

ATLAS UK-IT ITk Integration Meeting

PP1 - Mechanical Design and Data Cable Feedthroughs

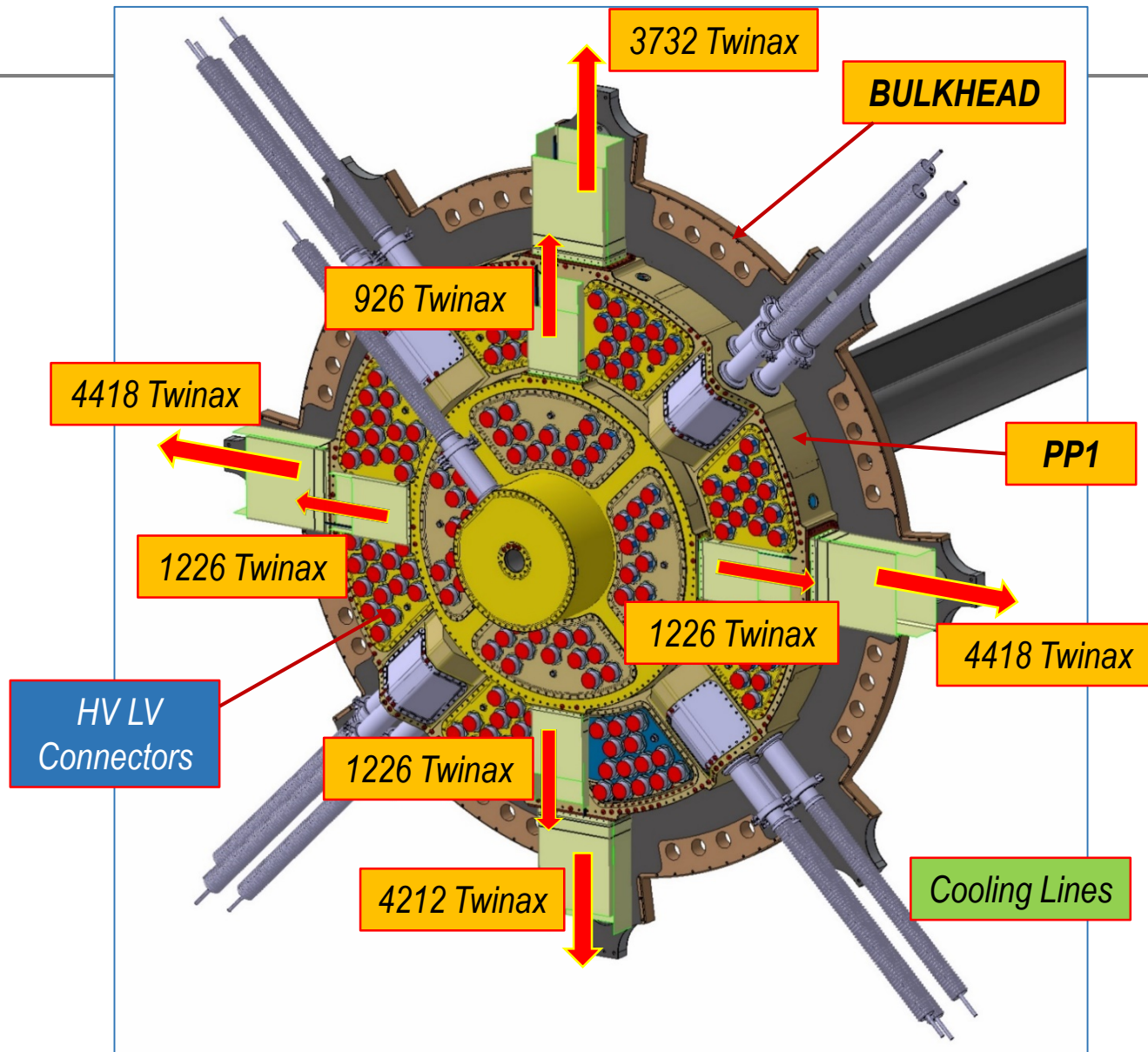
INFN-LNF

D. Orecchini, F. Rosatelli, S. Tomassini

March 17th, 2020



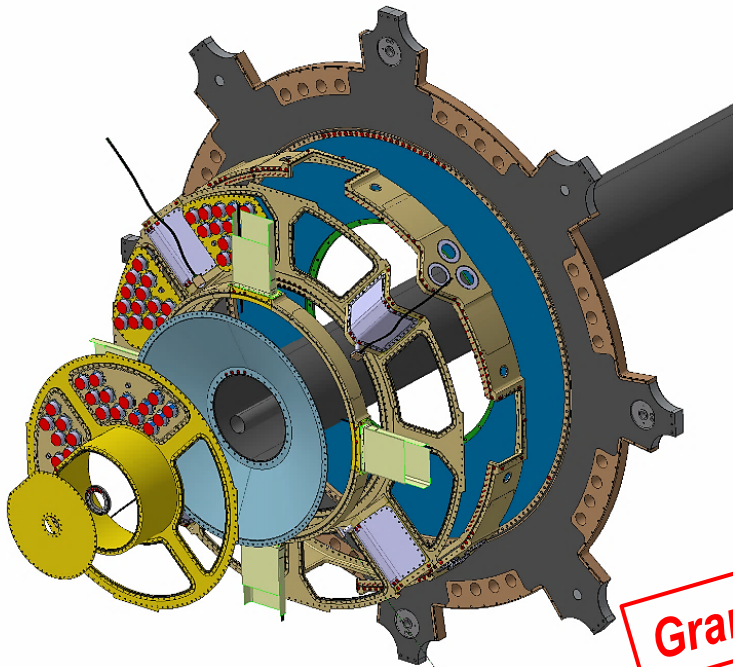
- **PP1 DESIGN OVERVIEW**
- **PP1 MASS BUDGET**
- **PP1 BULKHEAD INTERFACE**
- **PP1 IST INTERFACE**
- **PP1 IPT INTERFACE**
- **COOLING LINES INTERFACE**
- **RADIATION MONITOR ON PP1**
- **PP1 PROTOTYPING ACTIVITY**



MAIN ASPECTS IN HILIGHT:

- Feedthrough for:
 - **16780 Twinax Cables** (Outer System)
 - **3805 Twinax Cables** (Inner System)
- Cooling lines:
 - **12 lines** (Outer System)
 - **2 lines** (Inner System)
- HV –LV Connectors: - **112** (Outer System)
- **52** (Inner System)
- Pixel System Nitrogen Overpressure of about: **4mBar**
- Dew Point temperature: **< -60°C**
- External Dew Point: **< -30°C**
- **Heaters on the body to avoid condensation**
- **Close the Faraday Cage**

PP1 MASS BUDGET



Grand Total: 84 Kg

TECHNOLOGICAL ASPECTS

Parts material: Aluminum alloy 6082 (Anticorodal)

Connection screws material: Ergal 7075-T

Total weight (Included Bolts & Nuts): 32 Kg

HV – LV CONNECTORS (ACT Type 94)_ n.164

Total weight : 16 Kg

TWINAX CABLES 34 AWG:

