



# DFM Production Plan

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# Production Plan

## Design Phase (CERN)

- CERN deliverables
  - 3D Design
  - Design file
  - Specification drawings
  - Technical specification
  - Assembly procedure
- → to be approved by DDR

## Manufacturing Preparation phase (SOTON)

- Southampton University deliverables
- → to be approved by PRR

## Manufacturing phase (SOTON)

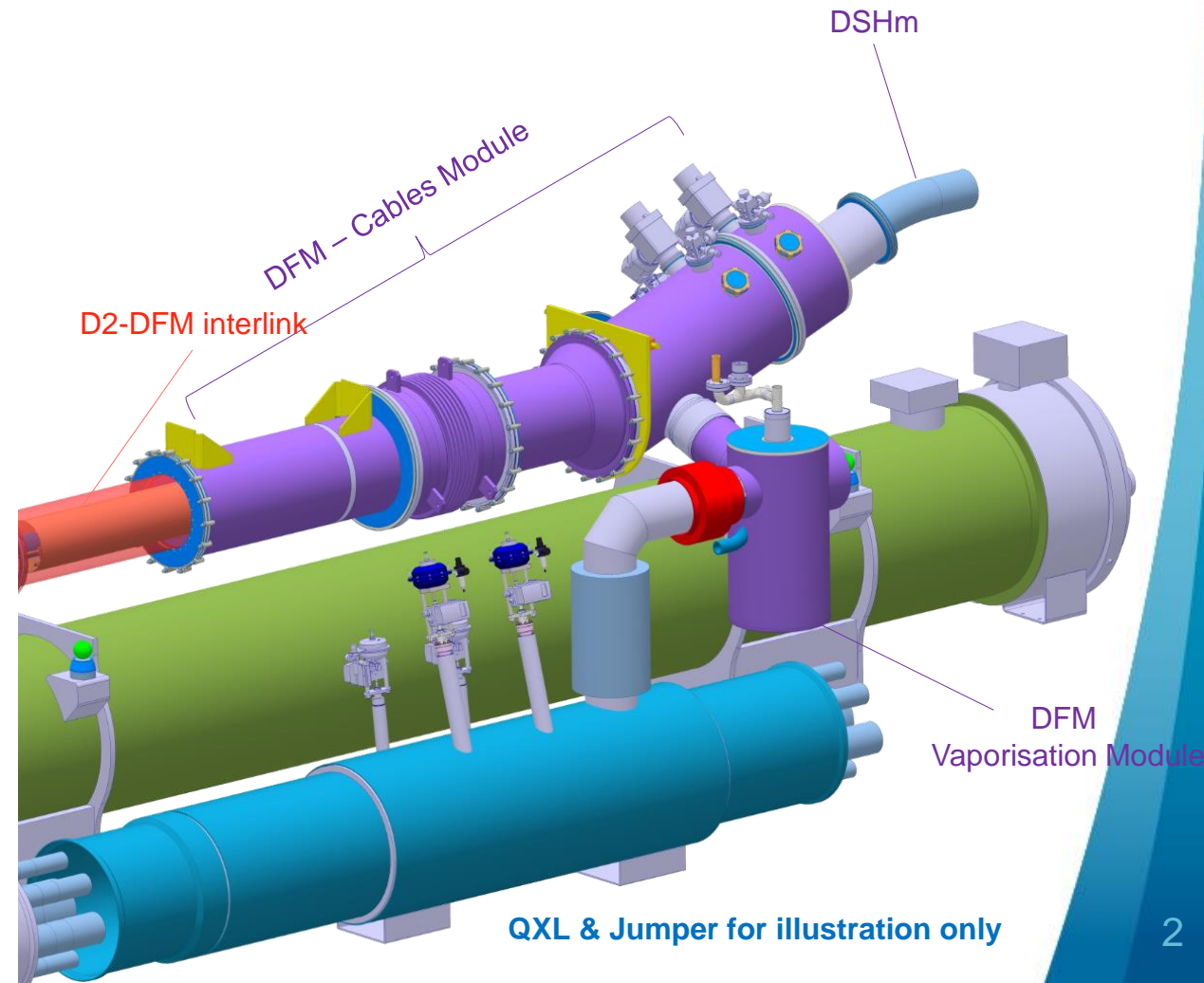
- Manufacturing of 5 Units
- Qualification
  - Documentation
  - Production tests
  - Performance qualification tests
- → to be approved by CERN

## Delivery to CERN

## Installation in LHC tunnel

- Only basic testing before installation (electrical tests, visual inspection, dimension control)
- Final qualification after installation in tunnel

