Wrocław University of Technology

Polish in-kind contribution to the FAIR cryogenic system

Maciej Chorowski, Jarosław Fydrych

Wrocław University of Technology - Poland

FAIR Cryogenics Review, 27-28.02.2012

Contents

1. Polish in-kind contribuition
2. Local cryogenics for Super FRS
3. Local cryogenics for SIS100
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6. Current activities and future actions
7. Conclusions

Expression of Interest for the FAIR in-kind contribution

Expressions of Interest
in providing in-kind contributions
for the construction of the
Facility for Antiproton and Ion Research

FAIR

Affiliation: Wroclaw University of Technology
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Country: 50-370 WROCLAW, POLAND
Name/Function: Prof. MACIEJ CHOROWSKI
DEAN of Faculty of Mechanical and (1) Power Eng.

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Wydział Mechaniczno-Energetyczny
Wybrzeże Wyspiańskiego 27, 50-370 Wrocław
tel. 320 23 25, 320 35 08, 320 26 76; fax 320 42 28
NIP 896-000-58-51

Short description of work package/contribution/PSP no. proposed to take over:

1. Local Cryo for Super Fragment Separator
2. Local Cryo for Collector Ring (CR)
3. Local Cryo for SIS 100

DZIEKAN
M. Chorowski
Dr hab. inż. Maciej Chorowski
Prof. nadzw. PWr.

Please sketch your expertise and/or refer to similar technical components:
Cryogenic transfer lines and cryostats (including He II), cryogenic chambers, automatic control of high inertia objects design, manufacturing and commissioning of cryogenic systems.

Is it planned to produce the components in your own workshops? YES/NO
Human resources/size of institute's workshops including designers 20
Is it planned to procure items together with external industry? YES/NO
Planned industrial partners Kriosystem Ltd, ZEC Service
Funding agency (name) MNiSW .... is informed on this EoI YES/NO
Funding agency has approved procurement of items of EoI YES/NO
Funding agency has approved appropriate funding YES/NO

date, signature
7.12.2007 M. Chorowski

Expression of Interest for the FAIR in-kind contribution

Expression of Interest No 15

WP-Number: 2.5.12 / 2.8.12

Description (PSP structure):
Super-FRS / *Local Cryo*
SIS100 / *Local Cryo*

From (Company):
Wroclaw University of Technology

Address:
Wybrzeże Wyspanskiego 27
50-370 Wroclaw

Country: PL

Received at: 2007-12-07
Corrected for 'no CR Local Cryo' by IKAB secretary, 2008-02-20

Signed by: Maciej Chorowsi
(Dean of Faculty of Mechanical and Power Eng.)

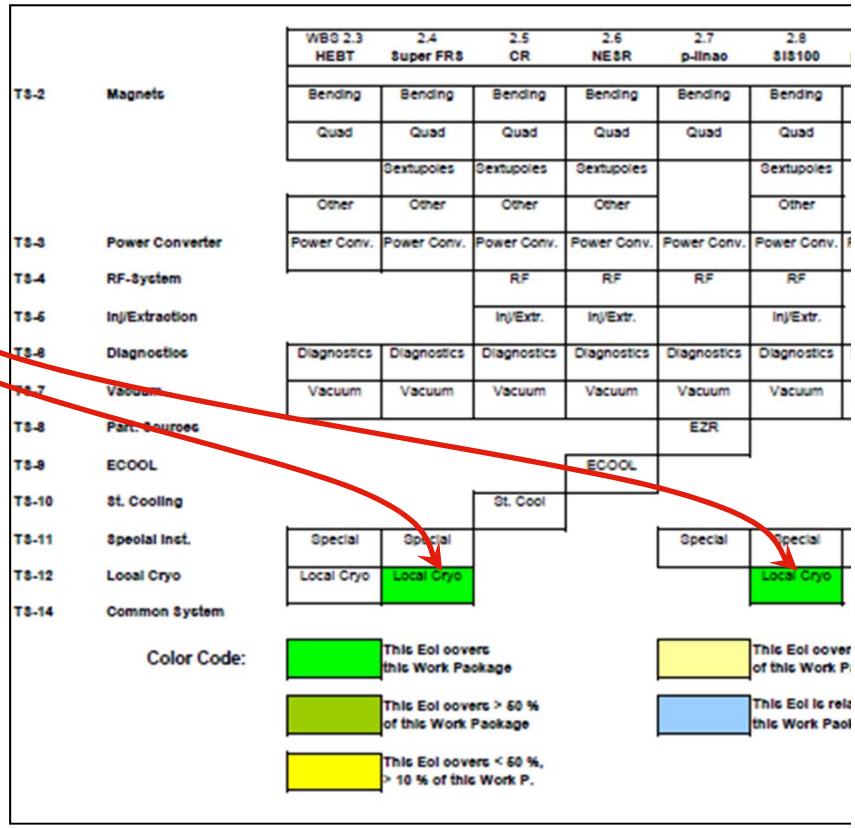
Contact: Maciej Chorowski
maciej.chorowski@pwr.wroc.pl

Planned to produce in own workshops: *not specified*

Human res. / size of inst. workshops: 20 persons, incl designers

Planned to procure together with ext. industry: YES
Planned industrial partners: Kriosystem Ltd, ZEC Service

Funding agency: MNiSW
is informed ? YES



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Expression of Interest – details (agreed in 08.2011)

Local Cryogenics for SuperFRS

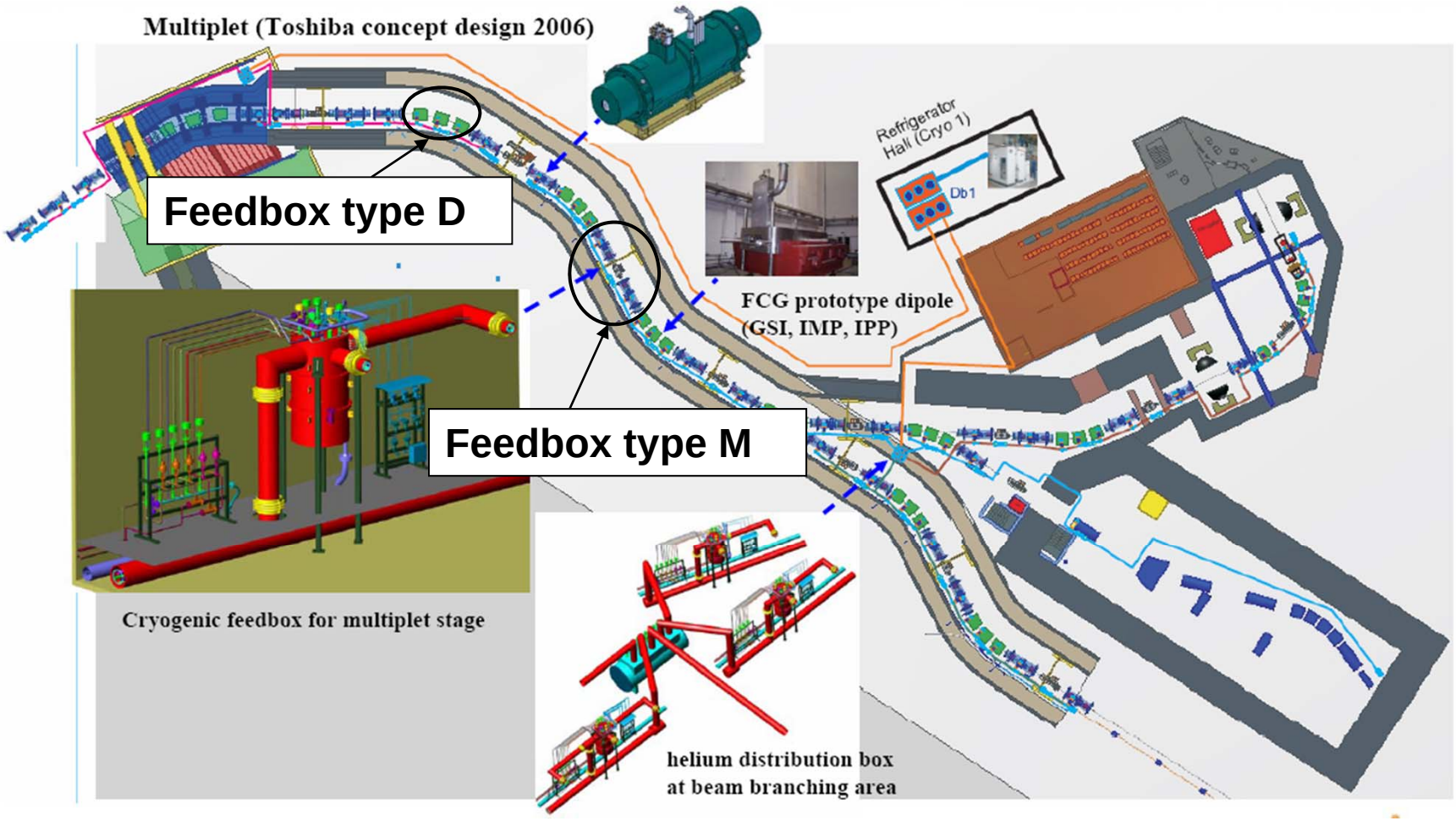
No.	Items	Pieces	Costs [k€]	Costs list reference number
1.	Feedbox D module	11 (8+2+1)	1540	2.4.12.2
2.	Horizontal - Left Bend Connection Line D module	11 (8+2+1)		
3.	Horizontal – Middle Straight Connection Line D module	11 (8+2+1)		
4.	Horizontal - Right Bend Connection Line D module	11 (8+2+1)	?	?
5.	Feedbox M module	11 (7+2+1+1)	2560	2.4.12.3
6.	Horizontal - Left Bend Connection Line M module	11 (7+2+1+1)	?	?
7.	Horizontal - Right Bend Connection Line M module	11 (7+2+1+1)	?	?
8.	Vertical Connection Line D/M module	11	756	2.4.12.4
9.	Cryogenic transfer line D/M module	~20 x 12m	?	?
10.	Cryogenic Transfer Line Joint M module	9	?	?
11.	Cryogenic Transfer Line Joint D-1 module	4	?	?
12.	Cryogenic Transfer Line Joint D-2 module	4	?	?
13.	Transfer Line Joint - End module	~4	?	?
14.	Branch Box module	1	420	2.4.12.1
15.	Cryogenic transfer line B module	1	?	?
		Total:	5276	

