



EUROPEAN UNION
European Structural and Investing Funds
Operational Programme Research,
Development and Education



FRAMEWORK PURCHASE AGREEMENT

concluded in accordance with Section 2079 et seq. of Act No. 89/2012 Coll., Civil Code,
as amended (hereinafter the "**Civil Code**")

Ústav fyziky plazmatu AV ČR, v.v.i.

(Institute of Plasma Physics of the Czech Academy of Sciences)

With its registered seat at: Za Slovankou 1782/3, 182 00 Prague 8

ID No.: 61389021

VAT No.: CZ61389021

Registered with the Register of public research institutions kept by the Ministry of Education, Youth and Sports of the Czech Republic in compliance with Act No. 341/2005 Coll., on public research institutions

Represented by: doc. RNDr. Radomír Pánek, Ph.D., Director

Bank details: ČSOB a.s.

Account No.: 164465621/0300, IBAN: CZ11 0300 0000 0001 6446 5621, SWIFT: CEKOCZPP

Data mailbox No.: "zipnqqk"

(hereinafter the "**Buyer**")

and

Budker Institute of Nuclear Physics of Siberian Branch Russian Academy of Sciences (BINP SB RAS)

With its registered seat at: 11 Lavrentiev av., 630090, Novosibirsk, Russia

ID No.: 1025403658136

VAT No.: 5408105577

Registered with Novosibirsk State Registry Chamber in July 19, 1994

Represented by [REDACTED], Deputy Director

Bank details: "Bank Otkritie Financial Corporation" (Public Joint-Stock Company)

SWIFT: JSNMRUMM

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Data mailbox No.: 11 Lavrentiev av., 630090, Novosibirsk, Russia

(hereinafter the "**Seller**")

(the Buyer and the Seller jointly also as the "**Parties**" or individually as the "**Party**")

are entering on the day, month and year specified below into this Framework Purchase Agreement (hereinafter the "**Agreement**").

1. FUNDAMENTAL PROVISIONS

- 1.1. The Buyer is the recipient of funding provided by the Ministry of Education, Youth and Sports of the Czech Republic for the Project "COMPASS-U: Tokamak for cutting-edge fusion research", Reg. No. CZ.02.1.01/0.0/0.0/16_019/0000768 and for the Project "ALIMAT-F: Pokročilé technologie tekutých kovů pro fúzní aplikace na infrastrukturu COMPASS", Reg. No. CZ.02.1.01/0.0/0.0/18_046/0016011, granted within the framework of the Operational Programme Research, Development and Education (hereinafter the "**COMPASS-U**" or "**ALIMAT-F**", respectively, or jointly the "**Project**").
- 1.2. The Seller won the public procurement procedure announced by the Buyer pursuant to Act No. 134/2016 Coll., on Public Procurement, as amended (hereinafter the "**Public Procurement Act**" or "**PPA**"), for tender entitled "System for plasma heating with neutral particle beam for COMPASS-U Tokamak - Round 2" (hereinafter the "**Tender**").
- 1.3. Performance hereunder shall be based on the following annexes which form an integral part hereof:
 - a) technical specifications relating to the devices to be purchased which forms an integral part hereof as Annex No. 1 (hereinafter the "**Technical Specification**"). This Technical Specification also formed a part of the tender documentation in the Tender as its Annex No. 1;
 - b) part of the Seller's bid as submitted in the Tender which describes the devices in technical detail (hereinafter the "**Bid**"); the Bid (technical part only, i.e. the Table of minimal technical requirements, as offered by the Seller) is attached as Annex No. 2 to this Agreement and forms an integral part hereof;
 - c) price schedule and deliverables which forms an integral part hereof as Annex No. 3 of this Agreement (hereinafter the "**Price Schedule and Deliverables**"). The Price Schedule and Deliverables include name of each device, delivery time of each device, unit price for each device, amount of advance payments, terms and conditions of advanced payments, further the breakdown of the price of each device according to which it will be possible, if necessary, to take over and issue an invoice for individual part(s) of the ordered device for the price(s) specified in the Price Schedule and Deliverables;

d) the tender documentation used in the Tender (hereinafter the "**Tender Documentation**").

- 1.4. This Agreement shall be considered for the comprehensive unit and obligations and rights shall be always interpreted in accordance with these documents. In case of any discrepancy between the provisions of this Agreement and the provisions of its Annexes the provisions of this Agreement shall prevail, except for the provisions of Annexes containing conditions and specifications that are more favourable to the Buyer (i.e. better technical specification values and/or more technically advanced or demanding solutions or results etc.), in which case such provisions of Annexes shall prevail. In case of any discrepancy between the provisions of the Annexes the provisions containing conditions and specifications that are more favourable to the Buyer shall prevail.
- 1.5. The Seller acknowledges that the Buyer considers the Seller's participation in the Tender, provided that he has met all qualification criteria, as constituting sufficient confirmation that the Seller will be able to act, within the meaning of Section 5 Paragraph 1 of the Civil Code, during performance hereunder, with all necessary knowledge, professional care and diligence pertaining to his profession or status, and that the Seller shall be liable for any acts lacking such required professional care, knowledge or diligence. The Seller shall not abuse his professional knowledge or economic position to create dependence on the part of the weaker party or to establish an apparent and unjustified imbalance in the mutual rights and obligations between the Parties hereto.
- 1.6. The Seller declares that he has all required professional qualifications that are necessary to deliver the subject-matter of performance hereof and that there are no obstacles on this part that would prevent him from providing subject-matter pursuant this Agreement to the Buyer.
- 1.7. The Seller is aware that the Buyer does not act as an entrepreneur in relation to the subject-matter of this Agreement.
- 1.8. The Seller declares that he assumes the risk of change in circumstances within the meaning of Section 1765 Paragraph 2 of the Civil Code.
- 1.9. The Parties declare to maintain confidentiality about all information acquired in relation to this Agreement and its performance whose disclosure may cause harm. This shall not inflict the Buyer's obligation ensuing from legal regulations.
- 1.10. The Seller acknowledges that with view to the fact that the purchase price of the object of purchase is financed from the subsidy, failure to comply with Seller's obligation may affect the financing. Any expenditure declared ineligible, imposed payments or administrative sanctions resulting from breaching of such obligation on basis of this Agreement shall represent damage that occurred to the Buyer.
- 1.11. The Seller further acknowledges that he is aware of the importance to the Buyer of the fulfilment of this Agreement in terms of quality and schedule and that in the event of a failure by the Seller to meet them (e.g. in case of delay with delivery and/or in the case if

the devices do not meet the stipulated requirements) the Buyer may incur substantial damage. Duly and timely performance hereunder is essential for the Buyer, in particular, given the follow-on activities within the framework of the Project and observation of the respective deadlines for their completion.

2. SUBJECT-MATTER OF THE AGREEMENT

2.1. The subject-matter of this Agreement is the obligation of the Seller to deliver under the terms and conditions agreed herein and to transfer ownership right to the Buyer to the components of the system for plasma heating with neutral particle beam for COMPASS-U Tokamak which is composed of individual devices which shall fully comply with the requirements and specification stipulated herein, including, but not limited to, the identification of the goods, quantity and technical parameters stipulated in the Technical Specification (hereinafter the "**Devices**" or individually the "**Device**") and to enable the Buyer to acquire the ownership title to the Devices in compliance herewith. The delivery of the Devices hereunder shall also comprise as follows:

- a) design documentation of the Devices;
- b) transport of the Devices to the place of delivery covered with insurance (risks, responsibility, etc.) related to their delivery and transport and the payment of other fees related to transport of the Devices, if any;
- c) installation, commissioning and checking perfect functionality of the Devices at the Buyer's laboratory;
- d) demonstration of operation of the Devices and testing of parameters of the Devices required by the Buyer;
- e) provision of training of the Buyer's staff in Czech or English language at the place of delivery;
- f) delivery of instructions and maintenance manuals for operation of the Devices in Czech or English language to the Buyer, both in written and electronic form (on a data medium);
- g) delivery of other supplies, certificates, protocols and other documents related to the Devices in conformity with agreed standards;
- h) provision of warranty service for the Devices free of charge;
- i) provision of spare parts for a period of five (5) years from the last day of the warranty period stipulated herein, if requested by the Buyer.

The supply of the Devices shall also include necessary research and development activities, potential additional works and/or deliveries, and if applicable a free license to use the supply for the needs of the Project, including its follow-up phases (the Devices, other supplies and related activities to be made hereunder shall be referred to jointly as the "**Object of Purchase**").

2.2. The Seller undertakes to duly deliver, under the terms and conditions agreed herein and within the time frame agreed herein, at his own cost and risk the items (Devices) forming the Object of Purchase to the Buyer at the prescribed location and to hand them over to the Buyer. The Seller shall be liable for delivery of the said items fully in accordance with this Agreement and its Annexes, his Bid submitted within the Tender and applicable legal,

technical and quality regulations. For the sake of clarity, the Seller's obligations hereunder to deliver the Object of Purchase, performance of which has been included in the purchase price specified herein, shall also include all the activities under the above Article.

- 2.3. The Devices shall be delivered as new, previously unused and in top quality, corresponding, with its construction and other properties, to the highest international quality standards in the segment of science and technical development. The Devices shall meet all relevant requirements specified in the generally applicable legal regulation and technical standards of the European Union and/or the Czech Republic for legal and adequate operation by the Buyer, which is entirely the Seller's responsibility.
- 2.4. The delivery of the Devices hereunder shall also comprise the handover of design documentation and any all other documentation related to the Devices that is required to handle the Devices and to operate it or that is required by generally applicable legal regulation and technical standards of the European Union and /or the Czech Republic.
- 2.5. This Agreement further stipulates the obligation of the Buyer to take over the duly and timely delivered Object of Purchase or its individual parts (Devices) and pay corresponding part(s) of the purchase price, under the terms and conditions agreed herein, to the Seller. For the sake of clarity, the Buyer shall be hereunder obliged to accept and take over only the parts of the Object of Purchase that are fully in compliance with all requirements specified in this Agreement (including its Annexes).

3. PARTIAL PURCHASE AGREEMENT

- 3.1. The Object of Purchase will be performed and completed by the Seller for the Buyer in parts, within the extent and under the terms defined in partial purchase agreements which shall be concluded simply by the Seller's acceptance of a written order issued by the Buyer (hereinafter the "**Order**"). Order made by using e-mail shall be understood to have been made in writing. The Order shall be communicated by the Buyer to the Seller via an e-mail sent to the e-mail addresses of all representatives of the Seller in matters of the Orders and their acceptance as listed in Article 11.2 hereof. The Seller undertakes to carry out his performance hereunder only on the basis of the binding Order constituting a partial purchase agreement of the Parties on the terms of such Order, in particular on the volume of items to be supplied and the time-frame of the supply.
- 3.2. Despite the fact that this Agreement, the Technical Specification as well as the Price Schedule and Deliverables include more types of the Devices, the Seller acknowledges and agrees that the Buyer shall be entitled to order any type or combination of the Devices in any quantity up to the maximum limit amounting to the Estimated Value of the Public Contract defined in the Tender documentation. The Seller further acknowledges and agrees that the Buyer shall not be obliged to order any of the Devices from the Seller. Therefore, the Seller may not seek from the Buyer any Order(s) in connection herewith, nor claim on the Buyer any payment or compensation except for corresponding part(s) of the purchase price to be paid for the actually ordered and duly delivered parts of the Object of Purchase.
- 3.3. The Seller shall be obliged to accept the Order of the Devices and deliver each of them in

accordance with this Agreement, particularly with the Price Schedule and Deliverables.

- 3.4. The Buyer shall specify in each Order his proposal for number of particular items of the Devices to be supplied by the Seller, time-frame of the supply as stipulated in the Price Schedule and Deliverables as well as corresponding part of the purchase price specified herein for the number of items to be supplied, which shall also comply with the relevant unit price stipulated in the Price Schedule and Deliverables as well as in the Seller's Bid submitted within the Tender.
- 3.5. The Seller shall confirm his acceptance to the Buyer in writing within ten (10) business days of receiving the Order. Acceptance made by using e-mail shall be understood to have been made in writing. Confirmation of acceptance communicated by at least one of the Seller's representatives in matters of the Orders and their acceptance according to Article 11.2 hereof shall suffice for acceptance of the Order by the Seller.
- 3.6. The Parties agreed that should the Seller not reply within ten (10) business days the Order is deemed accepted, unless the order has not been sent to the e-mail addresses of all representatives of the Seller in matters of the Orders and their acceptance as listed in Article 11.2 hereof. Should the Order contain a requirement, which exceeds the framework agreed herein or in the Tender Documentation or the Seller's Bid submitted within the Tender, which the Seller has not agreed to perform, the Seller shall notify the Buyer of such excess requirement within the above deadline, otherwise it shall be understood that the Seller agrees with such additional performance, without a claim to increase the purchase price specified herein.
- 3.7. The Buyer shall be entitled to cancel his Order anytime; in such an event the Buyer shall be obliged to reimburse the Seller for the costs which were demonstrably expended by the Seller with respect to that Order by the time the Order will have been cancelled as well as further costs which the Seller have demonstrably incurred due to that cancellation up to the amount that the Seller could not demonstrably avoid. The Seller shall be obliged to prove the amount of these costs. In any case of Order cancellation, the maximum reimbursement for cost incurred unavoidably due to cancellation may be the part of the purchase price corresponding to the delivery ordered in that Order.

4. TERM, PLACE OF DELIVERY AND HANDOVER

- 4.1. This Agreement is concluded as a framework agreement for the period of 4 years from the date of the execution of this Agreement.
- 4.2. The Seller agrees to execute the subject-matter of this Agreement according to the schedule stipulated in each partial purchase agreement based on the Order issued by the Buyer in accordance with delivery time stipulated in the Order which shall comply with the Price Schedule and Deliverables.
- 4.3. The place of delivery shall be the Czech Republic according to exact instructions communicated by the Buyer prior to each delivery of the Device. Unless the Buyer communicates otherwise, the place of delivery and installation shall be at the department

of Tokamak of the Buyer at the address: U Slovanky 1770/3, 182 00 Prague 8. Unless the Buyer communicates otherwise, the address regarding any communication between the Parties shall be the registered seat of the Buyer, i.e. Za Slovankou 1782/3, 182 00 Prague 8. The Object of Purchase or its individual parts shall be delivered in compliance with international conditions for goods transport INCOTERMS® 2010 according to the DAP rule; the costs for unloading the Device at the place of delivery is paid by the Seller. In case of conflict, the provisions of this Agreement shall take precedence over the INCOTERMS® 2010.

