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Organisation européenne pour la recherche nucléaire

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The NA-CONS Project

Price Enquiry

Technical Specification

Supply of Hot Isostatic Pressing (HIP) process for Target Splitter Collimators in the North Area

Abstract

This Technical Specification concerns the supply of a Hot Isostatic Pressing (HIP) process for bonding components of the target splitter collimators in the context of CERN's North Area Consolidation project.
The delivery is expected to span from Q2 2025 to Q4 2025.

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Table of Acronyms

Acronym	Definition
NA-CONS	North Area Consolidation Project
LHC	Large Hadron Collider
TCSC	Target Splitter Collimator - Version C
SY-STI	Accelerator Systems department – Source Targets and Interactions group
HIP	Hot Isostatic Pressing
TIG	Tungsten Inert Gas
MP	Manufacturing Plan
IACS	International Annealed Copper Standard

1. INTRODUCTION

The Contract will be performed in accordance with the General Conditions of CERN Contracts (CERN/FC/6674-II). However, this Technical Specification prevails over the General Conditions of CERN Contracts with regard to the particular provisions specified in this document, and this without prejudice to any other provision in the General Conditions of CERN Contracts.

Capitalised terms in the body text are defined either in the General Conditions of CERN Contracts or in the present document.

1.1 Introduction to CERN

CERN, the European Organization for Nuclear Research, is an intergovernmental organization with over 30 Member States[1]. Its seat is in Geneva but its premises are located on both sides of the French-Swiss border (https://maps.web.cern.ch/). CERN's mission is to enable international collaboration in the field of high-energy particle physics research and to this end it designs, builds and operates particle accelerators and the associated experimental areas. At present, more than 10 000 scientific users from research institutes all over the world are using CERN's installations for their experiments. Further information is available on the CERN website: http://cern.ch.

The accelerator complex at CERN is a succession of machines with increasingly higher energies. Each machine injects the beam into the next one, which takes over to bring the beam to an even higher energy, and so on. The flagship of this complex is the Large Hadron Collider (LHC) (see Figure 1).