Expression of Interest – details (agreed in 08.2011)

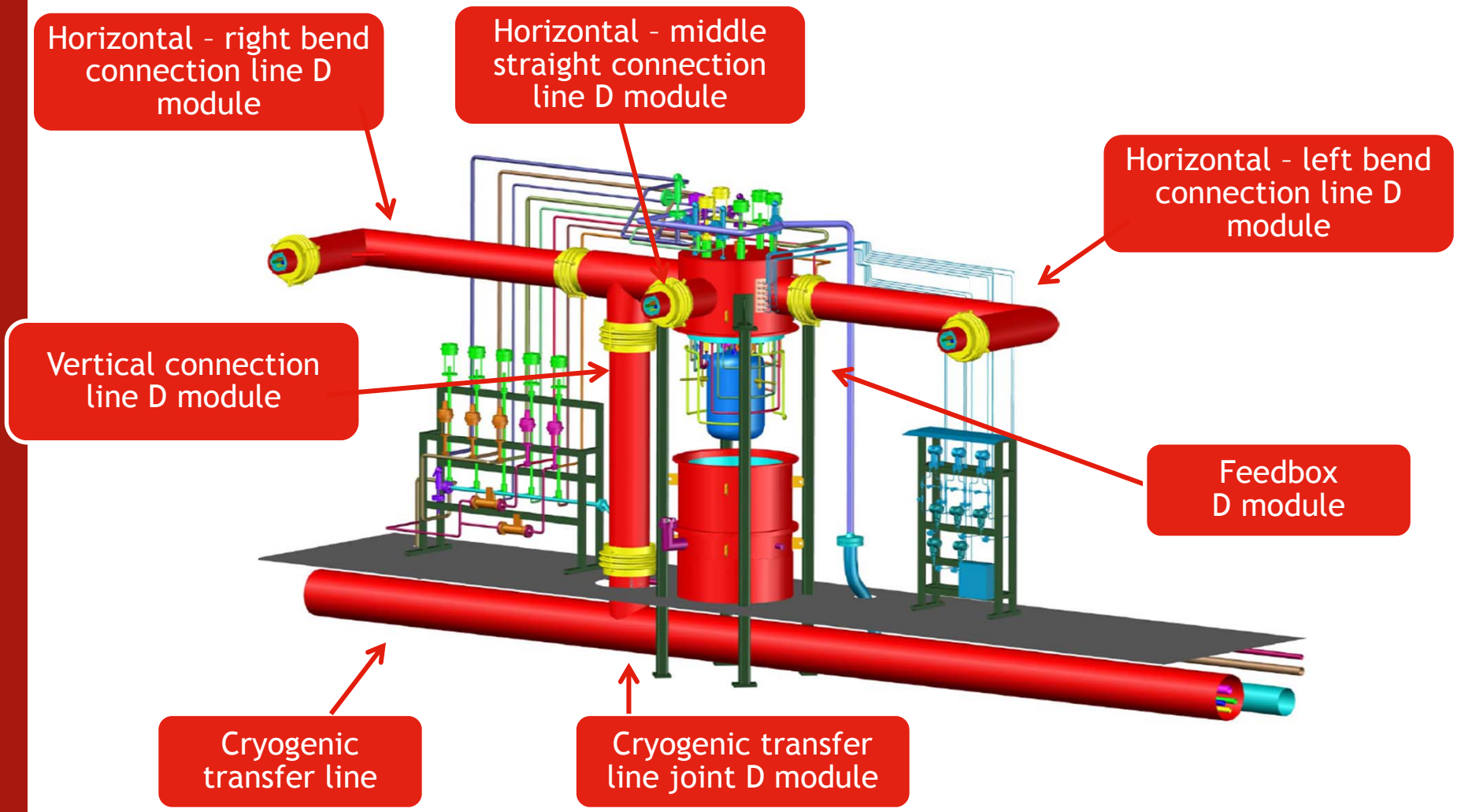
Local Cryogenics for SIS100

No.	Items	Pieces	Costs [k€]	Costs list reference number
1.	Connection between Bypass Line and Cryostat End Cap	12	1542.3	2.8.12.5
2.	Bypass Line 12 m long linear section	12		
3.	Bypass Line 9 m long linear section	6		
4.	Connection box	17	1138.9	2.8.12.6
5.	Endbox	3	326.7	2.8.12.3
6.	Feed-in box	3	305.0	2.8.12.12
7.	Feed box	4 (3+1)	687.8 (459.0+228.8)	2.8.12.1 2.8.12.2
8.	Current lead box	3	208.0	2.8.12.10
9.	Distribution box	2	?	?
10.	Transfer line	?	?	?
		Total:	4208.7	

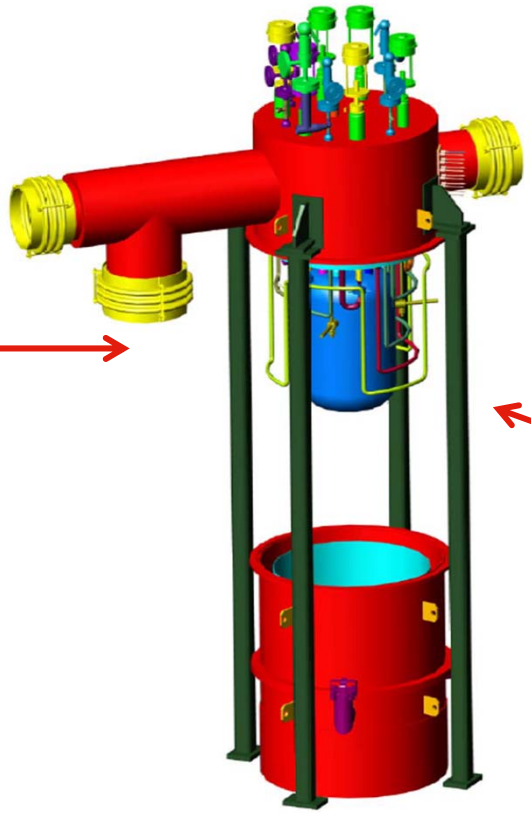
Local cryogenic system of Super FRS



Super FRS / Local Cryo
Items of the Dipole modules



Super FRS / Local Cryo
Items of the Multiplet modules



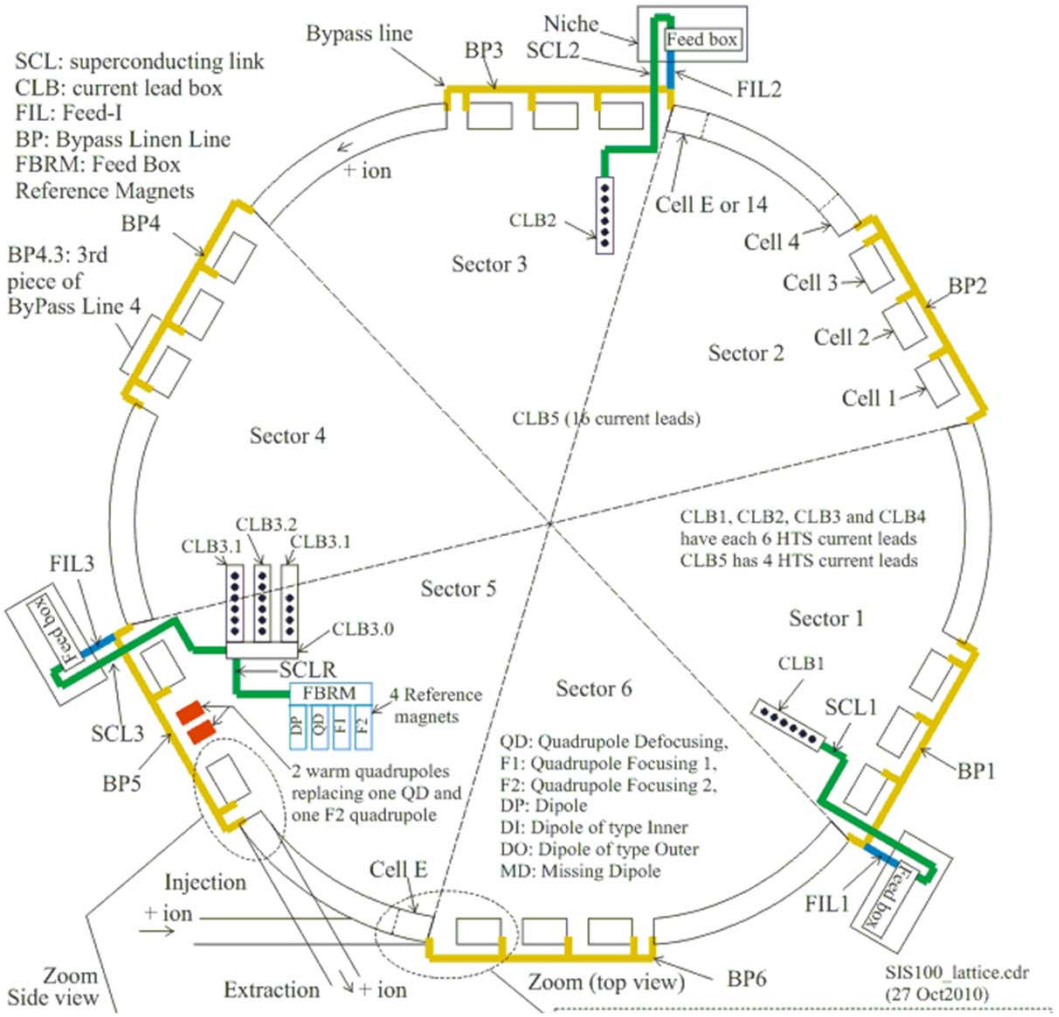
Horizontal – right bend connection line M module