- 4.4. The Buyer agrees to carry out all preparatory works required for commissioning of the Devices sufficiently in advance, as the distribution of power and gases, ensuring water cooling etc., exactly following the Seller's instructions. The Seller shall be obliged to deliver these detailed instructions to the Buyer not later than 12 months prior to the agreed day of delivery of the Devices. If the Seller fails to deliver the required instructions in time, he shall be responsible for possible delays in the preparation of the place of delivery for the Devices by the period by which he failed to observe the deadline to deliver the instructions.
- 4.5. The Seller shall deliver the Object of Purchase in compliance with this Agreement, generally applicable legal regulation and the technical standards of the European Union and /or the Czech Republic. The number of deliveries shall depend on the number of the actually ordered Devices. The Parties shall perform the acceptance of each Device; a Device is accepted by the Buyer's approval of/signature on the Handover Protocol of Acceptance of the Device after successful completion of the site acceptance test by the Seller. Technical requirements for the acceptance of each Device are defined in the Technical Specification.
- 4.6. The Seller undertakes to execute and hand over the design documentation of each ordered Device no later than three (3) months upon the Order. The Seller shall prepare and submit to the Buyer for approval the handover protocol of design documentation as regards the delivery of the design documentation of the ordered Device in compliance with this Agreement (hereinafter the "**Handover Protocol of Documentation**").
- 4.7. The Seller shall be obliged to notify in writing the Buyer's authorized employee specified herein or communicated to the Seller otherwise of the exact date of delivery of the Object of Purchase or any part thereof (including the Device or any of its part) always not later than 21 days prior to the delivery.
- 4.8. As soon as the Device is considered from the Seller's point of view to be in accordance with requirements stipulated in the Technical Specification for the acceptance of each Device, the Seller shall be obliged to notify in writing the Buyer's authorized employee specified herein or communicated to the Seller otherwise of the same and shall prepare and submit to the Buyer for approval the handover protocol of acceptance of each Device (hereinafter the "**Handover Protocol of Acceptance**") as regards the delivery of each Device, in accordance with the Technical Specification and upon meeting of all requirements in accordance with this Agreement; the Handover Protocol of Documentation and the Handover Protocol of Acceptance must include details on the Seller and Buyer, description of the items that are the subject of handover and takeover, declaration of the Buyer as to

whether the Buyer accepts or does not accept the supply, the date of execution of the protocol on handover and takeover of the supply and it shall be signed by competent (authorized) representatives of both Parties (the Handover Protocol of Documentation and the Handover Protocol of Acceptance shall be referred to jointly as the "**Handover Protocols**").

- 4.9. Before completion of the acceptance of each Device the Seller shall demonstrate to the Buyer operability, failure-free operation, reliability, safety, problem-free inter-operability of all provided systems and technologies and quality of the Device, including fulfilment of all guaranteed parameters and limits as are defined in the Technical Specification. The acceptance of each Device shall beyond any doubt demonstrate that all required limits and parameters stipulated in the Technical Specification have been duly and properly met.
- 4.10. Upon the completion of the acceptance of each Device, the Seller shall submit to the Buyer for approval the Handover Protocol of Acceptance. The necessary prerequisite for its approval by the Buyer shall be fulfilment of all obligations on the part of the Seller under this Agreement, including, without limitations, training of the Buyer's personnel, handover of all documentation foreseen in this Agreement and handover of the Device without legal or factual defects to the Buyer.
- 4.11. In case of any defects of the delivered Object of Purchase or any part thereof, in particular, but not limited to, if the Seller fails to deliver the Device in agreed technical condition and quality or if the Device shows apparent defects or it is damaged or broken or the Seller fails to deliver required documentation for the Device or fails to take all actions related to the commissioning of the Device or ensuring its proper functionality in compliance with this Agreement, the Buyer shall be entitled to refuse the takeover of that defective delivery. Whenever technically possible the Seller shall remedy the deficiencies within one (1) month, unless the Parties agree otherwise. The Buyer shall be entitled at his discretion (but not obliged) to take over the defective part(s) of the Object of Purchase despite its defect, in particular if such defect does not have a material impact on its functionality. If the Buyer does not exercise his right not to take over the defective part(s) of the Object of Purchase, the Parties shall make a list of ascertained defects in the Handover Protocols, including the manner of and deadline for their removal. Till the remedy of the defects the Buyer shall be entitled to postpone any due payments up to the amount corresponding to the price of the defective part(s) of the Object of Purchase. However, these periods do not imply that the Seller is not in delay with delivery.
- 4.12. Should the Object of Purchase or any part thereof have defects, which are not apparent at the handover (i.e. hidden defects), the Parties shall follow regulation stipulated in Section 2112 Paragraph 1, second sentence, of the Civil Code to make claims.
- 4.13. The Parties exclude application of Section 2126 of the Civil Code and they agree that the Seller shall not be authorized to use institutes established therein.
- 4.14. The ownership title to individual parts of the Object of Purchase shall pass to the Buyer as of the moment when the Handover Protocol of Acceptance is signed by both Parties in compliance with this Article.

- 4.15. The Seller shall bear the risk of damage to the Object of Purchase until passing that risk to the Buyer. The Buyer assumes the risk of damage to the parts of the Object of Purchase along with the transfer of the ownership right to that parts; this fact shall not relieve the Seller from his liability for damage caused as a consequence of defects of the Object of Purchase or part thereof.

5. PURCHASE PRICE AND PAYMENT CONDITIONS

- 5.1. The total purchase price for the Object of Purchase according to this Agreement shall be composed of a sum of purchase prices for all ordered Devices, while the purchase price for each Device has been set forth on the basis of the Seller's Bid as follows:

Device No.1 – Vacuum tank assembly

550 000. 00 Euro, excluding VAT

(in words: five hundred fifty thousand EUR), excluding VAT

Device No.2 – Ion sources assembly

1 270 000.00 Euro, excluding VAT

(in words: one million two hundred seventy thousand EUR), excluding VAT

Device No.3 – Accelerating grids

250 000.00 Euro, excluding VAT

(in words: two hundred fifty thousand EUR), excluding VAT

VAT shall be imposed on top of all payments made hereunder according to valid legislation. The purchase prices for each Device as stated above shall be in accordance with the Price Schedule and Deliverables (Annex No. 3) in particular with the respective cells called the "The purchase price of the individual device excluding VAT" (the purchase price for each Device shall be individually referred to as the "**Purchase Price for the Device**" and the sum of the purchase prices for all ordered Devices shall be referred to as the "**Purchase Price**").

- 5.2. The Purchase Price for the Device cannot be exceeded, is independent of the development of prices and changes in the foreign exchange rates and may be changed only in accordance with the Act on Public Procurement.
- 5.3. The Parties declare that the Purchase Price for the Device shall cover any and all performance provided by the Seller hereunder and include all of the Seller's activities executed and all of the Seller's costs accrued or associated with the proper performance hereof. The Purchase Price for the Device shall in accordance with the Price Schedule and Deliverables include especially all expenses related to development, construction, delivery and handover of such Device, including design documentation, transport, installation, commissioning, input reviews, presentation, performance tests, warranty service and training of Buyer's staff, any customs duties, fees, insurance, packaging and its disposal, documents for such Device and all other Seller's costs required to meet his obligations hereunder as well as the costs associated with creation and protection of intellectual property and Seller's claims arising on the basis of intellectual property laws.
- 5.4. The Parties have agreed that upon Seller's request, the Buyer shall provide advance

payments for the financing of the Object of Purchase. The maximum amounts and the terms and conditions of the advance payments are specified in the Price Schedule and Deliverables.

- 5.5. The Parties have agreed that the Seller shall be authorized to invoice the Purchase Price for the Device as follows:
 - 5.5.1. The Seller shall be authorized to invoice the price for delivery of the design documentation of a Device in the amount of 10 % of the Purchase Price for the Device upon execution of the Handover Protocol of Documentation in compliance with this Agreement provided that all terms and conditions stipulated herein and all requirements for delivery of the respective design documentation of such Device are met. Since the relevant portion (10 %) of the advance payment (e.g. 35 %) has to be taken into account, the Seller shall then receive just the remaining part (e.g. 6.5 % price after deducting the 3.5 % portion of advance payment);
 - 5.5.2. The Seller shall be authorized to invoice 90 % of the Purchase Price for the Device for delivery of the Device upon execution of the Handover Protocol of Acceptance in compliance with this Agreement provided that all terms and conditions stipulated herein and all requirements for delivery of the respective Device are met. Since the relevant portion (90 %) of the advance payment (e.g. 31.5 %) has to be taken into account, the Seller shall then receive just the remaining part (e.g. 58.5 % price after deducting the 31.5 % portion of advance payment).
- 5.6. The Seller shall issue a final invoice for the whole Purchase Price for the Device after execution of all Handover Protocols in respect of such Device in compliance with this Agreement provided that all terms and conditions stipulated herein and all requirements for delivery of the respective Device are met. The final invoice shall be in accordance with the Price Schedule and Deliverables and shall include, among others, all payments already provided by the Buyer in respect of such Device and itemized budget (i.e. price breakdown of its individual items/activities) based on the Technical Specification and terms hereof.
- 5.7. The due date of all invoices issued hereunder shall be thirty (30) days from the date of their delivery to the Buyer. The Buyer shall be obliged to pay the Seller invoiced amounts to his bank account specified in heading of this Agreement. A payment of the invoiced amounts shall be understood to be effected on the day such are remitted to the bank account of the Seller. The tax documents – invoices issued by the Seller hereunder shall comply with all applicable legal regulations of the Czech Republic and include the following data:
 - a) Commercial name and seat of the Buyer
 - b) Tax identification number of the Buyer
 - c) Commercial name and seat of the Seller
 - d) Tax identification number of the Seller
 - e) Number of the tax document – invoice
 - f) Quantity and nature of performance supplied, incl. specification of the delivered Device
 - g) The date of issue of the tax document – invoice
 - h) The day of the supply of performance, in so far as it differs from the issue date of the tax document – invoice
 - i) Due date

- j) The respective part of the Purchase Price for the Device
- k) Statement that the performance is provided in connection with the Project and its number

and, furthermore, the tax documents – invoices shall also be in compliance with agreements on avoidance of double taxation, if applicable in particular cases. The Buyer is entitled to request itemization of the Purchase Price for the Device in accordance with his determination. The Buyer is obliged to inform the Seller about this request in advance.

- 5.8. Should a tax document – invoice not be issued in compliance with payment terms defined herein or should it not meet the statutory requirements, the Buyer is entitled to return the tax document – invoice back to the Seller as incomplete, or incorrectly issued, for its correction, or re-issue, within ten (10) business days from the date of its delivery to the Buyer. In such a case, the Buyer shall not be in default with the remittance of the Purchase Price for the Device or any portion thereof, and the Seller shall issue a corrected invoice with a new but identical maturity period which shall commence to run on the day of delivery of the corrected or re-issued tax document – invoice to the Buyer.
- 5.9. The Buyer's and the Seller's invoicing details are given in heading of this Agreement.
- 5.10. No payment on tax document – invoice issued by the Seller shall constitute acceptance of the Object of Purchase/Device or any part thereof or a statement on flawlessness of invoiced performance or conclusive acceptance of flawlessness of the Object of Purchase/Device or any part thereof.
- 5.11. The Seller shall not be authorized to perform set offs of its receivables against the Buyer, unless prior written consent is granted by the Buyer.

6. RIGHTS AND OBLIGATIONS OF THE PARTIES

- 6.1. The Seller undertakes to fulfil all obligations arising therefrom with due professional care, within the deadlines specified herein and/or hereunder, at his expense and risk and for the Purchase Price defined herein.
- 6.2. Unless otherwise specified in this Agreement, all things necessary to perform pursuant to this Agreement shall be ensured by the Seller.
- 6.3. During the performance of this Agreement the Seller proceeds independently, unless hereunder stated otherwise. The Seller shall be obliged to take into account, in the performance of this Agreement, all requirements of the Buyer that are aimed at achieving the highest quality of the objectives hereof, unless such are contrary to the law. If the Seller receives instructions from the Buyer, the Seller shall follow such instructions unless these are against the law or in contradiction to this Agreement. If the Seller finds out or should have found out by exercising professional care that the instructions are inappropriate or contradicting valid standards of the European Union or the Czech Republic or are in contradiction to this Agreement, then the Seller must promptly notify the Buyer.
- 6.4. The Seller agrees to the specifications as defined in Technical Specification, and declares, at

the time of execution hereof, that he is not aware of any deficiencies therein and that he will be able, on the basis of these specifications, to deliver the Object of Purchase in the required quality without the need for any additional work.

- 6.5. In case that a higher version of the Device or a part thereof is produced during the period from the execution of this Agreement and the delivery of the Device, the Seller may, if agreed by the Buyer in writing in advance, deliver that higher version of the Device under the terms and conditions laid down herein without increasing the Purchase Price for the Device, while maintaining the deadline to deliver the Device and identical or better parameters of the Device compared to the parameters of the Device originally agreed herein.
- 6.6. In the event that at the time of delivery of the Object of Purchase or any part thereof hereunder the laws or technical standards of the European Union or the Czech Republic, or technical conditions governing goods and its operation in force shall be different from legal or technical standards in effect at the time of execution of this Agreement, the Seller shall take into account the content of such standards or legislation.
- 6.7. The Seller shall be obliged to inform the Buyer on his request about the progress of the works carried out in order to complete and deliver the Object of Purchase, in the form of an electronic message in Czech or English language no later than ten (10) business days upon such request delivery. If required by the sponsor or operational programme rules or subsidy/grant conditions determined by the sponsor, the Seller shall be obliged to also inform the Buyer about the progress of works every three (3) months in the form of an electronic message in Czech or English language sent to the Buyer's contact person stipulated herein.
- 6.8. The Seller shall be obliged, in relation to third persons, to maintain confidentiality about all facts that he learned during the implementation hereof and in relation hereto, in particular, those that are protected with applicable generally binding legal regulations (in particular, business secret, personal data, confidential information) or that the Buyer declared to be confidential. The obligation to maintain confidentiality shall continue even after the termination of this Agreement. The Seller agrees to secure the meeting of that obligation also in case of all his employees or other persons that the Seller uses to implement this Agreement.
- 6.9. If personal data are processed during the performance hereof within the meaning of Regulation (EU) 2016/679 of the European Parliament and of the Council of April 27, 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) and other related legal regulation of the Czech Republic, the Seller shall comply with all obligations arising from this Regulation. For the avoidance of doubt, any breach of legal obligations or agreement between the Parties hereto in relation to the processing of personal data on the part of the Seller shall be considered to constitute a material breach hereof.
- 6.10. The Seller undertakes, under the terms and conditions hereof, in accordance with

instructions issued by the Buyer and using all due professional care, to:

- a) duly archive all documents produced in connection with the performance hereunder for a period of 10 years after the end of the performance hereunder, but at least until the end of 2033, and allow the Buyer access to these archived documents at any time during that period. The Buyer shall be entitled to take possession of the above documents from the Seller free of charge after the period of 10 years from the end of performance under the Agreement; the Seller shall contractually bind its potential subcontractors to adhere to the same rules;
- b) cooperate within the framework of potential financial control procedures pursuant to Act No. 320/2001 Coll., on financial control, as amended, which includes, but is not limited to, allowing the sponsor or the competent managing authority of the relevant operational programme access to also those portions of the Bid submitted within the Tender, the Agreement, Orders, subcontracts and related documents that might be subject to protection under special legal regulation, provided that all requirements set forth by legal regulation with respect to the manner of conducting such controls will have been observed; the Seller shall contractually bind its potential subcontractors to comply with this obligation accordingly;
- c) enable observance of any publicity obligations stemming from the rules of the relevant operational programme; and
- d) enable the Buyer to fulfil its obligations pursuant to the Act on Public Procurement.