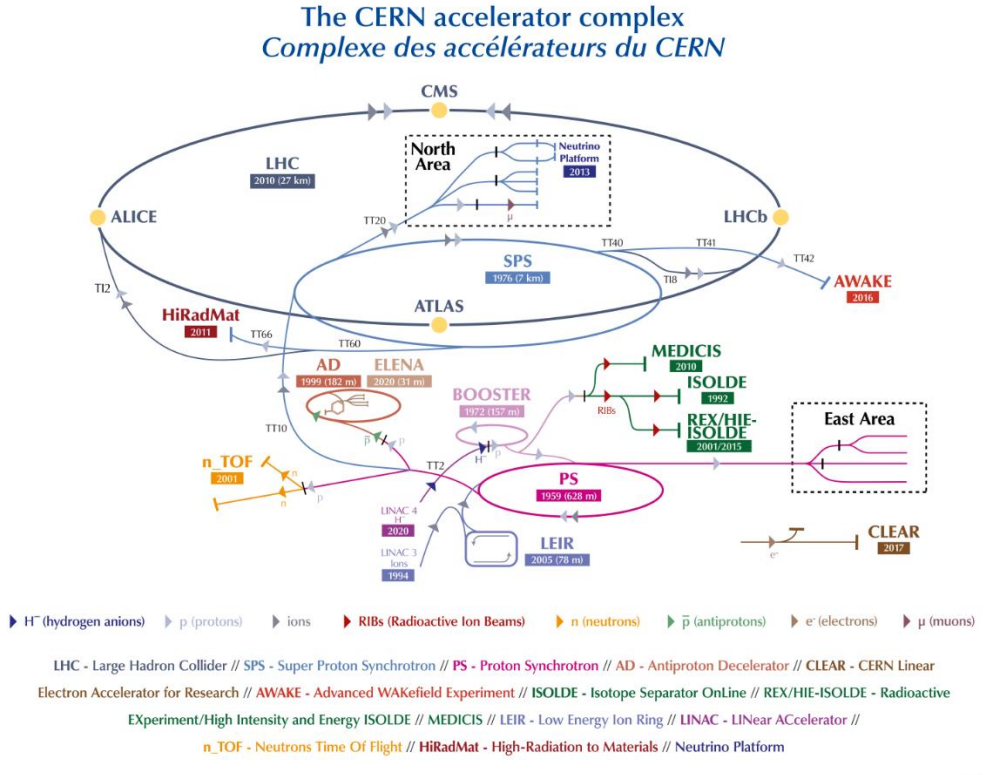

Figure 1: CERN Accelerator Complex

[1] http://home.web.cern.ch/about/member-states

1.2 Introduction to the NA-CONS project and the beam intercepting devices

A consolidation of the North Experimental Area, part of the Super Proton Synchrotron complex, has been approved in 2021 (NA-CONS project). This project will see a major two-phased facelift in the upcoming years that covers the renovation of the beam lines, infrastructures, and services to recover a conventional level of reliability and bring the facility into compliance with modern safety requirements and compliant with current beam intensities. Several beam-intercepting devices need to be designed, produced, and installed to implement this upgrade project. Among these, the Target Splitter Collimator (TCSC) is a device working in harsh environments and under challenging thermomechanical loads, whose reliability is essential to the operation of the experimental area complex.

1.3 Introduction to the Accelerator Systems (SY) Department – Sources Targets and Interactions (STI) Group

The Accelerator Systems Department (SY) is responsible for the accelerator beam-related technical systems of beam instrumentation, beam transfer, electrical power converters, radio frequency and targets, collimators, and absorbers of the CERN accelerator complex and its experimental facilities. Within the SY Department, the Sources, Targets, and Interactions (STI) Group is in charge of the Beam-Intercepting Devices.

2. SCOPE OF THE SUPPLY

CERN intends to place a contract (the "Contract") for the supply of a Hot Isostatic Pressing (HIP) process for bonding components of the target splitter collimators in the North Area (in whole or in part, the "Supply"). The HIP process shall be performed by the Contractor and cannot be subcontracted.

The successful bidder (the "Contractor") shall provide the Supply as defined in this Technical Specification, including its annexes.

2.1 Content of the Supply

The Supply shall include:

- *Technical deliverables* as specified in § 3:
  - A pre-series HIP-bonded assembly;
  - Series HIP-bonded assemblies.

- *Activities* as specified in § 4:
  - On the Contractor's site:
    - Pre-series and series HIP process (see § 4.1.1);
    - Packing and shipping (see § 4.1.2).

- *Documentation* as specified in § 5:
  - Manufacturing Plan (see § 5.1.1);

- Record of the pre-series HIP process (see § 5.1.2);
- Record of the series HIP process (see § 5.1.3);
- Production schedule (see § 5.2).

- *Options* as specified in §§ 3.2 and 4.2.

2.2 Materials Provided by CERN

CERN will provide the following materials for the purpose of the performance of the Contract:

- Six assemblies to be HIP-bonded.

The assemblies that will be provided by CERN adhere to the drawing listed in § 9. The main components that constitute the assembly are depicted in Figure **2**. They will be delivered to the Contractor's site in two stages, one for the pre-series HIP bonding and five for the series HIP bonding, as stated in § Table **1**.