Horizontal – left bend connection line M module

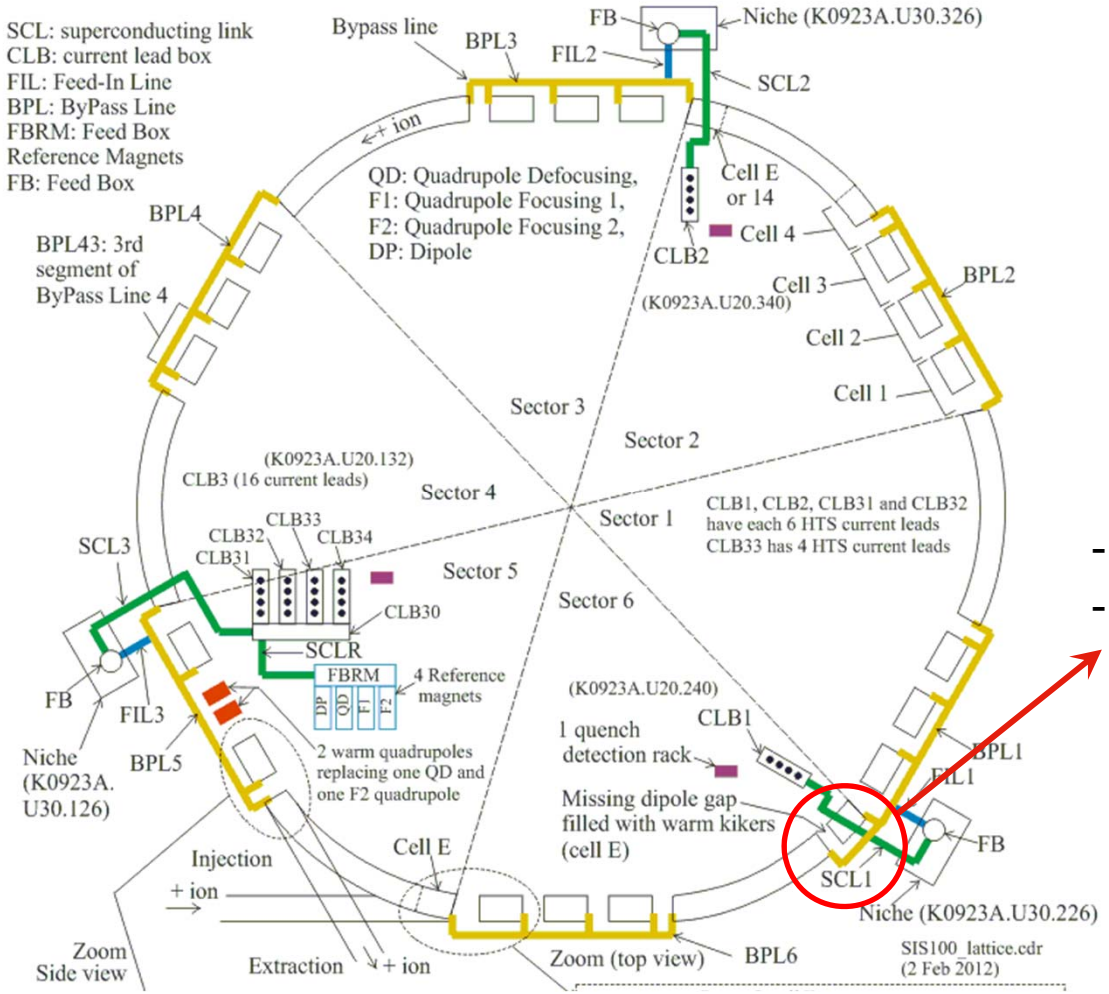
Vertical connection line M module

Feedbox M module

Local cryogenic system of SIS100 (scheme dated: April 2011)



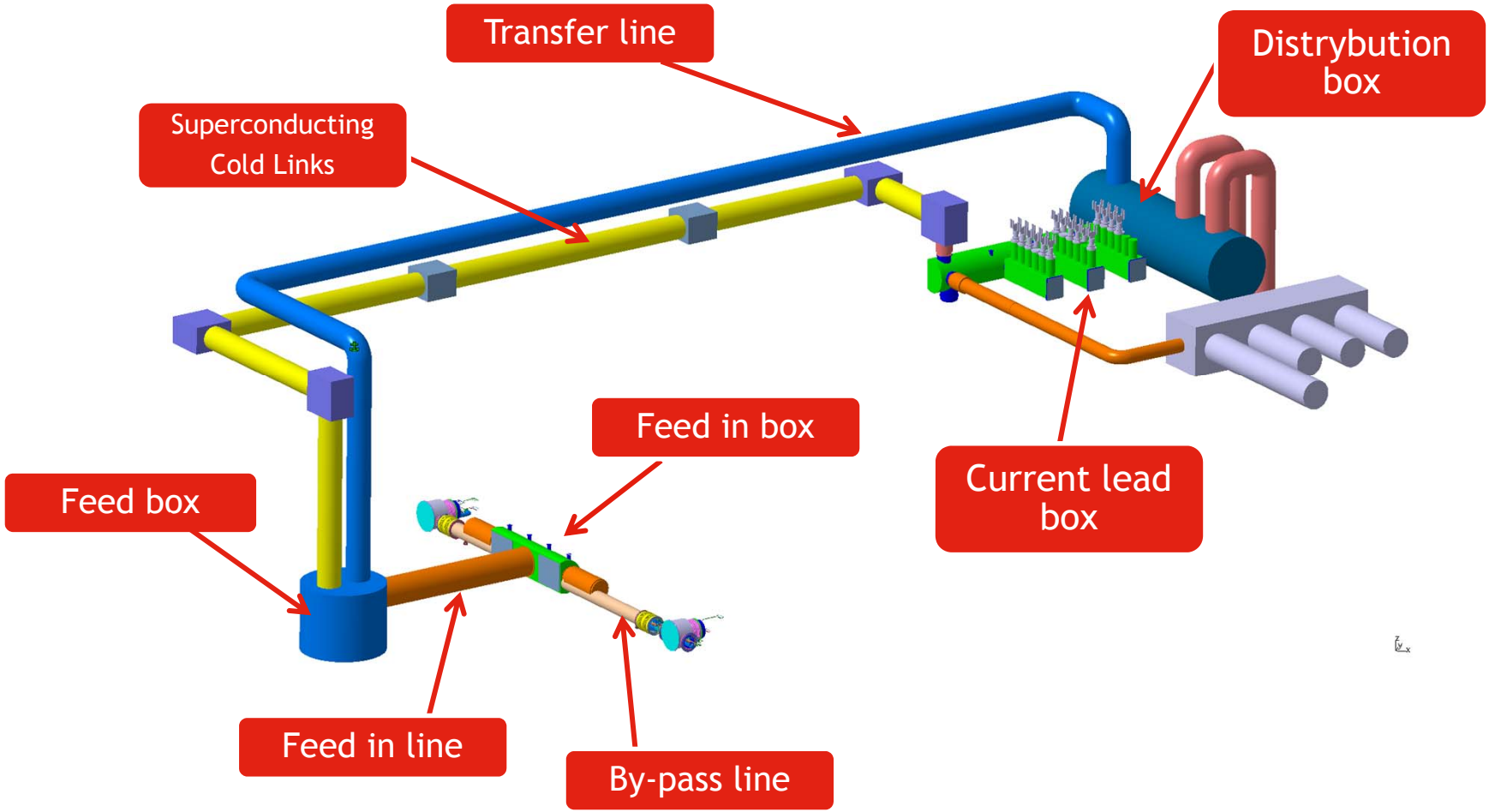
Local cryogenic system of SIS100 (scheme dated: 06 February 2012)



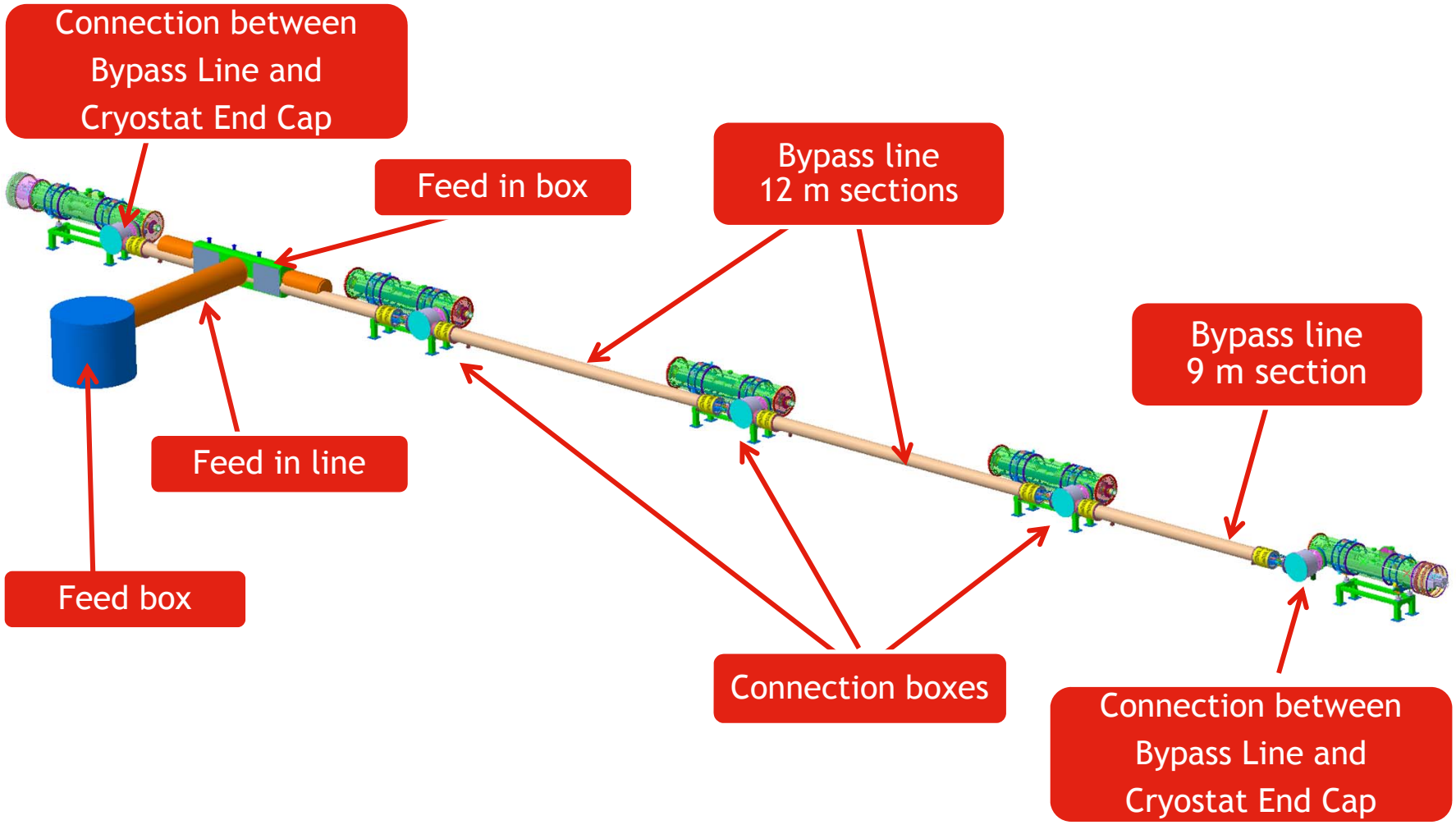
Added:

- connection box
- bypass line
- 12m section

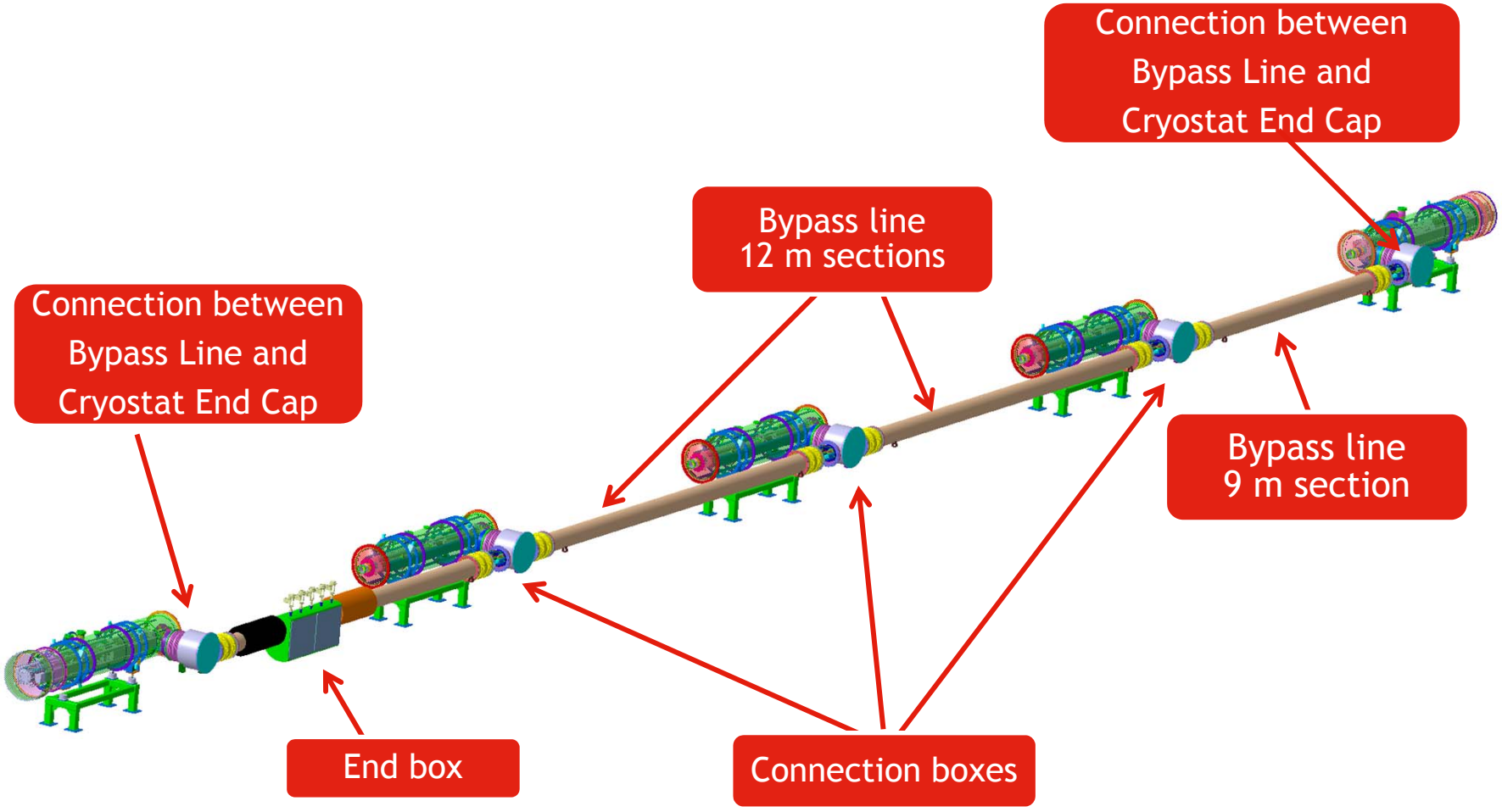
SIS100 / Local Cryo - items at the niche in Sect. 5



SIS100 / Local Cryo - items in the tunnel in Sects. 1,3 and 5



SIS100 / Local Cryo - items in the tunnel in Sects. 2,4 and 6



GSI-WUT arrangements for the work on Local Cryogenics (July 2011)

1. GSI provides all available documents

   - **WUT representatives' working visit at GSI in August 2011**

2. GSI and WUT choose one or two Local Cryo items for initial design works

   - **Chosen items: Item 1: Bypass line 12 m section**

     Item 2: Connection box

3. WUT works on the design of the selected items

   - **Initial design of Item 1 provided to GSI in Sept. 2011**

4. GSI-WUT iterative design discussion

   - **Discussion on the design in Jan-Feb. 2012**

5. WUT modifies and develops the item designs

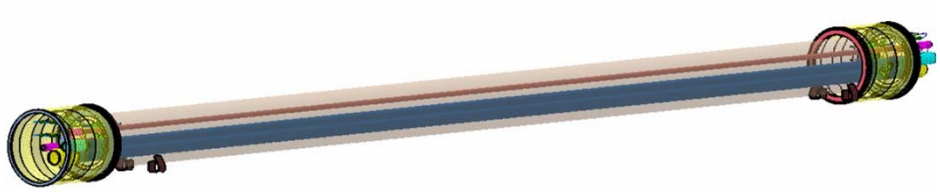
   - **Simultaneous improvements and developments of the item design in Jan-Feb. 2012**

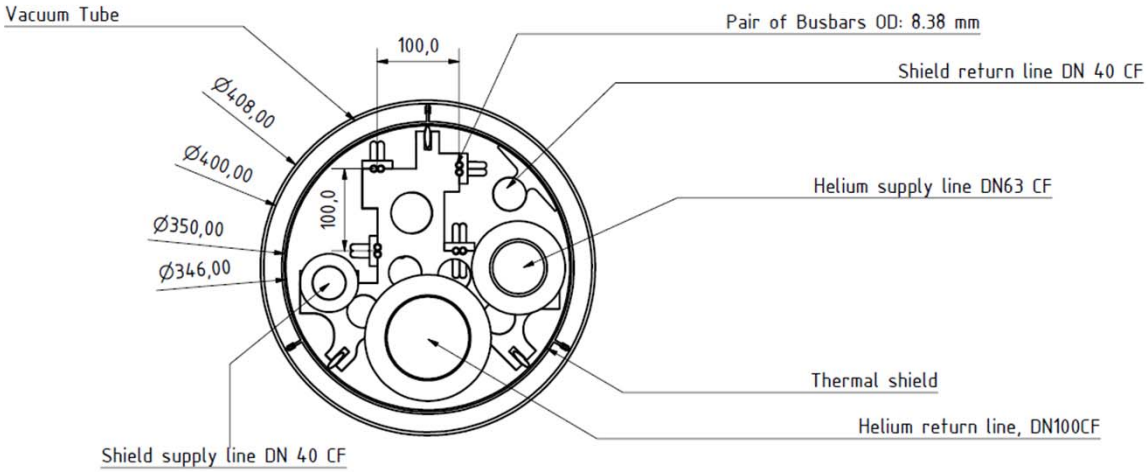
SIS100 / Local Cryo – design status
Bypass Line 12 m section

Technical data provided by GSI:

- Functional description
- Conceptual scheme
- 3D model (simplified and without the 5th process line DN25)

Quantity: 12 (13?)





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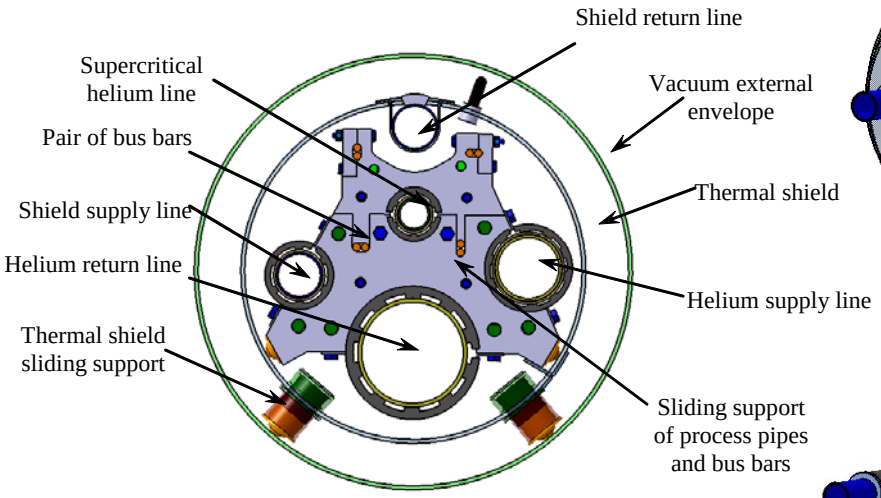
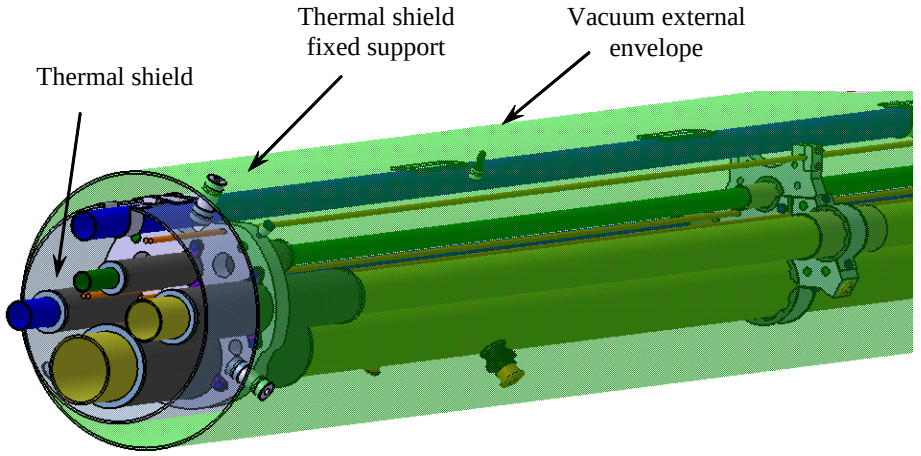
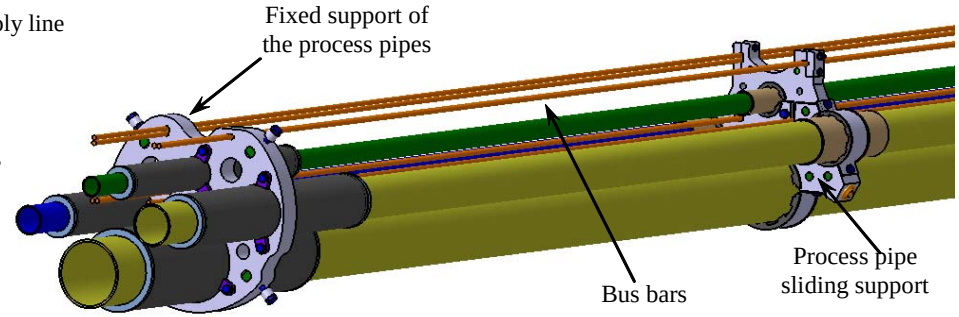
SIS100 / Local Cryo – design status
Bypass Line 12 m section

