

# Status of the PANDA Solenoid Magnet Production in BINP



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# PANDA solenoid magnet, BINP responsibility

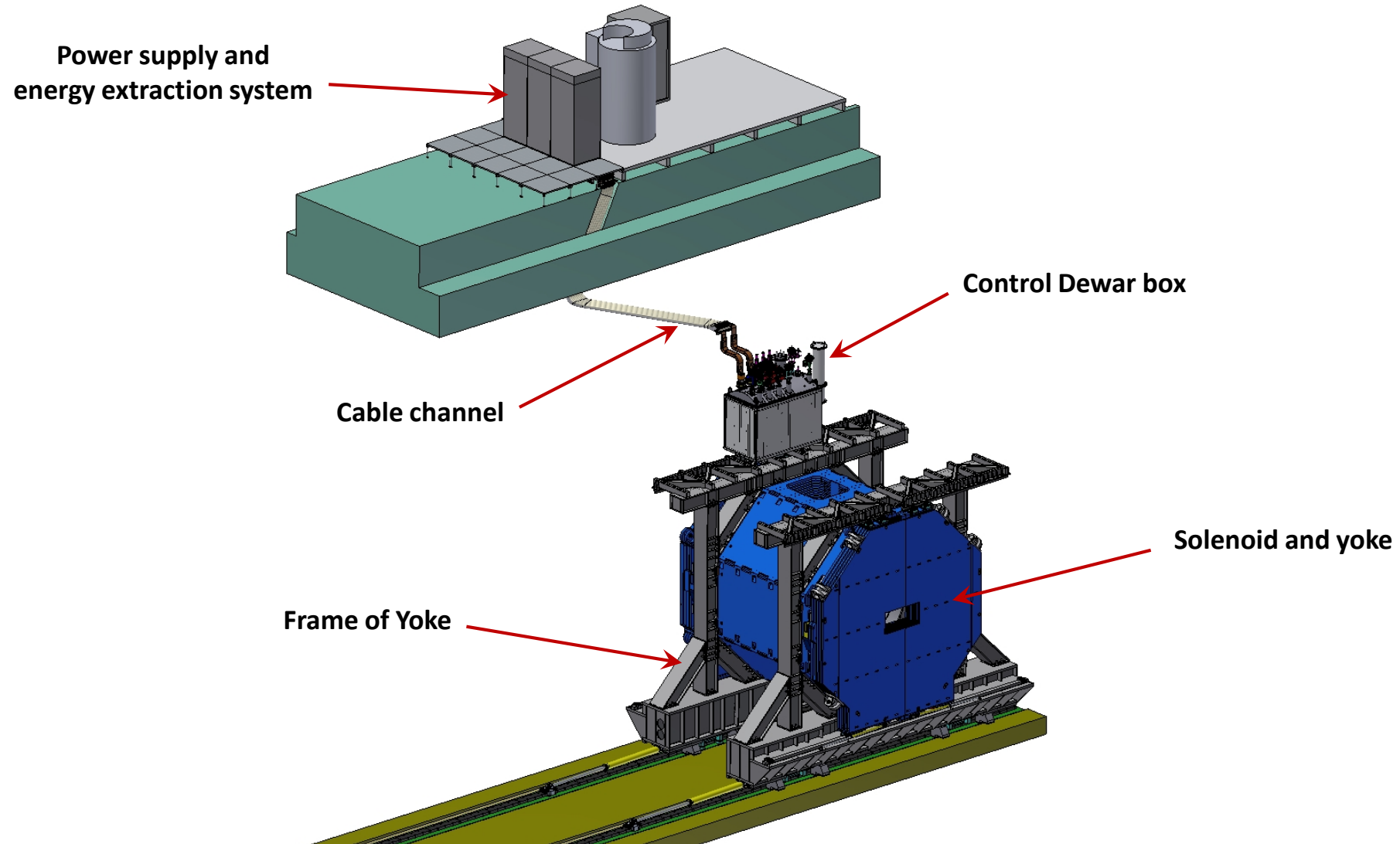


Figure 1. Arrangement of the components of the PANDA solenoid.

## Development of the PANDA solenoid magnet

<b>Name of item</b>	<b>Status of work</b>
Yoke and frame	Design is ready, production
Cryostat of solenoid	Design is ready, technological development, Call for tender
Cold mass	Design is ready, technological development, Call for tender
<b>Conductor purchasing</b>	<b>Development work, preparation Call for tender</b>
Control Dewar box	Preliminary design December 2019
PANDA solenoid power cabling	Design is ready, production
Power supply and energy extraction system	Detail design is ready, production
Magnet safety system	in process

**Table 2. Status of work of the PANDA solenoid production.**

## The main milestones of the yoke production

Name of milestone	Date 2017/10
FDR of the yoke	20-25/11/2017
Contract with SibMash (SET), signed	2/11/2017
Purchasing raw materials (1 <sup>st</sup> batch, 60 t)	26/12/2017
Start of production of the 1 <sup>st</sup> octant	01/2018
<b>Status production</b>	
First octant production, W3	11/2018
Welding of 8 octants	ready
Machining of 6 octants	ready
Final machining of the vertical octant	11/2019
Final machining of the upper octant	11/2019
Production of the Upstream door	11/2019
Production of the Downstream door	11/2019
Production of a tooling for the yoke assembly	11/2019

**Table 3. The main milestones of the yoke production.**

## The main milestones of the yoke production

<b>Name of milestone</b>	<b>Date 2017/10</b>
<b>Production of the all barrel octants</b>	<b>11/2019</b>
<b>Production of the frame and beams</b>	<b>11/2019</b>
<b>Production of the doors</b>	<b>12/2019</b>
<b>Control assembling at SET</b>	<b>12/2019</b>
<b>Finalization of the parts</b>	<b>12/2019-01/2020</b>
<b>Assembling of the Yoke at BINP</b>	<b>? Q2-2020</b>

**Table3. The main milestones of the yoke production.**

## The main milestones of the Cryostat production

Name of milestone	Date 2017/10
FDR of the Cryostat	08/02/2019
FDR of the Cold Mass	17/04/2019
Status production	
Cryostat	Design is ready, technological development, Call for tender
Cold Mass	Design is ready, technological development, Call for tender
First Prototype of the Coil	11/2019
Tooling for winding Coil (and Prototype)	11/2019
Tooling for impregnation of Coil (and Prototype)	11/2019
2 <sup>nd</sup> and 3 <sup>rd</sup> Prototype production	12/2019 – 02/2020
Tooling for assembling of the Magnet	Design is ready, technological development, Call for tender
Tooling for installation of the Magnet into the Yoke	Design is ready, technological development, Call for tender

Table 3. The main milestones of the Cryostat production.

