

Technical Specifications (In-Cash Procurement)

Technical specification of CWP-818, 819 and 820

The document provides a brief technical specifications and scope for the installation works associated with Service Vacuum System (SVS) and Disruption Mitigation System (DMS) lines/pipes/pipe spools and their corresponding support structures. It outlines short description of the various work package(s), overall schedule, activities under the concerned work packages, etc. The detailed description and specifications of the work have been given in the respective Construction Work Packages (CWPs) ...

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1 Purpose

The document provides a brief overview of the scope and technical specifications for the installation works associated with various Construction Work Packages (CWPs) for the Service Vacuum System (SVS) and the Disruption Mitigation System (DMS) lines/pipes/pipe spools and their corresponding support structures. It outlines a common framework specification for the CWPs, an overall schedule, main activities under the concerned work packages, etc. The detailed description and specifications of the work have been provided in the respective CWPs and their attachments. Considering the installation phases and requirements at different locations in the tokamak building (B11), a Frame Work Contract (FWC) is planned to cover the three CWPs, CWP-818, 819, and 820.

2 Introduction

The installation works within the present scope of the contract is broken down into three CWPs [1] associated the Hand Over Packages (HOP) and described in Table 1.

Table 1: Introduction to CWPs

Sr. No.	Description of works	Area	CWP	HOP	IDM UID for CWP
1.	CWP - Install PBS31 pipework in Port Cells at B1 level in Bldg 11	B11-B1	CWP-0818	55	5XGDYT (refer for CWP-0818 only)
2.	CWP - Install PBS18 DMS lines in Port Cells and East Gallery at B1 level in Bldg 11	B11-B1	CWP-0819	55	5XGDYT (refer for CWP-0819 only)
3.	CWP - Install PBS18 DMS ring headers at L1 in Bldg 11 (IO)	B11-L1	CWP-0820	135	5XGDYT (refer for CWP-0820 only)

ITER Organization (IO) shall issue a Task Order (TO) for each of the above CWPs as per the site requirements and shall define a contact person (CP) for each CWP for the day-to-day coordination and execution of the work.

3 Definitions

For a complete list of ITER abbreviations see: ITER_D_2MU6W5 - ITER Abbreviations. The specific definitions and abbreviations are given below:

CWP: Construction Work Package

FWC: Frame Work Contract

IO: ITER Organization

TO: Task Order

DMS: Disruption Mitigation System

SVS: Service Vacuum System

CP: Contact person

HOP: Hand Over Package

PIC: Protection Important Component

PIA: Protection Important Activity

T2D: Type 2 Diagnostic

4 Scope of work

The scope of work includes performing the installation activities by deploying skilled resources and equipment/tools/infrastructure to fulfil the requirements defined in respective CWPs ([5XGDYT](#)) and its attachments.

The list of lines associated with these CWPs is provided in Table 2.

Table 2: Description of lines in CWPs

CWP	Description of the lines in CWP	Size of lines	Approx. Length of line (m)
CWP-0818	Non Tritium roughing line	DN150	180
CWP-0818	Exhaust line	DN150	180
CWP-0818	Active roughing line	DN150	180
CWP-0818	Helium Tracer line	DN25	180
CWP-0818	Optional gas supply line	DN25	180
CWP-0818	Backfill gas line	DN25	180
CWP-0818	Vent line	DN25	180
CWP-0818	Type 2 Diagnostic (T2D) rough line	DN100	50
CWP-0819	DMS Propellant gas line 1	Inner pipe: 1/8" tube, Outer pipe: DN8	70
CWP-0819	Non-radioactive gas line 3	DN8	70
CWP-0819	Non-radioactive gas line 4	DN8	70
CWP-0819	DMS Hydrogen Deuterium line 2	Inner pipe: DN10, Outer pipe: DN32	70
CWP-0820	DMS Propellant gas line 1	Inner pipe: 1/8" tube, Outer pipe: DN8	90
CWP-0820	Non-radioactive gas line 3	DN8	90
CWP-0820	Non-radioactive gas line 4	DN8	90
CWP-0820	DMS Hydrogen Deuterium line 2	Inner pipe: DN10, Outer pipe: DN32	90

5 Layout of the lines

Figure 1 to Figure 6 describes the overview layout of the lines associated with the three CWP's.