6.11. The Buyer undertakes to deliver to the Seller any and all source documents, materials or other information which are necessary for the delivery of the Object of Purchase or any part thereof and which the Seller can reasonably request from the Buyer under the condition that the Seller raised any such requirement with sufficient advance ensuring fulfilment of the deadlines for the delivery of the Object of Purchase or any part thereof.

7. WARRANTY, WARRANTY AND POST-WARRANTY SERVICE

- 7.1. The Object of Purchase has defects if it or its any part does not correspond to the result set forth in this Agreement.
- 7.2. The Seller shall be liable for any defects of the Object of Purchase or any part thereof at the time of their handover and takeover, and shall also be liable for any defects of the Object of Purchase or any part thereof found during the entire warranty period (quality warranty).
- 7.3. The Seller guarantees that in the course of the warranty period, the Object of Purchase shall have properties laid down in this Agreement, applicable legal regulations and standards and usual properties, if applicable.
- 7.4. The Seller provides a quality warranty on the Object of Purchase and all its parts of 24 months. The warranty period for the Device shall start on the day of the signature of the Handover Protocol of Acceptance by both Parties in compliance with this Agreement. If the Handover Protocol of Acceptance lists any deficiencies, the warranty period shall begin on the day, which follows the day, in which the last deficiency was removed.

- 7.5. The Seller shall pass any existing components warranty to the Buyer. If on the warranty list or other document submitted by the Seller the warranty period is of longer duration, then this longer warranty period shall have priority over the period stated in this Agreement.
- 7.6. The Buyer shall request the Seller to remove the defects of the Object of Purchase or any part thereof during the warranty period in writing without undue delay upon their discovery, but no later than on the last day of the warranty period (hereinafter the "**Claim**"). Even the Claim asserted by the Buyer on the last day of the warranty period is considered to have been asserted in due time.
- 7.7. The Seller undertakes to arrive to examine the Claim, notify the Buyer of whether or not he accepts the Claim, and provide in writing the deadline for the removal of the defect within two (2) weeks from the delivery of the Claim by the Buyer.
- 7.8. The Seller undertakes to gratuitously remove any defects of the Object of Purchase or any part thereof without undue delay and shall bear all the expenses related to the removal of the defects. The deadline for the removal of the defect is thirty (30) calendar days from the delivery of the Claim, unless otherwise agreed between the Parties. In case that the character, significance and extent of the defect objectively does not allow to fulfil the agreed period to remove the defect by the Seller, a reasonable longer period can be agreed with the Buyer. If it shows that a defect in the Object of Purchase or any part thereof is irremovable, the Seller agrees to deliver free of charge, without undue delay, to the Buyer a replacement Object of Purchase or any part thereof having the same quality and parameters as it was agreed for the Object of Purchase hereunder.
- 7.9. The Seller shall be obliged to remove the defects within the specified time limit, even if he believes that he is not liable for the defects. The costs of removing the defects in these disputed cases shall be borne by the Seller until the clarification or resolution of the conflict.
- 7.10. The Parties shall make a report concerning the removal of the claimed defect which will confirm such removal. The warranty period is extended by the period that elapsed between the assertion of the Claim and the removal of the defect.
- 7.11. In case that the Seller does not remove the defect within the stipulated or mutually agreed period or if the Seller refuses to remove the defect, then the Buyer shall be entitled to remove the defect at his own costs and the Seller shall reimburse these costs within one (1) month after the Buyer's request to do so. In such a case the existing warranty remains intact.
- 7.12. The acts of the Parties constitute the Claim if they are made in writing or by electronic communication by one of the representatives of one Party stipulated herein to the address of the representative of the other Party stipulated herein.
- 7.13. Usage and storage of the delivered Object of Purchase and/ or any part thereof must be done by the Buyer in accordance with the Seller's instructions. In the event of non-compliance, the Buyer is no longer entitled to claim quality warranty.

- 7.14. The Seller shall guarantee the service to the Object of Purchase and/ or any part thereof for the period of five (5) years as of the signature of the corresponding Handover Protocol of Acceptance by both Parties. The service means that the Seller, at the Buyer's invitation, shall provide to the Buyer service of the Object of Purchase or any part thereof exceeding the scope of the warranty service without undue delay under the most advantageous conditions under which it provides comparable service to third parties and meeting the terms and conditions (except for the payment) of the service as it is agreed for warranty service herein.
- 7.15. In addition, the Seller guarantees to the Buyer unlimited free access to software updates of the Devices in the course of the entire duration of the operation of the Devices when such software update is included in the Purchase Price. Access guarantee means the communication of the current online access points, including the communication of all required access data (codes, passwords, etc.) provided that the access point is accessible anytime when the Buyer seeks such access.
- 7.16. The Seller agrees that if the Buyer enters into a service agreement with him to perform post-warranty service to the Object of Purchase, it shall be laid down in the terms and conditions of such an agreement that the price per one (1) hour of the work of a service technician during working hours shall not be higher than EUR 8.00 EUR (in words: eight EUR) excl. VAT and the price for the transport of a service technician to the place of the service intervention (1 way there and back) shall not be higher than EUR 350.00 (in words: three hundred fifty EUR) excl. VAT at least for the period of two years upon expiration of the warranty period. The minimal working time of a service technician per one intervention shall not be smaller than 30 hours.

8. INTELLECTUAL PROPERTY RIGHTS

- 8.1. This Article applies only if in connection with the performance of this Agreement, the Object of Purchase or any of its part constitute an author's work within the meaning of Act No. 121/2000 Coll., on copyright, on rights related to copyright and amending certain acts, as amended (hereinafter the "**Copyright Act**"). In such case it is deemed to be a contract work in the sense of Section 61 of the Copyright Act (hereinafter the "**author's work**") and the Seller grants to the Buyer a royalty-free license to use the author's work (or any of its parts) for the purposes of this Agreement and for the purposes of research and education or publication activities for the duration of the property rights to the author's work on the territory of the whole world, including sub-license for the purpose of implementing the Project, including its follow-up phases.
- 8.2. For the purposes of this Agreement, author's work and industrial rights are hereinafter jointly referred to as intellectual property rights. In the event that the author's work or part thereof is created in connection with the performance of this Agreement, and the Seller is entitled to register such author's work or part thereof through any of the forms of industrial property rights (i.e. trademark, patent or invention, utility or industrial design, etc.) protected under applicable legislation of the Czech Republic, other country or an international or supranational organization, the Seller shall grant to the Buyer, for the

duration of the protection of the relevant industrial property rights, a royalty-free license to use the author's work for the purposes of the Project and other research and educational activities or publication activities, as well as for the purposes of this Agreement on the territory of the whole world. The Buyer shall be entitled to disclose the results of the author's work to any third party without the prior consent of the Seller.

8.3. The Parties declare that they have agreed that the Seller's remuneration for license(s) granted under this Article is already reflected and included in the Purchase Price agreed herein.

8.4. The Seller declares that the provision of license(s) to the Buyer does not infringe the intellectual property rights of third parties and that he is entitled to transfer the license to the Buyer. If the Seller fails to comply with this provision, he undertakes to pay all third-party claims for infringement of the intellectual property rights of third parties and compensation for damages caused by the Buyer.

8.5. The Seller undertakes to transfer the complete documentation created in connection with the performance of this Agreement, which is relating to the subjects of intellectual property under this Article. For the avoidance of any doubt, the Parties have agreed that all software created in connection with the performance of this Agreement as the copyrighted work (meaning software on PCs, FPGA, microcontrollers, microprocessors and other programmable devices) shall be received by the Buyer under the following conditions:

8.5.1. Type of SW compilation procedure and back-up solution

If possible, the software will be compiled on virtual machines backed-up by the Seller in order to maintain the possibility of compilation of the software throughout the expected longevity of the Object of Purchase. Alternatively, the bit copies of real computers with the installed software along with a detailed PC description will be backed up.

8.5.2. Access to the source code of the SW specifically developed for the realization of the Object of Purchase delivery

If the software is developed by the Seller or third parties specifically for the Object of Purchase, the Buyer will obtain the source codes (source code in language used by programmer to write the code), binary files and compilation instructions (including the programs used for the compilation, list of dependencies and deployment manual).

8.5.3. Access to the source code of the SW developed by the Seller independently to the Object of Purchase delivery

If the software belongs to the Seller and it was developed independently on the Object of Purchase delivery and the Seller is not willing to provide the source codes to the Buyer, then the Buyer requires to obtain binary files at delivery of the Object of Purchase and the source codes after 10 years from the delivery at latest.

8.5.4. Access to the source code of the SW developed by the third parties independently to the Object of Purchase delivery

If the software belongs to a third party and it was developed independently on the Object of Purchase delivery, the Seller is required to make demonstrable effort to obtain the source codes for the Buyer. If it is not possible, the Buyer requires at least backed-up binary files

and software documentation.

- 8.6. In the event that the author's work or its part has been produced as a result of joint effort of the Seller and the Buyer, the Parties undertake to submit a joint application for any industrial rights as co-applicants. All natural persons participating on the creation of the author's work or its part shall be co-authors.
- 8.7. All licences and other entitlements under this Article shall be provided as irrevocable. Termination of this Agreement has no influence on granting of licences.
- 8.8. The intellectual property rights according to this Article shall pass to the legal successor of the Buyer or to the future operator/owner of the Object of Purchase, for the duration of the protection period granted to that particular intellectual property right and/or period of existence of ownership rights to copyrighted work or without any restriction to other intangible goods within the meaning of this Agreement.
- 8.9. The Seller shall assign/submit to the Buyer valid licences to use the software, which is subject to the license terms, bought by the Seller, at the latest upon signing the Handover Protocol of Acceptance. The assignment of the licences shall be in accordance with the licensing policy of the software vendors.

9. LIABILITY, SACTIONS

- 9.1. In the event that the Seller is in delay with delivery of the Object of Purchase or any part thereof by the deadline specified in the Price Schedule and Deliverables, then the Seller shall be obliged to pay to the Buyer a contractual penalty in the amount of 0,02 % from the total value of undelivered Device (i.e. from the value of the Purchase Price for the Device excluding VAT) per each commenced day of delay in the first ninety (90) days of delay and 0,035 % from the total value of undelivered Device per each commenced day of delay in the following days of delay, while the maximum total amount of the agreed contractual penalty shall not exceed 5 % of the Purchase Price for the Device excluding VAT of the delayed Device (as stipulated in Article 5.1 hereof). For the sake of avoidance of any doubt, the Parties have agreed that in the event of a simultaneous default on more Devices, the contractual penalties imposed hereunder shall add up.
- 9.2. The Seller shall be further obliged to pay to the Buyer contractual penalties in the following cases:
 - 9.2.1. if the Seller is in delay with the delivery of the design documentation in compliance with this Agreement, then the Seller shall be obliged to pay to the Buyer a contractual penalty in the amount of EUR 200 per each commenced week of delay;
 - 9.2.2. if the Seller is in delay with proper completion or correction of an incompletely or insufficiently delivered documentation even after a period of thirty (30) calendar days of the Buyer's notification claiming such a defect, then the Seller shall be obliged to pay to the Buyer a contractual penalty in the amount of EUR 100 per each commenced week of delay commencing upon such period;

- 9.2.3. if the Seller fails to remove ascertained defects within the deadline stated in any of the Handover Protocols, the Seller shall be obliged to pay to the Buyer a contractual penalty in the amount of 0.05 % of the Purchase Price for the Device excluding VAT of the defective Device (as stipulated in Article 5.1 hereof) per each commenced day of delay;
- 9.2.4. if the Seller is in delay with the removal of a defect under warranty or other defects which timely removal is not secured by a contractual penalty explicitly agreed above, then the Seller shall be obliged to pay to the Buyer a contractual penalty in the amount of EUR 400 per each commenced week of delay;
- 9.2.5. if the Seller fails to meet his obligations related to warranty specified in Article 7.11 hereof, which fulfilment is not secured by a contractual penalty explicitly agreed above, then the Seller shall be obliged to pay to the Buyer a contractual penalty in the amount of EUR 2000 per each such individual case of the breach of an obligation;
- 9.2.6. if the Seller fails to meet any of his obligations related to the training the Buyer's staff, delivery of instruction and maintenance manuals for operation of the Device(s), warranty certificates or other documentation relating to the Device(s), which fulfilment is not secured by a contractual penalty explicitly agreed above, then the Seller shall be obliged to pay to the Buyer a contractual penalty in the amount of EUR 4000 per each individual case of breaching the obligation.
- 9.3. In case of delay with the payment of the Purchase Price or any part thereof the Buyer undertakes to pay to the Seller an interest at the statutory rate.
- 9.4. The Buyer shall be entitled to set off any receivables he may have at any time on the basis of his right to claim contractual penalty hereunder, against any of the Seller's receivables arising from his right to claim the Purchase Price or any part thereof.
- 9.5. The Parties exclude application of Section 2050 of the Civil Code, i.e. the Buyer shall be entitled to seek damages in addition to the contractual penalty hereunder.
- 9.6. If either Party breaches its duty arising from this Agreement or it should or could know about such a breach, it shall inform the other Party, which may incur damage, without undue delay and warn it of potential consequences; in such a case, the Party suffering damage has no right to be compensated for damage which it could avoid after being notified hereunder.
- 9.7. The due date of all contractual penalties stipulated herein shall be thirty (30) days from delivery of the complaining Party's notification to the other Party. The notification under this paragraph shall include description and date of the particular event that entitles one of the Parties to impose a contractual penalty on the other Party. In case of delay with payment of the contractual penalty the breaching party undertakes to pay to the other party an interest in the amount of 0.1% of the outstanding contractual penalty for each day of delay.

