Contractor is the sole responsible for the operating instructions, the documentation and manuals provided.

3.1.15. The written approval of INFN, in agreement with Elettra, and the delivery permission shall not release the Contractor from the above responsibilities.

3.2 Phases of the supply

The supply of the magnets shall be divided into three phases specified by the time-schedule attached to the Contract.

3.2.1. The first phase will include:

- The startup of the procurement of the materials/components necessary for the realization of the magnets.
- The engineering of all the instruments and equipment necessary for the realization of the magnets.

- The setup of a Production Schedule Document for the construction (see also sect. 4.2).
- The setup of a Technical File, whose contents are described at paragraph 3.2.4.
- The holding of a Design Review Meeting during which the Technical File shall be discussed and approved.

3.2.2. For each type of magnet the second phase will include:

- The supply and/or construction of all the equipment necessary for the realization of the magnets.
- The completion of the procurement of all the materials/components necessary for the realization of the magnets.
- The construction, testing (specified in chapt. 6) and delivery to Elettra of the 1st magnet (also referred as the 1st off magnet).
- The approval by INFN, in agreement with Elettra, of the FAT test results of the 1st off magnet.
- The dimensional, electrical and thermo-hydraulic (where appliable) tests on the magnet (to be held at Elettra).
- The electromagnetic measurements aimed to characterize the magnet and check for any non-compliance of manufacturing and/or assembly (to be held at Elettra).
- The authorization by INFN, in agreement with Elettra, to proceed to the serial construction, following the approval of the results of 1st off magnet.

3.2.3. For each type of magnet the third phase will include:

- The construction and dimensional tests of the magnetic yokes.
- The construction and dimensional and electrical tests of the coils.
- The construction and/or the supply of the mechanical accessories.
- The assembly and dimensional and electrical tests of the magnets.
- The execution of the FAT.
- The approval by INFN, in agreement with Elettra, of the FAT test results with consequent authorization to ship the magnets.
- The packaging, insurance and shipping to Elettra of the assembled magnets.
- The dimensional, electrical and thermo-hydraulic (where appliable) tests on the magnets (to be held at Elettra).
- The electromagnetic measurements aimed to characterize each magnet and check for any non-compliance of manufacturing and/or assembly (to be held at Elettra).
- The formal acceptance of the magnets.

3.2.4. The Technical File shall include:

- A detailed description of the mechanical design of the equipment and instrumentation needed for the construction of the magnets.
- A complete set of construction drawings (on paper and in digital format, to be defined in agreement with INFN and Elettra), including cross-references, such as to ensure the possibility of replicating the construction of the magnets in all their parts (yokes, coils and accessories). These drawings shall be developed using a CAD system (preferred software is CATIA) and must meet the UNI – ISO 128 standards.

- The detailed description of the realization process of the yokes and the coils, which includes the adopted procedures and specifications as well as the list of the selected materials for the construction.
- The detailed description of the procedure of the Factory Acceptance Tests envisaged in this specifications document.
- The detailed description and planning of the procedure of the verifications/tests envisaged in this specifications document.

3.2.5. The Technical File shall be completed and delivered to INFN within the deadlines indicated in the time-schedule attached to the Contract. The delivery of the time schedule shall be compliant with the offer. The approval of the Technical File will take place during the Design Review Meeting, to be held at Elettra. The agenda of the meeting will be proposed by the Contractor, in agreement with INFN and Elettra. Following the successful conclusion of the Design Review Meeting, INFN, in agreement with Elettra, will issue the formal written authorization to proceed with the second phase of the supply.

3.2.6. The review and approval of the Technical File by INFN, in agreement with Elettra, shall not release the Contractor from its responsibility to perform all the actions necessary to realize yokes, coils and accessories that meet the specifications contained in this document and all the attachments.

4 Contract management

4.1 Technical responsible for the Contractor

The Contractor shall appoint a technical manager (Contract Engineer) in charge of the contract, who will coordinate all the technical and organizational communications between the parties for the entire contract duration and, in the following, during the period of warranty and service.

