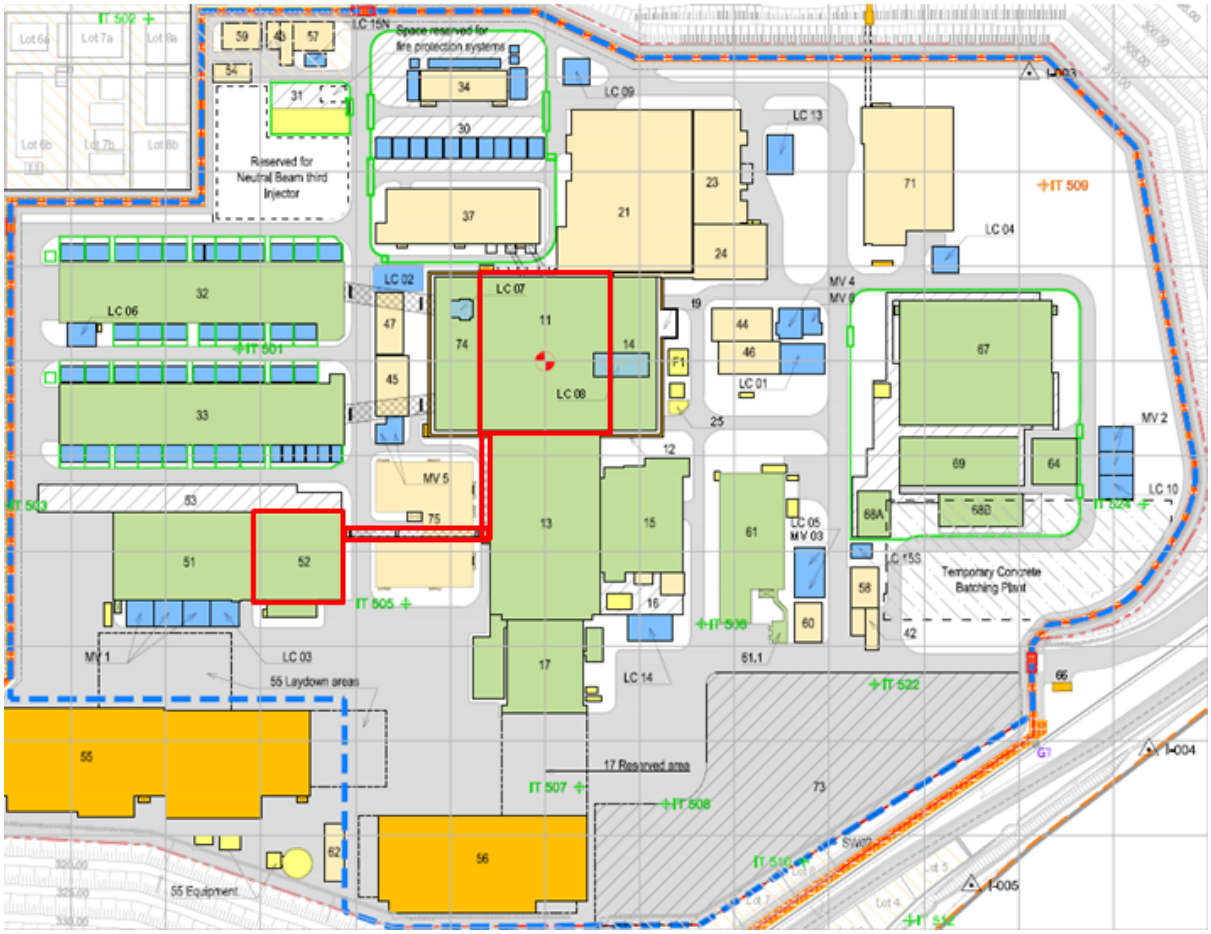
Technical summary for the Balance of Plant Group 4, Multi-Process Lines Installation works