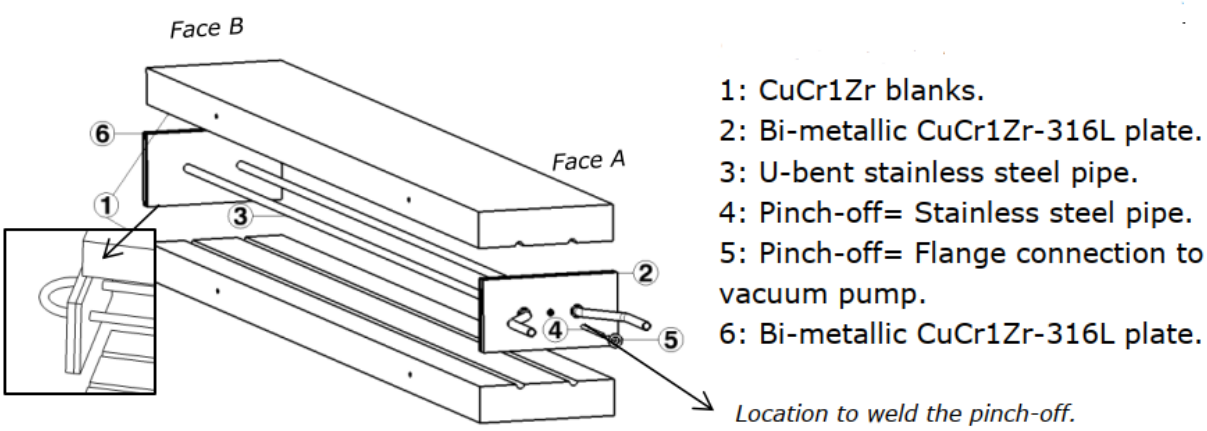

Figure 2: Assembly of components to be HIP-bonded

Each of the assemblies that will be delivered to the Contractor's site will be already under vacuum and sealed off. The assembly will consist of two CuCr1Zr plates with machined grooves that host stainless steel pipes. The following steps will be performed by CERN, to obtain a leak tight assembly ready for HIP:

- A bi-metallic CuCr1Zr-316L plate will be welded on the upstream and downstream surfaces of the assembly, removing the need for a HIP capsule;
- A pinch-off pipe (n° 4 in Figure 2) will be welded onto one of the bimetallic plates, which will allow to pump out the air from the interior of the assembly and hence create the internal vacuum needed for HIP;
- During creation of vacuum in the assembly interior, the assembly will be subjected to a helium leak test to ensure leak tightness;
- After the required vacuum level will be achieved and the leak test is completed, the pinch-off pipe will be closed and TIG welded to seal off the assembly;

- The portion of the steel pipes outside of the assembly (which includes the U-bend and the two extremities) will be covered with stainless steel foil to prevent their corrosion during the HIP cycle.

A total of six such assemblies will be delivered to the Contractor's site and shall be HIP-bonded, as defined in § 3.1, Table **1**. Each assembly delivered to the Contractor's site will have a unique identifier engraved on. These identifiers shall be used to refer to each assembly in the HIP process record (see §§ 5.1.2 and 5.1.3), in order to have a clear traceability of the HIP cycle each of the assemblies was subjected to.

3. SPECIFICATION OF THE TECHNICAL DELIVERABLES

The Supply shall include the technical deliverables as specified in the present section. In the framework of this procurement, the production of pre-series and series units is required.

3.1 Dimensions and Interface Requirements

A first pre-series HIP cycle shall include one assembly. The series assemblies shall be HIP cycled following the quantities specified in Table 1. The Contractor may include fewer assemblies than what is defined in Table 1, only in the case there is a limitation due to the size of the oven. In such case, this shall be communicated to CERN for written acceptance.

Table 1: Definition of HIP cycles to be performed

HIP cycle	Designation	Number of assemblies to be included in each HIP cycle	Applicable assembly drawing
A	Pre-series	1	SPSTCSC_0005
B	Series	2	
C	Series	3	

3.2 Optional Technical Deliverables

The following optional technical deliverables may be ordered by CERN:

- Design of the support structure for HIP (see § 4.2.1);
- Manufacturing of the support structure for HIP (see § 4.2.2);
- Thermal treatment of the assemblies after the HIP process, to recover CuCr1Zr material properties (see § 4.2.3);
- Two additional HIP cycles (see § 4.2.4);
- Thermal treatment of assemblies after these two additional HIP cycles (see § 4.2.5).