4.2 Contract scheduling

Within two weeks from the contract signature, the Contractor shall submit in writing, for approval by INFN, in agreement with Elettra, a detailed Production Schedule Document describing the scheduling of the following steps:

- construction (including the lead time of the procurement of the material),
- dimensional checks,
- all envisaged tests,
- assembly,
- FAT,
- shipping of the magnets.

The Production Schedule Document shall be in accordance with the deadlines specified in the time-schedule attached to the contract.

The Contract Engineer shall send in writing a progress report, regularly on a monthly basis, highlighting the status of activities and the correspondences, or any deviations, between the planned baseline and the actual work achievements.

4.3 Validations

The 1st off magnet and/or the prototype of the main components and other sub-components of the system shall be checked ("validation") prior to their mass production and/or assembly, as specified in Chapter 6 and Chapter 7.

4.4 Delivery address

The goods shall be delivered to the following address:

Elettra – Sincrotrone Trieste S.C.p.A.
Strada Statale 14 km 163,5 in AREA Science Park
34149 Basovizza, Trieste ITALY

The Contractor shall deliver the goods only after receiving written authorization from INFN, in agreement with Elettra. The packaging shall be of good quality and shall be made in such a way to be reused.

4.5 Quality certifications

The Contractor shall be certified according to a quality system ISO-9001, or equivalent, for the design, construction and testing of the specified goods. Furthermore the Contractor shall verify that all its sub-contractors shall follow the same quality system.

Inspections and approvals envisaged in this document will not release the Contractor from its full liability concerning the entire supply.

4.6 Warranty

The warranty period for the magnets, object of this document, will be 24 (twenty-four) months, with possibility for INFN to ask for an additional warranty period up to 36 (thirty-six) months. The warranty period shall start from the date of formal acceptance of the magnets after the tests performed at Elettra (see Chapt. 7).

The guarantee shall not expire in case of package opening, in order to allow examinations and visual inspections. No modification or operational changes will be performed by INFN, Elettra or ESS, without the approval of the Contractor, throughout the duration of the guarantee period.

4.7 Safety and prescriptions

The goods and all their components will be built according to the "state of the art" or according to the best engineering practice as established by the Italian Laws.

Labels and indications of potential dangers must be exposed in a clear way.

5 Technical specifications

5.1 General requirements

The design, the engineering and the selection of raw materials and semi-finished products to be used for the construction, shall ensure a correct operation of the magnets for a life-time cycle equal to at least 20 (twenty) years and shall take into account the operating environment where the magnets will be installed, which is, a tunnel where a linear proton accelerator (of which the magnets will be part) will be assembled. The accelerator will operate at a maximum energy of 2 GeV and ionizing radiations will be present in the tunnel

itself. The temperature in the tunnel will be about 20 °C and the expected total integrated radiation dose, during 40 years of operation, is equal to 10 MGy.

Each magnet assembly shall have a magnet identification plate attached to it with the following data:

- Manufacturer name,
- Magnet type (corrector C5 or C6),
- Unique serial number,
- Construction date,
- Nominal electrical and magnetic parameters,
- Total mass.

5.2 Magnet yokes

5.2.1. The magnetic yokes shall be realized assembling four quadrants; each quadrant will be built gluing a suitable pack of steel laminations, which are realized by a stamping process. The material to be adopted for the laminations shall be a low-carbon steel, non-grain-oriented, laminated, with a thickness of 1 mm, suitable for electromagnetic applications and pre-coated on both surfaces with epoxy resin. The required steel shall have a B(H) curve better or equal than the B(H) curve of the steel M270-50 A HP which has been used in the simulations. The laminations shall be coated with the resin Rembrandtin EB 549. The materials and/or different arrangements chosen by the Contractor must be evaluated and approved by INFN in agreement with Elettra. The drawings listed in tab. 2 describe, for each magnet, the geometry of a single lamination and of the assembly of the magnet itself.

	C5	C6
Assemblies	C5C001	C6C001
Interfaces	C5P006	C6P006

Tab. 2 – Correctors drawings.