1. Purpose

The purpose of this Call for Nominations is to establish a list of candidates who will be invited to participate in a tender process, starting with a pre-qualification for a contract for installation works of Multi-Process Lines system, in the following Buildings on the ITER Organization (IO) Site, Cadarache, France:

- Building 52 – Cold boxes cryoplant building, plus limited zone in Area 53
- Plant Bridge (PB) – Cryo-bridge between the Cryoplant building 52 and the Tokamak building 11
- Building 11 - Tokamak building (L3, B1, B2 and B2M levels, North West shaft and South West shaft)

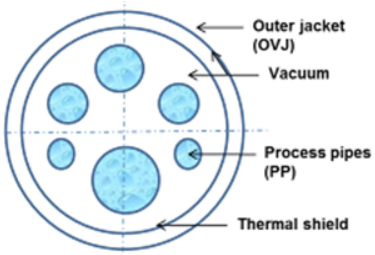


2. Background

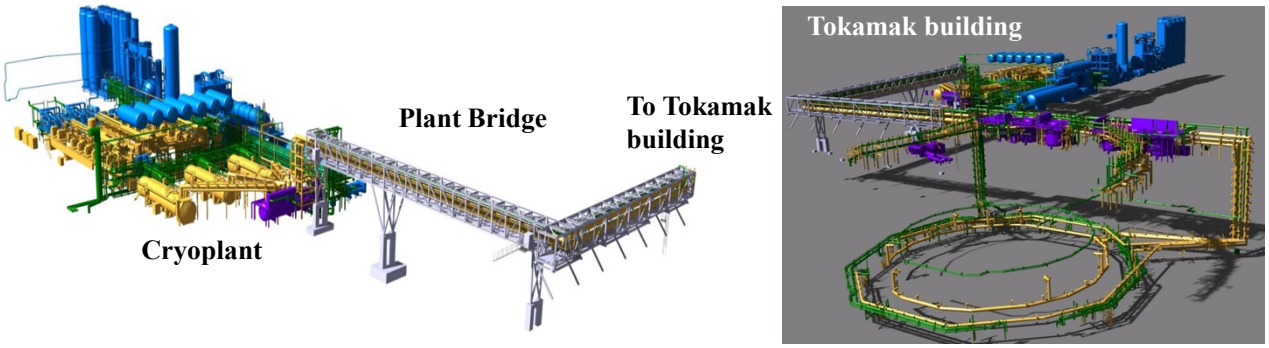
ITER is based on the 'Tokamak' concept of magnetic confinement, in which the plasma is contained in a doughnut-shaped vacuum vessel. The fuel - a mixture of Deuterium and Tritium, two isotopes of Hydrogen - is heated to temperatures in excess of 150 million °C, forming hot plasma. Strong magnetic fields are used to keep the plasma away from the walls; these are produced by superconducting coils surrounding the vessel, and by an electrical current driven through the plasma.

A large scale cryogenic system has been designed to provide the required operational conditions for the magnet system and the associated sub-systems. The Multi-Process Lines system (MPLs) is part of the overall cryogenic system intended to distribute and recover the cold power needed by the cryogenic system.

The MPLs system are pipe in pipe construction where the inner process pipes carrying helium at low temperature are arranged in radial fashion (refer to the picture below). The process pipes wrapped with multi-layer insulation are assembled inside thermal shield and outer vacuum jacket (OVJ).



The MPLs system form a structured network with a total length of about 1.7 km spread inside the Tokamak building, on a dedicated Plant Bridge and in Cryoplant Building/Area. The picture below shows the three-dimensional (3D) schematic layout of the MPLs system (highlighted in Yellow) in the Cryoplant, the Plant Bridge and the Tokamak building.



The routing of MPLs is including large number of bends at odd angles, branches and tight positional tolerances due to limited space availability, specifically inside the Tokamak building. The MPLs demand high availability and reliability which is ensured via extensive technical specifications along with stringent design, fabrication, inspection and quality control, safety and regulatory requirements. The table below summarizes the brief technical specifications of the MPLs system.