Advances in the item design at WUT:

- Optimisation of the arrangements of the process lines and bus bars,
- Addition of the 5th process line DN25,
- New design of the process line support system,



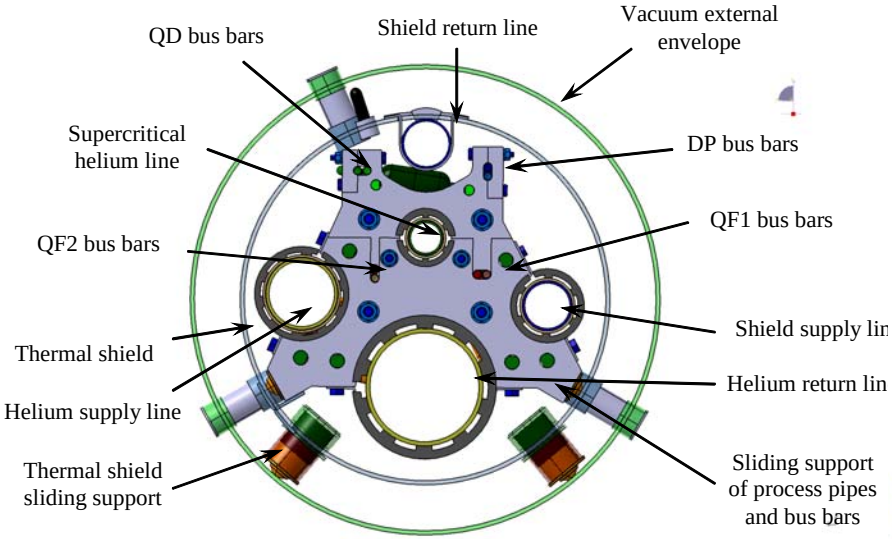


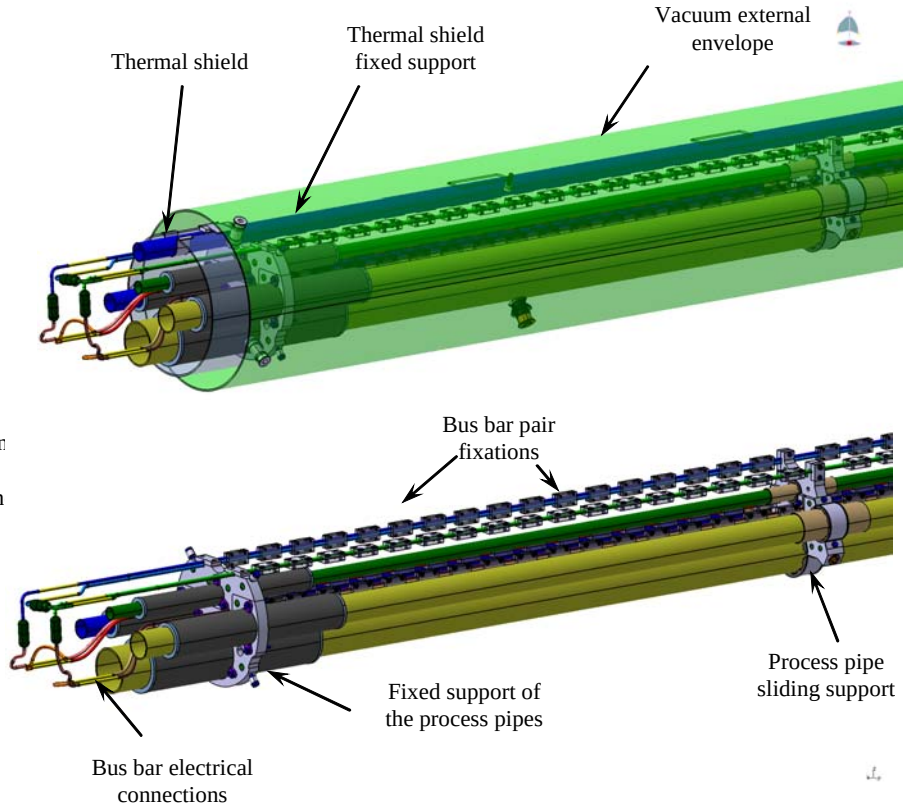


SIS100 / Local Cryo – design status
Bypass Line 12 m section

Advances in the item design at WUT:

- Development of the constructions of sliding and fixed supports,
- Development of bus bar electrical connections,
- Addition of bus bar fixations,



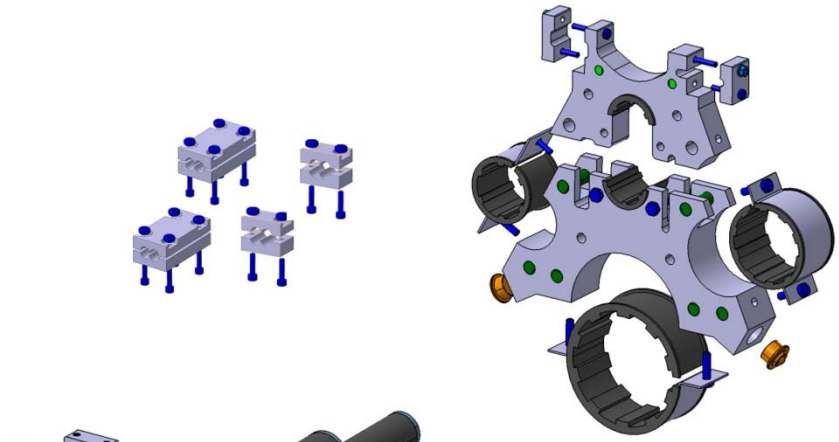


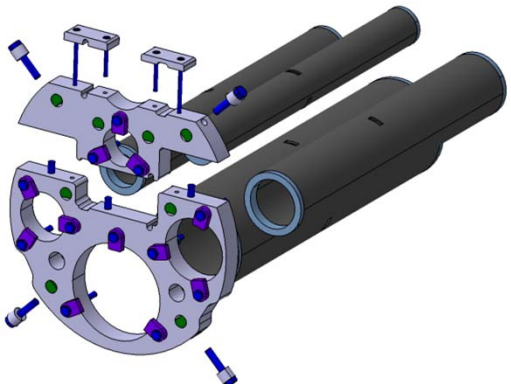
Wrocław University of Technology

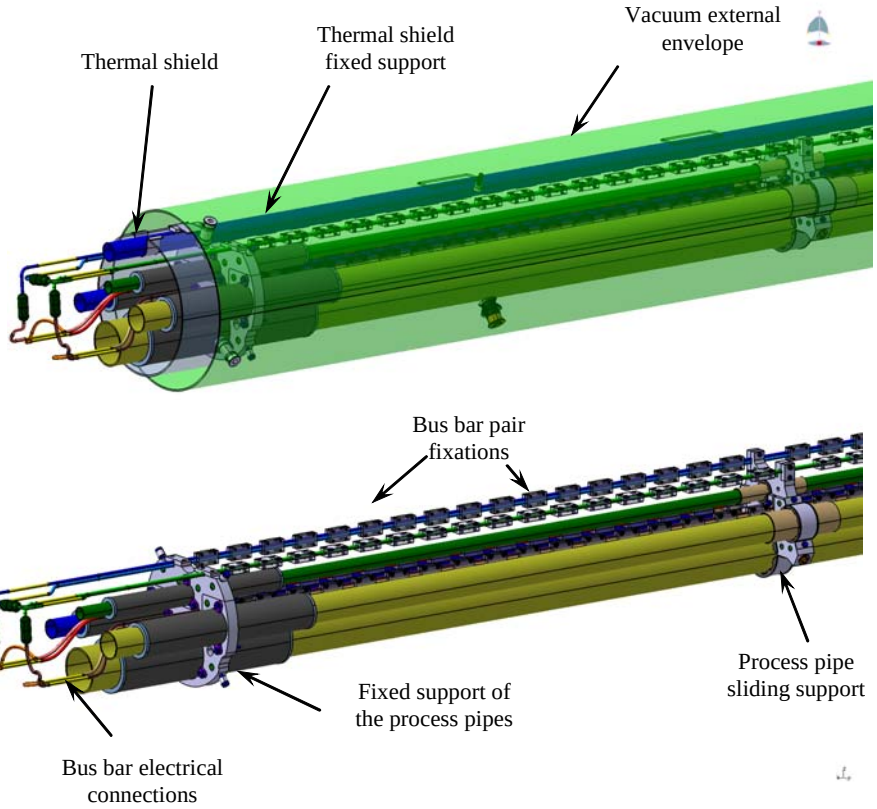
SIS100 / Local Cryo – design status
Bypass Line 12 m section

Advances in the item design at WUT:

- Developement of the constructions of sliding and fixed supports,
- Developement of bus bar electrical connections,
- Addition of bus bar fixations,