# Status of the PANDA conductor development/ procurement

# Main risks

- Purchasing super conductive conductor - lack of a manufacturers

Rutherford cable, 8 strands, extruded in Al matrix

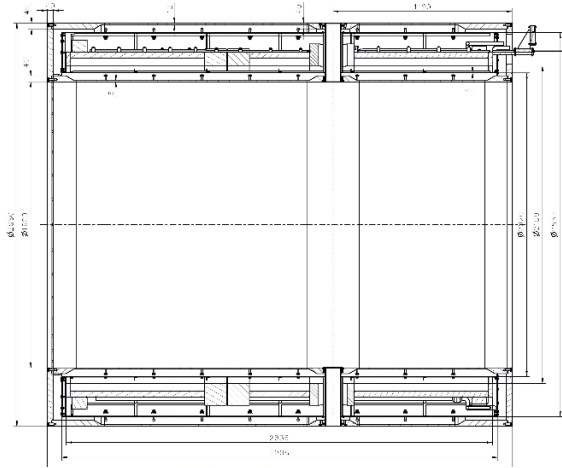


Figure 6. Longitudinal section of the cryostat with cold mass.

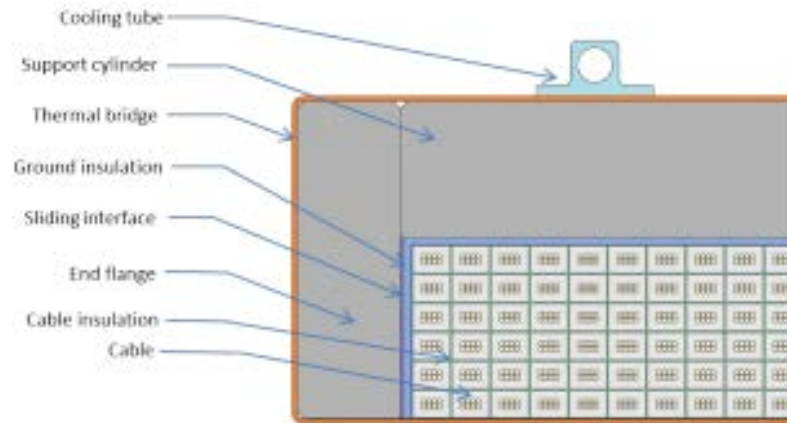


Figure 5. Cold mass cross-section.

Thickness (after cold work) at 300 K	mm	7.93	$\pm 0.03$
Width (after cold work) at 300 K	mm	10.95	$\pm 0.03$
Critical current (at 4.2 K, 5 T)	A	> 14690	
Critical current (at 4.5 K, 3 T)	A	> 16750	
Overall Al/Cu/sc ratio		10.5/1.0/1.0	
Aluminum RRR (at 4.2 K, 0 T)		> 1000	
Al 0.2% yield strength at 300 K	MPa	> 30	

Table 7. Conductor mechanical and electrical parameters.

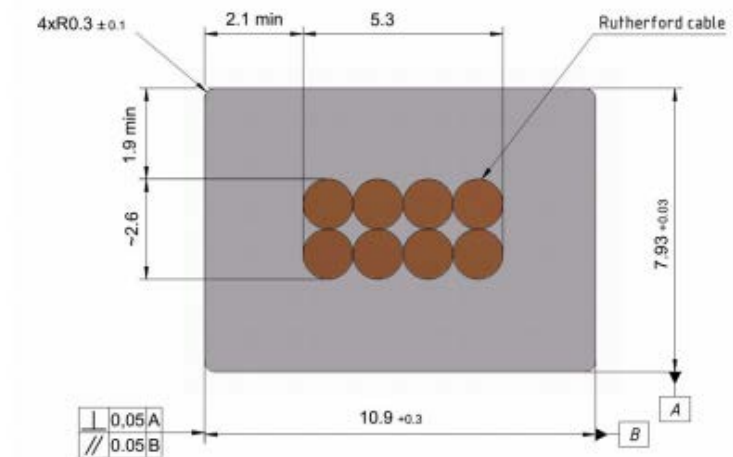


Figure 9. Drawing of the conductor.



# Status of the PANDA conductor development/ procurement

Rutherford cable co-extrusion/ conklad in a pure Al

## Plan

Production of new dies  
Tests of the Conklad

- July 2019 - ready.  
- July 2019. - ready

Cryogenic tests in CERN/ VNIIKP

- December 2019/ February 2020

Request 1000m Cu Rutherford cable for tests in SARKO

- preparation of the contract

Preparation contracts for PANDA NbTi strands production, VNIINM

- 11-12/ 2019

Preparation contracts for PANDA Rutherford cables production, VNIIKP

- 1-2/ 2020

1000m Cu Rutherford cable for tests in SARKO

- 02-03/ 2020

Preparation contracts for PANDA conductor production with SARKO

- 02-03/ 2020

# Status of the PANDA conductor development/ procurement

## Rutherford cable co-extrusion/ conklad in a pure Al Plan

### Procurement A995/998 wire 9,5 mm

- Preparation of the contract for purchasing 3500 kg A995 aluminum raw material;
- Sign of the contract for production A995/998 wire  $\varnothing$  9,5 mm with NANOSELECTRO:
  - First step - production from A995 aluminum raw material 147 kg;
  - 2<sup>nd</sup> step - production 2500 kg A995/998 wire 9,5 mm.

Conklad - 02/2020 in SARKO with prototype PANDA cable and A995/998 wire 9,5 mm.

Tests of the prototype PANDA cable and A995/998 matrix after Conklad - 02-03/2020

Co-extrusion/ Conklad - 02/2020 in SARKO with Cu Rutherford cable 1000m and A995/998 wire 9,5 mm.