10. TERMINATION OF AGREEMENT, FORCE MAJEURE

- 10.1. This Agreement may be terminated by its completion, by its expiration, by agreement of the Parties or by withdrawal from the Agreement for reasons specified by law or the Agreement.
- 10.2. The Buyer is entitled to withdraw from this Agreement without any sanction if any of the following circumstances occur:
 - 10.2.1. the Buyer is withdrawn from or loses the financial subsidy and/or funding for the implementation of the Project or will not be awarded such subsidy and/or funding;
 - 10.2.2. any expenditure or any part thereof, which may arise on basis of this Agreement, are declared by the subsidy provider or other controlling body to be ineligible;
 - 10.2.3. the Seller loses the license to execute activities, which constitute the subject-matter hereof; the Seller shall be obliged to inform the Buyer without delay about the mere fact that he may be subject to proceedings leading to potential withdrawal of his authorization to perform activities hereunder;
 - 10.2.4. the Seller enters liquidation;
 - 10.2.5. insolvency proceedings were commenced against the assets of the Seller (or similar proceedings under the laws of another country), where a decision on bankruptcy was issued, or insolvency petition rejected because of insufficient assets to cover the costs of insolvency proceedings, or where bankruptcy was cancelled because property was completely insufficient or receivership was introduced by special legislation;
 - 10.2.6. it has become obvious, considering all pertinent facts and circumstances, that the Seller's activities do not lead, to the fulfilment of a material part of objectives defined herein due to reasons on the part of the Seller;
 - 10.2.7. it is revealed that the Seller stated in the Bid certain information or submitted documents which do not correspond to reality and which had or could have had impact on the results of the Tender that lead to the execution of this Agreement (Section 223 Paragraph 2 letter c) PPA); or
 - 10.2.8. the Seller breaches this Agreement in a material manner (as presumed in Article 10.3. hereof).
- 10.3. The following shall be considered to constitute a material breach hereof by the Seller:
 - 10.3.1. the Seller is in delay with delivery of any supply hereunder for a period exceeding four (4) calendar months, except where the delay has been caused solely by the Buyer;
 - 10.3.2. any of the supplies submitted to the Buyer under this Agreement do not meet the technical or other parameters foreseen by this Agreement, even after the Buyer has requested the Seller twice to meet or supplement them;
 - 10.3.3. in the event that the Seller yields, transfers or assigns its rights and obligations hereunder to a third party without prior consent in writing from the Buyer;
 - 10.3.4. the Seller breaches his obligations in relation to the processing of personal data within the meaning of Article 6.9. hereof;
 - 10.3.5. the Seller violates continuously or repeatedly (continuous) laws, regulations, technical

standards and norms of the Czech Republic or other countries, which he agreed to observe herein; or

- 10.3.6. the Seller breaches this Agreement in such a manner that the Buyer will not be able to meet his objectives for which he concluded this Agreement, or if such conduct on the part of the Seller causes considerable damage to the Buyer.
- 10.4. The Seller is entitled to withdraw from this Agreement without any sanction if the Buyer is in delay with the payment of the Purchase Price or its part for more than two (2) calendar months after an additional period for the payment of the relevant part thereof specified by the Seller in written notification had been provided.
- 10.5. The Party which is hereunder entitled to withdraw from this Agreement may withdraw entirely or just with respect to some partial purchase agreement(s). If herein or in the withdrawal not expressly stated otherwise, termination of this Agreement does also terminate the partial purchase agreements concluded hereunder (i.e. by acceptance of the Order).
- 10.6. The act of withdrawal from this Agreement shall become effective on the day of delivery of the notification in writing from one Party to the other with consequences of the Agreement termination effective in the "ex nunc" regime. In case of the Agreement's termination due to reasons given in Article 10.2. hereof, the Seller shall be eligible for payment for the actually delivered Devices to the Buyer, if such had been executed in accordance with the terms and conditions agreed hereof.
- 10.7. The withdrawal from the Agreement is without prejudice to the arrangements on a contractual penalty and indemnification.
- 10.8. Circumstances precluding liability shall be deemed to have been constituted by such obstacle(s) which arose independently of the will of the obliged Party, and which prevent fulfilment of that Party's obligation, provided that it could not be reasonably expected that the obliged Party could overcome or avert this obstacle or its consequences, and furthermore that such Party could foresee such obstacle when it entered into the respective covenants (hereinafter the "**Vis major**"). Liability cannot be precluded by obstacles that arose only after the obliged Party was in default with fulfilment of its obligations, or which arose in connection with its economic situation. The effects precluding liability shall be limited to the period during which the obstacles causing these effects persist.
- 10.9. Should a situation occur, which the Party could reasonably consider to constitute Vis major, and which could affect fulfilment of its obligations hereunder, such Party shall immediately notify the other Party and shall attempt to continue in its performance hereunder in a reasonable degree. Simultaneously, such Party shall inform the other Party of any proposals, including alternative modes of performance; however, without consent of the other Party, it shall not proceed to effect such alternative performance.
- 10.10. If a situation constituting Vis major occurs, the deadlines imposed hereunder shall be extended by the period of the duration of the said Vis major event.

11. REPRESENTATIVES, NOTIFICATIONS

11.1. The Buyer has appointed the following authorised representatives for communication with the Seller in relation to the Object of Purchase hereunder:

In technical matters:

[REDACTED]

Telephone number: [REDACTED]

E-mail: [REDACTED]

In contract matters:

[REDACTED]

Telephone number: [REDACTED]

E-mail: [REDACTED]

11.2. The Seller has appointed the following authorised representatives for communication with the Buyer in relation to the Object of Purchase hereunder:

In technical matters:

[REDACTED]

Telephone number: [REDACTED]

[REDACTED]

In contract matters (excluding Orders and their acceptance):

[REDACTED]

Telephone number: [REDACTED]

E-mail: [REDACTED]

In matters of the Orders and their acceptance pursuant to Article 3 hereof, the Seller has appointed the following 1 to 3 authorised representative(s):

1. [REDACTED]

Telephone number: [REDACTED]

[REDACTED]

2. [REDACTED]

Telephone number: + [REDACTED]

E-mail: [REDACTED]

3. [REDACTED]

Telephone number: [REDACTED]

E-mail: [REDACTED]

11.3. In order to change the authorized persons, a notification to the other Party by e-mail is sufficient if accompanied by requesting a confirmation of delivery (unless the Parties agree otherwise) not later than 3 calendar days as of such change.

11.4. Unless this Agreement provides otherwise, all notifications between the Parties hereunder

must be made in writing and delivered to the other Party by an authorised delivery service, in person (with written confirmation of receipt), by registered mail sent using a postal service provider, or may be made by electronic communication with an electronic signature or by using data mailbox (data mailbox numbers are given in heading of this Agreement). If a document notifying a certain legal action is to be delivered hereunder, such document is regarded as delivered on the day when it was received by its addressee. If such document is sent by registered mail and if its receipt by the addressee is not reported, it is regarded as delivered or the legal effects of the notified legal action shall start on the tenth (10th) day after its repeated dispatching in the above manner, unless the law stipulates in a specific case otherwise. Simultaneously, the copy of such document shall be sent via e-mail to the above representatives for communication in technical and contract matters.

11.5. In technical matters (including among others claiming the warranty), electronic communication through the above representatives is permitted.

12. GOVERNING LAW AND DISPUTE SETTLEMENT

12.1. Both Parties declare that this Agreement and any and all legal relationships arising therefrom are governed by the laws of the Czech Republic. The Parties acknowledge that areas not expressly regulated by this Agreement are governed by the relevant provisions of the Civil Code.

12.2. Any and all disputes arising out of this Agreement or legal relationships related thereto shall be settled by mutual negotiation between the Parties. If a dispute cannot be settled amicably by negotiation within sixty (60) days, such a dispute shall be decided by the competent court in the Czech Republic having jurisdiction according to the registered office of the Buyer based on application of any of the Parties. Any and all disputes shall be always governed by Czech law.

13. FINAL PROVISIONS

13.1. This Agreement represents a complete agreement between the Buyer and the Seller.

13.2. The Seller shall not be entitled to transfer rights and duties from this Agreement or its part on third parties, to transfer his claims against the Buyer that arose on the basis or in connection with this Agreement on third parties, nor to set off any of its claims or his debtor's claims against the Buyer's claims, unless prior written consent is granted by the Buyer.

13.3. If any Party breaches any duty under this Agreement and knows or should have known about such breach, the Party shall notify and warn the other Party of possible consequences.

13.4. Should any of the provisions hereof appear or shall be determined invalid, ineffective, non-existent or unenforceable at a later date, then such invalidity, ineffectiveness, non-existence or unenforceability shall not cause the invalidity, ineffectiveness, non-existence or unenforceability hereof as a whole. In such a case, the Parties undertake, to clarify without

undue delay any such defective provisions herein within the meaning of Section 553 Paragraph 2 of the Civil Code, or to replace it, by mutual agreement, by a new provision that most closely reflects the intentions of the Parties at the time of conclusion hereof, to an extent permitted by the laws and regulations of the Czech Republic.

13.5. The Parties agree on publishing of this Agreement and related information according to Public Procurement Act and Act No. 340/2015 Coll., on Special Conditions for the Effectiveness of Certain Agreements, the Disclosure of These Agreements and the Register of Agreements (Act on the Register of Agreements), as amended.

13.6. This Agreement becomes valid on the date of its signature by the authorized representatives of both Parties and effective on the date of its registration into the Register of Agreements.

13.7. This Agreement may be amended or modified exclusively in the form of written and numbered amendments specifying the time thereof, and signed by the authorized representatives of the Parties. In accordance with Section 564 of the Civil Code, the Parties explicitly exclude executing amendments hereto in any other manner or form.

13.8. This Agreement was made out in English and executed in four (4) counterparts, each having the force of original. Each Party shall obtain two (2) counterparts.

13.9. The Annexes listed below form an integral part of this Agreement:

Annex 1: Technical Specification

Annex 2: The Seller's Bid submitted within the Tender (technical part only, i.e. the Table of minimal technical requirements, as offered by the Seller)

Annex 3: The Price Schedule and Deliverables

13.10. By attaching their signature hereto, the Parties express their consent with the content of the Agreement hereof in its entirety.

In Prague on _____

In Novosibirsk on _____

On behalf of the Buyer:

On behalf of the Seller:

Ústav fyziky plazmatu AV ČR, v. v. i.

BINP SB RAS

Name: doc. RNDr. Radomír Pánek, Ph.D.

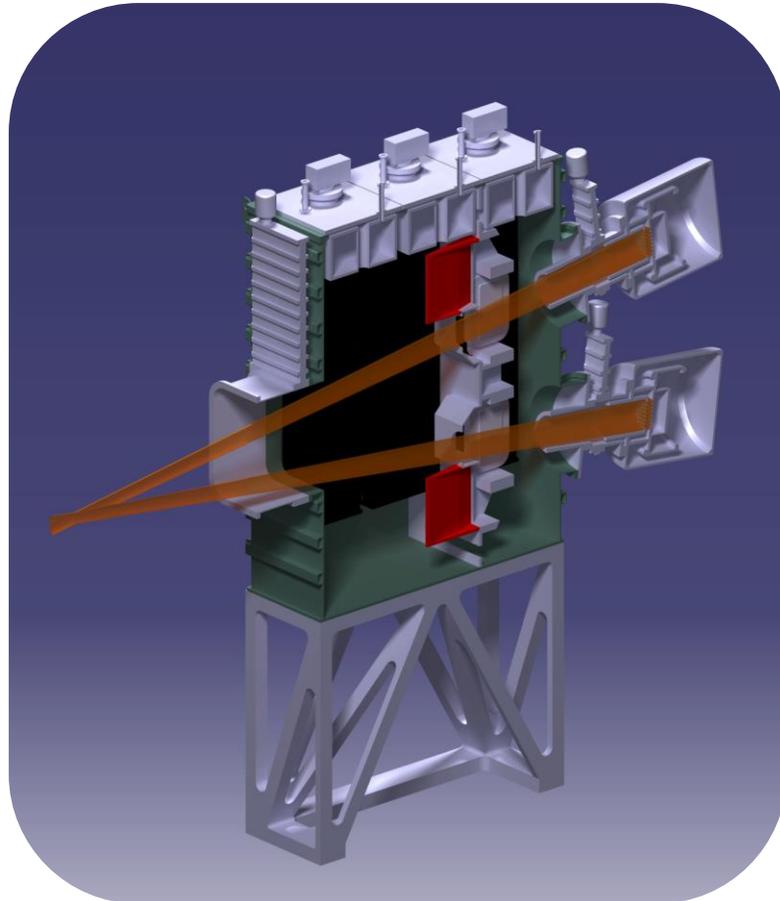
Function: Director

Name: [REDACTED]

Function: [REDACTED]

Technical specification

System for plasma heating with neutral particle beam for COMPASS-U Tokamak



Institute of Plasma Physics of the Czech Academy of Sciences

Date: 22.6.2020

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2. Introduction

This document contains the binding technical specifications for the devices of the framework purchase agreement of the public tender “System for plasma heating with neutral particle beam for COMPASS-U Tokamak”.

The tender “System for plasma heating with neutral particle beam for COMPASS-U Tokamak” includes the development, design, manufacturing, temporary storage, transportation to the customer, installation on customer premises and commissioning of devices for additional heating systems of tokamak plasmas that utilize beams of accelerated neutral particles for heating tokamak plasmas. Such system is here after referred to as Neutral beam heating system (NBHS)

The extent of delivery for “System for plasma heating with neutral particle beam for COMPASS-U Tokamak” contains all parts necessary to connect to the outlets located on Buyer’s premises in a controlled and safely manner according specification, including all design works, installation works, tests, commissioning, training of the Buyer’s employees/staff, documentation and spare parts.

This document is divided in the following way. In **chapter 3** the list of devices, their general description and general requirement applicable to all devices are presented. In **chapter 4** requirements for particular devices are presented in dedicated subchapters for each individual device. In **chapter 5** the procedure of the acceptance and performance testing is stated. All stated requirements are mandatory for the Seller to fulfill / attain unless explicitly stated otherwise. For such cases the keyword “optional” is used. Glossary of used terms is presented in **chapter 3.2**

If a particular general technical specification is not applicable to an individual device due to the nature of operation of this device it can be disregarded for that particular device as “not applicable”, e.g. Acceleration voltage for a vacuum tank.

3. General description

The Buyers vision is to have several independent neutral beam heating systems that consists of a common vacuum tank each equipped with a pair of neutral beam ion sources placed above each other where the devices of the NBHS are functionally identical. To allow the Buyer greater versatility in construction and procurement the neutral particle beam heating systems are divided into several subcomponents, referred herein as **devices** and listed in Table 1. As a consequence, none of the device **No. 1, No. 2, or No. 3** constitutes a fully working NBHS on their own. But a NBHS can be constructed by their combination. Therefore, most of the general requirements are applicable for them also and all devices have to be designed and constructed with regards to these general requirements. A working NBHS consists of one device No.1 and one device No.2 **at least**.

Extent of delivery and applicability of general technical requirements may differ for individual devices. If the technical specifications associated with a particular device that are stated within chapter **4 Device specific requirements** concerning a particular device are in conflict with general requirements the requirement for that particular device are to be followed (i.e. have a higher priority).

Table 1 List and names of devices for the framework agreement

Device No.	Device Name	Short description
1	Vacuum tank assembly	Vacuum tank for 2 x 1MW, 80keV neutral beam heating system
2	Ion source assembly	1 MW, 80keV neutral beam ion source for neutral beam heating system and its corresponding power supplies
3	Accelerating grids	Spare set of accelerating grids for a 1 MW neutral beam heating source

3.1. General description of devices

*Device No. 1 **Vacuum tank assembly** – vacuum tank for 2 MW neutral beam heating system*

This device is a common vacuum tank capable of hosting two independent 1 MW neutral beam ion sources. Adding one or two devices No. 2 will produce a full and complete 1 MW or 2 MW NBHS, respectively, without the need for procuring or adding any additional components (except components explicitly stated as “provided by the Buyer”).

