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REPORT

ON

**TECHNICAL DESCRIPTION FOR THE MARKET SURVEY OF:**

**LN2 vacuum insulated transfer line**

**Abstract**

This document provides the technical description for the design, manufacture, delivery of the Liquid Nitrogen (LN2) transfer line to connect the ITER Liquid Nitrogen Plant to ITER Tokamak complex distribution network.

Additionally, it defines the installation works required to install the LN2 line at ITER site.

| **F4E Reference** | **F4E\_D\_2VEZJV** |  | **-** |
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# **Introduction**

The ITER project aims to build a fusion device, twice the size of the largest current devices, with the goal of demonstrating the scientific and technical feasibility of fusion power. It is a joint project between the European Union, China, India, Japan, South Korea, the Russian Federation and the USA. ITER is being constructed in Europe, at Cadarache in the south of France.

Most of the components that make up the ITER project are to be manufactured by each of the participating countries and contributed in kind through so-called Domestic Agencies including Fusion for Energy.

The European Joint Undertaking for ITER and the Development of Fusion Energy or 'Fusion for Energy' (F4E) is a type of European organisation known as a Joint Undertaking created under the Euratom Treaty by a decision of the Council of the European Union.

The experimental fusion reactor ITER will require Liquid Nitrogen to be supplied to several subsystems.

This report provides a description of the technical requirements for the vacuum insulated transfer line dedicated to supply Liquid Nitrogen (LN2) to the Tokamak complex.

F4E plans to publish a Call for Tender for the final design, manufacturing, testing and shipment of the components that make up this Liquid Nitrogen (LN2) line will be launched in 2024.

The information provided in this technical description is limited and simplified for the purpose of the market survey. It cannot be used as a detailed technical specification for the procurement.

# **Cryogenic lines design overview**

## Rigid cryolines

### Scope

The LN2 network supplies B11 from Area 53 through the LN2 line Bridge:

* Starts from A53 (red cross in Figure 1 – ITER plant layout) at interface point with LN2 plant.
* LN2 line in cryobridge (green line)
* Connection to LN2 distribution in B11 (blue box) before the building penetration

A map of a factory

Description automatically generated

Figure 1 – ITER plant layout

### Operation

These lines will operate with Liquid Nitrogen (1MPa) and will have a design pressure of 1.5 MPa and will operate in a range of temperatures from 77 K to 293 K.

### Description

The Liquid Nitrogen (LN2) transfer line is a DN25 pipe vacuum insulated, approximately 240m long.

PED and CE marking shall be considered for all components and assemblies.

Pipe shall be designed and manufactured according EN13480.

A view of a 3D model of one of the cryolines is shown in Figure 2.

A blue background with orange lines

Description automatically generated

Figure 2 – Cryolines

### Subcomponents

In the current design proposal, the cryoline is made up of a combination of several sections, including:

Rigid vacuum insulated transfer lines,

Interface kits,

Flexible lines,

Instrumentation section,

Dewar filling connection,

Supports,

Accessories.

All these modules incorporate required spacers, expansion sections, absorption sections, pumping ports, vacuum protection burst disks, vacuum barriers, etc...

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| --- | --- |
| Supports | Instrumentation and Equipment section |

**Figure 3 – Examples of some of the subcomponents of the rigid cryolines**

#### Rigid Cryogenic line

The generic cross section shall contain:

 An Outer Vacuum Jacket pipe (OVJ).

 A DN 25 inner pipe for the LN2.

This section goes from the LN2 plant interface (Figure 4 **– Cryolines** interface) to cryobridge. It includes

A close-up of a machine

Description automatically generated

**Figure 4 – Cryoline interface**

Right after the interface point, there will be a branch to supply B74. The line will be supported to the ground and will have a dewar filling station at the end of the line.

#### Dewar station

The line is equipped with one branch which provides a dewar filling station.

#### Rigid cryoline to the Cryobridge.

The line goes south to Building 51/52 north face rack and after it takes east direction until the end of the building supported to the rack as it is represented in the 3D model.

A blue pipes and a blue pipe

Description automatically generated with medium confidence

Figure 5 Rack routing

A collage of a factory

Description automatically generated

Figure 6 Cryobridge routing

#### Flexible section in Cryobridge.

Inside the Cryobridge, the rigid will change to a flexible line divided in two pieces, one for each part of the Bridge. The line will be supported to existing supports and Cryobridge structure

A line of a machine

Description automatically generated with medium confidence

Figure 7 Cryobride routing

At the end of the Cryobridge the line there will be a piece of rigid pipe, the Instrumentation section. This piece of rigid pipe will contain the required instrumentation.

After Instrumentation section, the line will turn east and enters B13 though a building penetration (2m).

The last section from Building B13 penetration to Building 11 penetration will be flexible.

The line will be connected with the Tokamak building network coming from B11 (see interface).

#### Instrumentation section

Prior interfacing with the Tokamak distribution, the Cryoline is equipped with an instrumentation skid including.

* Manual valves
* Pressure release valve
* Temperature sensor
* Degassing device (venting)

A diagram of a machine

Description automatically generated

Figure 8 Instrumentation P&D

### Supports

Supports must be designed to adapt the installation of the line to the existing supporting structures.

Support shall be designed and manufactured according to Eurocode and justified against the applicable load conditions.