4. SPECIFICATION OF THE ACTIVITIES

The Supply shall include the activities listed in the present section. These activities shall comply with the requirements specified below.

4.1 Activities at the Contractor's Premises

During the Contract, CERN shall have free access, during normal working hours, to the Contractor's premises, including manufacturing and assembly sites and Subcontractor's premises. The change of manufacturing place is subject to prior written approval by CERN. The Contractor shall notify CERN two weeks prior to performing each of the HIP cycles, so that CERN, or a representative of its choice may attend the execution of the HIP cycle.

4.1.1 Pre-series and Series HIP Process Activities

The process to be followed for each HIP cycle is defined hereafter. The process shall be identical for the pre-series and series HIP cycles.

The assemblies shall be inserted in the HIP oven, fixed on the support structure (see § 4.2.1). The parameters to be adhered to during the process are defined in Table 2:

Table 2: Definition of the temperature and pressure stepping in each HIP cycle

Phase	Duration	Temperature	Pressure
1	30 minutes	Room temperature	Increased to 22.5 MPa
2	190 minutes	Increased to 950 °C ±10 °C, 5 °C/min	Increased to 100 MPa
3	180 minutes	Kept at 950 °C ±10 °C	Kept at 100 MPa
4	160 minutes	Cool-down to < 150 °C, 5 °C/min ±3 °C/min	Decreased to ambient pressure

In phase 1 defined in Table **2**, the pressure shall be linearly increased to the specified value over the duration of the phase. For phases 2, 3 and 4, the rate of increase and decrease of pressure shall be applied proportionally to the rate of change of the temperature of the gas.

Argon gas shall be used as inert gas during the HIP process.

A visual representation of the HIP cycle is provided in Figure **3**3:

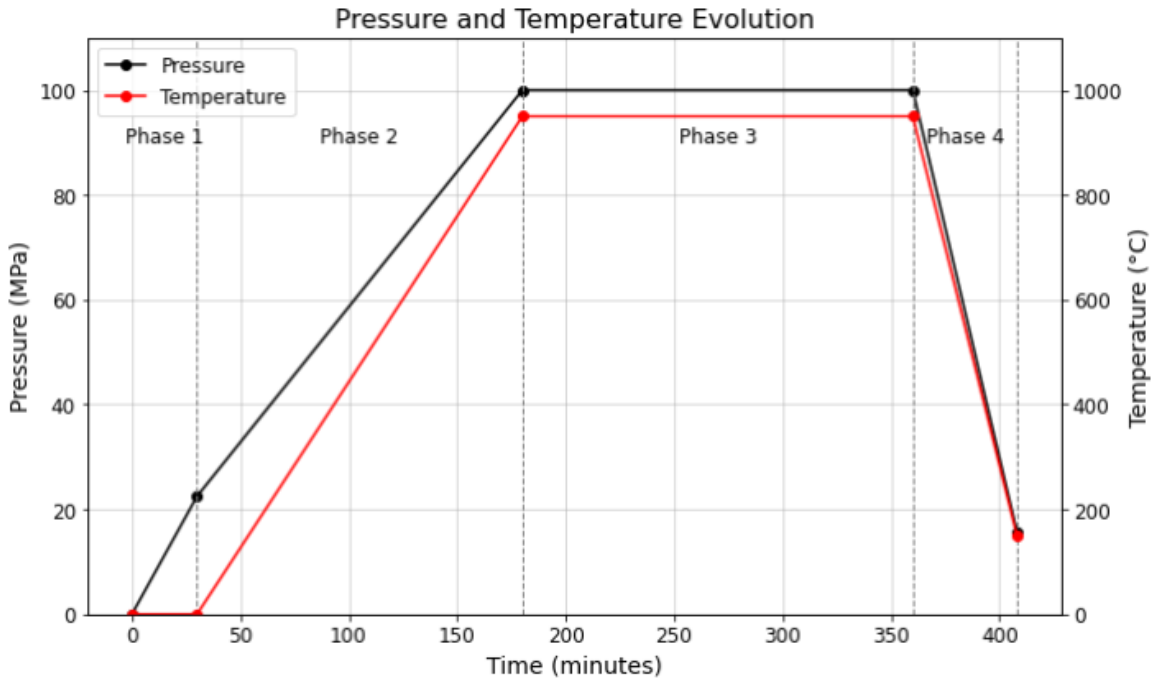

Figure 3: Pressure and temperature evolution during the HIP cycle

4.1.2 Packing and Shipping

The Contractor shall be responsible for the packing and the transport to CERN of the assemblies. In this case, the Contractor shall take up a dedicated all-risk transport insurance for the Supply concerned in accordance with the provisions of DAP Incoterms 2020 conditions, CERN Prévessin (FR).

In all cases, the Contractor shall comply with the packing and shipping instructions available under: https://procurement.web.cern.ch/system/files/document/packing-and-shipping-instructions_0.pdf and, in particular, ensure that the Supply is packed in a way that guarantees the absence of any contamination and that no damage or any possible deterioration in performance due to transport conditions can occur.

4.2 Optional Activities

CERN may order the following optional activities:

4.2.1 Design of the support structure for HIP

The Contractor shall design a support structure to secure the assemblies in place during the HIP cycle, to prevent contact between the different assemblies and the HIP oven and facilitate the handling of the assemblies.

The support structure design shall consider the maximum number of assemblies that shall be included simultaneously in the same HIP cycle as defined in § 3.1.

It is crucial that the design of the support structure accounts for the expected thermal expansion of the assemblies during the HIP cycles, to ensure they will not expand freely.

4.2.2 Manufacturing of the support structure for HIP

The support structure described in § 4.2.1 shall be manufactured.

4.2.3 Assembly thermal treatment after the HIP process

The Contractor shall submit to CERN for written acceptance a heat treatment process to be performed on the assemblies after the HIP cycle, with the aim to recover the material properties of the CuCr1Zr. After the heat treatment, the CuCr1Zr blanks shall comply with the following:

- Temper H120, according to EN 12167;
- Electrical conductivity @T=20°C > 43 MS/m (> 75% IACS).

These properties shall be achieved throughout the CuCr1Zr volume.

Achievement of the temper shall be demonstrated by performing a Brinell hardness test according to EN ISO 6506-1.
The electrical conductivity test method used shall be at the discretion of the Contractor, as specified in § 8.3 of EN 12420.

The results of these tests shall be summarized in a report, which shall be submitted to CERN for written acceptance prior to the delivery of the heat-treated assemblies.

In case the heat treatment will be performed in an oxidizing environment, the Contractor shall shield the stainless-steel pipes (n°3 of Figure **2**) to prevent their oxidation during the heat treatment. The Contractor shall implement protective capsules for those pipes on both sides of the assembly. A pinch-of pipe will be needed in each capsule, in order to achieve a sealed vacuum and protect the pipes from oxidation during the heat treatment.

4.2.4 Additional HIP cycles

Two additional HIP cycles may be ordered by CERN as required. Those HIP cycles shall adhere to the same process defined in § 4.1.1

4.2.5 Thermal treatment after the additional HIP cycles

In case additional HIP cycles are requested by CERN (see §4.2.4), the related assemblies shall undergo a thermal treatment in accordance with what is defined in §4.2.3.

5. SPECIFICATION OF THE DOCUMENTATION

The Supply shall include the documentation related to the Supply (§ 5.1) and the documentation related to the performance of the Contract (§ 0). This documentation shall comply with the requirements specified below.

5.1 Documentation Related to the Supply

The documentation related to the Supply shall include:

- Manufacturing Plan (MP) (see § **Erreur ! Source du renvoi introuvable.**);
- Record of the pre-series HIP process (see § 5.1.1);
- Record of the series HIP process (see § 5.1.3).