*Device No. 2 **Ion source assembly** - 1 MW neutral beam heating source for neutral beam heating system*

This device represents one 1 MW neutral beam source. Combined with device No. 1 **Vacuum tank assembly** and without any additional hardware a Neutral beam heating system is created. This device encompasses all the connecting cables and the necessary work to integrate and commission the *Ion source assembly* on a *Vacuum tank assembly* into a *fully working NBHS*.

*Device No. 3 **Accelerating grids** - Spare set of accelerating grids for a 1 MW neutral beam heating source*

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This device is the assembled and adjusted set of accelerating grids (the ion optics) for the Device No. 2 **Ion source assembly**. To be used as a drop-in replacement part in case of ion optics damage.

The vision of the Buyer is that a full and complete neutral beam heating system will be designed and then divided into the above-mentioned devices. As a general approach to dividing the NBHS everything that is inside the physical vacuum tank of NBHS or bolted to it is considered part of Device No.1. Everything else is part of Device No.2. More detailed assignment of individual components of the whole NBHS to one of the 3 devices is given in the **Chapter 4, Device specific requirements**.

3.2. Glossary of used terms

Ion source – Part of the NBHS where ions are created by means of a radiofrequency plasma discharge.

Neutral beam – The beam of the fast-neutral particles, which can be injected into the plasma and causes additional plasma heating.

Removable Calorimeter – A stand-alone beam dump for use during full-scale beam conditioning and tests (1 MW, 1 s pulse) and which will be manually removed when the NBHS is to be connected to the tokamak

Movable Calorimeter - Part of the NBHS vacuum tank which serves as the beam dump during neutral beam tests and conditioning (1 MW, 0.25 s pulse) and which can be moved by remote action from the beam path when operation with tokamak is required.

Vacuum tank – Part of the NBHS through which the formed beam passes from the neutralizer. The main components placed in vacuum tank are cryopumps, bending magnet and ion dump, electron dump. *The cryopumps placed in vacuum tank guarantee required vacuum level, the bending magnet deflects residual ions which are part of the formed beam.*

Bending magnet – Part of the NBHS, which removes residual ions from the formed beam and deflects them into an appropriately sized positive and negative ion dump.

Positive and negative ion dump – Part of the NBHS where the residual charged particles from the formed beam are deflected. It is usually made of copper plates and actively cooled for efficient heat removal in the case of the ion dump.

Output aperture – An orifice placed in the Vacuum tank of the NBHS that is the last component to limit the size (scrape) the beam of neutral particles that leaves the NBHS. Although components may be placed after the output aperture, they are not hit by the beam (e.g. output valve)

Repeller grid - Part of ion optical system of the NBHS. It is a grid, which is negatively biased to avoid acceleration of electrons from the secondary plasma (arising from collisions of fast ions with neutral gas) back to the ion source. Usually it is the second to last grid along the beam path. The last grid being grounded.

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Cold head - Part of the vacuum pumping system of the NBHS. The cold heads serve as the cooling source for the cryogenic vacuum pumps. The cold heads are basically cryo-coolers based on closed Gifford-McMahon cycle and use helium as working gas.

Stand by vacuum pump – Vacuum pumps that keep the components of the NBHS evacuated for long periods of time. They have comparatively slow pumping speeds so the NBHS cannot properly function when only these are operational.

3.3. General parameters and extent of delivery

The Seller must deliver devices that are new and capable of functioning as NBHS and are compatible with the buyers' premises, equipment and with other devices procured within this framework contract. The devices must be controllable by the buyer and have sufficient longevity. For that goal the Seller will provide control software, documentation and maintenance instructions. The Seller will install the devices on the buyers' premises at the Buyers address stated in the framework contract and fully aid in the integration of the devices into each other and the tokamak experiment. The Seller will provide training to selected staff of the Buyer. General requirements given in this chapter describe the general properties that the devices must poses individually or in combination and are expanded on in more detail in the following chapters. These general requirements are meant as a guideline for any technical parameter that is not described unambiguously or in sufficient detail in this technical documentation.

3.3.1 Capability

Each NBHS must be capable of providing heating power and energy for the COMPASS-U tokamak plasmas during the tokamak experiment. The NBHS performance parameters must comply with requirements stated within this document for each individual ordered device.

3.3.2 Compatibility

The devices supplied by the winner of the tender will not be used as standalone systems therefore it is necessary that they are compatible with the buyers existing equipment. For all interconnections metric industrial standard sizes must to be used where ever possible. Exceptions must be explicitly stated in the documentation and approved by the Buyer. All interconnections on the Buyer side that do not follow any standard are given in this document.

All delivered devices must be compatible with all other devices delivered based on this public tender. That is, it must be possible to operate all the devices at the same time without negative interference between them that would cause them not to reach the parameters given by this technical specification, e.g. one ion source not reaching full power due to electromagnetic interference from a different ion source that is operating at the same time. This is specifically valid for two Ion source assemblies installed to one shared Vacuum tank assembly.

3.3.3 Spare parts

All critical components and spare parts must be available for purchase in the EU. If some of the spare parts are not available for purchase in the EU they have to be delivered with the devices in such numbers that the planned lifetime (See 3.3.5 Longevity) will not be compromised.

Spare parts must be provided also for each component that has a mean time between failures (MTBF) lower than 2 years of standard operation i.e. 1500 operational hours or is to be replaced in regular maintenance in the warranty period.

Additionally, if the high voltage power supplies will be built as modular, we require that at least 5% of the installed number (rounded up) of the High voltage switching modules, used in the HV power supply, to be delivered as additional spare parts.

3.3.4 Installation

The Seller will install the procured devices on the buyer's premises and demonstrate their proper functionality. The Seller will provide sufficient human and other resources to accomplish this task. Availability of equipment and human resources from the buyer to aid in installation not stated explicitly in this document cannot be expected.

3.3.5 Longevity

The device must be able to perform more than 30 000 pulses with full performance parameters or at least 15 years – whichever from these two conditions is satisfied first.

This requirement does not specify warranty period or service interval, it specifies that the system and its parts must be designed for this longevity. This longevity is valid unless specified otherwise in the individual parts of this Technical specification. Maintenance intervals and expected extent of consumables must be explicitly stated in the delivered documentation.

3.3.6 Training

The Seller must provide as part of device delivery adequate training for selected staff of the buyer for operation, maintenance and control of the NBHS. Extent of the training shall be at the minimum 24 hours (i.e. 3 working days). Upon completion of the training, the Contractor will issue to the trained employees a written certificate that they had successfully completed the training and that they are fully competent to operate, maintain and control the delivered devices and the NBHS constituted by those devices.

For each of the topical areas of the training, it must include these sections:

- 1) Introduction: description of the function, parameters and interactions with other parts
- 2) Operation: daily start, stop, operation; solution of the commonly occurring errors and faults; location of further information about faults
- 3) Maintenance: maintenance procedures, including periodic checks and list of long-term maintenance requirements

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- 4) “Safety and Health Protection During Work” training: according Czech law requirements (BOZP – Bezpečnost a ochrana zdraví při práci)
- 5) Training of emergency situations handling: including training in reactions to serious faults
- 6) Overview of assembly and disassembly instructions and procedures

The Seller must provide for each of the topical areas outline, synopsis and materials used during the training. Training materials must be provided and are considered part of documentation of the delivered devices.

The Seller must provide training focused on software and firmware – use, programming, deploying, functionality, error descriptions and searching for causes.

3.3.7 Control

The delivered devices must contain the means to control all available parameters of the NBHS. The NBHS must be provided with a standalone **control computer**. Each ion source must have one dedicated PC compatible computer. Each individual neutral beam source must be able to operate independently of the other neutral beam source of the NBHS. This assumes other common components are operational.

The control system of the NBHS must perform **safety checks** with regards to its own safety when processing external operational requests. Both from operators and tokamak control system.

To facilitate **synchronization** with the tokamak control system (CODAC) the control computer of the device must be able to receive an external clock signal and trigger signal.

For performance evaluation and data processing reasons the control computer of the NBHS must provide **data storage**.

The control computer must be able to **communicate** with the control system of the tokamak (CODAC).

The control system must also implement a high-level protection system (**interlock**) for failure of other protection systems.

Detailed values and description for the control aspect of the devices is given in **3.4.7 Data acquisition and control**

3.3.8 Software

The control computers and hardware must be delivered with the appropriate control software. The details of the requirements for software, its source code and backups are given in **Chapter 3.4.8.3.3.8**. Due to the expected longevity of the NBHS 15+ years the Seller must deliver also the source codes of the control software and settings of development tools used to facilitate porting the control software by the Buyer in future to different hardware.

3.3.9 Documentation

The Seller must deliver design, construction and operational documentation to all the mechanical, electrical and software components that are not commercially available. The manufacturing drawings for the entire device are not required, but the construction documentation for some parts of the Devices must be delivered in such an extent that maintenance and production of spare parts will be possible. This includes source codes and overview electrical schematics with precise part numbers. Documentation will also include all modifications performed on commercial products. Delivery of the complete documentation to the buyer is a necessary condition for signing of the Handover protocol of Acceptance (Acceptance protocol). Acceptance of the documentation by the Buyer does not in any way release the seller from the full liability for the correctness, completeness and complete execution of any documentation of information provided or from meeting the rest of parameters and conditions specified within this Technical specification.

Seller must provide the implementing documentation that provides detailed design documentation and specification of the proposed technical solution of the designed equipment, including (following list is non-exhaustive):

- Technical drawings (extent given above)
- Connection schemes and diagrams
- Parameters and tolerances of the individual parts
- EMC concept, including grounding scheme and its requirements on the building, and cable shielding concept
- Required floor space
- Cooling scheme and definition of coolant connections
- Analysis of major failure modes
- Safety requirements including control and regulation of the installed systems
- Basic considerations (analysis) of the lifetime of the individual parts of the NBHS
- Service and maintenance manuals and maintenance procedures description
- Initial revisions reports, permits, certificates, accreditation protocols.
- etc.

Part of the documentation must be delivered as Design Documentation of the ordered devices prior to the delivery of the device in question (see Annex No. 3 Price Schedule and Deliverables). The Seller's Design Documentation must provide level of details, which demonstrates that the Technical requirements tables present in this Technical Specification are satisfied. It must also provide the Buyer enough information for the necessary on-site preparation for accepting the ordered devices, e.g. sizes, support points, connection port locations etc.

3.4. Common parameters

This chapter lists and evaluates the parameters that the complete functional parts of the NBHS must fulfill. Therefore, all **devices No.1, No.2 and No.3** must be designed and built in such a way that the following table of general parameters can be achieved with a complete NBHS. Even devices that do not

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constitute a complete NBHS on their own must be designed, built and delivered with these parameters in mind.

3.4.1 Neutral beam requirements

Here a list and values of technical parameters of the neutral particle beams produced by a complete NBHS is presented

Table 2 General technical requirements of the neutral beam heating system

No.	Name and description of the requirement	Value / description
1)	Maximum attainable energy of the main neutral beam component (deuterium)	≥ 80 keV
2)	Fraction of the main neutral beam component in the output power at maximum power operation	$\geq 60\%$
3)	Pulse length at maximum power	≥ 1 s
4)	Beam parameters setpoint time resolution (time granularity of the setpoint waveform)	≤ 1 ms
5)	Output voltage range	$\leq 20\% - \geq 100\%$
6)	Stability of the beam energy (RMS) each ion source	$\pm 2\%$
7)	Stability of the beam current (RMS) each ion source	$\pm 3\%$
8)	Working gases of the beam	Hydrogen, deuterium (specification parameters are for deuterium)
9)	Heavy impurity content (Z>)	$\leq 1\%$ of output power
10)	Output flange size for each beam	DN 250 CF
11)	Ramp-up time of the beam to/from the maximum output power (10%-90%)	≤ 2 ms
12)	Ion source type	Radiofrequency
13)	Modulation of the beam power	NBHS must be able to change the output power during a single discharge according to a pre-defined waveform or real-time feedback control provided requests with minimal rate of change 1 MW/ 5 ms
14)	Maximum power at full duration pulse (row 3 in this table) repetition characteristics	each 15 minutes for 8 hours with a $\geq 90\%$ success rate
15)	Operation without Flywheel generators	The NBHS must be able to perform short(>5ms) full power shots without requiring the flywheel generators

3.4.2 Material and construction requirements for NBHS

The following section of general technical parameters summarizes the philosophy and general expectations of the devices design.

Table 3 Material and construction requirements for the NBHS

No.	Name and description of the requirement	Value / description
1)	Use of magnetic materials	Magnetic materials can be used only for the necessary components of the ion source and bending magnet and neutralizer
2)	Grounding of the device	All conducting parts and components accessible to people during operation must be grounded to the ground of the device.
3)	Electrical safety	All cabinets containing potentially dangerous equipment must have interlocked access doors.
4)	Electrical insulation	The NBHS will be galvanically insulated from all equipment in the tokamak experimental hall.
5)	Magnetic shielding	Components must be sufficiently shielded from the magnetic field generated by the tokamak so that the function of the injector won't be negatively influenced by the magnetic fields, i.e. loss of efficiency or beam deflection higher than 1 cm. The vertical magnetic field of the tokamak is a dipole field. The maximum magnitude of the magnetic field in the region of the NBI changes can be calculated as $B_z = 30[mT]/(R[m]/4[m])^3$. The radial component of the magnetic field is $B_r < 0.001 T$
6)	Shielding electromagnetic interference to surrounding equipment	All sources of electromagnetic interference must be adequately shielded, filtered or suppressed in such a way that they do not interfere with the tokamak operating systems
7)	Size and shape of the NBHS	Shape and placement of the components must be compatible with the shape of the COMPASS – U tokamak, see Chapter 3.4.9 in this Technical specification.

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8)	Subsystem placement (racks with auxiliary systems, power supplies etc.)	All NBHS subsystem racks must be designed so that they can be placed out of the experimental hall (at least 25 m away from the injector ion source). Except ion source protection snubber rack, placing this out of the experimental hall is optional
9)	Fine adjustment of device No. 1 position and orientation	Stand of the device has to facilitate precise and robust fine adjustment of the placement and orientation of the beam. It must be possible to perform this fine adjustment without heavy machinery.
10)	Lateral movement of the NBHS	The NBHS must include means to allow for lateral movement (i.e. in direction of the beams) of the injector by >1m for maintenance and repair. (e.g. include wheels and rails). Dismounting the Ion source to reach the 1 m of movement is acceptable.
11)	Range of fine adjustment of device No. 1 Vacuum tank assembly. For all axis, in isolated motion	$\pm 2\text{cm}$ $\pm 1^\circ$
12)	Fine adjusting of Ion source (device No.2) aiming	The mount of the ion source to the vacuum tank must allow for fine adjustment of the ion source aiming without the use of heavy machinery, i.e. without the use of a crane or similar)
13)	Fine adjusting of Ion source (device No.2) aiming range	$\pm 1.5^\circ$
14)	Anchor points	The device has to be equipped with suitable anchor points to facilitate transportation by a crane.
15)	Transport by crane	The Seller will provide the drawings for an appropriate crane spreader beam for NBHS transport
16)	Actuating major mechanical components	Regularly used major mechanical components (e.g. vacuum valves) must be actuated pneumatically by remote action
17)	Pressurized air	Pressurized air supply is available, $P < 6 \text{ Bar}$, for controlling pneumatic equipment
18)	Ionizing radiation resistance	Neutron fluxes inside the Tokamak experimental hall $\sim 10^{10} \text{ n/cm}^2/\text{s}$ during tokamak discharges. Up to $10^{13} \text{ n/cm}^2/\text{annum}$.