5.2.2. The yokes must be realized using iron coming from the same production batch.

5.2.3. Each assembled quadrant shall be labelled with a unique serial number.

5.2.4. The assembly of the quadrants shall conform to the construction drawings realized by Elettra and will be approved by INFN. The first assembly shall respect the dimensions, the tolerances and the symmetries between the poles as specified in the technical drawings; the repeatability of the assembly itself, with respect to the required mechanical tolerances (specified in the technical drawings), shall be obtained by means of transverse and longitudinal precision plugs, inserted subsequently between the quadrants.

5.2.5. The parallelism of the internal surfaces of each quadrant shall remain within ± 200 µm.

5.2.6. Any non-compliance of the alignments and parallelisms, detected on the first elements (quadrants and/or assembled yokes) of each series will be accepted only if this will not cause a degradation of the magnetic performances. Any revision of the specification will be based on magnetic measurements to be held at Elettra.

5.2.7. All components of each yoke shall be suitably protected from corrosion and damage during the phases of construction, assembly, testing, transport and storage.

5.2.8. The magnetic yokes shall be protected against rust by means of painting, except for the surfaces of the poles and the contact surfaces between the quadrants. The paint used must meet the following requirements:

- Be non-magnetic
- Be resistant to mechanical stresses (knocks, abrasions, scratches, etc.)
- Be resistant to ionizing radiations as per specification of the resin used for the coils impregnation.
- Be flame-retardant
- Be orange RAL 2003 in color[2].

5.2.9. Non painted surfaces shall be protected from corrosion by a film of oil, or other equivalent protection.

5.2.10. The yoke shall have a dedicated threaded bolt for ground connection as specified in the technical drawings.

5.3 Coils

5.3.1. The coils of the magnets C5 and C6 are dimensioned in the assembly drawings listed in tab. 2 and are built with the conductor and the number of turns listed in tab. 3.

	C5	C6	unit
Conductor (WxH)	3.15 x 3.55		mm
Number of turns in width (W)	4		
Number of turns in heigth (H)	18	30	

Tab. 3 – Coil drawings

5.3.2. The coil windings shall be made with OFHC (Oxygen Free High Conductivity) copper conductors with dimensions specified in the technical drawings listed in tab. 3; possible alternatives must be examined and approved by INFN in agreement with Elettra.

5.3.3. The inter-turn insulation will be realized by means of fiber-glass taping around the conductor, or, in alternative, adopting a suitable pre-insulated conductor; in both cases the chosen method shall be submitted and approved by INFN, in agreement with Elettra. The insulated conductor shall then be formed into the final coil shape. After the coil forming, an additional insulation to ground shall be realized by means of a further fiber-glass layer.

5.3.4. The impregnation of the windings of each coil shall be performed using the resin Araldite® F, suitable for use in environments with ionizing radiation. Different resin compounds must be evaluated and approved by INFN, in agreement with Elettra.

5.3.5. In order to avoid the presence of resin-rich areas (fragile to impacts) and the occurrence of delamination, all empty spaces between the windings shall be filled

[2] Closest RAL color to ESS ORANGE RGB(255,125,0).

with a suitable material (modelled fiber-glass blocks), able to sustain the working conditions described in point 5.1.

5.3.6. On completion of impregnation, the appearance of the resin must be transparent and free from bubbles; dyes mixed with the resin are not allowed, in order to observe, as much as possible, the outer layers of the conductor windings. Similarly, painting the outer surface of the coils is not permitted.

5.3.7. No coil repair as well as no joint between conductors inside the coils shall be allowed.

5.3.8. Each coil shall be tested and then labelled with a unique serial number.

5.3.9. Each coil shall be provided with 2 (two) thermal switches (normally closed) which shall be assembled with a good thermal contact on the outlet termination of the coil itself. The switches shall have a threshold of 60 ± 5 °C. The switches shall be radiation resistant. The exact position will be indicated in the technical drawings. The switches type and the assembly process shall be evaluated and approved by INFN, in agreement with Elettra.

5.4 Mechanical components and accessories

5.4.1. The mechanical components and accessories necessary for the realization and assembly of the magnets C5 and C6 are described in the technical drawings listed in Tab. 2. Different solutions or proposals shall be submitted for evaluation and approval by INFN, in agreement with Elettra.