Cold work to result the overall geometrical conductor dimensions - 03-04/ 2020

Production PANDA NbTi strands - 06-07/ 2020

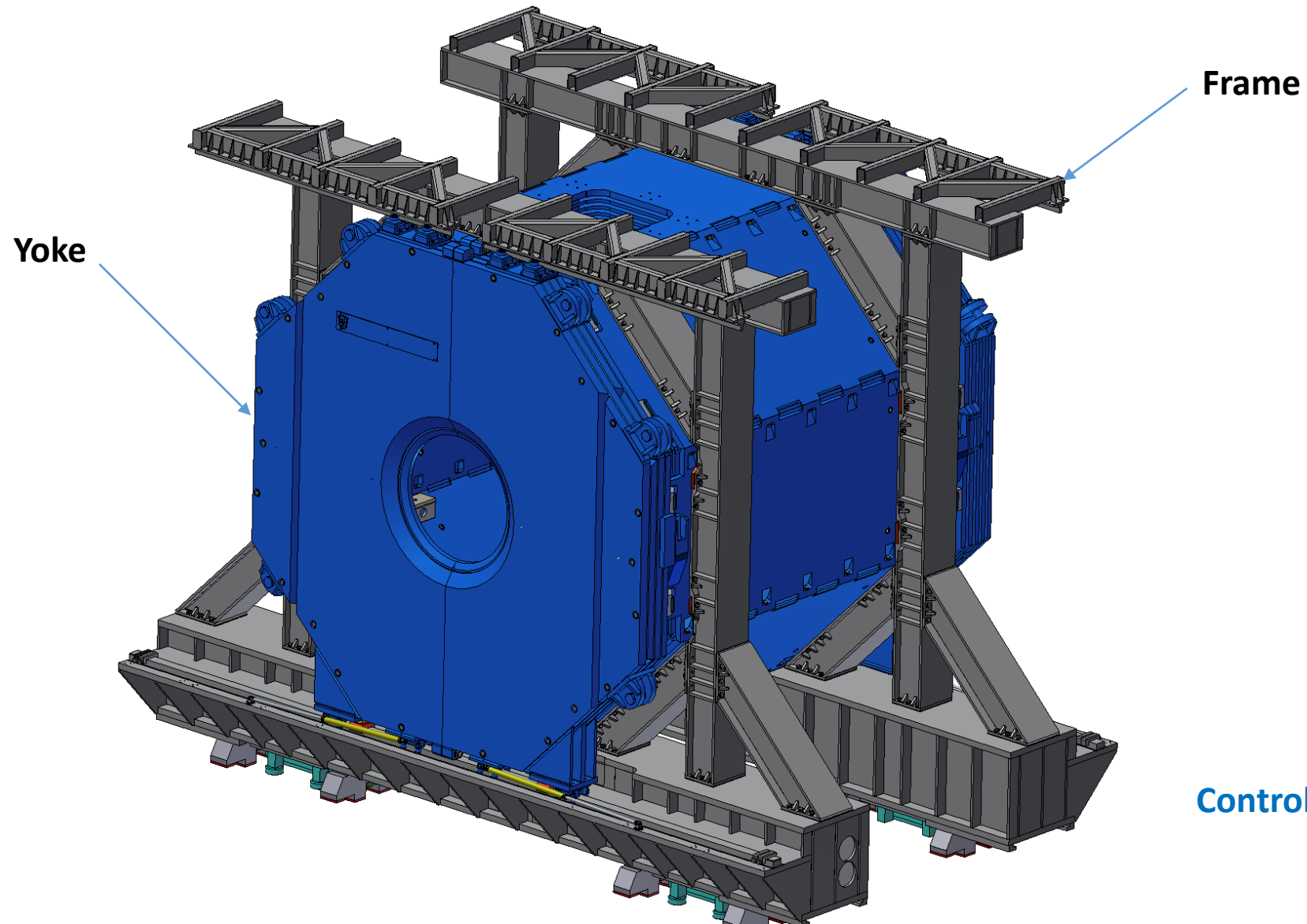
Production PANDA NbTi conductor with A995 matrix - 07-08/ 2020

## Sarko.

- Produced about 20 meters a conductor from A95 and NbTi cable;
- 4 pieces the conductor 3,5m prepared for following tests;
- Mechanical tests should be in BINP;
- Cryogenic tests for RRR and critical currents should be carried out in Bochvar institute and CERN.