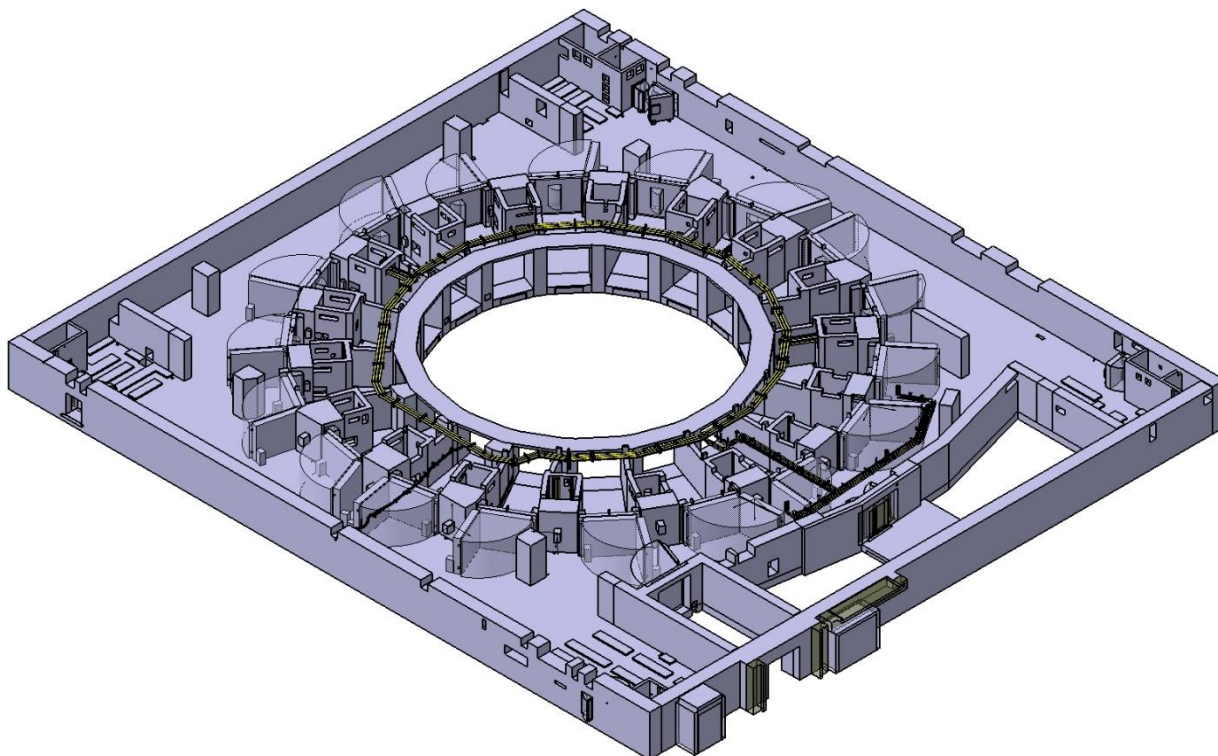


Figure 1: Layout of the lines in CWP-0818 and CWP-0819 at B11-B1 (CWP-0818: Yellow lines, CWP-0819: Green lines)

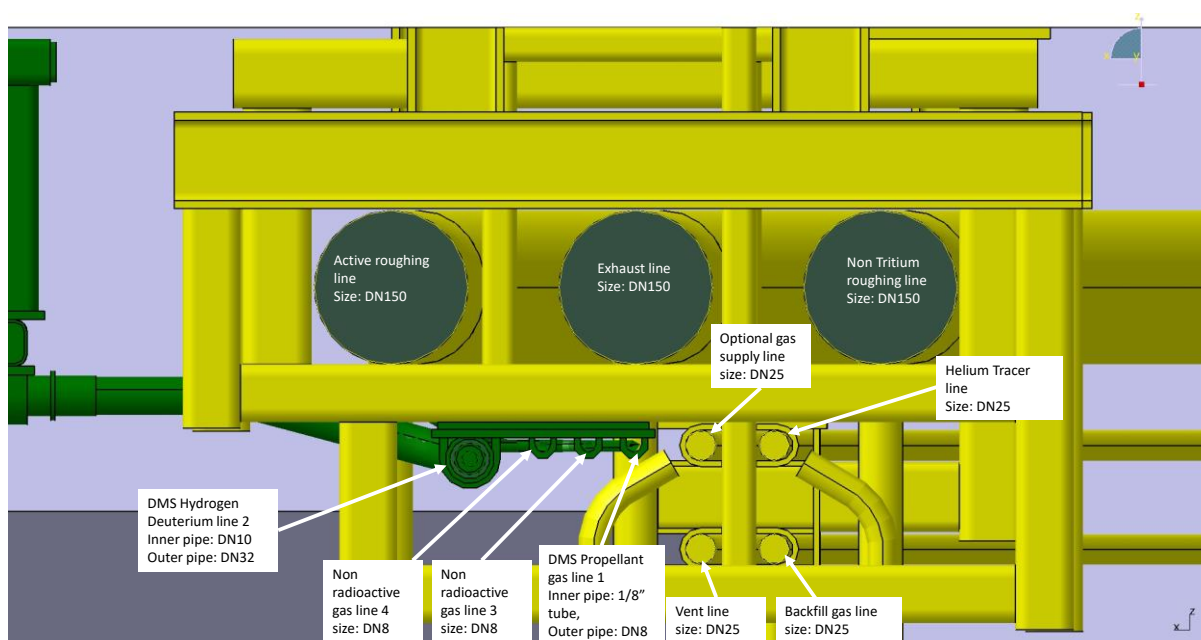


Figure 2: Cross sectional view of the lines in CWP-0818 and CWP-0819 at B11-B1 at Port Cell 01 (CWP-0818: Yellow lines, CWP-0819: Green lines)