5.4.2. The magnets assembly shall allow their opening/closing in two halves: the upper (made by a single quadrant) and the lower one (made by the remaining three quadrants).

5.4.3. The electrical protections shall be realized according to the IP20 protection grade.

6 Inspections and Factory Acceptance Test (FAT)

6.1 Generality

6.1.1. The goal of the FAT is to verify the conformity of the magnet components with respect to the mechanical and electrical specifications. The magnets shall be delivered only after written notification by INFN, in agreement with Elettra, of acceptance of the positive result of the.

6.1.2. Some of the tests shall be repeated at Elettra as specified in chapt. 7 "Tests at Elettra".

6.1.3. The FAT procedures and its planning shall be submitted during the Design Review Meeting and their implementation shall be approved by INFN, in agreement with Elettra. INFN, in agreement with Elettra, reserves itself the right to request additional measurements or tests to validate the conformity of the goods.

6.1.4. The Contractor shall provide the instruments and the devices needed for the FAT. All the devices shall be calibrated and the calibration certificates shall be available for examination.

6.1.5. The Contractor shall write a Technical Report for each test, which shall include the following:

- Date and operator
- Goal of the test
- Description of the test
- Adopted instrumentation
- Calibration of the instrumentation
- Performed measurements
- Comments (if any)
- Test results
- Signatures (Contractor – Customer)

The components which have passed the tests shall be univocally marked for their identification. After the tests have been performed, no modification or changes of the component shall be allowed. All the Technical Reports shall be integral part of the delivery.

6.2 Steel yokes

6.2.1. Spot test shall be performed on the stamped laminations. The first 10 laminations shall be tested and in the following one out of 10000 shall be tested. Any non-conformal piece shall be discarded.

6.2.2. Each single quadrant shall undergo the following dimensional checks:

- Longitudinal pole profile and reference surfaces geometrical verification (dimensions and tolerances specified in the technical drawings).
- Outer surfaces parallelism geometrical verification (dimensions and tolerances specified in the technical drawings).

Any non-conformal quadrant shall be replaced at Contractor's costs.

6.2.3. The following dimensional checks shall be performed on each single assembled yoke:

- Transversal and longitudinal pole profile geometrical verification (dimensions and tolerances specified in the technical drawings).
- Pole profile simmetries and surfaces parallelism geometrical verification (dimensions and tolerances specified in the technical drawings).

Any non-conformal component shall be replaced at Contractor's costs

6.2.4. The dimensional tests shall be repeated after opening and closing the yoke two times.

6.3 Coils

6.3.1. The conductor shall be dimensionally verified and inspected.

6.3.2. All the impregnated coils shall be dimensionally checked with respect to the technical drawings and shall be visually inspected to highlight possible defects such as the presence of bubbles, cracks, delamination, etc. The impregnation shall not have areas too rich in resin and the thickness of the resin, at the surface of the coils, must not exceed 0.5 mm.

6.3.3. Each coil shall be tested to detect any possible inter-turn short-circuit The Contractor shall propose a testing method which shall be approved by INFN, in agreement with Elettra.

6.3.4. For each magnet family the electrical resistance of each coil shall be measured and scaled for a temperature of 22 °C.

6.3.5. Each completed coil shall be dip in water, at ambient temperature, for at least 6 (six) hours; only the coil terminals shall stay above the water surface. The insulation resistance shall be measured according to the following:

- A 5 kV DC voltage shall be applied, between the conductor and an electrode in contact with water, for at least 60 seconds.
- The dispersion current shall be measured for the whole period of 60 seconds.
- The calculated resistance shall not be lower than 20 MΩ.

6.3.6. For each corrector family the following test shall be performed, on a spot basis, on 2 (two) coils; if negative results will be observed, the test shall be repeated on 2 (two) further coils again on a spot basis. If negative results will be observed again all the coils shall undergo the test.