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		Effective dose outside of the experimental hall ≤6 mSv
19)	Water leak resistance	Delivered devices must be sufficiently water resistant in case of coolant water leaks and/or condensation.

3.4.3 Vacuum requirements

The NBHS must be equipped with sufficiently sized vacuum pumping equipment. The vacuum pumps must cope with steady state outgassing of the NBHS components and the gas flow from the Tokamak during a plasma discharge. The buyer insists on using cryo-condensation pumps as the main vacuum pump type. Those have to be cooled by closed cycle helium refrigerators (a.k.a. Cold heads). For cooling radiation baffles of the cryopumps, liquid nitrogen can be used (optional). Stand by vacuum pumps will be provided by the buyer.

Table 4 List of requirements for the vacuum components

No.	Name and description of the requirement	Value / description
1)	Stand by vacuum pump type (pump provided by the buyer)	Turbomolecular + dry roughing pump
2)	Stand by vacuum pump pumping speed for N ₂ (pump provided by the buyer)	500 –100010 l/s
3)	Neutral gas pressure at the output aperture during a NBHS beam pulse	≤1·10 ⁻² Pa
4)	Neutral gas pressure at the output aperture without a NBHS beam pulse with cryo pumping turned on	≤2·10 ⁻⁶ Pa
5)	Neutral gas pressure at the output valve of the NBHS during a tokamak discharge	≤1·10 ⁻² Pa
6)	Vacuum gasket type	Ports with sizes ≤ 300 mm standard CF sealing surfaces (ISO/TS 3669-2:2007) and corresponding copper gaskets have to be used. Larger connections can use elastomer gaskets.

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7)	Overpressure safety	The device must be equipped with reliable overpressure protection. Burst valve, pressure relief valves etc.
8)	Cryopump capacity without regeneration	≥100 pulses each with ≥2 s duration
9)	Interface for monitoring of vacuum state	The delivered device must continuously monitor the level of vacuum in the injector with sufficient accuracy for reliable operation. The device must have an optical output for allowing monitoring of vacuum quality
10)	Cryopump cold source	<4K Closed cycle Helium refrigerator (provided by the buyer) see chapter 3.5.1 Liquid nitrogen for radiation baffle cooling consumable (optional)
11)	Maximum number of cold heads needed in vacuum tank assembly	8 (a design utilizing only 6 is strongly preferred by the Buyer)
12)	Cooling performance of each cold head at 4 K	1.8 W
13)	Maximum allowed total leak rate of the NBHS (1×Device No.1 + 2× device No.2)	$<10^{-6} \text{ Pa}\cdot\text{m}^{-3}\cdot\text{s}^{-1}$
14)	Gate valve between ion source and vacuum tank assembly	Must have an additional pumping port to facilitate separate pump down of the ion source.

3.4.4 Gas handling requirements

The NBHS must be equipped with a sufficient and reliable gas handling system that supplies working gasses to the Ion source and the neutralizer of the NBHS. Since parts of the gas handling system of the NBHS are usually placed both the device No. 1 and device No. 2 we place the requirements on the gas handling system as general requirements. All components of the gas handling system that are physically placed outside of the device No.2 and are detachable from it are considered to be part of the device No. 1 and are to be delivered with each delivered device No. 1

GH System must provide:

1. Ion source and neutralizer working gas supply Pressure controlling and measuring.
2. Interlock on missing working gas pressure. No ion source high voltage possible if working gas not present in ion source feed line.

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3. Changing of working gas must be possible without the use of tools. At least two separate inlet ports for connecting working gas supply.
4. Working gas supply will be provided by the buyer.
5. A pump down port with DN KF 40 connection.
6. Over pressure protection.
7. Ability to work with H₂, D₂, He, Ar (two at the same time, more is optional).
8. Maximum inlet working pressure at least 5 bar.
9. Ability to use different gas in ion source and neutralizer.
10. Bake-able to 150°C, all metal design with ceramic electrical breaks.

3.4.5 Cooling requirements

It is expected that the components of the NBHS will require cooling (besides cryogenic pumps). General requirements and parameters of cooling options available at the premises of the buyer are given in the following table. The proposed design and the delivered devices must not require additional coolant types or lower coolant temperatures from the Buyer. The Seller can utilize waste products from the NBHS (e.g. cold nitrogen from cryopump radiation baffle cooling) or include other coolants in closed loops inside NBHS components and transfer heat via heat exchangers to the coolants available at the buyer's premises.

Table 5 List of technical parameters for cooling of the NBHS

No.	Name and description of the requirement	Value / description
1)	Allowed Coolant type	Water, demineralized water, ambient air
2)	Cooling water temperature	The system must be equipped with cooling water temperature monitoring. Cooling water temperature cannot reach the boiling point of water at the operating pressure.
3)	Air flush system	For the case the cooling water circulation stops for longer than 5 min a gas flushing of the cooling pipes has to be performed automatically in order to prevent damage to the system by the freezing the cooling medium
4)	Cooling of the device	All subsystems and components accessible during operation by personnel must be cooled so that the surface temperature will not exceed 55 °C.

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5)	Cooling lines	The devices must include all required coolant distribution pipes.
6)	NBHS Coolant connections	The buyer will provide one coolant supply and return line for each complete NBHS (Device No. 1 + at least one Device No. 2)
7)	Air cooling	The buyer will not supply coolant air other than the ambient air where equipment to be cooled will be located.

Table 6 Parameters of the available cooling options at Buyers premises

No.	Name and description	Value / description
1)	Lowest available coolant temperatures	Demineralized water: $\geq 10^{\circ}\text{C}$ Plain water: $\geq 10^{\circ}\text{C}$ Air: $\geq 25^{\circ}\text{C}$
2)	Maximum operational continuous coolant flows per 1MW of neutral beam (1 ion source) Does not include operation of full scale calorimeter	Demineralized water: 30 l/min Plain water: 350 l/ min Air: 100 l/ min
3)	Maximum input coolant pressures	Demineralized water: ≤ 5 bar Plain water: ≤ 8 bar Air: ≤ 5 bar

3.4.6 Electrical power requirements

The device has to be delivered together with all necessary power supplies. The NBHS will be connected to the electrical distribution system of the buyer. At the buyers premises two sources of electrical power are available. Standard 3 phase AC continuous from the public distribution network and high voltage high power from on-site flywheel generators. The device must correctly operate in the whole range of the voltage and frequency values of the high energy input power provided during normal flywheel operations.

Table 7 List of technical requirements on electrical power supply

No.	Name and description of the requirement	Value / description
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1)	Input Electrical power parameters: Flywheel generators	-Voltage: 10.4 kV – 8 kV -Frequency: 85-55 Hz - Number of Phases: 3 -Voltage stability: the voltage will drop during flywheel pulse by ~25%
2)	Input Electrical power parameters: Public distribution network	- Voltage: 400 V -Frequency: 50Hz -Number of phases:3
3)	Maximum power drawn from the public distribution network per 1MW neutral beams (per 1 Device No.2)	50 kW
4)	Compatibility of electrical power supplies	All delivered equipment must be compliant with valid Czech, European and internal UFP rules and regulations (UFP rules available upon requests)
5)	Electrical insulation of the device	High voltage, control and grounded components are to be sufficiently insulated from each other.
6)	Safety of the device	The device must be equipped with visible (e.g. signaling lights) indications of the status of the High voltage components.
7)	Minimum “wall plug” efficiency (Input electrical power to output neutral particle power)	>30%
8)	Connecting cables type	Flexible. All cabling must be made of sufficiently flexible to facilitate relative and absolute movement of the NBHS components.
9)	Connecting cables length	All connecting cables must be delivered with such length that the requirement given in Table 3 point 8 can be fulfilled ($\geq 25\text{m}$) and additionally each NBHS can be moved by ± 3 meters around its mid position.
10)	Type of connectors	All delivered devices of the same type must have the same connectors at same positions.

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11)	Error output / Status OK	Each power supply that is to be energized by the Buyers flywheel generators must provide an optical “Status OK / No error” signal. In case this signal is not present the switchgear will refuse to connect the power supply to the flywheel generator.
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3.4.7 Data acquisition and control

The delivered devices must contain the means to measure and control all available parameters of the NBHS.

- a) The NBHS must be provided with a standalone **control computer**. Each ion source must have one dedicated PC compatible computer. The **control computer** must facilitate at minimum the functionality stated in the **Table 8 List of features of the data acquisition and control system**.

Table 8 List of features of the data acquisition and control system

1)	Acquire data of the time evolution of NBHS parameters during beam pulse with at least 10 kS/s sampling rate.
2)	All the acquired signals must be gathered with 10-bit resolution at minimum, i.e. at least 1024 levels.
3)	Autonomous testing of the device and diagnosis of its state without the aid of any other external computer system. Indicate (error codes or visually) malfunctioning subcomponents to aid in troubleshooting and repairs.
4)	Ensure the operation and communication of the device during a tokamak pulse by complying to received feedback requests from the tokamak control system-CODAC (1 kS/s rate at least) via serial communication: ion source power or extracted current, voltage of extraction grids and providing back output information about voltage and current of ion source and grids to CODAC.
5)	API of controlling system needs to have all key controlling features as GUI (graphical user interface)
6)	Possibility of switching off in case of device malfunction, external requirement by user or disconnection with tokamak controlling system
7)	Controlling system should automatically protect the device and shall not allow it to operate with parameters which could cause damage of the device
8)	Have the capability do asynchronous operation of the device. That is without the signals from the tokamak control system (CODAC)

- b) The control system of the NBHS must perform **safety checks** with regards to its own safety when processing external operational requests. Both from operators and tokamak control system. Request received from external sources (tokamak control system or operators) might

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overstep the safety limits of the device. The device must be able to modify these requests in such a way that no damage is done to the device. This includes e.g. maximal and minimal allowed values and safety ramps of operational parameters.

- c) To facilitate **synchronization** with the tokamak control system (CODAC) the control computer of the device must be able to receive an external clock signal and trigger signal. The clock signal, when present, must be used as a reference for the data acquisition time axis.
- d) For performance evaluation and data processing reasons the control computer of the NBHS must provide **data storage** for at least these types of information:
 - o List with history of malfunctions and errors in local database or log. It must be accessible via API to allow data transfer into the tokamak database
 - o All parameters/values of the system displayed in GUI (including required parameters and measured values during the pulse) in local control computer for each pulse (at least last 10 000 pulses). These stored signals must have time resolution ≤ 0.1 ms and time axis synchronized with trigger and optical clock
 - o The stored data must be accessible via API to allow data transfer into the tokamak database
- e) The control computer must be able to **communicate** with the control system of the tokamak (CODAC) in the following ways:
 - o Real time communication during a tokamak discharge via a serial link with at least a 1 kS/s transfer rate to facilitate feedback control of the NBHS
 - o Communicate via Ethernet connection (TCP/IP protocol) using API (application program interface) of the control program.
- f) The control system must also implement a high-level protection system (**interlock**) for failure of other protection systems. Interlock must allow switching of the system into safe mode based on external requests gained via optical lines (e.g. working gas filling status, vacuum, valve position, tokamak status etc). Then interlock must have set of optical outputs for operation safety controlling (e.g. calorimeter position, capacitor banks charging status, connection of energetics, etc.). The Seller must provide a list and description of all implemented interlocks within the scope of device documentation.

3.4.8 Software

To utilize the neutral beam heating system proper control hardware and software must be available to the Buyer. In the following table a list of requirements on the NBHS software is given.

Table 9 List of requirements for the software of the devices

No.	Name and description of the requirement	Value / description
1)	SW long term support	The development tools for the NBHS software must be backed-up by the Seller in order to maintain the possibility of software and other programmable

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		logic controllers design upgrade 10 years after the delivery of the NBHS.
2)	Type of SW compilation procedure and back-up solution for compilation devices (e.g. PC)	<p>If possible, the NBHS software will be compiled on virtual machines backed-up by the Seller in order to maintain the possibility of compilation of the software many years after the delivery.</p> <p>Alternatively, the bit copies of real computers with the installed software along with a detailed PC description will be backed up.</p>
3)	SW backup	The Buyer will obtain the binary files, deployment manual and description of the HW for which the binary files are intended.
4)	Communication protocols documentation and signal description	The Buyer will obtain description of all communication interfaces, used protocols and signals used for communication with and within the NBHS.
5)	Access to the source code of the SW	<p>Any source code provided to the Buyer will be provided in the electronic form.</p> <p>The source code will be provided in programming language used by programmer to write the code.</p> <p>The Seller will also provide compilation instructionsdescription of the version of the used compilation programs, list of dependencies and deployment manual. The equivalent information will be provided for all programmable logic controllers (design, synthesis and implementation process setting) and other programmable devices.</p>

3.4.9 Space and size constraints for the NBHS

The delivered devices will be combined into working NBHS and will be placed in the experimental hall of the COMPASS Upgrade tokamak. There they will be interfaced with the tokamak and as such they must comply with the space restrictions given by this requirement. The schematic representations of expected available space for the delivered NBHS is depicted in Figure 1 and Figure 2. The vacuum tanks of the delivered NBHS will be placed on platforms around the tokamak such that the midplane of the tokamak will coincide with the midplane between the two ion source assemblies of a fully equipped NBHS.

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The NBHS system must be right-left symmetric as much as possible. The buyer intends to change the orientation of the NBHS with respect to the tokamak in various physics experiments and any components sticking out on one side could hinder this operation. Due to the limited space around the tokamak the Seller is encouraged to design the NBHS as small as possible. Given dimensions are hard limits and their overstepping will be considered as a failure to meet the tender requirements! From the given dimensions the Buyer encourages to design the device as thin and short as possible and maximize the height of the device. The given space limits do not apply to components of the NBHS that can be placed farther away from the actual injector, e.g. racks of power supplies and auxiliary equipment.