# 3D model of the Yoke and Frame.



Control assembling 12/2019

# Module production

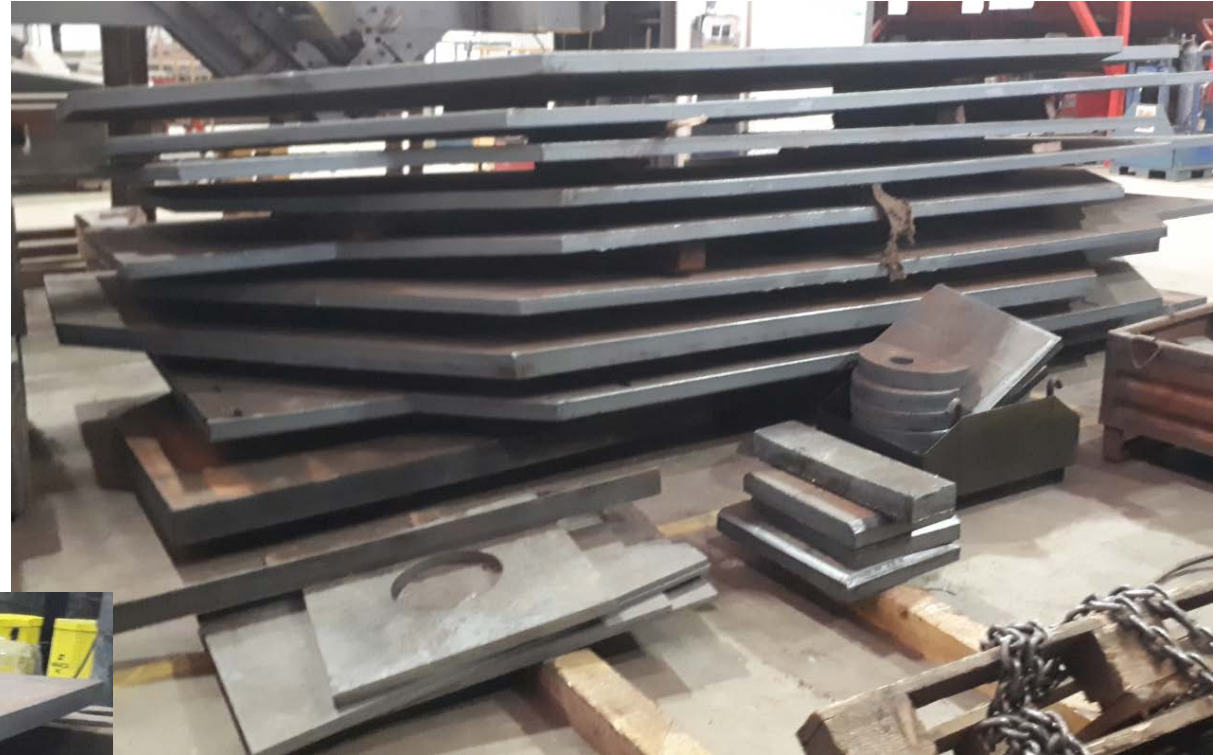


**Module after welding**



**Finished module**

# Upstream Door production



05.11.2019

# Downstream Door production



05.11.2019

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PANDA Magnet

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# Beam production





## Top Frame production



05.11.2019

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PANDA Magnet

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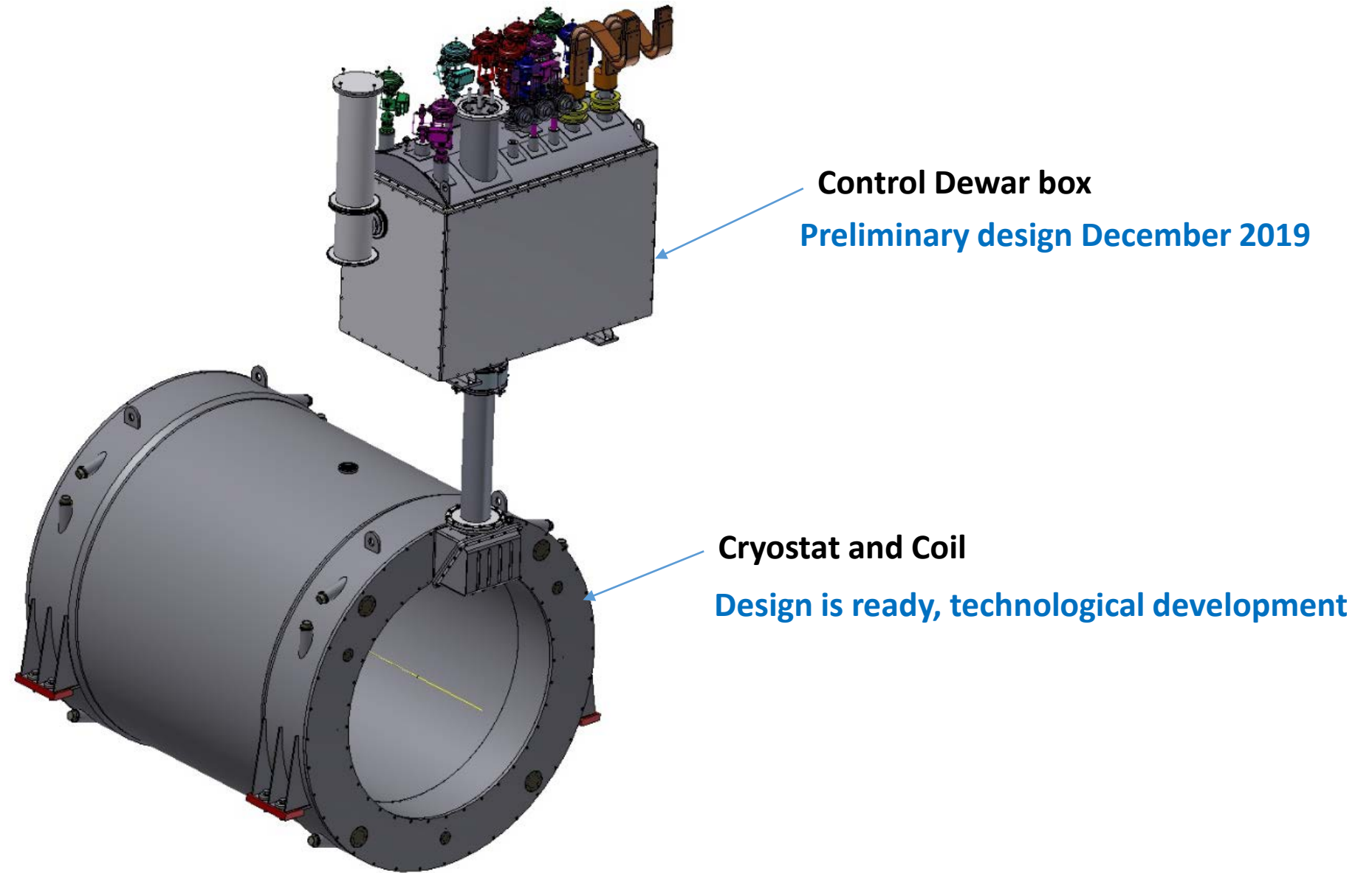
# Vertical Beams production