- The selected coils shall be energized in order to reach a surface temperature of 70 °C.
- At 70 °C the current shall be interrupted and the coils shall be left cooling to room temperature.
- The above procedure shall be repeated 10 (ten) times.
- On completion of the procedure the insulation test described at point 6.3.5 shall be repeated.
- No significant deviation of the coil insulation resistance shall be observed; no electric discharges of any kind shall be observed. Each defective coil shall be discarded. During this procedure the action of the thermal switches shall be monitored.

6.4 Mechanical components and accessories

6.4.1. Upon receipt of the materials and/or semi-finished components, they shall be dimensionally checked and inspected to detect possible defect or non-compliance. The relevant technical specifications and/or data sheets shall be provided by the Contractor as well.

6.4.2. Each finished mechanical component and/or accessory shall be dimensionally checked with respect to the technical drawings.

6.4.3. The Contractor shall replace any defective component at his costs.

6.5 Assembled magnet

6.5.1. Each assembled magnet shall undergo an insulation test. The test procedure shall be proposed by the Contractor in the Technical File and shall be approved by INFN, in agreement with Elettra.

6.5.2. Each assembled magnet shall undergo a lifting test. The test procedure shall be proposed by the Contractor in the Technical File and shall be approved by INFN, in agreement with Elettra.

7 Tests at Elettra

All magnets shall be characterized by means of metrological, electrical and magnetic measurements.

Any magnetic performance which does not comply with the requirements will result in mechanical and electrical checks of the magnet with respect to the relevant specifications. Mechanical and/or electrical non-compliances shall result in the non-acceptance of the magnet itself and the Contractor shall replace the magnet or its defective components at the Contractor's costs, as specified in paragraph 3.1.8.

8 Documentation

The delivery of the magnets shall include the following documentation. The documentation shall be written in English.

- All the documents of the Technical File updated to the most recent revision.
- All the material certifications and/or data sheets.
- Magnets part list.
- Technical Reports of the verifications/tests performed on the magnet components and of the FAT performed for each magnet.

The documentation shall be provided in two copies both in paper and digital format, the latter stored on suitable portable media.

Electrical schemes, mechanical and assembly drawings shall be provided in digital format. The list of the file formats shall be agreed in the Technical File.

Typical file formats are: MS Office (doc, xls, ...), Adobe Acrobat (pdf), SolidWorks and CATIA (step files).

9 Contacts

Personnel to be contacted for technical question:

Name	Phone	e-mail
Mario Maggiore	+39 049 8068530	mario.maggiore@lnl.infn.it
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10 Drawings list

- Corrector yokes and mechanical components and accessories.

	C5	**C6**
Assemblies	C5C001	C6C001
Interfaces	C5P006	C6P006

- Corrector coils.

	C5	**C6**	**unit**
Conductor (WxH)	3.15 x 3.55		mm
Number of turn width (W)	4		
Number of turns height (H)	18	30	

11 Acronyms List

Short name	Description
A2T	Accelerator-To-Target
CAD	Computer Aided Design
CDR	Critical Design Review
C5	Corrector Magnet type 5
C6	Corrector Magnet type 6
C8	Corrector Magnet type 8
DmpL	Dump Line
D1	Dipole Magnet type 1
Elettra	Elettra – Sincrotrone Trieste S.C.p.A.
ESS ERIC	European Spallation Source ERIC
FAT	Factory Acceptance Test
FE	Finite Element
FEM	Finite Element Method
HEBT	High Energy Beam Transport
HBL	High-Beta Linac
IKC	In-Kind Contribution
INFN	Istituto Nazionale di Fisica Nucleare
LWU	Linac Warm Unit
MBL	Medium Beta Linac
QA	Quality Assurance
QC	Quality Control
Q5	Quadrupole Magnet type 5
Q6	Quadrupole Magnet type 6
Q7	Quadrupole Magnet type 7
Q8	Quadrupole Magnet type 8
RAMI	Reliability, Availability, Maintainability, Inspectability
SAR	System Acceptance Review
SAT	Site Acceptance Test
SoW	Scope of Work
SPK	Spoke Linac
TF	Technical File
TP	Technical Proposal
PSD	Production Schedule Document