Specification/description	Multi-Process Lines
No. of process pipes (PP)	1 to 7
Length	~ 1700 m
No of lines	20
Outer Vacuum Jacket (OVJ)	DN 300 to DN 1100
Element/Spool shape	Straight, Tee, Elbow, Z, seismic decoupling system, confinement plate, associated external supporting system
Temperature levels	4.5 K (3.8 K), 50 K, 80 K, 300 K
Fluid	Helium (He)
Pressure of process fluid	Maximum 21 bar A
Materials of PP/OVJ	1.4306,14435 (304L/316L)
Quality Classes (QC)	QC 1
Seismic Classes (SC)	SC1 (SF), SC1 (S), SC2, NSC

Specification/description	Multi-Process Lines
Safety Classes	SIC-II, SR, Non-SIC

Note:- NSC: Non Seismic Class, Non-SIC: Not Safety Important Class, SC1(SF): damage limit 'normal' as per code for Seismic Level-2, SC1(S) and SC(2): damage limit 'faulted' as per code for Seismic Level-2, SIC-II: Safety Important Class which is part of secondary confinement boundary for nuclear establishment (Tokamak building) – stringent quality control and inspection by nuclear authority, SR: Safety related, QC1: 100% volumetric inspection, QC2: typically 20% volumetric inspection.

The detailed design of MPLs is ongoing and expected to be completed for all MPLs mid of 2018. They are divided into five lots and each lot is composed of several MPLs. Each MPL is divided into number of spools/elements for ease of manufacturing, assembly, transport, handling and installation at site. The maximum length of spools has been kept about 11 meter for straight elements and 14 meter for Tee elements. The MPLs will be supplied with all their associated supporting system in different buildings.

The table below gives details about the lots, associated MPLs, the location, the number of process pipes and the number of expected spools/elements to be installed.

Lot	Name	PBS No.	Location	OVJ DN	Number of process pipes	Number of spools
X1	Manifold for ACBs magnets	342CA0	11	1100	5	7
	Manifold for ACB cryopumps	342CF0	11	700	4	7
	Cryopumps line between Buildings	342CU0	PB, 52	700	4	16
	Magnet line bet. Buildings	342CM0	PB, 52	1000	5	16
	Thermal Shields Cryoline	342CK0	11	300	1	6
X2	CTCB-He CB1 cryoline	342CL1	52	700	7	2
	CTCB-He CB2 cryoline	342CL2	52	700	7	2
	CTCB-He CB3 cryoline	342CL3	52	700	7	3
	CTCB-LHe tank cryoline	342CI0	52, 53	500	5	8
X3	TCC North	342CHN	11	600	6	20
	TCC South	342CHS	11	600	6	19

Lot	Name	PBS No.	Location	OVJ DN	Number of process pipes	Number of spools
X4	TF North	342CTN	11	500	5	22
	TF South	342CTS	11	500	5	20
	PF/CC Lower	342CPL	11	500	5	18
	CS Lower	342CCL	11	500	5	15
X5	CS Upper	342CCU	11	500	5	3
	PF/CC North	342CPN	11	500	5	3
	PF/CC South	342CPS	11	500	5	4

3. Scope of Work and installation challenges

3.1. Scope of work

The installation works has to be performed in the following buildings:

- Building 52 – Cold boxes cryoplant building, plus limited zone in area 53
- Plant Bridge (PB) – Cryo-Bridge between Building 52 and Tokamak building 11
- Building 11 - Tokamak building in which MPLs are present at six different areas L3 galleries, L2, L1 and B1 north and south shafts, B1 port cell, B2 galleries and B2M lower pipe chase

The installation of MPLs and their associated external supports will be done area by area in different buildings. Within a given area, activities shall be divided into different Construction Work Packages (CWP); each CWP will include installation of one or more lines identified in Installation Work Packages (IWP).IWP will be established by the selected Contractor.