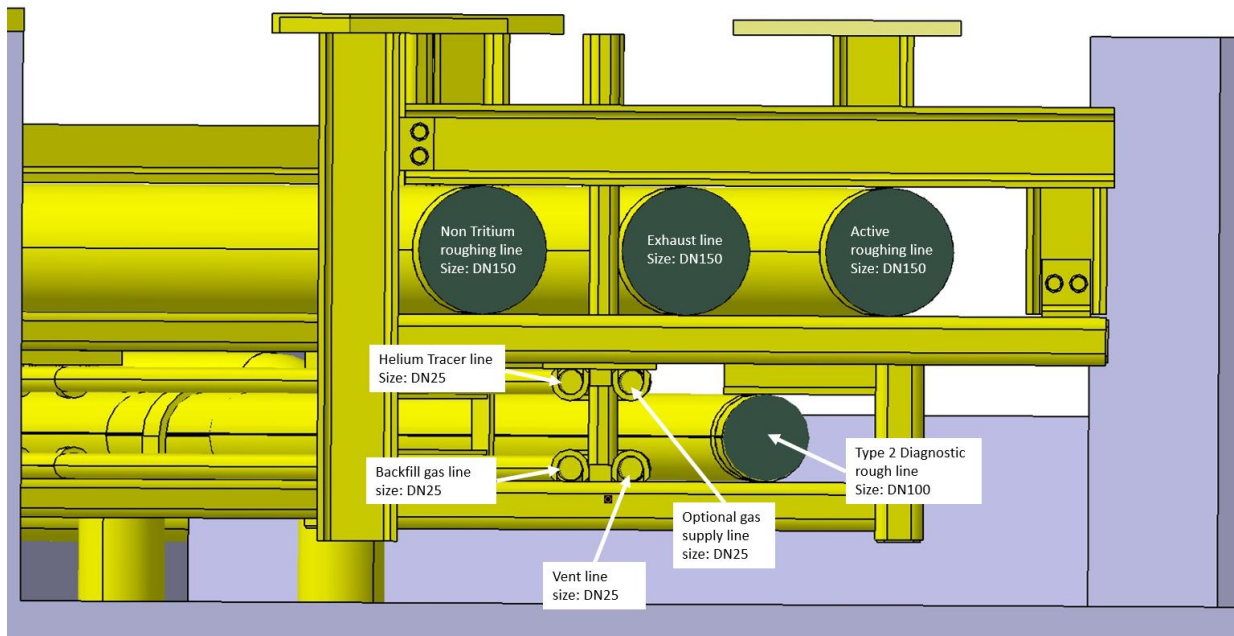


Figure 3 Cross sectional view of the lines in CWP-0818 at B11-B1 at Port Cell 03 (CWP-0818: Yellow lines)