Table 10 Maximum dimensions of the NBHS, i.e. Device No. 1 with two devices No. 2

No.	Name and description of the requirement	Value / description
1)	Maximum length	4400 mm
2)	Maximum width	1650 mm
3)	Maximum height	4500 mm

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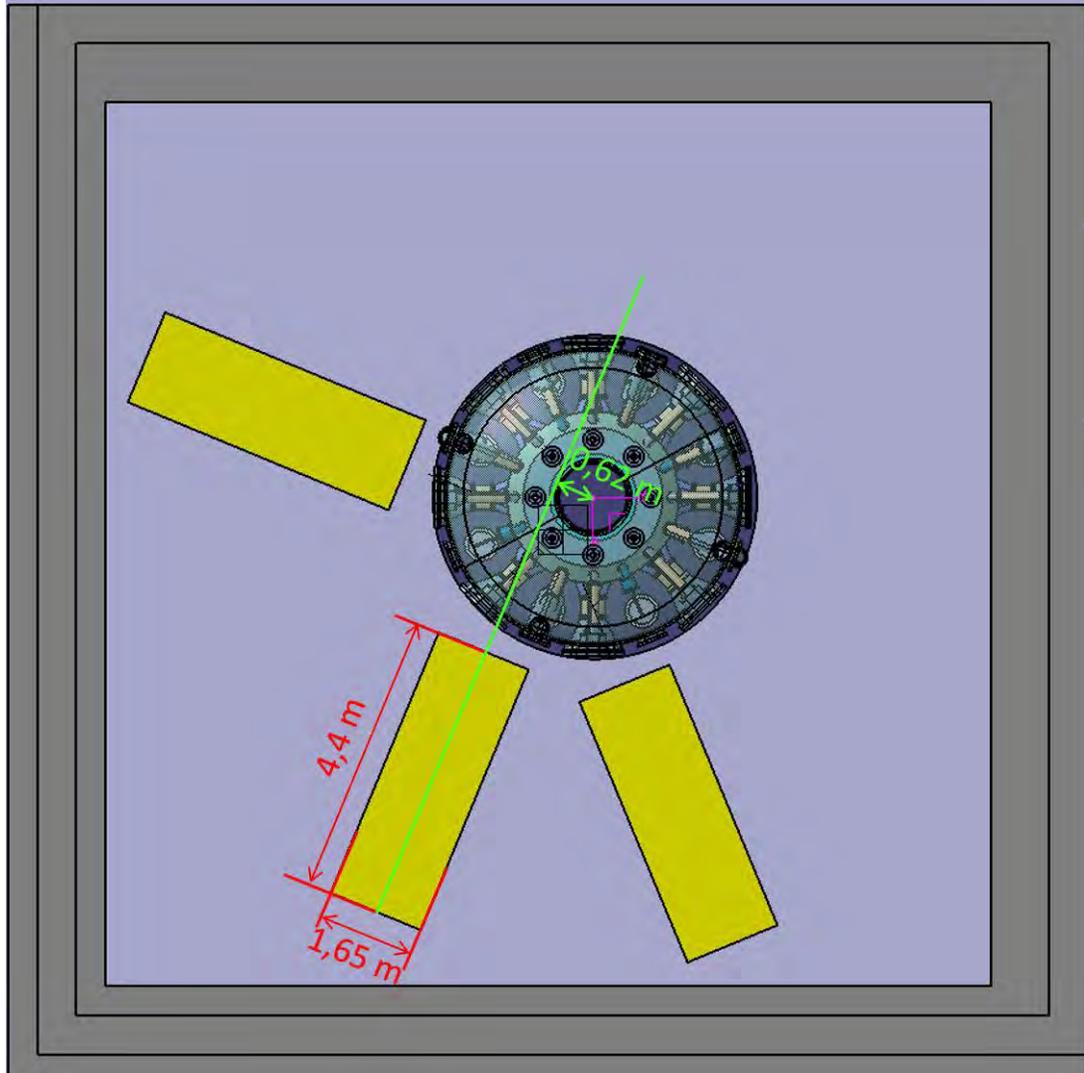


Figure 1 Schematic representation of intended placements and available space for the NBHS (top view) Depicted yellow rectangles are in scale with the dimensions given in Table 10.

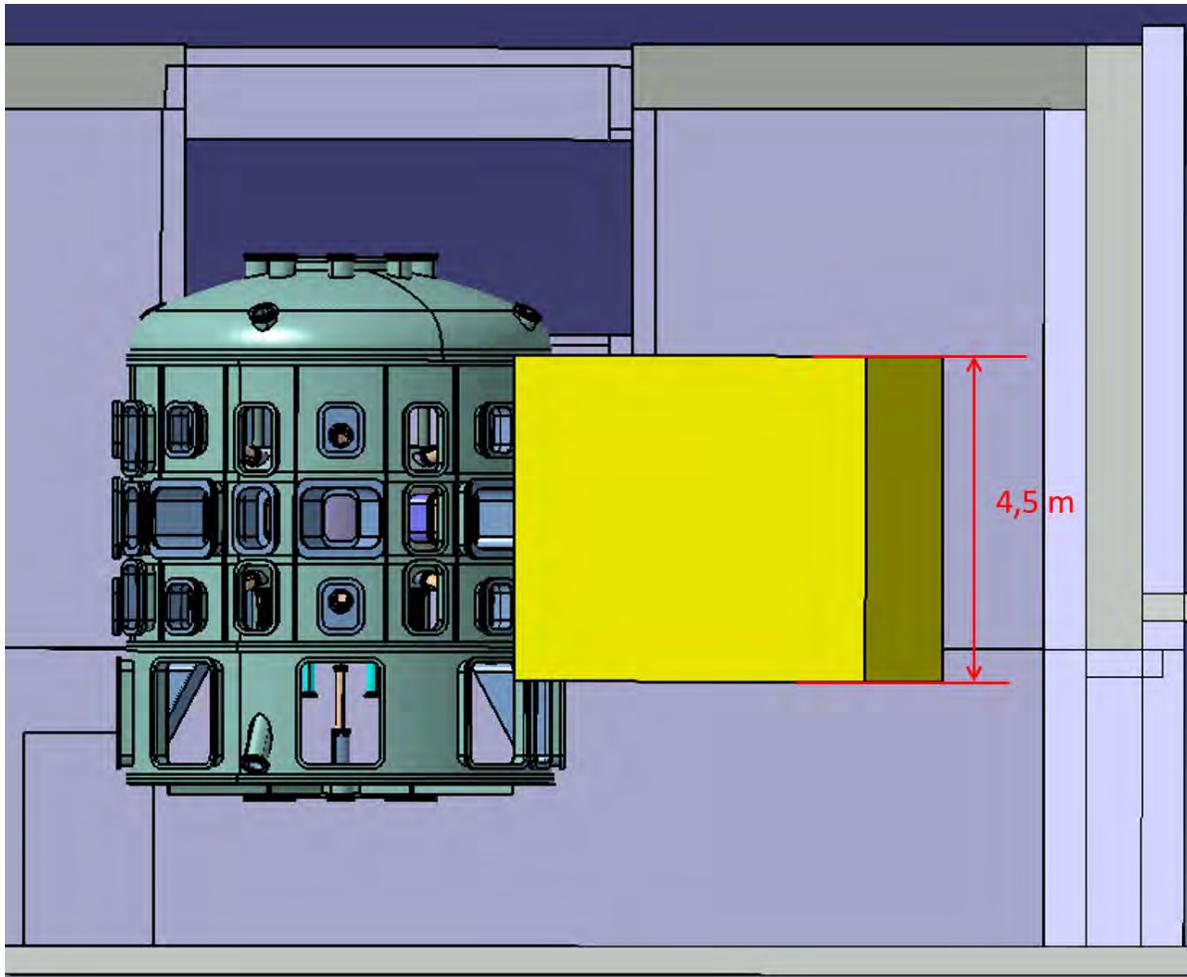


Figure 2. Schematic side view of available space for the NBHS

3.5. Components provided by the buyer

The buyer will provide several components that the Seller must utilize in the delivered devices. The buyer provides technical details of the components to be used within this document in the following chapters. Additional information can be provided upon request

3.5.1 Refrigerators for the cryogenic vacuum pumps

The Buyer will provide cold sources to be used for the cryogenic vacuum pumps. The refrigerators are closed cycle Gifford-McMahon refrigerators using helium as the working gas. Parameters of the cold heads are given in Figure 3 and Table 11. For cooling the radiation baffles of the cryopump liquid nitrogen is available at the buyer's premises.

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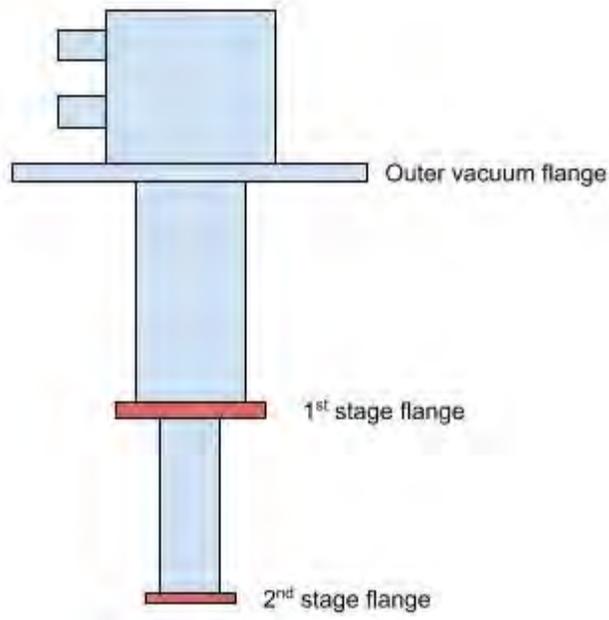


Figure 3 Schematic representation of closed cycle refrigerators to be used for cryopump pumping surface cooling.

Table 11 Technical parameters and dimensions of the closed cycle refrigerators to be used as cold source of the cryopumps

1)	Cooling capacity	2 nd stage : ≥ 1.8 W at 4.2 K
		1 st stage : ≥ 40 W at 50 K
2)	Minimum temperature < 3.5 K	
3)	Cool down time to 4.2 K < 120 minutes	
4)	Dimensions	a. Outer vacuum flange sealing surface to 2 nd stage flange end face distance: 392.6 \pm 0.1 mm
		b. Vacuum flange inner surface to 1 st stage flange end face: 156.1 \pm 0.1 mm
		c. 1 st stage flange to 2 nd stage flange: 236.5 mm
		d. Diameter of 2 nd stage flange: 68 mm
		e. Diameter of 1 st stage flange: 125 mm
		f. Diameter of the outer (vacuum) flange: 180 mm

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5)	2 nd stage flange has 6 equally spaced (60° spacing) and tapped 5 mm diameter holes. Placed on diameter 58±0.2mm
6)	1 st stage flange has 8 equally spaced (45° spacing) and tapped 5 mm diameter holes. Placed on diameter 110±0.2 mm.
7)	Outer vacuum flange has 8 equally spaced (45° spacing) 5 mm diameter holes placed on diameter 170 ±0.2mm.
8)	Outer vacuum flange seal: elastomer o-ring
9)	Outer vacuum flange sealing area: annulus 140 – 147.5 mm in diameter

3.5.2 Mechanical vacuum pumps

The buyer will provide the mechanical pumping system and the necessary mounting hardware for the primary and initial high vacuum operation of the NBHS before the operation of the cryo-pumping system can be initiated. The parameters of the mechanical pumping system are given in the following table:

Table 12 Parameters of the stand by pumping system of the NBHS

No.	Description of the parameter	Allowed value / description
1)	Ultimate pressure of the pumping system	<10 ⁻⁷ Pa
2)	Pumping speed	500 - 1000l/s

A mechanical pump for pumping down the Gas handling system will be provided. The parameters of the pumping system are in the following table:

Table 13 Parameters if the pumping system of the gas handling

No.	Description of the parameter	Allowed value / description
1)	Ultimate pressure of the pumping system	<10 ⁻⁷ Pa
2)	Pumping speed	>80 l/s
3)	Connection flange	DN KF 36

3.5.3 Working gas supply

The buyer will provide the required consumable working gases for the NBHS. The working gas will be routed by two gas feed lines to the NBHS at max 5 bar pressure.

3.5.4 NBHS platform

The buyer will provide a suitable platform that will put the midplane of the NBHS to roughly the same level as the midplane of the tokamak. This platform will not have any fine adjustment capabilities.

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Radial movement of the NBHS and all position and angle fine adjustment must be provided by the NBHS itself particularly the vacuum tank assembly (Device No.1). The platform will be designed and built after the Seller provides the technical documentation, mainly size and weight, to the devices to be procured (device No.1 and No.2).

3.5.5 Beam duct

The connecting vacuum piece between the output flanges of the NBHS and the tokamak will be provided by the Buyer. The beam duct will be designed after the Seller provides the detailed design of the devices. Part of the beam duct are the corresponding vacuum gate valves.

3.5.6 Gate valves

The buyer will provide the necessary vacuum gate valves for connection the stand-by pumping system (turbomolecular and roughing pump) and the gate valves for connection of the output flanges to the beam duct of the tokamak. All other vacuum valves are the responsibility of the Seller, e.g. valve between the Vacuum tank assembly and Ion source assembly.

4. Device specific requirements

4.1. Device No.1 Vacuum tank assembly

This device is a common **Vacuum tank assembly** capable of hosting two independent 1 MW neutral beam ion sources. Adding **one** or **two** devices No.2 will produce a full and complete 1MW or 2 MW NBHS, respectively, without the need for procuring or adding any additional components, except components stated in **Chapter 3.5** of this Technical specification. The **Vacuum tank assembly** provides the necessary gas handling and pumping for the two attached neutral beam sources. It contains components that are tied to operation of both of the individual Neutral beam ion sources.

4.1.1 Extent of delivery

Extent of delivery besides stated general requirements stated above must be such that after integrating an ion source assembly to the vacuum tank in the future does not require any modifications inside the Vacuum tank assembly. For example, temperature sensors of the movable calorimeter must be delivered with the vacuum tank assembly as they are placed inside the vacuum but the DAQ hardware (placed outside the vacuum) will be part of the Ion source assembly. Venting the vacuum tank assembly to install an Ion source assembly is expected. After adding to the device components provided by the buyer (vacuum pumps and cold heads) and closing unused ports by blind flanges, a working vacuum vessel will be created.

The device must be delivered with appropriate **vacuum gauges**, vacuum gauge controller and visual readout of the vacuum pressure. Connecting cables that propagate the gauges output signal to the interlocks and control systems are part of Device No.2

The vacuum tank assembly must be delivered with the proper **gas handling** and **coolant distribution manifolds**. Both gas handling and cooling manifolds must be designed in such a way that up to two **ion source assemblies** (Device No.2.) can be integrated into them with the use of hand tools, i.e. must make use of demountable connections.

The device must be equipped with suitable thermal sensors for monitoring the status of the cryopump (thermal baffles and actual pumping surface). A suitable visual display must also be provided with the delivery of a **Vacuum tank assembly**.

All vacuum tank assemblies delivered based on this framework contract must be functionally identical. Each of them is a drop-in replacement to the other vacuum tank assemblies. They have to be interchangeable with each other. They must also accept each of the ion sources delivered within the framework contract.