The installation activities to be carried out during the installation phase leading to the final acceptance of the MPLs system are as follows:

- Preparation of the Installation Readiness Review (IRR) in order to assess the readiness of the selected Contractor with regards the project requirement before starting the installation works
- Survey activities of embedded plates and penetrations in order to check that the embedded plates used for the fixation of the external supports are located within the tolerances as per design
- Inspection of spools using dedicated tools in order to check that no damage is occurred either during the transport from the manufacturer workshop to IO site or

during the storage phase. Reparation of damaged and on-site final adaptation parts of MPLs or external supports shall be envisaged, if required

- Transport of spools and external supports from the storage area to the temporary workshop (if needed) and then to the installation site
- Purge / Blow-off and flushing of process pipes in order to remove particles and dust eventually accumulated during assembly, provided that safety measures are implemented by the selected Contractor in accordance with IO occupational health and safety requirements
- Lifting and handling of spools (with customized tooling and handling equipment while needed) and external supports to the installation place has to be done in accordance with the applicable guidelines and procedures which shall be submitted at the IRR stage
- Welding of parts of external supports together and external supports to the embedded plates.
- Welding of adjacent spools and the last spool to the interface equipment by a junction/interconnection. The junction will be standardized to introduce simplicity in design and join variety of combinations of spools. The total estimated weld length (process pipes + OVJ) to be performed is about 2.5 km . Orbital welding machine will be used preferably
- Weld inspection (visual, thermal, Non-Destructive tests) to be performed in accordance with the applicable procedure and IO occupational health and safety requirements
- MLI wrapping of the junction between two spools or between the last spool and the equipment interface in accordance with the applicable procedure
- Thermal shield junction between two spools or between the last spool and the equipment interface in accordance with the applicable procedure
- Test Readiness Review (TRR) in order to assess the readiness of the selected Contractor to perform all the required tests (Pressure test, Helium Leak testetc)
- Provisional acceptance tests (Hydraulic continuity, Pressure test, Helium Leak test) to be performed before connecting the last spool to the Equipment interface in accordance with the applicable procedure and ITER occupational health and safety requirements. This will be followed by CE marking of completely installed MPL.
- Final acceptance tests (Pressure test, Helium Leak test,.) to be performed after connecting the last spool

All the MPLs spools, external supports and all the necessary items needed to make the junction (MLI, sleeve, etc.) will be free issued by IO to the selected Contractor, except for the consumables (welding materials, test materials, welding equipment etc.), accessories and special tooling (lifting and handling tools, etc.) and waste management for the installation.

Note that the selected Contractor shall perform the installation works of MPLs system under the technical supervision of the company who is responsible of Engineering and Procurement of MPLs system. The installation works shall be done in accordance with procedures and guidelines established by IO and the MPL supplier

Note also that the above information is preliminary only and will be further detailed at the Call for Tender stage.

3.2. Installation challenges

The installation of MPLs is challenging and highly integrated task due to the tight positional tolerances, limited space availability and minimum repair capability once all the systems are in position, specifically inside the Tokamak building. It demands high level of co-ordination between various installation agencies, quality, safety officers and site construction in-charge. Most of the MPLs in Tokamak building are Quality Class One (QC 1) components which requires 100% volumetric inspection. Specific inspections and controls will be performed during the installation; this has to be considered in the plan. It is important to maintain the schedule window provided for various installation activities, without much interruption. In order to comply with the specified insulation vacuum pressure, strict cleaning activities and cleanliness control is required during installation. Environment free from dust, particles, metal chips and other debris, no carbon steel construction nearby (cutting, grinding) and stop of building construction activities nearby is foreseen to create vacuum class environment. The site constraints, limitations and dependencies needs to be considered to properly plan the installation.