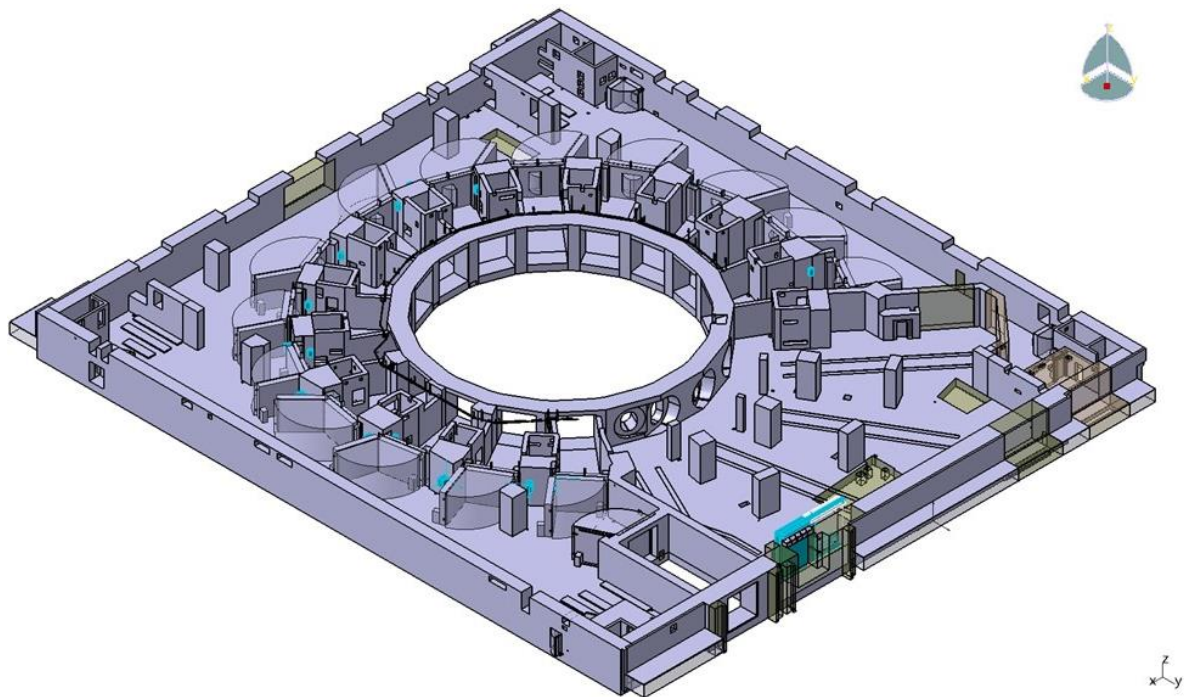


Figure 4: Layout of the lines in CWP-0820 at B11-L1 (CWP-0820: Blue lines)

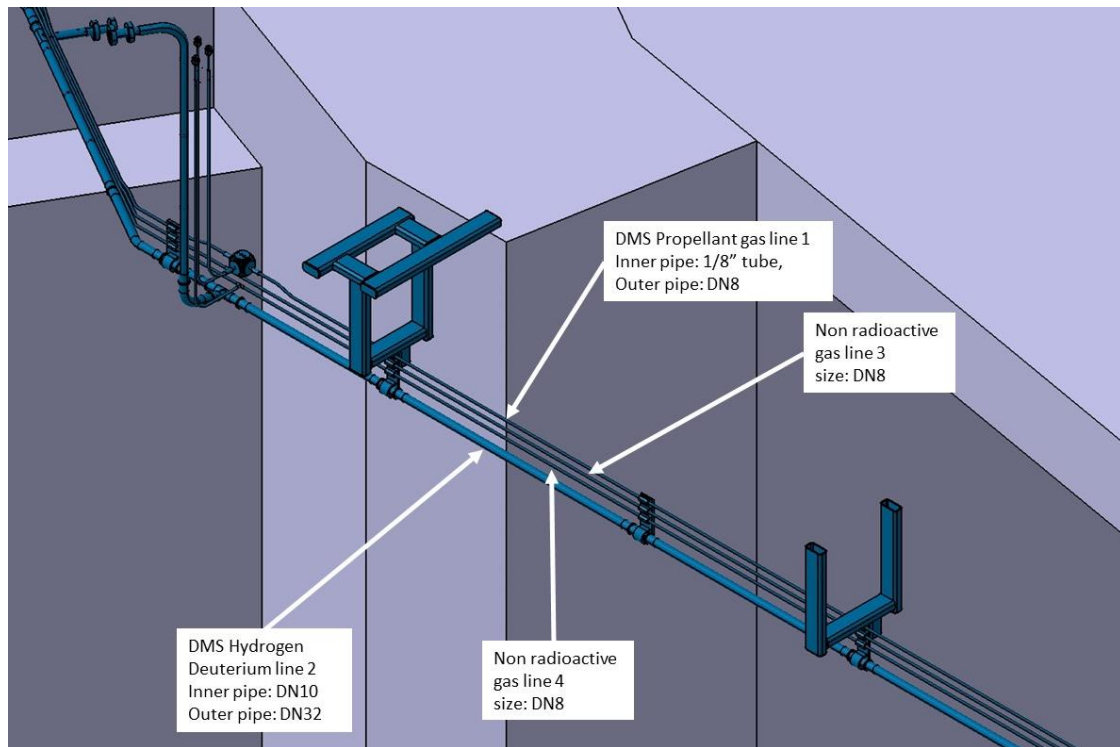


Figure 5: Zoomed view of the lines in CWP-0820 at B11-L1 (CWP-0820: Blue lines)