## Same QA requirements as for DFX



# Required qualifications for acceptance

## Same requirements and qualification test proposal as for DFX

*Proposal of qualification sequence*

- Required qualifications to comply with PED, operation and CERN QA requirements
- Qualifications based on calculation reports
  - Respect of heat loads budget
  - LHE vaporisation rate
  - Helium buffer volumes in case of LHE supply stop
- Production inspections and qualifications
  1. Weld inspections (visual + NDT acc. to standards)
  2. Dimensional controls
  3. Pressure test according to PED for application CAT III
- DFM device qualifications by testing
  4. Assemblability of the complete DFM
  5. Thermo-mechanical design (all operation modes)
  6. Leak tightness levels after pressure test and thermal cycle of structures and cold welds

Phase	Steps	2. Dim.	3. P-test	4. Assy.	5. Struct.	6. Leak T
Initial Configuration	Assemble full DFX	X		X		
	Pump vacuum Vol. P < 10 <sup>-4</sup> mbar					
Thermal cycle	LN2 filling				X	X
	Warm up to 300K					
Pressure and leak tests	Leak test vacuum volume					X
	Pressurised He volume to P <sub>test</sub>		X			
	Leak test He volume					X
Reporting	Document					

*Acceptance leak tightness levels for tests performed acc. to harmonised standards to PED*

	Unit	Helium volumes	Insulation vacuum
Maximum allowed leak rate at RT	[mbar.l.s <sup>-1</sup> ]	1.10 <sup>-10</sup>	2.10 <sup>-8</sup>

# Summary

- Design performed by CERN up to specification drawings
- South Hampton University in charge of manufacturing and qualification
- Ready for installation at delivery to CERN
- Same qualification requirements as for DFX
- Finance Committee : September 2019
- Detailed design Review : Nov/Dec 2019

# Spare slides

# Acceptance criteria : documentation

## Documentation compliant with PED Category III operation

- Design calculation reports
- Material certificate to standard acc. to application
- Welds:
  - Welding procedures
  - Welders qualifications
  - Welds inspections reports
  - Weld inspectors qualification
- Pressure test, procedure and report

## Documentation for performance qualification

- Design reports
- Assembly procedure
- Dimensional controls report
- Electric test (instrumentation) report
- Leak test procedure, qualifications and reports

## 9.2 Acceptance

Acceptance of the Supply shall be subject to the successful completion of the tests specified in § 3.7 by the supplier on its premises and the submission to CERN, for written approval, of all compliant tests results or other certificates requested by CERN in § 6.

## 6 DOCUMENTATION

The Supply shall include the documentation specified in §6.1 and §6.2.

### 6.1 Design documentation

The documentation related to the design of the Supply shall include:

- Detailed design file:
  - Description of operating modes;
  - List of design parameters and operating procedures considered for the design;
  - Design calculation reports, validated by notified body when required by PED:
    - Vacuum vessels design calculation report;
    - Helium vessel design calculation report according to standards (stress distribution);
    - Bellows design calculation report according to EN 14917+A1;
    - All others calculations required by standards;
  - Assembly procedure;
- Specification drawings of all manufactured part according to ISO-GPS standards;
- Technical specifications for procurement.

### 6.2 Manufacturing preparation documentation

The documentation related to the preparation of the manufacturing of the Supply shall include:

- Manufacturing and Inspection Plan (MIP) mentioning schedule and milestones;
- Manufacturing drawings of all manufactured parts according to ISO-GPS standards;
- Welding procedures;
- Production test procedures;
- Cleaning procedure;
- Acceptance test procedure.

### 6.3 Manufacturing documentation

The documentation related to the manufacturing of the Supply shall include:

- Material certificates;
- Pressure test reports;
- Qualification test certificates of welders and/or welding operators;
- Welding qualification records;
- Non-conformity reports, if applicable.

### 6.4 Assembly and Qualification documentation

The documentation related to the assembly and qualification of the Supply shall include:

- Dimensional controls report;
- Electric test report of all installed instrumentation;
- Qualification certificates of leak testing personnel;
- Leak test reports using the template provided in Annex 1;
- Leak test operator certification;
- Leak detector calibration certificate;
- Acceptance test report;
- Detailed tunnel assembly sequence including welding, inspection and testing operations;
- Detailed maintenance operation sequence;
- EC/EU declaration of conformity;

### 6.5 Quality Plan and Progress reports

The Supplier shall submit a Quality Plan in accordance with the schedule defined in § 9. The Quality Plan shall include all the necessary information, in particular, the actual progress in con-

# §9 Performance of the collaboration agreement

## ■ Design Phase

- (design calculations, operating modes, assembly sequence, specification drawings)
- → **CERN's approval via DDR**

## ■ Manufacturing preparation

- (Manufacturing drawings, MIP, manufacturing & testing procedures)
- → **CERN's approval via PRR**

## ■ Manufacturing phase

- (Manufacturing, cleaning)

## ■ Assembly and qualification phase

- (qualification campaign, reporting)
- → **CERN's approval of documentation**

## ■ Delivery to CERN

### 9.2 Acceptance

Acceptance of the Supply shall be subject to the successful completion of the tests specified in § 3.7 by the supplier on its premises and the submission to CERN, for written approval, of all compliant tests results or other certificates requested by CERN in § 6.