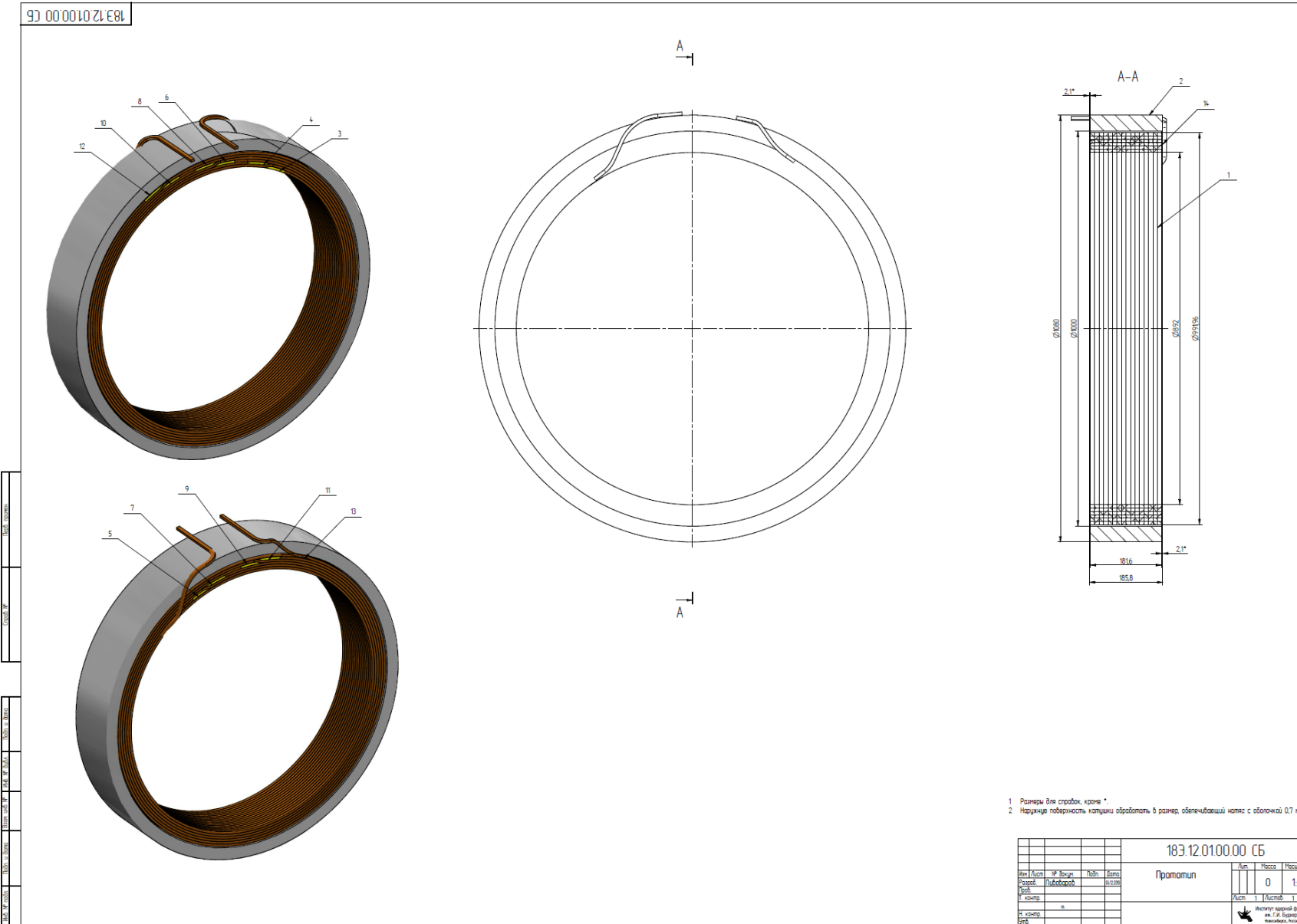
# Angle Beams production



## 3D model of the Magnet and Control Dewar.



# The Prototype of the Coil (3pcs.)



$d = 1\text{m}, L=180\text{ mm}$

Conductor:  
Al - 10,85 mm x 7.93 mm,

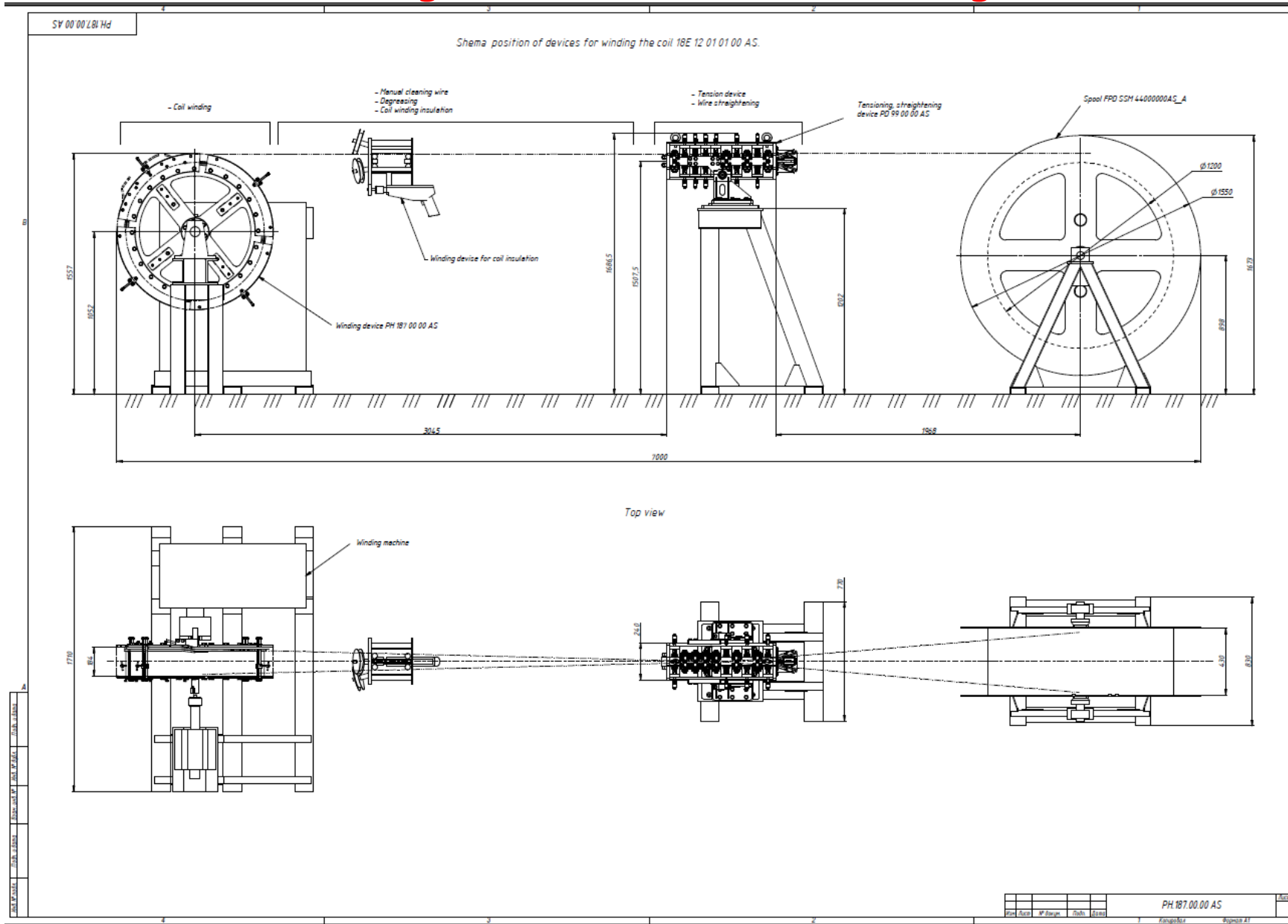
6 layers - 16 turns

- 1 Размеры для справок, кроме \*
- 2 Наружная поверхность катушки обработана в размер, обеспечивающий зазор с оболочкой 0,1 мм

183.12.0100.00 C6					Прототип			Лист	Всего	Исполнен
№	Автом.	№ докум.	Дата	Время	Исполнен	Лист	Всего	Исполнен	Лист	Всего
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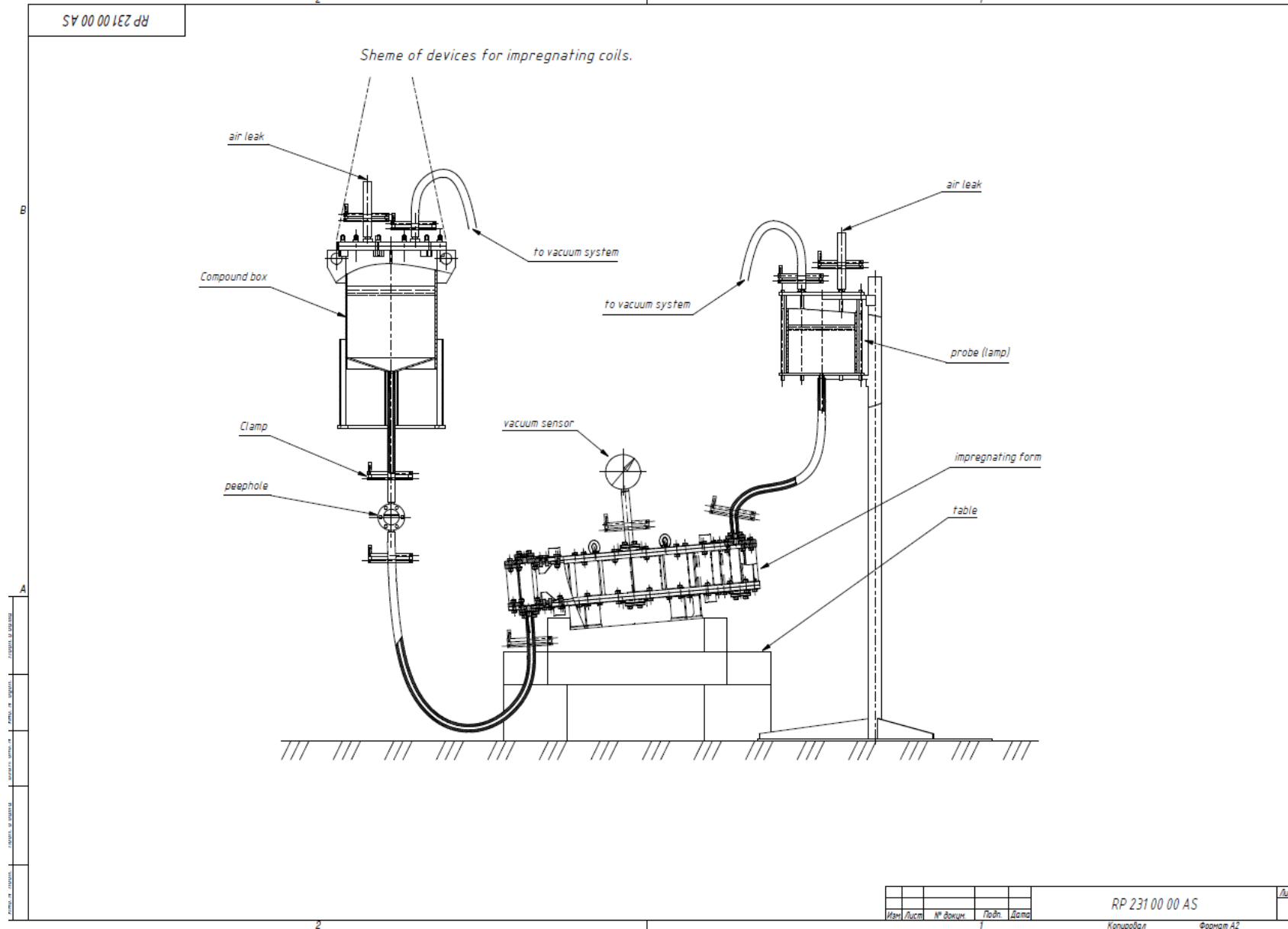
**Design is ready, production**