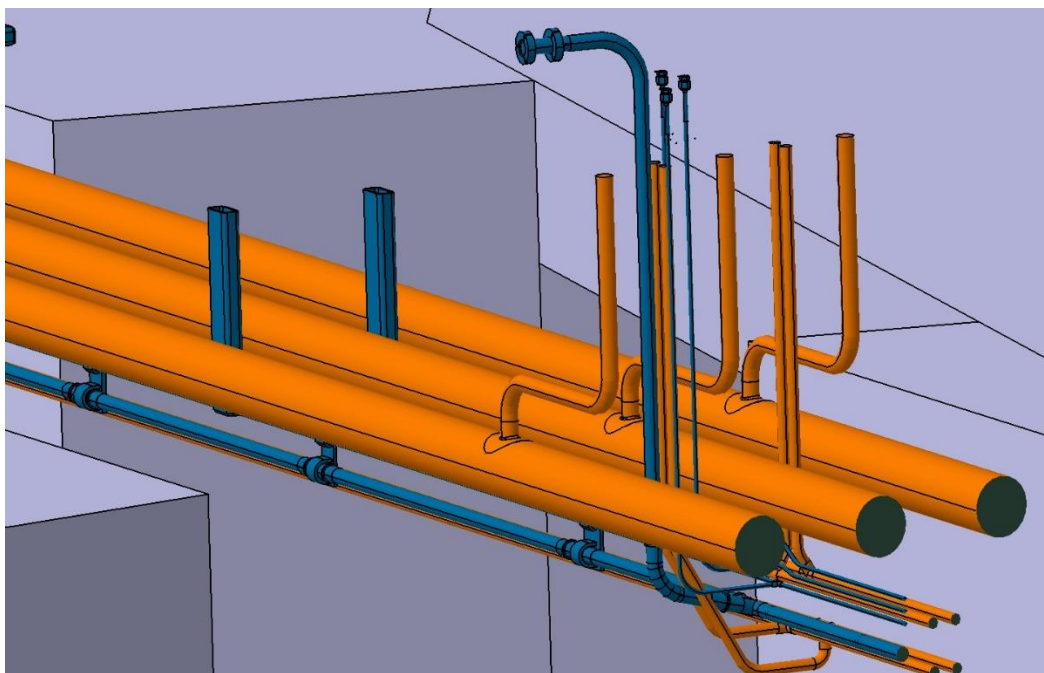


Figure 6: Zoomed view of the lines in CWP-0785 (Orange) and CWP-0820 (blue) at B11-L1

Note: As shown in Figure 6, the lines of CWP-0820 are in close proximity of CWP-0785 (not in the scope of current specifications), the installation activities of CWP-0820 need to be carried out in close coordination with the works of CWP-0785.

6 Description of works

The contractor's scope of work includes the activities defined in the corresponding CWP. The main activities have been described in Table 3.

Table 3: Main activity description for pipes and supports for CWP-0818, CWP-0819 and CWP-0820

Main activity description for pipes and supports	CWP-0818	CWP-0819	CWP-0820
Transfer of the components inside the building and Contractor workshop	Not Included	Not Included ^{Note-1}	Not Included
Pre-installation survey	Included	Included	Included
Preparation of final execution drawing	Included ^{Note-2}	Included ^{Note-2}	Included
Procurement of temporary Support material and accessories, anchor bolts, fasteners if needed	Included	Included	Included
Procurement of Studs Welded and all bolting material	Included	Included	Included
Procurement of Material for testing, Welding materials (filler metals etc.)	Included	Included	Included
Pre-fabrication of piping spools	Not Applicable	Included ^{Note-3}	Included
Modification of pre-fabricated spools, if needed	Included	Not Applicable	Not Applicable
Modification of pre-fabricated supports, if needed	Included	Included	Included
Installation of primary supports	Included	Included	Included
Installation of secondary supports	Included	Included	Included
Installation of piping spools	Included	Included	Included
Touch up Coating and Painting	Included	Included	Included
Earthing support & pipes only if Electrical continuity test is not satisfactory	Included	Included	Included
Electrical continuity test	Included	Included	Included
Pressure tests (pneumatic test)	Not Applicable	Included	Included
Leak tests	Included	Included	Included
Cleaning, drying, flushing, reinstatement	Included	Included	Included
Preservation	Not Applicable	Included	Included

Legend:

Included = Instructed to the contractor through this document,

Not Included = Not Instructed to the contractor through this document.

Note-1: The activity, “Transfer of the components inside the building and Contractor workshop” is part of the scope in CWP-0819, however, this specification supersede the CWP-0819 for this activity and thus removed from the contractor’s scope.

Note-2: The activity, “Preparation of final execution drawing” is not part of the scope in CWP-0818 and CWP-0819, however, this specification supersede the CWP-0818 and CWP-0819 for this activity and thus included in the contractor’s scope.

Note-3: The activity, “Pre-fabrication of piping spools” is not part of the scope in CWP-0819, however, this specification supersede the CWP-0819 for this activity and thus included in the contractor’s scope.

Note-4: The installation of components classified as PIC is PIA [3]. Please refer to [1] and its attachments for the detailed system classification.

The following sub-sections provides the details of requirements for the activities under the scope of works [4].

6.1 Site survey

The Contractor shall perform a survey of the work area relevant to the installation in compliance with [2]. The site surveys include but are not limited to checking the following: position of embedded plates and penetrations required for assembling the Equipment, access constraints to the working area.