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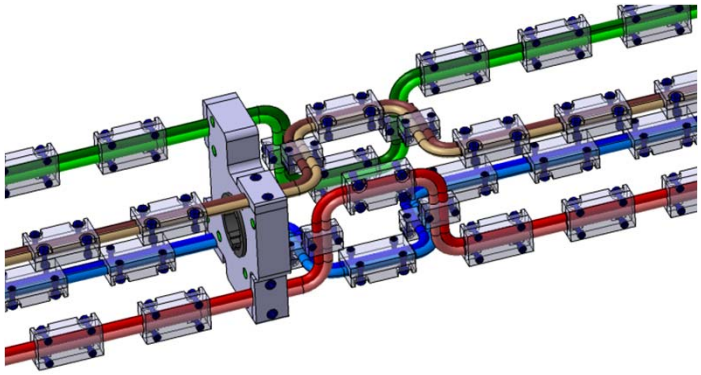
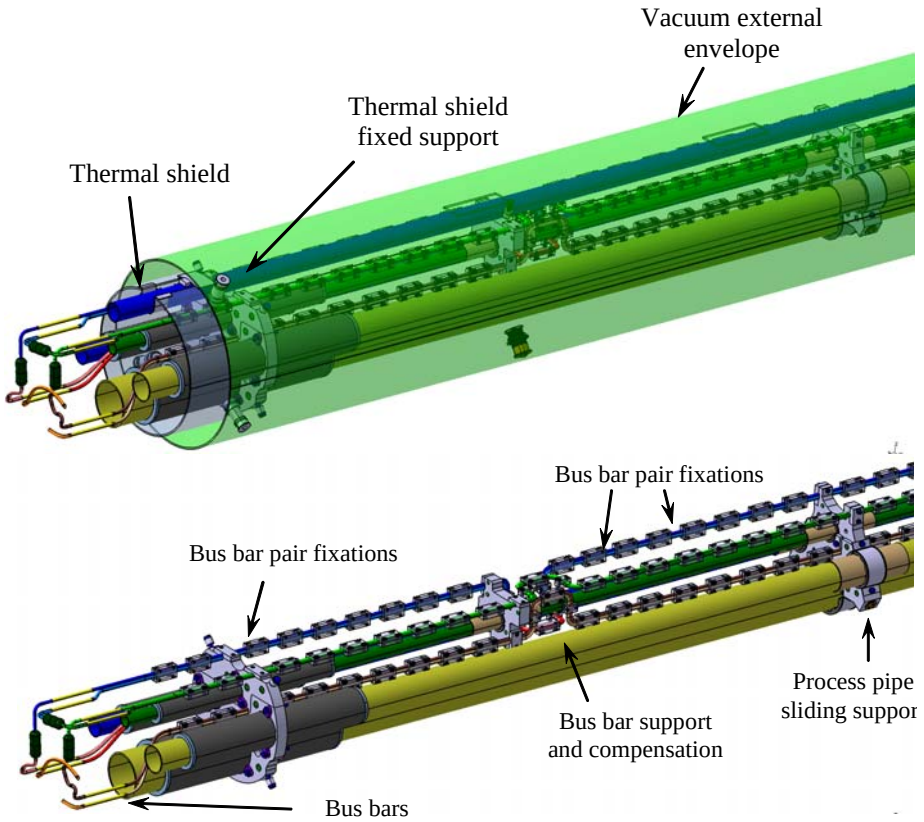
SIS100 / Local Cryo – design status
Bypass Line 12 m section

Advances in the item design at WUT:

- Development of the bus bar support system,
- Development of the thermal shrinkage compensation system of bus bars.





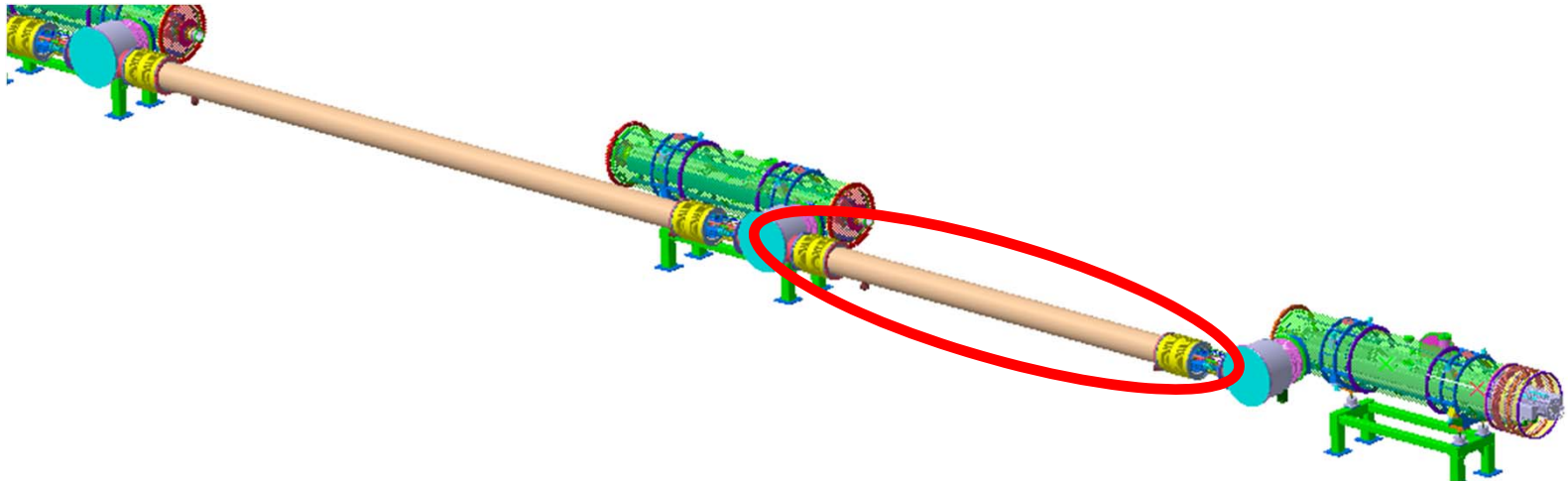
SIS100 / Local Cryo – design status
Bypass Line 9 m section

Technical data provided by GSI:

- Functional description
- Conceptual scheme
- 3D model (simplified and without the 5th process line DN25)

Quantity: 6

Comments: The design of these items will base on the design of the Bypass Line 12 m section.



SIS100 / Local Cryo - design status

Connection between Bypass Line and Cryostat End Cap

Technical data provided by GSI:

- Functional description,
- Conceptual scheme,
- 3D model (simplified and without the 5th process line DN25),

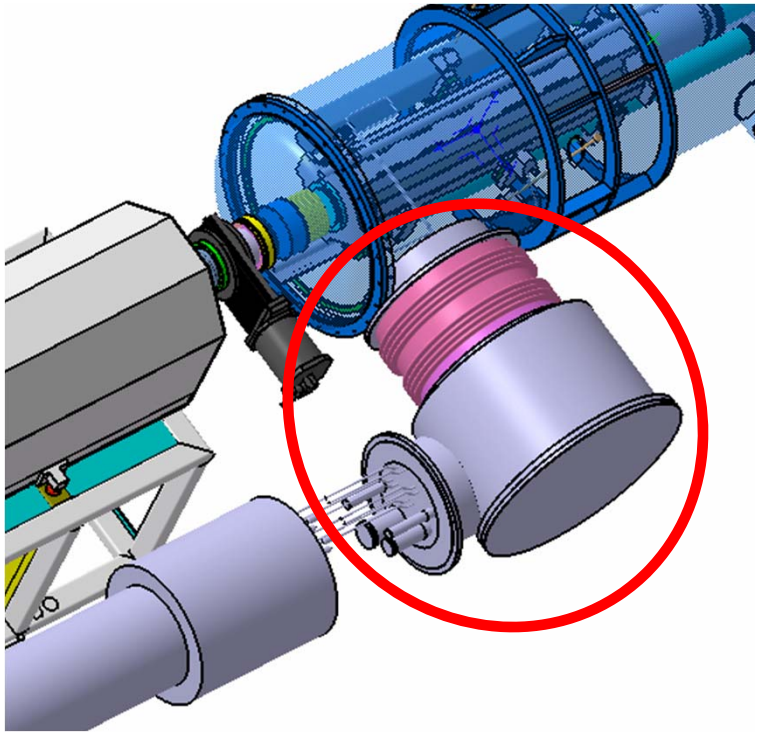
Quantity: 12 (6 right, 6 left)

Comments:

The designs of the magnet cryostat end caps are not completed.

The interfaces of the process lines and bus bars, between the end caps and connections, are not precisely specified.

Design status: *as received from GSI*



SIS100 / Local Cryo – design status
Connection box

Technical data provided by GSI:

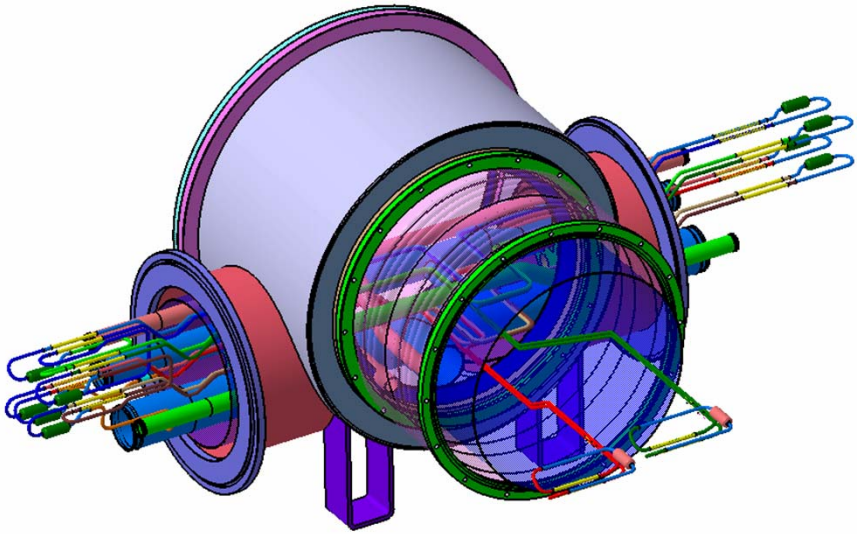
- Functional description,
- Conceptual scheme,
- 3D model (simplified and without the 5th process line DN25),

Quantity: 17 (or 18?)

Comments:

The designs of the magnet cryostat end caps are not completed.