# Drawing of the Devices for winding coil (scheme).



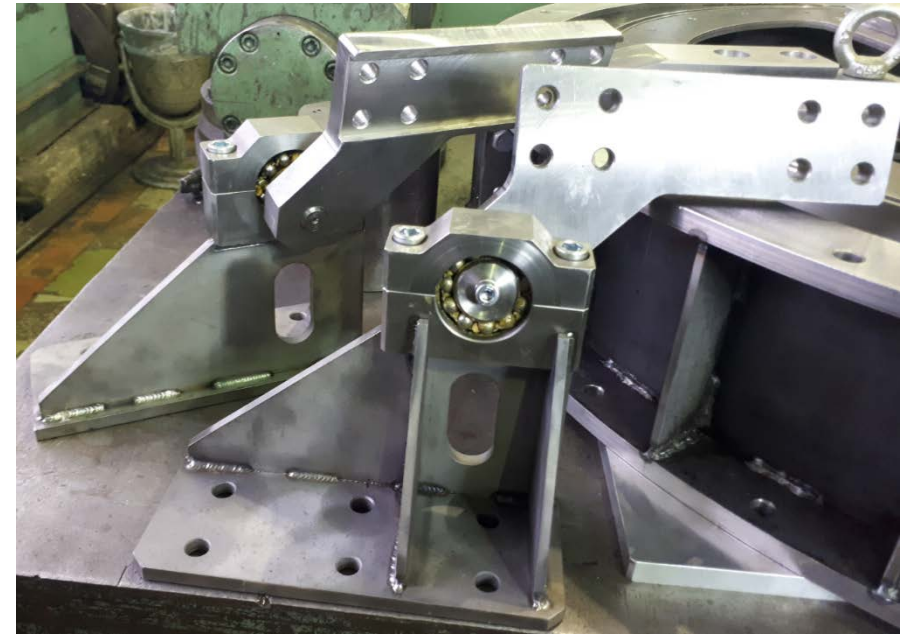
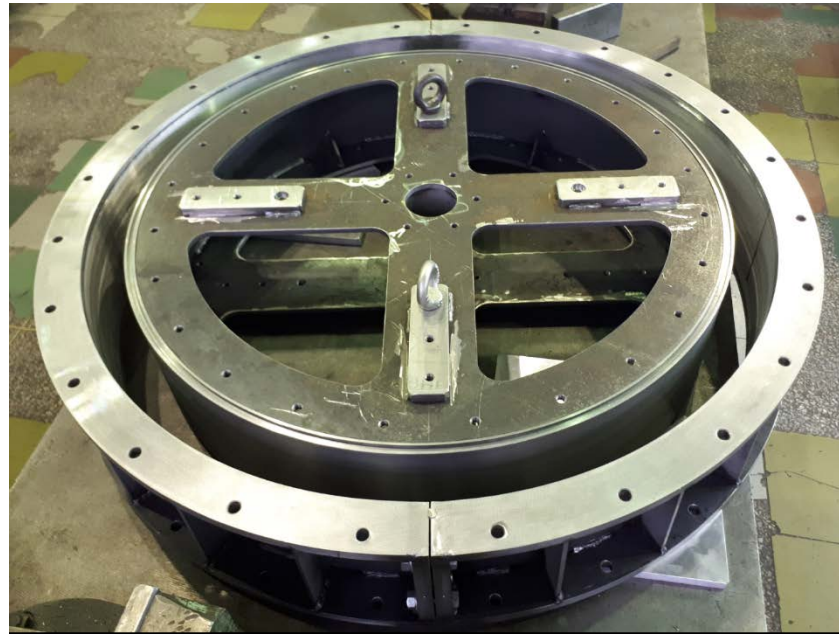
Design is ready, production