6.2 Pre-fabrication of spools

The IO will provide design isometrics, general assembly drawings and composite drawings to the Contractor. The Contractor based on design isometrics shall develop fabrication isometrics. The Component (spool) breakdown proposed by the Contractor will be presented in the fabrication isometrics, taking in account manufacturability, space available for assembly, installation efficiency, and effective use of materials.

The Components (spools) shall be optimized for a minimum on-site work (i.e., minimum field welds) while taking in account restrictions for access and handling resulting from ITER site configuration.

The Contractor shall prepare and submit the plan, including isometrics for manufacture, to the IO for approval prior to starting the manufacturing activities. The Contractor shall manufacture the pre-assembled Components in such a way so that the wastage of the base materials is minimized.

The Contractor shall join by welding (Section 6.5) the base materials (pipe lengths, tees elbows, etc.) to form pre-manufactured components (spools) in accordance with the approved fabrication isometrics.

For double walled pipe, spools are to be manufactured with all spacers welded to the process or guard pipe as per the design documents. Provisions shall be made to ensure the spools are not damaged during transportation and handling due to sliding of the guard pipe. The Contractor shall fit suitable covers (such as plastic cap or sheet, aluminium foil, etc.) to the pipe spools.

6.3 Modification of pre-fabricated supports and spools, if needed

If the free issued supports and piping spools require modification due to, for example, building or installation tolerances, the Contractor shall inform the IO in case any modification is necessary.

6.4 System classification and quality requirements

The safety and quality classification as well as the ESP/ESPN category/level of each equipment (tagged item) under the applicable CWP's has been provided in the attachments of (5XGDYT) as follows:

1. CWP-818: https://user.iter.org/?uid=5XGDYT_v1_2.D&action=get_document
2. CWP-819: https://user.iter.org/?uid=5XGDYT_v1_2.E&action=get_document
3. CWP-820: https://user.iter.org/?uid=5XGDYT_v1_2.G&action=get_document

Please refer General Management Specification for Contractors in [6], and section-7 of [6] for the quality requirements.

6.5 Cleanliness requirements

The internal and external surfaces of all equipment shall be clean, free of scale, rust, debris, grease, oil, dust and other foreign materials. Prior to the start of installation activities, the Contractor shall submit a cleaning procedure for the IO approval, which the Contractor shall follow in order to meet the requirements of this technical specification.

Tools shall be clean and dry, free of contamination, from for example oil.

Tools that have been in contact with carbon steel shall not encounter stainless steel base materials, components or equipment. Tools to be used for the fabrication of stainless steel piping shall be made of stainless steel or coated protected by stainless steel, plastic (nonhalogenated).

Piping Components shall be stored separately to avoid accidental switching with tools previously used on carbon steel fabrication work.

The openings of all Components shall be protected with a suitable cover (such as plastic cap or sheet, aluminium foil, etc.) to protect from the ingress of gross contamination. All protective covers shall be free of halogens.

All openings shall be protected from the ingress of dust and/or water. Covers shall be defined in the contractor's Clean Work Plan.

To avoid the ingress of foreign material, all ends of components / equipment shall retain their protections while not required to be open.

Prior to joining the spool to the installed equipment, the Contractor shall confirm the cleanliness and the absence of any gross contamination of the fixed part. The cleanliness shall be demonstrated by complying with the requirements of cleanliness test while the absence of gross contamination shall be checked via endoscopic inspection.

The cleanliness of the internal surfaces of the components and equipment shall be demonstrated by a wet wipe test in accordance with the IO Standard Wipe Test for Cleanliness. The wet wipe

test shall be performed at a distance, measuring no less than 2DN of the Component/Equipment from any of its ends. The wet wipe test can be performed on any internal surface.

This test shall use a clean lint free cloth dipped in a solvent which evaporates at room temperature, such as isopropanol, ethanol or acetone. Appropriate safety precautions against fire hazard, breathing in of solvent fumes, eye and skin protection must be taken while carrying out such tests.

- The cloth shall be dipped in the solvent, which shall then be allowed to evaporate in a safe manner. There shall be no change in the appearance of the surface of the dry cloth.
- Dip the cloth in the solvent and gently wipe the surface of the component while the cloth is still wet.
- The solvent shall be allowed to evaporate from the cloth and the surface of the component until they are dry.
- If there is any evidence of a deposit on the cloth (i.e. a stain or a change in colour) then the item shall be regarded as unclean.
- Similarly if the surface of the component that has been wiped shows any evidence of a change in colour or reflectivity of light, then the item shall be regarded as unclean.