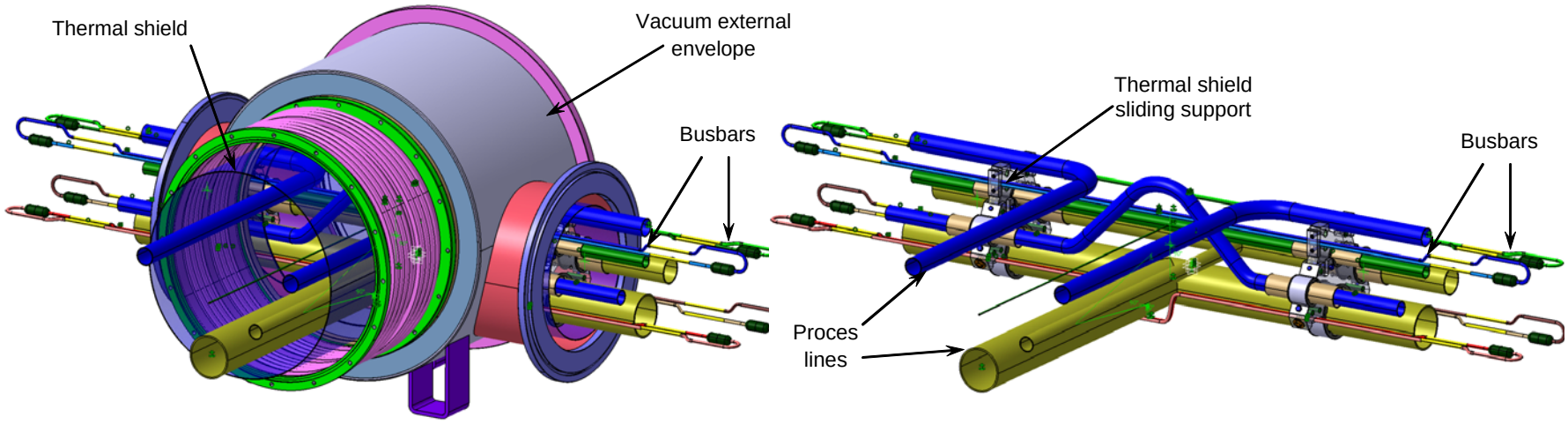
The interfaces of the process lines and bus bars, between the end caps and connection boxes, are not precisely specified.



SIS100 / Local Cryo - design status
Connection box

Advances in the item design at WUT:

- Optimisation of the arrangements of the process lines,
- Addition of the 5th process line DN25,
- Development of bus bar electrical connections,
- New design of the process line support system.



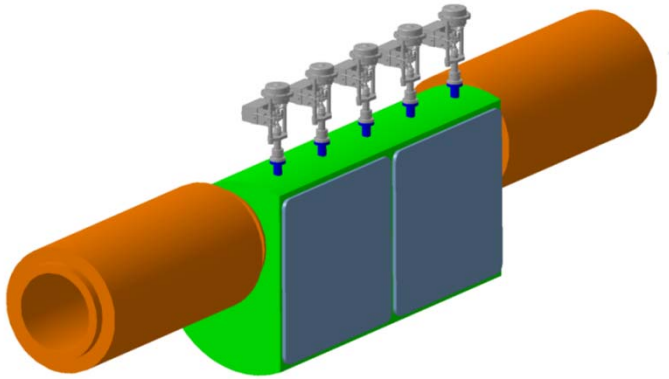
SIS100 / Local Cryo - design status
End Box, Feed-In Box and Feed-In Line

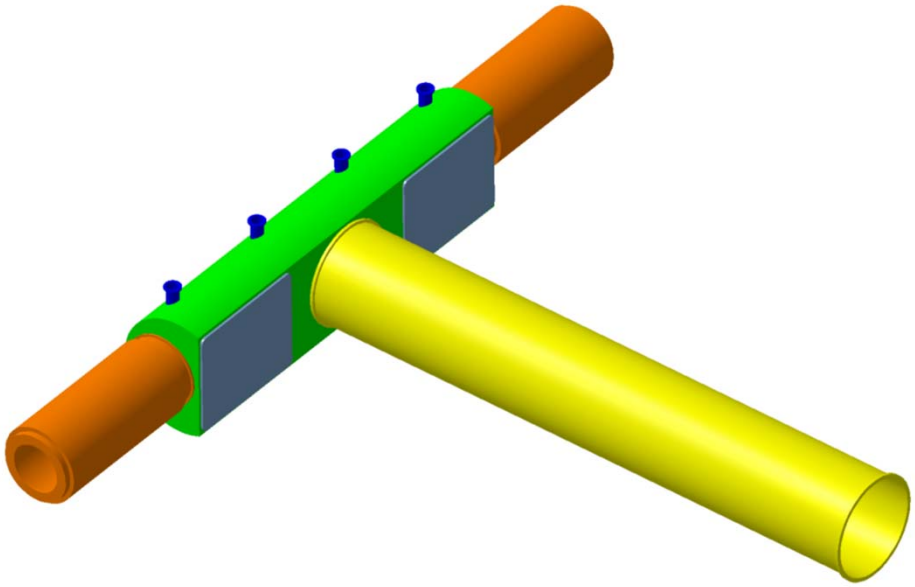
Technical data provided by GSI:

- Functional descriptions,
- Conceptual schemes,
- 3D models (external shape only, without any internal parts),

Quantity: 3+3+3

Design status: *as received from GSI*





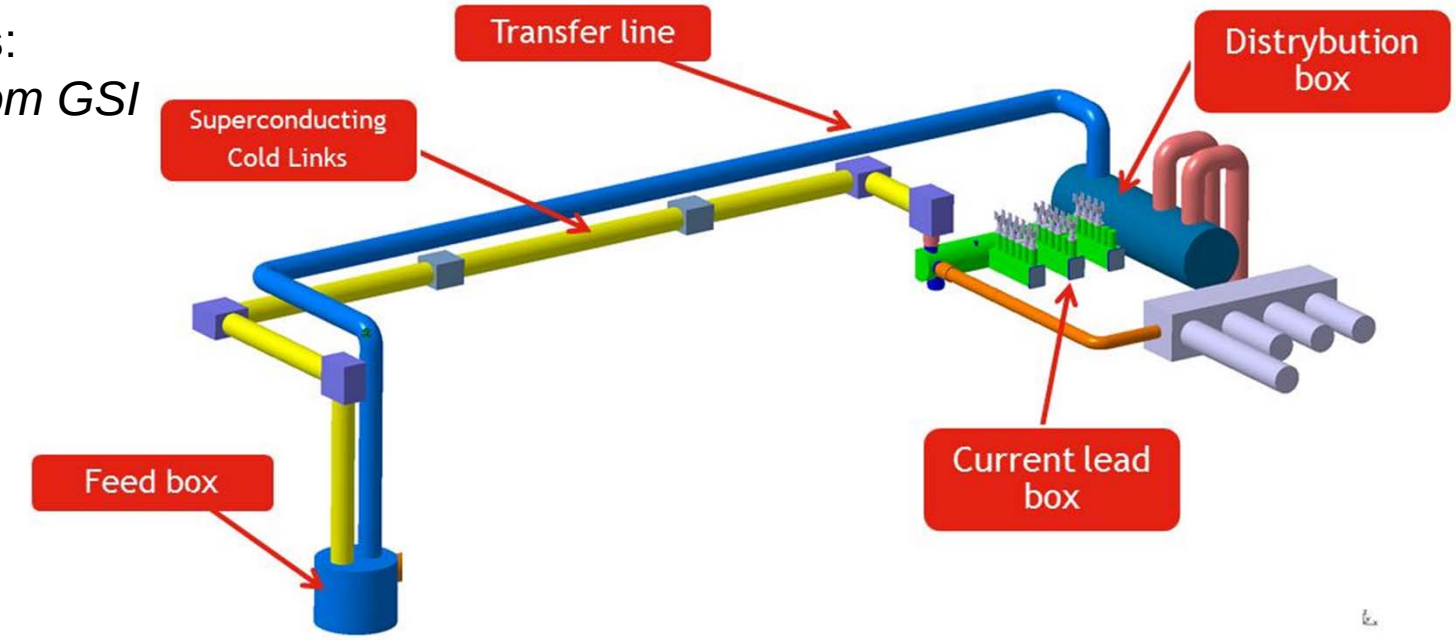
SIS100 / Local Cryo - design status Items at the niches

Technical data provided by GSI:

- Functional descriptions,
- Conceptual schemes,
- 3D models (external shape only, without any internal parts).

Quantity: 3

Design status:
as received from GSI



Design and fabrication procedure

Conceptual design including all the technical solutions of important construction nodes /dimmensions, locations, material specification, quantity/, for all the cryogenic devices that form a joint mechanical structure.

Specification of the operation and failure mode conditions together with the definition of the thermal and mechanical load sets.

Strength analysis which bases on the FEM numerical calculations of stresses and displacements in the whole joint mechanical structure, including possible modifications in the location and quantities of the supports and thermal compensation elements.