# Drawing of the Device for impregnation coil (scheme).



Design is ready, production

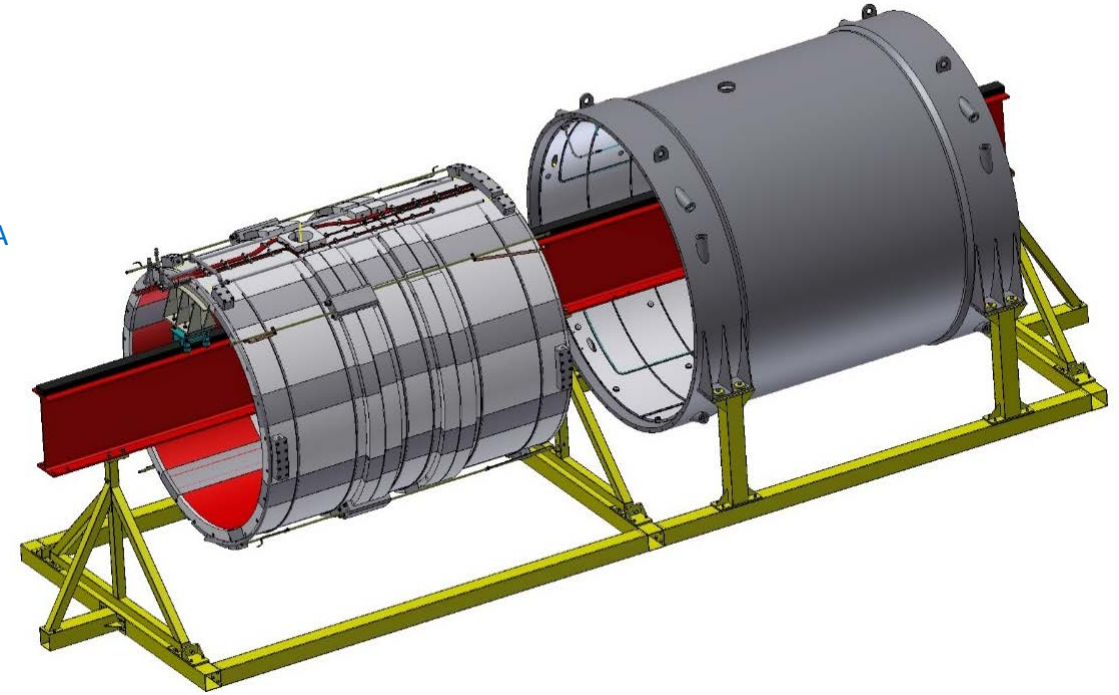
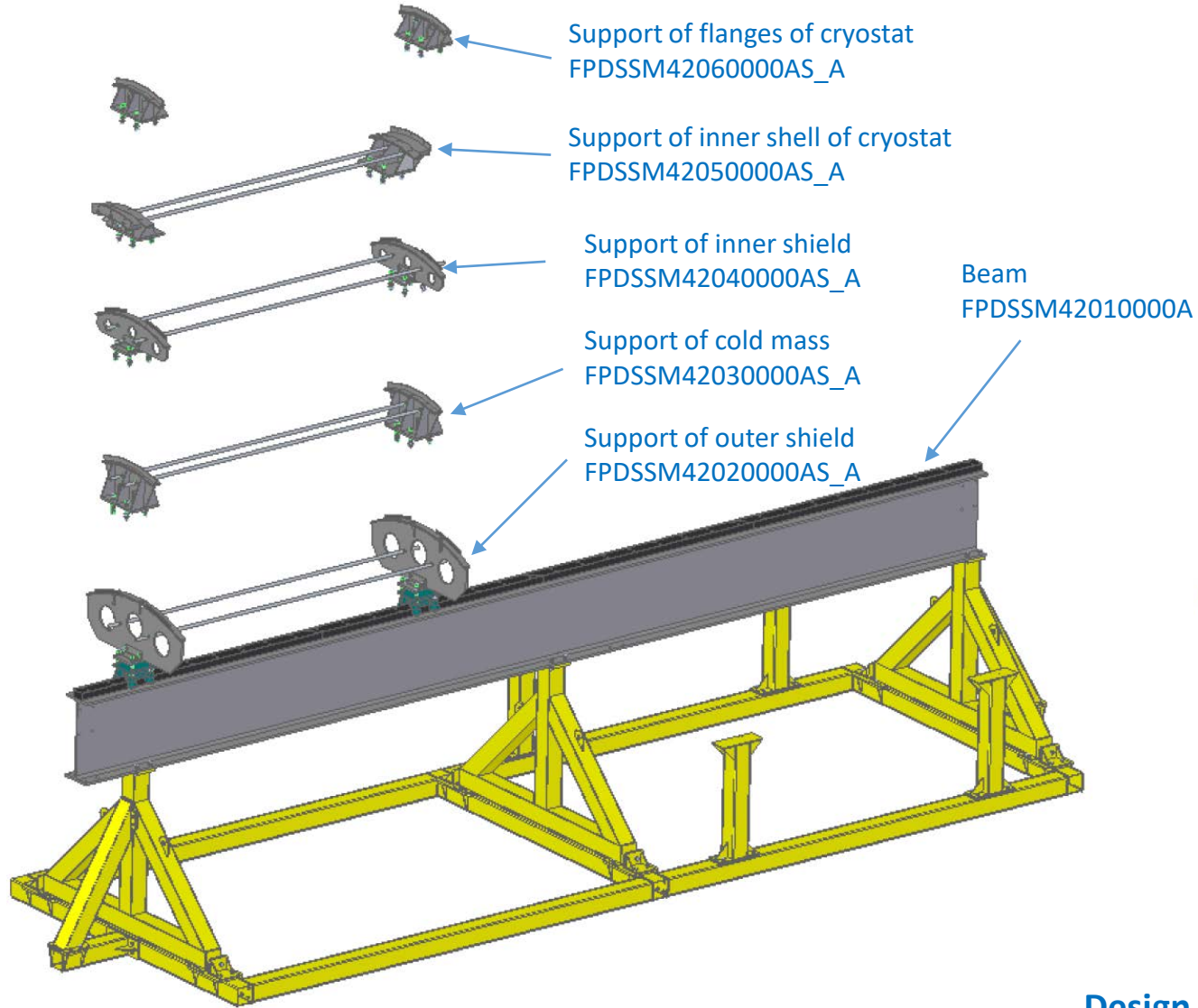
# Tooling for winding and impregnation coil of Prototype