The buyer assumes that due the physics constraints it will be necessary cool the radiation baffles of the cryopump by using liquid nitrogen. If this will be the case, a suitable reservoir for liquid nitrogen must be available inside the Vacuum tank assembly. A suitable reservoir is such that does not require refilling sooner than after 4 hours of normal cryopump operation. The device must be able to autonomously and in a safe manner refill the liquid nitrogen tank from a liquid nitrogen supply line

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provided by the Buyer. Visual cues must be present on the device when the system is without liquid nitrogen or not operating nominally, audio signalization is optional.

The two DN250 CF output flanges of the vacuum tank assembly must be located on a common demountable flange on the output side of the vacuum tank assembly. If in the future the buyer decides to change a configuration with just one bigger valve it must be possible to replace the output flanges without the use of cutting components of the Vacuum tank assembly.

The device must be equipped with a movable beam dump component that is capable of taking the full power of the beam for at least 250 ms. This device serves as a calorimeter, i.e. it must be equipped with temperature monitoring. Vacuum tank assembly must have a dedicated moving calorimeter for each of the two neutral beams.

Geometry of the individual neutral beams in a single vacuum tank assembly must be such that both beams must pass unhindered through an aperture (loss less than 3%) that is located 1150 mm in horizontal direction from the neutral beam exit ports. The aperture is 500 mm wide (in vertical direction) and will be placed symmetrically in relation to the two individual neutral beams. At the same time the both beams must cross at a point that is 2300mm away (or farther) from the output plane of the beams. This point represents the expected center of the plasma.

The ion source aiming range (Table 3 row 13) must also allow to aim the beams such that they cross at a distance that is 2000 mm or less from the beam output plane. The demountable front plate on the output side of the vacuum tank assembly delivered with the device does not need to be compatible with this particular requirement.

Table 14 Specific requirements of the Vacuum tank assembly

No.	Description of the requirement	Allowed value / description
1)	Number of movable calorimeters	2
2)	Number of bending magnets (w/o power supplies)	2
3)	Pulse length with maximum output power	See Table 2 General technical requirements of the neutral beam heating system row 3
4)	Number of neutral beam sources connection spots	2
5)	Rated output power in neutrals with two installed ion sources (devices No.2)	≥ 2 MW

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6)	Alignment of the ion sources	$\leq 8.5^\circ$ from axis, $\leq 17^\circ$ in between beams Beams are converging, independent for each ion source
7)	Positioning of the ion sources and ion optics	Beam Sources have to be placed vertically above each other, symmetrically to the mid-plane of the tokamak
8)	Beam positioning – Distance of Centers of neutral beams at vacuum tank assembly output aperture position.	< 500 mm
9)	Draining port	A draining port must be placed on the bottom of the neutral beam vacuum vessel. To be used for draining fluids from the vacuum tank in case of an accident. The port must be equipped with a DN25KF flange (i.e. “Kleine Flansche” 25mm)
10)	Ports to be used for Diagnostics of the neutral beams	<ol style="list-style-type: none"> 1. Thermocouples on movable calorimeter and on output aperture. 2. Observing window at ion source for plasma source spectroscopy. 3. At least one angled port for visual and spectroscopic observation of both beams after neutralization. 4. Optional: two angled observing ports, one for each neutral beam
11)	Venting port	A dedicated connection on the vacuum tank to allow for manual venting of the vacuum tank.
12)	Liquid nitrogen refill period	More than 4 hours
13)	Beam centers crossing over point position must be adjustable within the range <closest point, farthest point>, distance measured from the output flange of the vacuum tank assembly	<p>Closest point ≤ 2000 mm</p> <p>Farthest point ≥ 2300 mm</p>

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14)	Stand by pump connection flange	DN 200 CF
15)	Distance to limiting aperture from the output port of the vacuum tank assembly	1150 mm
16)	Aperture size in vertical direction	500 mm

4.2. Device No.2 Ion source assembly

This device represents one 1 MW neutral beam source and its corresponding power sources and control electronics. Combined with device No.1 **Vacuum tank assembly** and without any additional hardware an 1MW Neutral beam heating system is created.

4.2.1 Extent of delivery

To ensure greater flexibility for the buyer the Individual ion sources (device No.2) of the procured NBHS must be interchangeable with each other irrespective when they were procured during the duration of the framework agreement. This must be possible without the need to move the associated power supplies or the cables from the power supplies to the ion source. Ion sources and their power supplies must be functionally identical within manufacturing tolerance. It must be possible to install a particular ion source assembly to any position on any vacuum tank assembly.

If additional hardware is required to facilitate this functionality it must be present on each ion source or power supply/ RF source (e.g. appropriately selected tuning components, connectors etc.). The seller will provide the tuning procedure and any special equipment that is necessary for performing this and only this task (i.e. purpose-built hardware).

The delivery of the **Ion source assembly** encompasses the necessary work to integrate and commission the device into a **vacuum tank assembly**, and all points of the general extent of the delivery given in **Chapter 3.3**.

Each ion source assembly delivery must contain all the components of an NBHS that are not part of the Vacuum tank assembly. That includes among others the following (list not complete):

- All control hardware and software (computers, PLC etc.)
- All power sources and associated cabling (HV, RF, Repeller grid, Bending magnet, auxiliary power supplies etc.)
- All data acquisition and measurements cables
- The vacuum gate valve for separating the Ion source from the vacuum tank of the NBHS
- Installation and commissioning into a Vacuum tank assembly (Device No.1)

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- Other components and work such that the requirements of this Technical specification are met

Table 15 Specific technical requirements of the Ion source assembly

No.	Description of the requirement	Allowed value / description
1)	Output power in neutral beam	≥ 1 MW
2)	Conditions for determining beam power	<ul style="list-style-type: none"> a) Two Ion sources installed on a Vacuum tank assembly b) Both ion sources produce a neutral beam c) Power is measured after the output aperture of the beam in question
3)	Beam power range	20 - 100%
4)	Beam divergence	≤ 17 mrad
5)	Single beam Focal distance	> 3.4 m
6)	Position of narrowest beam diameter (beam focal length)	The focal point of the neutral beam must be at least 3.4 m away from the last grid of the ion optic system of each beam.
7)	Narrowest beam diameter (includes 90% of output power at maximum operating parameters)	≤ 200 mm

4.3. Device No.3 Accelerating grids

The accelerating grids serve in the NBHS to extract and create the ion beam that is subsequently neutralized in the neutralizer to create a neutral heating beam. They achieve that by applying appropriate voltages on the individual grids of the Accelerating grid assembly.

This device is an assembled, adjusted, tested and conditioned set of accelerating grids. The device must be delivered in a such configuration that the basic manipulation with it does not cause the grids to move with respect to each other. The device is to be used as a drop-in replacement in the Ion source assembly (Device No.2)

5. Acceptance and performance tests

Acceptance test will have two parts. First part, **Factory acceptance tests** will be done at the Sellers premises. Second part, Site acceptance tests will take place at the Buyers premises after device delivery.

5.1. Factory acceptance test

Ordered devices must be subject to performance testing at the seller's premises. In order to demonstrate that the required technical specifications have been met before shipping the devices to the Buyer. The Seller will inform the Buyer about these tests at least 2 months in advance. The Seller must allow the presence of Buyers personnel and the use of Buyers testing equipment at these Factory acceptance tests. Results of the factory acceptance tests will be reviewed and approved by the Buyer and if deemed unsatisfactory the test or their parts must be repeated or extended. The devices must not be shipped to the Buyer before the results of the factory tests are approved as successful by the Buyer.

Devices have to be tested as full NBHS system. In cases where this is not possible, individual device performance can be tested separately on an appropriate test stand. These refers mainly to the situation when only a single device will be ordered by the Buyer that cannot be tested as a whole NBHS.

During the **factory acceptance tests** the seller must demonstrate at least the following:

- Neutral beam creation and operation at maximum, minimum and several intermediate Voltage and power levels
- NBHS pulse repetition characteristics: see Table 2 on page 11 of this Technical specification
- Beam parameters, focal length, beam divergence and size
- Interlock functionality
- Control ability
- Stability of outputs
- Vacuum levels during standby and beam ON status
- Proper thermal performance of components

Sufficiency of the performed factory acceptance tests to confirm the above mentioned, and others, parameters will be solely decided by the solely buyer. A protocol of fulfilling factory acceptance test will be signed after successful completion of factory acceptance tests.

5.2. Site acceptance test

After the delivery of the ordered devices, their commissioning and site acceptance test at the Buyers premises will be performed by the Seller. The delivered devices will be subject to a series of tests to determine compliance with the tender requirements. The main focus of the site acceptance test will be the proper integration of the delivered devices and completed NBHS into existing infrastructure of the Buyer, compliance with provided documentation and others. Sufficiency of the performed site acceptance tests will be decided solely by the buyer.

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After successful completion of the acceptance tests the Seller shall prepare and submit to the Buyer for approval the handover protocol of acceptance of each Device, a "**Handover Protocol of Acceptance**".

Due to the ongoing Compass Upgrade project it might be possible that no Flywheel generators will be available around the expected time of delivery of ordered devices. For that case the Full power and maximum pulse duration tests will not be required. Instead of it a full power short pulse test will be performed (Table 2 Operation without Flywheel generators)

Since it is very well possible that at the time of delivery the intended usage point of the NBHS (i.e. tokamak plasma) will not be available. Therefore, a suitable beam dump capable of coping with the full beam power for the full operational time will not be available at the buyer's premises. The seller must provide a suitable beam target / dump capable of demonstrating the full power full pulse time operation of the beam during the acceptance test.

If the Buyer places an individual order that does not contain devices that can be integrated into a stand-alone working NBHS, e.g. a single device No.2 Ion source assembly, it is up to the buyer to provide the necessary functionality provided by the Vacuum tank assembly so that the procured device No. 2 can be subjected to acceptance tests.

6. Specifications for the Seller's Bid

This document (Technical Specification for System for plasma heating with neutral particle beam for COMPASS-U Tokamak) contains very detailed specifications and requirements, which must be followed and fulfilled by the Seller. This chapter contains the minimal technical details, which must be included in the Seller's Bid

1. **A general overall description** of the offered Neutral beam heating system its performance, subcomponents, power supply types, consumables, interfaces, floor space etc. (ten standard pages as a minimal extent)
2. **The minimal technical details and parameters**, as required by the **Table 16 Table of minimal technical requirements**
3. **The specific statement that the Neutral beam heating system detailed design** (which will be created by the Seller during the realization phase) **will fulfill all of the requirements contained in this Technical Specification**. This specific statement is included in the **Table 16 Table of minimal technical requirements**
4. **All information required by the Annex No.4 - Evaluation matrix.**

Table 16 Table of minimal technical requirements

No.	Name / description of the requirement	Allowed value / description	Seller's offered value / description
1)	Power in neutral beams for configuration: Device No.1+2×Device No.2	≥ 2 MW	2
2)	Power in neutral beams for configuration: Device No.1+Device No.2	≥ 1 MW	1
3)	Energy of the neutral beams	≥ 80 keV	80
4)	Pulse length at full beam power and energy	≥ 1 s	1
5)	Maximum power at full pulse length beam repetition period	≤ 15 min	15
6)	Single Beam divergence	≤ 17 mrad	17
7)	Narrowest beam diameter	≤ 200 mm	200
8)	Width of NBHS in configuration Device No.1+2×Device No.2	≤ 1650 mm	Yes
9)	Height of NBHS in configuration Device No.1+2×Device No.2	≤ 4000 mm	Yes
10)	Length of NBHS in configuration Device No.1+2×Device No.2	≤ 4400 mm	Yes

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11)	The offered devices and Neutral beam heating system fulfills all requirements in the Technical Specification	Confirmation statement (for example "Yes")	Yes
12)	The offered Device No.1 Vacuum tank assembly fulfills all requirements in the Technical Specification	Confirmation statement (for example "Yes")	Yes
13)	The offered Device No.2 Ion source assembly fulfills all requirements in the Technical Specification	Confirmation statement (for example "Yes")	Yes
14)	The offered Device No.3 Accelerating grids fulfills all requirements in the Technical Specification	Confirmation statement (for example "Yes")	Yes

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Table 1 Table of minimal technical requirements

No.	Name / description of the requirement	Allowed value / description	Seller's offered value / description
1)	Power in neutral beams for configuration: Device No.1+2×Device No.2	≥ 2 MW	2 MW
2)	Power in neutral beams for configuration: Device No.1+Device No.2	≥ 1 MW	1 MW
3)	Energy of the neutral beams	≥ 80 keV	80 keV
4)	Pulse length at full beam power and energy	≥ 1 s	1 s
5)	Maximum power at full pulse length beam repetition period	≤ 15 min	15 min
6)	Single Beam divergence	≤ 17 mrad	17 mrad
7)	Narrowest beam diameter	≤ 200 mm	200 mm
8)	Width of NBHS in configuration Device No.1+2×Device No.2	≤ 1650 mm	1650 mm
9)	Height of NBHS in configuration Device No.1+2×Device No.2	≤ 4000 mm	4000 mm
10)	Length of NBHS in configuration Device No.1+2×Device No.2	≤ 4400 mm	4400 mm
11)	The offered devices and Neutral beam heating system fulfills all requirements in the Technical Specification	Confirmation statement (for example "Yes")	Yes
12)	The offered Device No.1 Vacuum tank assembly fulfills all requirements in the Technical Specification	Confirmation statement (for example "Yes")	Yes
13)	The offered Device No.2 Ion source assembly fulfills all requirements in the Technical Specification	Confirmation statement (for example "Yes")	Yes
14)	The offered Device No.3 Accelerating grids fulfills all requirements in the Technical Specification	Confirmation statement (for example "Yes")	Yes

Bid price structure

The Price Schedule and Deliverables							
The mandatory terms and conditions of the tender							Prices offered by the Supplier
Number of the individual device	Delivered individual device/Completed task	Expected quantity of deliveries during the term of the Framework Purchase Agreement	Delivery period of the individual device/task after the Supplier's acceptance of the Order issued by the Contracting Authority	Maximum allowed advance payment (percentage of the purchase price of the individual device excluding VAT)	Date of the advance payment	Price cap	The purchase price of the individual device excluding VAT (i.e. unit price for delivery of 1 piece of device)
		[pieces]	[months]	[%]			[EUR]
No.1	Device No.1 - "Vacuum tank assembly" (Deliver and install the Device No.1 - Vacuum tank assembly at Buyers premises include the acceptance of each Device)	3	18	35	after the Order	The price for the device No.1 is capped at 550 000 EUR excl. VAT as maximum	550 000 EUR
No.2	Device No.2 - "Ion sources assembly" (Deliver and install the Device No.2 - Ion sources assembly at Buyers premises include the acceptance of each Device)	6	18	35	after the Order	The price for the device No.2 is capped at 1 270 000 EUR excl. VAT as maximum	1 270 000 EUR
No.3	Device No.3 - "Accelerating grids" (Deliver and install the Device No.3 - Accelerating grids at Buyers premises include the acceptance of each Device)	1	18	30	after the Order	The price for the device No.3 is capped at 250 000 EUR excl. VAT as maximum	250 000 EUR