The Contractor shall submit a Clean Work Plan for IO approval before commencing any work. The Clean Work Plan shall include but not be limited to,

- Provisions taken by the Contractor to avoid any gross contamination or external component entering into the system.
- Provisions taken by the Contractor to maintain the cleanliness of the working area.
- Spread contamination limits foreseen by the Contractor.
- Transportation plan for fabricated spools (from the workshop to the site or from the onsite workshop to the assembly location).
- Evidences of the compliance with the Clean Work Plan

6.6 Flushing and Drying requirements

Flushing and Drying shall be performed using dry air prior to commissioning to remove all debris and moisture which may have been introduced during weld preparation.

6.7 Welding Requirements

Welding materials shall be identified and controlled so that they can be traced to each welding operation performed on Equipment. The Contractor shall agree on a procedure for material traceability with the IO prior to commencement of the work. Filler metals and auxiliary materials shall comply with Section 9.4 of EN 13480-4.

All pipe / pipe fitting ends shall be prepared for future welding operations. End preparation shall be in accordance with applicable sections of the EN 13480-4 for the preparation for welding: Cleaning before and after Welding (Section 9.6), Joint Preparation (Section 9.7), Edge Preparation (Section 9.8) and Assembly for Welding (Section 9.9).

Welded joints shall comply with the requirements specified by the design and manufacturing codes. In addition to requirements of current section, the following requirements on welding qualification shall apply;

- Fillet welds cannot be qualified by butt welds;
- The range of approval, depending on type of joint, shall comply with Figure 7.

Type of joint in Approval Test Piece			Range of approval									
			Butt weld on plate				Fillet weld on plate	Butt weld on plate		Fillet weld on pipe	Branch welds on pipe	
			Welded from one side		Welded from both side			Welded from one side			Set on	Set through
			With backing	No backing	With gouging	No gouging		With backing	No backing			
Butt weld on pipe	Welded from one side	With backing	ok	no	ok	ok	no	yes	no	no	no	no
		No backing	ok	ok	ok	ok	no	ok	yes	no	no	no
Fillet weld	Plate		no	no	no	no	yes	no	no	no	no	no
	Pipe		no	no	no	no	ok	no	no	yes	no	no
Branch weld in pipe	Set on		no	no	no	no	no	no	no	no	yes	no
	Set through		no	no	no	no	no	no	no	no	no	yes

no	Indicates those welds for which the WPS is not approved
ok	Indicates those welds for which the WPS is also approved
yes	Indicates those welds for which the WPS is approved in the approval test

Figure 7: Range of approval

The contractor shall submit the Welding Procedure Specification (WPS), Welding Procedure Qualification Record (WPQR) and Welder Qualification Test Record (WQTR) for approval by the IO prior to commencement of the works.

In case of Pipework, the welding shall comply with EN ISO 15614 and ISO 9606.

Repairs shall be made using qualified personnel and qualified procedures. All repaired welds shall be documented in compliance with the relevant code. Imperfections shall be removed by grinding, gouging, plasma or machining from the entire weld affected. Repair welds shall be non-destructively tested in accordance to EN 13480-5.

6.8 Non Destructive Examination (NDE) Requirements

The Contractor shall perform the examinations for the scope of work described in accordance with this technical specification and the system specific NDE requirements included in the Contract Documents.

Visual examination shall be done in accordance to EN ISO 17635:2017, Table A.1 for 100% of the weld joints.

Radiographic examination of the weld joints shall be in accordance with EN ISO 17635:2017, paragraph A.6. The extent of radiographic examination is defined in Table 4.

Table 4: Extent of radiographic examination

CWP	Extent of radiographic examination
CWP-0818 (All lines except T2D rough line)	20%
CWP-0818 (Only applicable for T2D rough line)	100%
CWP-0819	100%
CWP-0820	100%

The image quality value (IQI), as defined in annex A of EN 17636 shall be 2 values better than the minimum requirement. In-process examinations shall be as required by paragraph 7.3.3 of the EN 13480-5. Dimensional and layout check to be included as part of the in-process examination. The dimensional, geometry and layout check of all the manufactured/installed pre-assembly spools and pipe runs shall be carried out as per approved fabrication isometric drawings.

NDE controllers shall comply with the requirements specified in Section 8.4.3 of EN 13480-5.

6.9 Pressure test requirements

Prior to initial operation or during installation (depending on the accessibility constraints), all Pipework Equipment installed in accordance with this technical specification shall be pneumatically tested using dry nitrogen gas in accordance with the code requirements. The test pressure shall be in accordance with the applicable standard or Contract Documents. The pneumatic test pressure shall be increased and maintained as per procedure in paragraph 9.3.3 of EN 13480-5.

The test procedure with shall be prepared by the Contractor and submitted to the IO for approval. The pressure test shall be performed before the Helium leak test.

6.10 Leak test Requirements

The Installation welds shall be helium leak tested in compliance with Table 5 [5].