### Installation scope

The cryogenic line will have to be installed at ITER site. The main tasks to be included.

* Scaffolding preparation
* Installation of supports and clamps
* Interface connection to LN2
* Installation and welding rigid sections
* 100% Visual examination welds done on
* 100% Radiographic examination of welds done on site for process pipes.
* Pressure and leak test process pipe.
* Leak test of Vacuum jacket.
* Installation and test Dewar filling station.

# **QUALITY AND NUCLEAR SAFETY REQUIREMENTS**

In addition to the applicable codes and standards the Supplier shall consider requirements arising from Quality Classification (QC) relevant to each component or sub-assembly [RD5 section 4.3]. See Annex A for the details of Quality Classification.

All components are non-safety related. Summary of classification is given in the Table 3‑2:

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| --- | --- |
| Quality classification | QC3 |
| Safety classification | Non Safety Relevant |
| Seismic classification | Non-Seismic Classified-NSC |

# **F4E MARKET SURVEY**

To establish an optimum contract strategy, F4E needs to develop its understanding of the market with a comprehensive list of EU suppliers interested in the procurement of the scope described in this document.

In the frame of the market survey, interested suppliers are invited to submit information by filling in the questionnaire in the following link:

[**https://ec.europa.eu/eusurvey/runner/LN2\_CRYOLINES**](https://ec.europa.eu/eusurvey/runner/LN2_CRYOLINES)

This information will be used by F4E and Iter Organization and will not be communicated to other parties.

# **Questions**

1. What is your Turnover and contract details (phone, e-mail, etc.)?
2. Is your company ISO 9001 certified? *Yes / No / Other (specify)*
3. Does your company have an engineering department with suitable qualified and experience engineers able to provide:
   1. Design analysis and justification report reports related to the scope of the technical note. *Yes/ No*
   2. Design reports including Installation, Operation, maintenance manuals. Yes/ No
   3. Mechanical structural analysis including process loads and accidental loads (Seismic, fire, external pressure). Yes/ Yes, subcontracted / No
   4. 3D models and 2D drawings produced according to quality standards? Yes/ No
   5. Does your company have a CATIA licence? Yes/ No
   6. Specific software for piping calculation. Yes/ No / subcontractor. Open: Specify
   7. Specific software for support calculation. Yes/ No / subcontractor. Open: Specify
4. Does your company have the different components required as part of the portfolio or Catalogue:
   1. Rigid vacuum insulation lines. *Yes / No / Qualified supplier*
   2. Flexible vacuum insulation line *Yes / No / Qualified supplier*
   3. Cryogenic valves. *Yes / No / Qualified supplier*
   4. Cryogenic valves. *Yes / No / Qualified supplier*
   5. Degasser. *Yes / No / Qualified supplier*
   6. Dewar filling station. *Yes / No / Qualified supplier*
5. Are products manufactured by your company marked with a unique serial number, and traceable up to raw materials? *Yes / No*
6. Can your company perform Non-Destructive Tests on welds (VT, Radiographic Testing, Leak test)? *Yes / Yes, subcontracted / No.*
7. Can your company provide the full set of manufacturing documentation including (when relevant)? *Yes / No*
   1. Drawings including constructive dimensions and tolerances.
   2. Parts list.
   3. Material certificates 3.1 full traceability linked to each individual part.
   4. Qualification tests and certificates for each part including NDEs (Non-Destructive Examination), leak tests, dimensional and cleanliness results.
   5. Mounting and installation instruction and procedures.
   6. Maintenance manual and procedures.
   7. PED and CE documentation.
8. Do you have experience in design and manufacture of components for nuclear industry? *Yes / No*. Please provide examples.
9. Do you have experience in installation activities including.
   1. Scaffolding installation and management. *Yes / No*
   2. Assembly and welding. *Yes / No*
   3. Site acceptance test including VT. *Yes / No /* Yes Subcontracting.
10. Does your company have a management system that defines provisions, processes and practices for nuclear safety? *Yes / No / Other (specify)*
11. Does your company have a management system that promotes nuclear safety culture? *Yes / No / Other (specify)*
12. Is there any requirement/question in this technical note that you consider as a potential limitation or risk area for you to be able to provide any of the parts? *List them and explain the background.*
13. Could you please select the scope you would be interested in?

a) Design, Manufacturing and delivery *Yes / No*

b) Installation and test at ITER site *Yes / No*

c) Complete scope a) and b). *Yes / No*

In case you select only option a) or b), could you briefly explain the reasons? *(specify)*

1. According to you, what is the expected delivery time for the described scope? (From Contract signature)
2. The following information does not represent a binding offer and it will only be used for Call for tender preparation. According to your experience, what is the range of price / unit for the following components.
   1. Rigid cryoline €/m *(specify)*
   2. Flexible line €/m *(specify)*
   3. Support €/unit *(specify)*
   4. DN25 manual valve €/unit *(specify)*
   5. Temperature sensor €/unit *(specify)*
   6. Relief valve. €/unit *(specify)*
   7. Degasser €/unit *(specify)*
   8. Dewar station €/unit *(specify)*
3. Judging from what is described in this Technical Note, please give a rough order of magnitude of your cost estimate. (Your answer here is not mandatory, not legally binding and will be treated as confidential by our project.)