05.11.2019

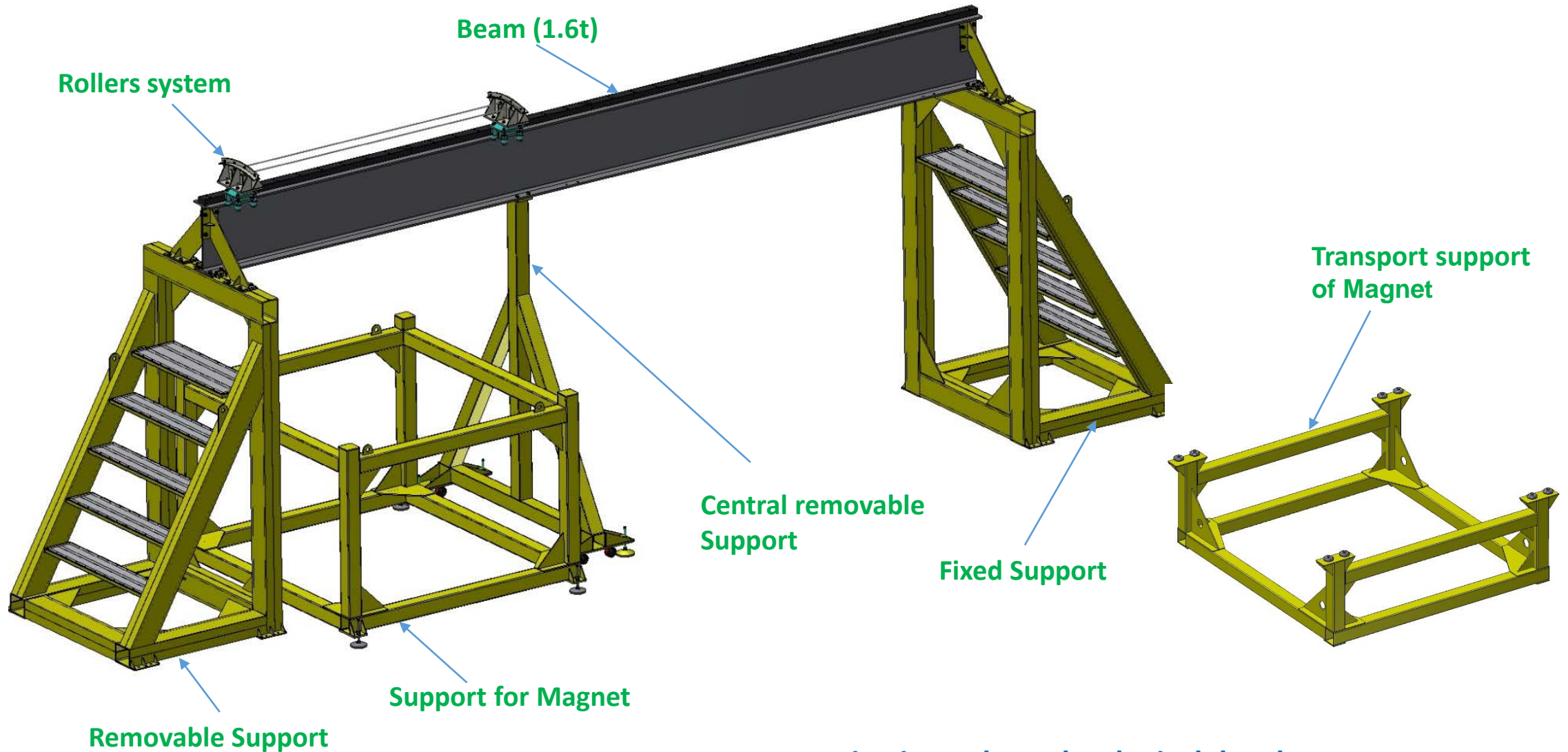


# Tooling for assembling of PANDA Magnet



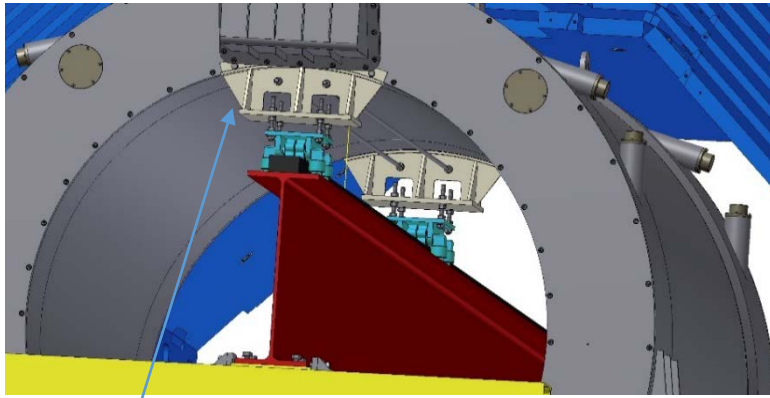
**Design is ready, technological development**

# Tooling for installation of the Magnet into the Yoke

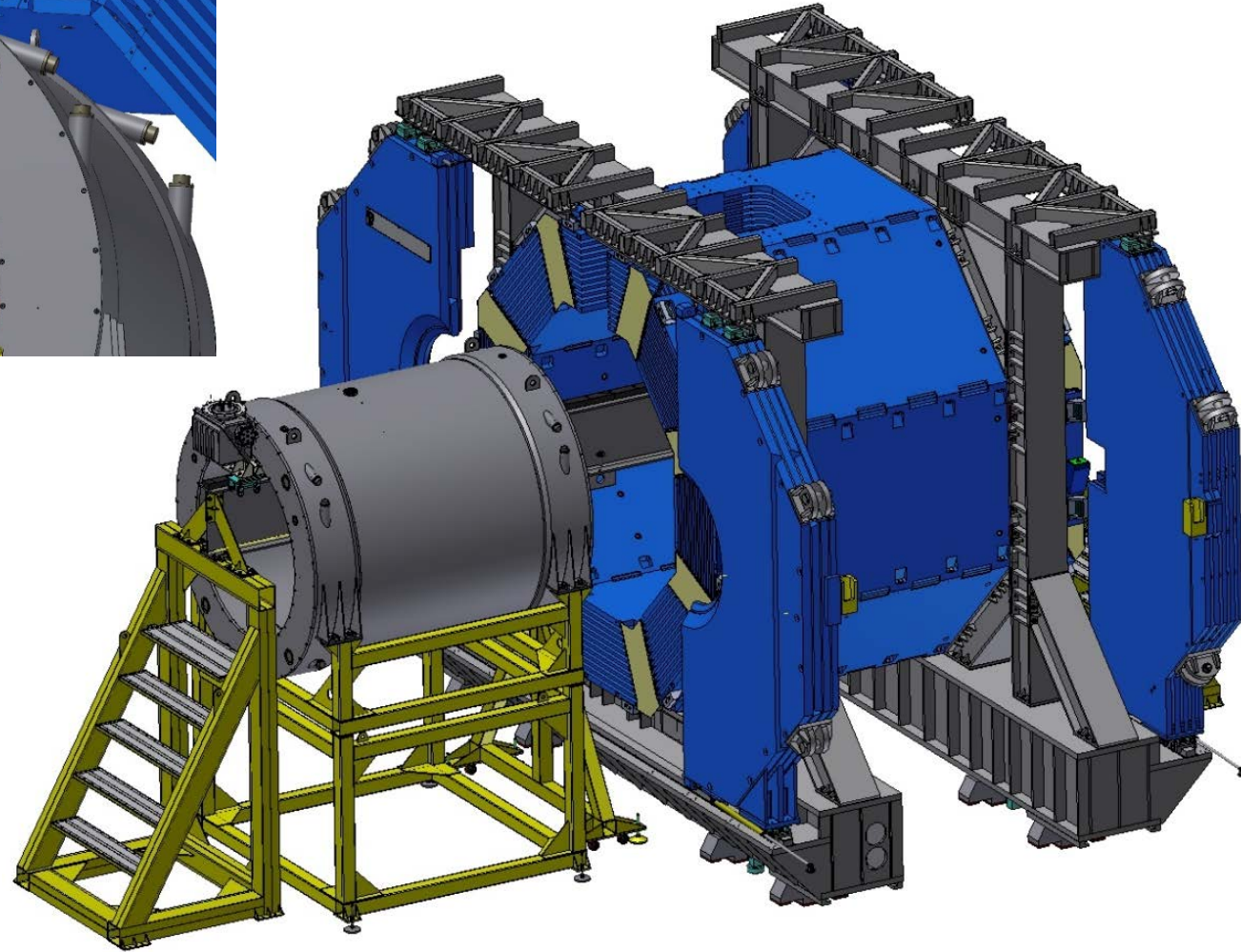


Design is ready, technological development

# Installation procedure of the Magnet into the Iron Yoke



Rollers system



**Insert removable support and install the rollers system for moving magnet.**



Thank you for your attention