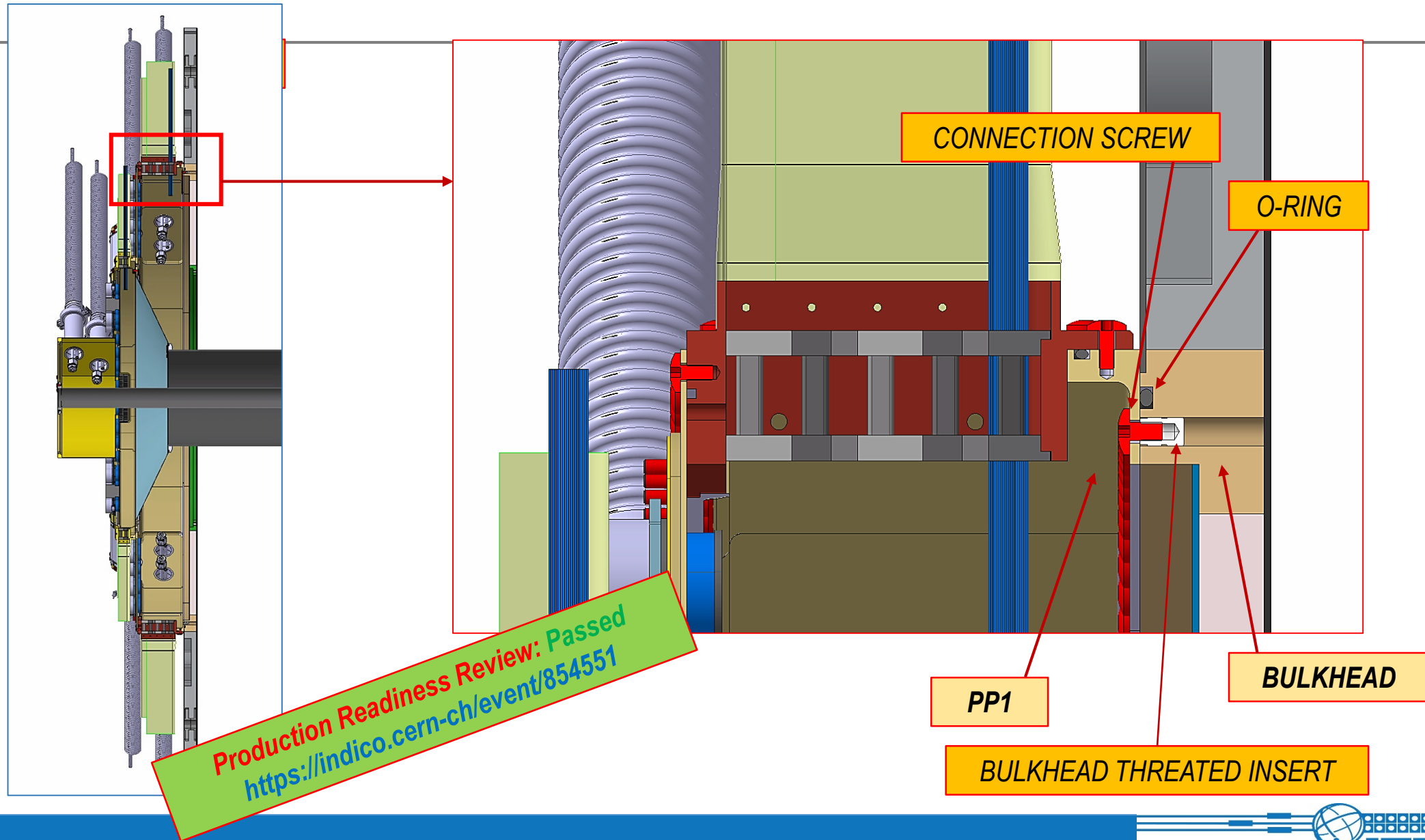
Total weight : 23 Kg (per 1m lenght)