5.1.1 Manufacturing Plan (MP)

The Contractor shall submit a MP in accordance with the schedule defined in § 7.1, including:

- Detailed description of the HIP process and preparatory activities;
- Equipment used and its characteristics (oven brand and model, oven dimensions, inert gas type, handling equipment, …);
- Mounting method in the HIP oven and proposed layout of the support structure (see § 4.2.1);
- Means of controlling the temperature and pressure increments according to the rates and values specified in § 4.1.1;
- Data acquisition system and process monitoring;
- Any other documentation that is planned to be produced by the Contractor during the HIP process;
- If any of the options as defined in § 4.2 are ordered by CERN, all relevant technical information shall be included in the MP.

Acceptance of the MP will be as defined in § 7.4.1.

5.1.2 Record of the pre-series HIP process

The Contractor shall submit a record for the pre-series HIP cycle performed including:

- The identifier of the HIP cycle (as defined in § 3.1);
- The identifier engraved on the pre-series assembly included in the HIP cycle (see § 2.2);Temperature and pressure transient recordings during each phase of the HIP cycle (as defined in § 4.1.1);
- Pictures of the assembly to be subjected to the HIP cycle in the following instances:
  - Before installation in the oven;
  - When installed in the oven;
  - After the HIP cycle has been performed.

5.1.3 Record of the series HIP process

The Contractor shall submit a record for the series HIP cycles performed including:

- The identifier of the HIP cycle and number of assemblies included in the oven (as defined in § 3.1);
- The identifier engraved on each series assembly included in each HIP cycle (see § 2.2);
- Temperature and pressure transient recordings during each phase of the HIP cycles (as defined in § 4.1.1);
- Pictures of the assemblies to be subjected to the HIP cycle in the following instances:
  - Before installation in the oven;
  - When installed in the oven;
  - After the HIP cycle has been performed.

5.2 Documentation Related to the Performance of the Contract

The Contractor shall submit a detailed production schedule including all the activities specified in § 2.1 in accordance with the schedule defined in § 7.1.

5.3 Creation, Updating and Control of Documents

The Contractor shall apply professional standards and codes in matters of document editing, design/drawing process, design reviews and approval, naming conventions and tagging, quality assurance/control.

The full documentation supplied in the framework of the Contract (including all drawings and schematics) shall be in English only.

The Contractor shall submit all documents produced exclusively in the following electronic formats:

- 3D models in CATIA® and/or STEP format;
- Drawings in CATIA®, AUTOCAD® **AND/OR** HP-GL® and/or PDF® format;
- Text documents in Microsoft Word® **AND/OR** PDF® format;
- Cost breakdowns and equipment lists in Microsoft Excel® and csv format;
- Schedules in Microsoft Project® **AND/OR** PDF® format.

6. APPLICABLE RULES, NORMS AND STANDARDS

The Supply shall comply with Laws. For the purpose of the Contract, and only if the optional technical deliverables as described in § 4.2.3 and § 4.2.5 are executed by the Contractor, Laws shall include all relevant rules, norms and standards and, and in particular:

- EN 12167: Copper and copper alloys Profiles and bars for general purposes;
- EN ISO 6506-1: Metallic materials - Brinell hardness test - Part 1: Test method;
- EN 12420: Copper and Copper Alloys – Forging.