Table 5: Extent of Leak test

	Extent	Test Scope
Assembly (installation) welds	100%	Local test of weld
Intermediate Assembly	100%	Global test of completed section

The maximum acceptable leak rate for individual weld tests shall not be greater than 10^{-10} Pa.m³.s⁻¹. The test procedure with shall be prepared by the Contractor and submitted to the IO for approval. The leak test shall be carried out at Ambient temperature, $\Delta P=0.1$ MPa (in either direction) and Concentration of He > 50% over area under test.

6.11 Preservation Requirements

The Contractor shall preserve the installed pipe works from degradation by maintaining positive pressure using dry gaseous Nitrogen, upon completion of installation activities and up to the handover to the IO.

7 Documentation

The Contractor shall submit the following documents for approval by the IO.

- Quality plans
- ITPs
- As-installed drawing
- Weld Visual Inspection Reports
- Welding Procedure Specification (WPS)
- Welding Procedure Qualification Record (WPQR)
- Welder and Welding Operators Qualification (WQ) or Welder Qualification Test Record (WQTR)
- Non-destructive examination readings and reports
- Clean Work Plan
- Pneumatic Test Plans
- He leak test procedure and reports
- Certification of fabrication and installation by Contractor as having met all the requirements of this specification
- EU declaration of conformity according to PED 2014/68/CE (if applicable)

8 Resources and site infrastructure requirements

In order to efficiently execute the work at ITER site, the contractor shall assign the skilled resources accordingly. The contractor shall have suitable infrastructure at ITER site for the execution of the various installation activities.

9 Waste Management Requirements

The contractor shall be responsible for maintaining the housekeeping in the areas they are working. The Contractor shall remove and take out any waste resulting from the installation activities in particular wooden cradles and frames used for transportation and shall be responsible for disposing of these under the waste disposal rules. The Contractor according to ITER site rules (ITER_D_ TYLAQ9) shall manage all wastes generated during the installation works.

10 Free Issue Materials and Services

10.1 Free Issue Materials (FIM)

The contractor shall provide all the tools, equipment and consumables needed for the installation and testing activities. The components/items/equipment which are to be installed shall be provided by IO. The contractor shall take utmost care to use IO's material, equipment, etc. as supplied to carry out the work and avoid any damage except for regular wear and tear.

10.2 Free Issue Services (FIS)

The IO shall provide the following services (including equipment, consumables and qualified manpower to carry out these services) to facilitate the installation work:

1. Scaffolding at work sites
2. Material movement and handling (using machines) at work site, from site workshop to work site, from storage to work site/work shop.
3. Electricity, water, compressed air, heating, cooling, ventilation

11 Schedule

The overall schedule for the current scope of works is defined in Table 6, which gives an overview of the timeframe in which the works shall start and be completed. Within this timeframe, the IO and the contractor shall establish a detailed installation plan for each CWP, considering all the inputs and constraints specified in the respective technical specifications of the CWPs. For the installation activities, the contractor is requested to propose a procedure and sequence of installation showing its capability to ensure work continuity throughout the contract duration without any interruption. This detailed procedure and sequence of installation shall be generated considering the overall timeframe to be fulfilled by the contractor. Nevertheless, the duration of each WP will be determined taking into account the updated information on constraints, which will be reviewed by IO and the contractor together and agreed upon before commencing the work.

Table 6: Overall schedule (tentative) for scope of works

CWP	Description of works	Start date	End date
CWP-0818	CWP - Install PBS31 pipework in Port Cells at B1 level in Bldg 11	Aug-2023	May-2024
CWP-0819	CWP - Install PBS18 DMS lines in Port Cells and East Gallery at B1 level in Bldg 11	Sep-2023	Jun-2024
CWP-0820	CWP - Install PBS18 DMS ring headers at L1 in Bldg 11	Jan-2024	Sep-2024

12 Confidentiality

The contractor shall keep all documents under the contract including drawings, procedures, work instructions etc. properly (digital or hardcopy) in their custody in safe condition. Contractor shall keep all the information strictly confidential. A separate non-disclosure agreement (NDA) will be signed.

Applicable References

- [1] [ITER_D_5XGDYT - CWP_CMA_Scope of Work for TCC1-CWP-0818-0819-0785-0820 – Deliverable 6.2 \[including its attachments and reference therein\]](#)
- [2] [ITER_D_46FN9B - ITER Dimensional Metrology Handbook](#)
- [3] [ITER_D_25VPUG - Technical Specification for the Installation of DMS Pipework and Supports in Building 11](#)
- [4] [ITER_D_VQ69HA - Technical Specification for the Pre-fabrication & Installation of Stainless Steel Pipework \(non-ESP, ESP,ESPN,PIC etc.\)](#)
- [5] [ITER_D_T3BEWM - Technical Specification for Leak Testing](#)
- [6] [ITER_D_TYLAQ9 - Specification CMA General Management Specification for Contractors - Deliverable 5.3](#)