4. Interface with Other Companies

There will be other contractors working on the IO site around the Buildings and also inside the Buildings involved in these installation activities.

4.1.Scaffolding

The IO will put in place a framework contract for the lease of scaffolding (scaffolding Contractor). This contract will be for the provision of scaffolding to the Contractor and other IO works contractors.
Due to the high level of interaction between different contractors, the use of this scaffolding Contract will be obligatory for all work being carried out in Work Site 2 as several works Contractors may use the same scaffolding. IO will pay the scaffolding contractor directly.

4.2.Lifting

IO will put in place a single framework contract through which mobile cranes can be leased by the Contractors.

This contract (lifting equipment services contract) will be a framework contract for the provision of lifting equipment (primarily mobile cranes) to the Contractors.

The use of this framework contract shall be obligatory for the Contractors working in Work Site 2 for the offloading components at the delivery point. In these case where the use of the lifting contractor is obligatory, IO will pay the lifting contractor directly (managed by CMA).

The responsibility for the lifting operation shall remain with the Contractor.

For Work Sites 3 to 5, the use of the lifting equipment services contract would be "encouraged" but not obligatory for the contractors.

4.3.Workshop

The IO will provide an area dedicated to the Contractor for the installation of his site facilities, possibly covering a workshop, local storage, and some pre-assembly activities on smaller components. These areas will be located on the ITER Worksite platform. The areas will be connected to the potable water, IT and electrical networks as well as to the industrial drainage network.

To support the pre-assembly activities, the Contractor shall provide a general workshop facility within the area described above and as appropriate to volume and schedule an off-site locally workshop to enable the pre fabrication and modification of pipe spools, steel structure, supports, insulation, temporary meanings, etc.
The contractor will be fully responsible for transport between the ITER site and these workshops, and for any ITER components while off-site.

The use of this framework contract shall be obligatory for the IO Contractors working in Work Site 2.

The IO will pay the lifting contractor directly but the responsibility for the lifting operation shall remain with the Contractor.

4.4.Structure

To manage the coactivity and the Installation schedule IO is currently working with a Construction Management-as Agent (CMA).

The IO, assisted by the Construction Manager as-Agent (CMA), will define the assembly process through Construction Work Packages (CWPs). Each CWP will define a package of works prepared and instructed to the Contractor by the CMA and performed by the Contractor as a unit, with a defined start and completion point and a required cost based upon the tendered unit rates for each type of work.

5. Required Competences

The competence and experience of the Contractor, and the ability, experience, and training of his engineering and construction team will have a direct influence on quality, re-work, and schedule, and ultimately on the performance of the Tokamak during operation; the Contractor will be required to demonstrate competence and experience in a number of key areas as listed down below.

Area of Competence
Codes and Standards
Occupational Safety
Process Development and Qualification
Quality Assurance / Quality Control
Regulated construction
Process piping and equipment installation (including test)
Pressure Equipment regulation
Multi core pipes installation
Carbon and stainless steel welding process
Inspection and Non-Destructive Examination
Instrumentation Installation
Junction wrapping
Lifting and Handling
Tooling Maintenance, Storage and Preservation

6. Nuclear and Quality Requirements

The ITER Organization is the nuclear operator of the ITER nuclear fusion facility (INB 174) under French nuclear law.

The Contractor shall install the MPLs system in conformance with EN 13480 – last version. The Contractor shall have a Quality Assurance System required for manufacturing and installing of Pressure Equipment. He shall comply with the defined requirements associated with those components as well as with the French Order of 7th February 2012 establishing the general rules for basic nuclear installations. The Quality requirements imposed by the Pressure Equipment regulations, the defined requirements and the French Order of 7th February 2012 will be detailed at the Call for Tender stage.

Components classified Protection Important Components related to Nuclear Safety **are to be installed**. The Protection Important Activity (PIA) list to be performed by this contract will be given in the Call for Tender phase.