7. PERFORMANCE OF THE CONTRACT

7.1 Schedule

The Contractor shall deliver the Supply in accordance with the following schedule, starting from the date of notification of award of the Contract to the Contractor:

Table 2: Schedule

	Milestones	Weeks	Indicative Date
T_0	Notification of award of the Contract to the Contractor		Apr 2025
	Submission of the MP (see § 5.1.1) and production schedule (see §5.2) and Contract kick-off at Contractor's production site (see § 7.3)	$T_0 + 3$	
T_1	Acceptance by CERN of the MP and production schedule (see § 7.4.1)	$T_0 + 5$	May 2025
	Delivery of pre-series HIP assembly (see § 2.2) at the Contractor's site	$T_1 + 4$	Jun 2025

	Milestones	Weeks	Indicative Date
	Submission of the pre-series HIP process record (see § 5.1.2) for written approval by CERN	$T_1 + 6$	
	Acceptance of pre-series HIP process record (see § 7.4.2) by CERN	$T_1 + 7$	
T_2	Delivery of the pre-series HIP-bonded assembly at CERN	$T_1 + 8$	Jul 2025
	Delivery of the series HIP assemblies (see § 2.2) at the Contractor's site	$T_2 + 4$	
	Submission of the series HIP process record (see § 5.1.3) for written approval by CERN	$T_2 + 6$	
	Acceptance of series HIP process record (see § 7.4.3) by CERN	$T_2 + 7$	
T_3	Delivery of the series HIP-bonded assemblies at CERN	$T_2 + 8$	Sep 2025

7.2 Contractor's Personnel

The Contractor shall assign an appropriate number of qualified personnel for the performance of the Contract. The personnel assigned by the Contractor shall at all times remain under the sole direction and responsibility of the Contractor.

The Contractor shall, at its own expense, ensure that its personnel assigned to the Contract has suitable training to comply with the requirements of the Contract.

7.3 Contract Follow-Up and Progress Monitoring

The Contractor shall assign a person in charge of the technical execution of the Contract and its follow-up, as well as a person in charge of the commercial follow-up, during the whole duration of the Contract. These persons shall be able to communicate (spoken AND written) in at least one of the official languages of CERN (English and/or French).

The Contractor shall organise a Contract kick-off meeting at the Contractor's site where the activities will take place. The MP (see § 5.1.1) and production schedule (see § 5.2) shall be submitted one week ahead of the meeting.

The Contractor shall notify CERN two weeks prior to performing each HIP cycle, so that CERN, or a representative of its choice may attend the execution of the HIP cycle.

All communications and documents shall be in English.

7.4 Acceptance of the Supply by CERN

7.4.1 Acceptance of the MP and production schedule

The Contractor shall submit to CERN for acceptance the MP and production schedule as specified in § 5.1.1 and § **Erreur ! Source du renvoi introuvable.** and according to the schedule defined in § 7.1.

CERN will verify the conformity of these documents in accordance with clause 22 of the General Conditions of CERN Contracts.

The start of the pre-series HIP process will be subject to CERN's prior written acceptance of these documents.

7.4.2 Acceptance of the pre-series HIP process record

The Contractor shall submit to CERN for acceptance the pre-series HIP process record as specified in § 5.1.2 and according to the schedule defined in § 7.1.

CERN will verify the conformity of these documents in accordance with clause 22 of the General Conditions of CERN Contracts.

The delivery to CERN of the pre-series HIP bonded assembly will be subject to CERN's prior written acceptance of the pre-series HIP process record.

7.4.3 Acceptance of the series HIP process record

The Contractor shall submit to CERN for acceptance the series HIP process records as specified in § 5.1.3 and according to the schedule defined in § 7.1.

CERN will verify the conformity of these documents in accordance with clause 22 of the General Conditions of CERN Contracts.

The delivery to CERN of the series HIP bonded assemblies will be subject to CERN's prior written acceptance of the series HIP process records.

8. CERN REPRESENTATIVES

All commercial and technical correspondence concerning the Invitation to Tender shall be communicated to the CERN Procurement officer and in copy to the Technical officer. Any communication by or to any other person than the CERN Procurement Service shall not be valid and have no effect.

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In case of absence:		
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9. ANNEXES

Applicable drawings are listed in Table .

Table 3: List of applicable drawings

Description	**Drawing number**
HIP assembly	**SPSTCSC_0005**