Prototyping of the key construction nodes for testing their operation parameters

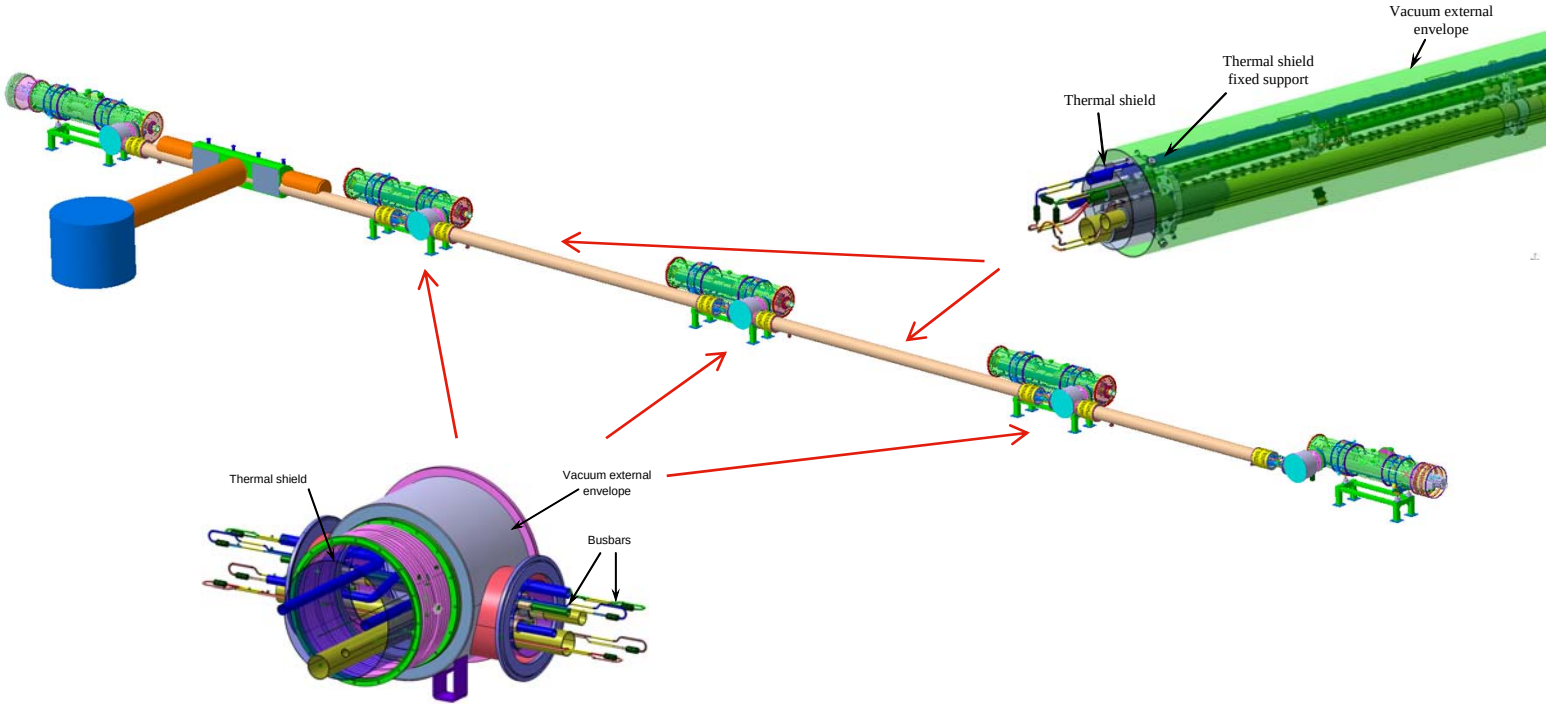
Final design documentation preparation (design calculations, assembly and workshop drawings) with respect to AD2000 code and PED Directive 97/23/EC

Manufacturing of the cryogenic items (subelements production, assambly, packing) with repsect to AD2000 code and PED Directive 97/23/EC

Transportation, installation and commissionig of the cryogenic devices

Current activities

Conceptual design including all the technical solutions of important construction nodes /dimmensions, locations, material specification, quantity/, for all the cryogenic devices that form a joint mechanical structure.



Current activities

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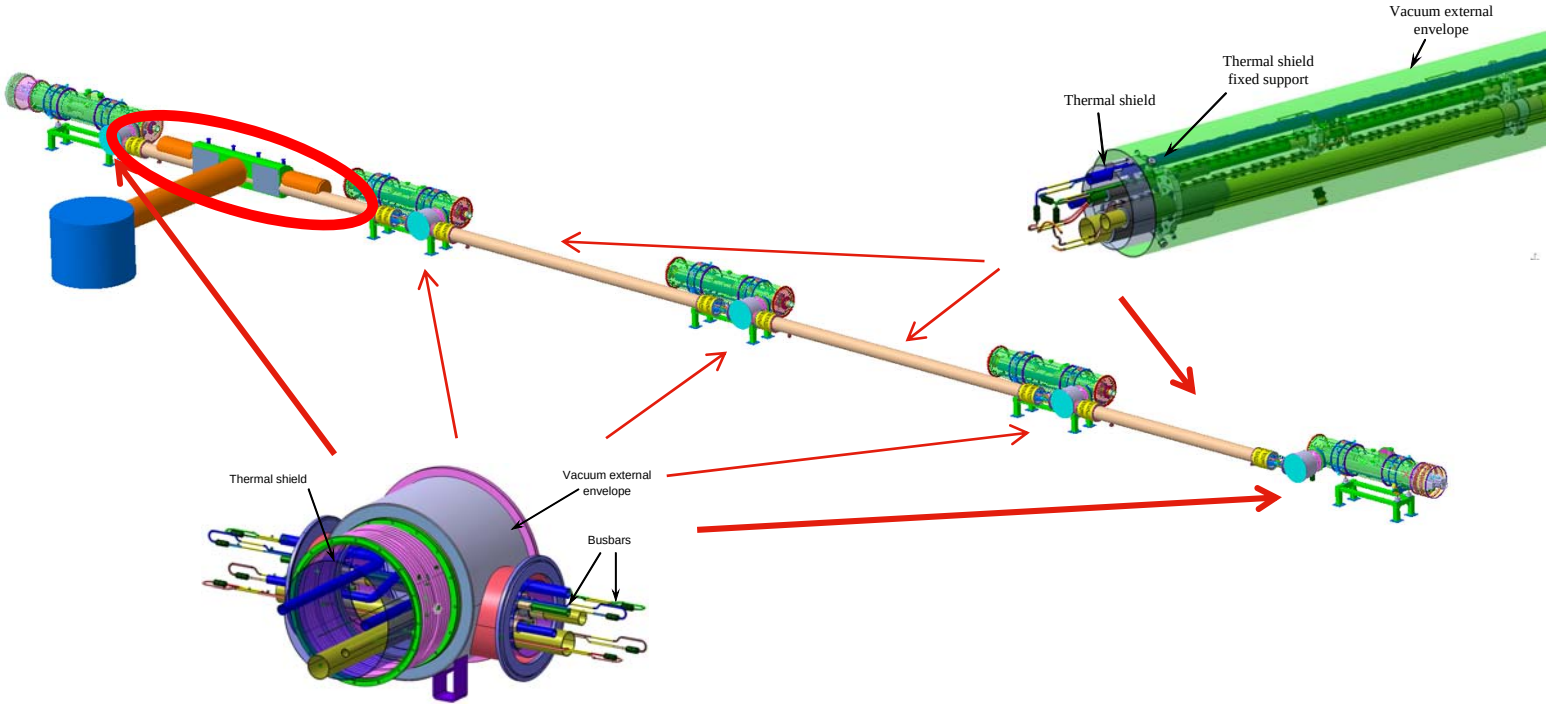
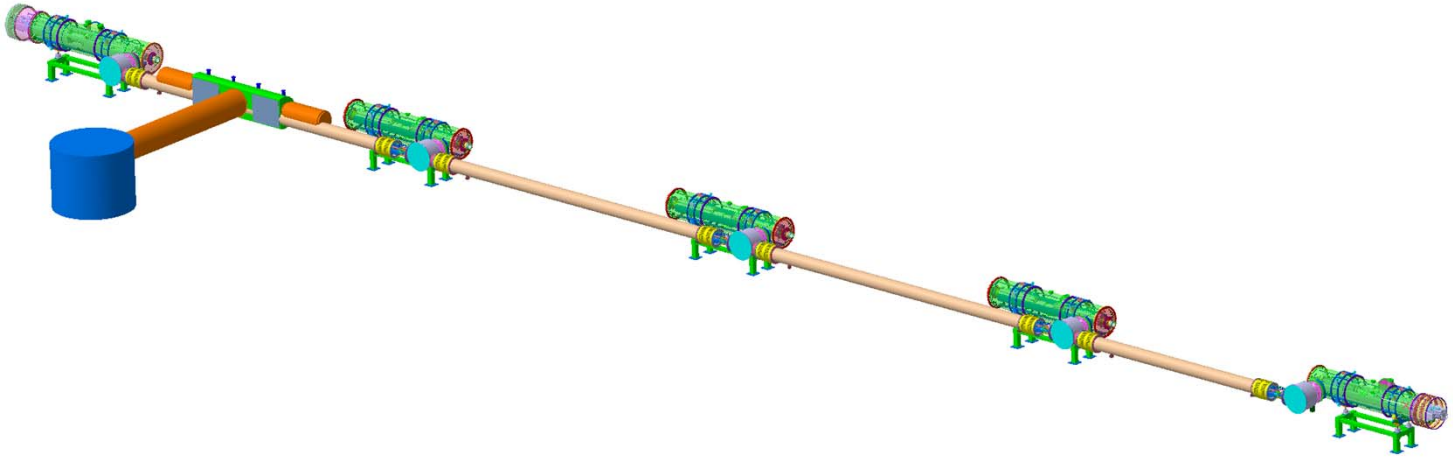


Future actions

Conceptual design including all the technical solutions of important construction nodes /dimmensions, locations, material specification, quantity/, for all the cryogenic devices that form a joint mechanical structure.

Specification of the operation and failure mode conditions together with the definition of the thermal and mechanical load sets.

Strength analysis which bases on the FEM numerical calculations of stresses and displacements in the whole joint mechanical structure, including possible modifications in the location and quantities of the supports and thermal compensation elements.



Future actions

Conceptual design including all the technical solutions of important construction nodes /dimmensions, locations, material specification, quantity/, for all the cryogenic devices that form a joint mechanical structure.

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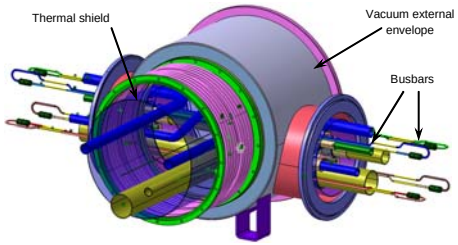
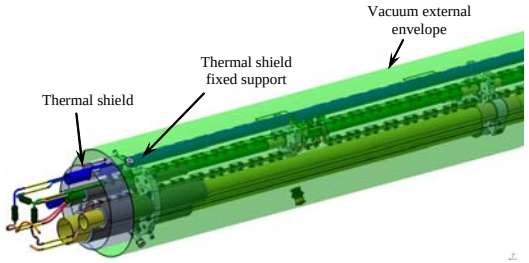
Prototyping of the key construction nodes for testing their operation parameters





Conclusions

1. Polish in-kind cotribuition to the FAIR cryogenics system covers the major part of the local cryogenics for SuperFRS and SIS1000.
2. The items of the local cryogenics have been characterized at GSI in terms of their functions, placeholders and locations. The initial 3D models were provided to WUT in August 2011.
3. The work on the SIS100 Bypass Lines (stright sections and connection boxes) started at WUT in September 2011 in respect to the proposed design and fabrication procedure.
4. Open points that can block or slow down the design phase:
   - interfaces between the items designed by different parites,
   - design of some related items (Magnet Cryostat End Caps),
   - mechanical loads for the interfaces (between Connection Boxes and Magnet Cryostat End Caps).