COOLING PIPES & FITTINGS INSIDE PP1

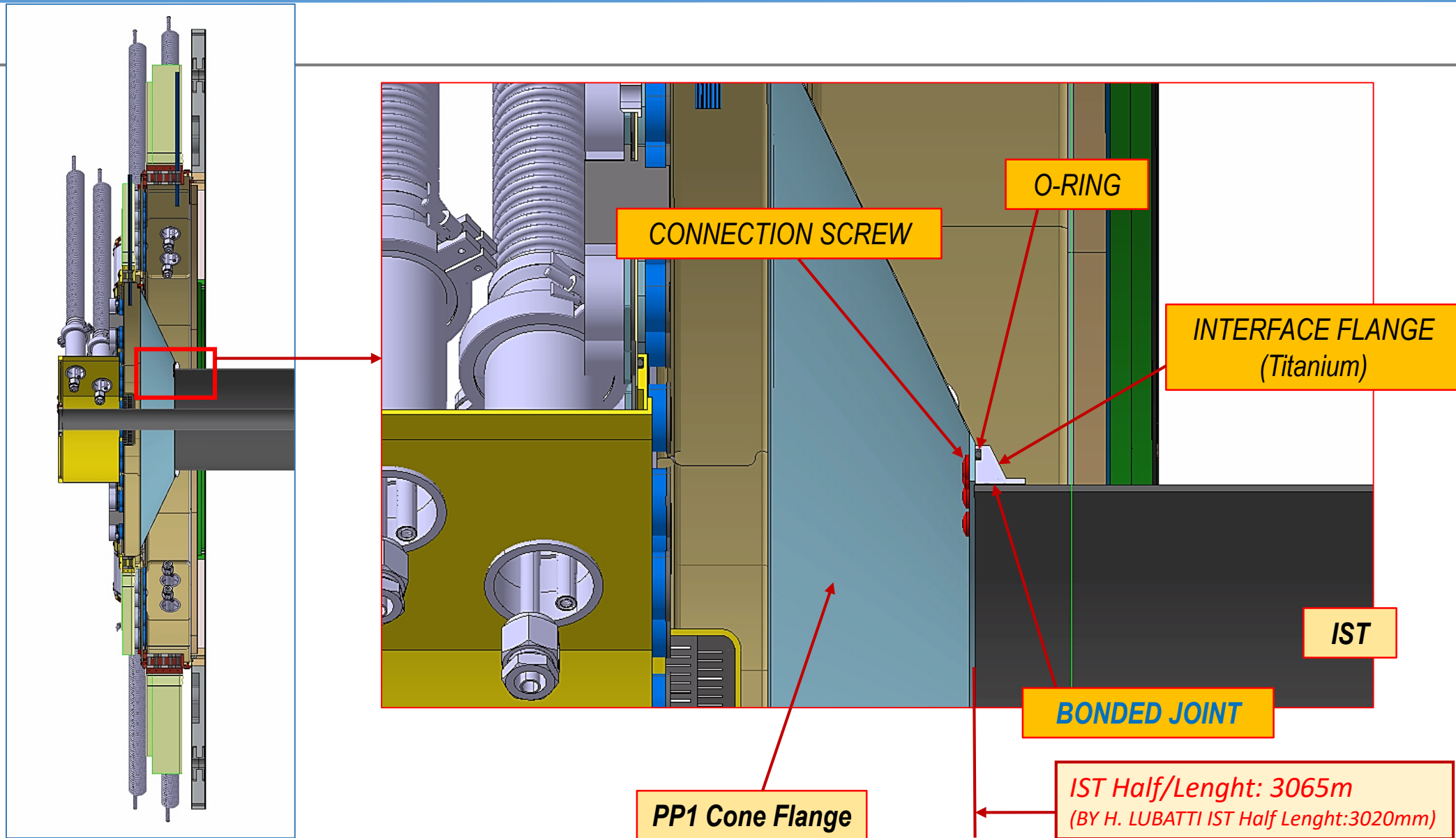
Total weight : 14Kg

COMPONENTS	MATERIAL	DENSITY	WEIGHT PER COMPONENT	N. COMPONENTS	TOTAL WEIGHT	
OUTER FLANGE_TYPE 1	Aluminum Alloy 6082 Anticorodal	2690 Kg/m3	1.02	4	4.08	OUTER REGION
BOLTS & NUTS	Ergal	2810 Kg/m3	0.0015	60	0.09	
OUTER FLANGE_TYPE 2	Aluminum Alloy 6082 Anticorodal	2690 Kg/m3	1.28	4	5.12	
BOLTS & NUTS	Ergal	2810 Kg/m3	0.0015	76	0.11	
OUTER WALL	Aluminum Alloy 6082 Anticorodal	2690 Kg/m3	3.99	1	3.99	
BOLTS & NUTS	Ergal	2810 Kg/m3	0.0015	960	1.44	
COOLING HOUSING	Aluminum Alloy 6082 Anticorodal	2690 Kg/m3	0.46	4	1.84	
CARTER Cooling Housing	Aluminum Alloy 6082 Peraluman	2670 Kg/m3	0.11	4	0.44	
BOLTS & NUTS	Ergal	2810 Kg/m3	0.0015	38	0.06	
OUTER PATCH PANELS	Aluminum Alloy 6082 Anticorodal	2690 Kg/m3	0.14	8	1.12	
TWINAX FEEDTHROUGH (Outer Region) Part 1	Aluminum Alloy 6082 Anticorodal	2690 Kg/m3	0.51	4	2.04	INNER REGION
TWINAX FEEDTHROUGH (Outer Region) Part 2	Aluminum Alloy 6082 Anticorodal	2690 Kg/m3	0.33	4	1.32	
CONE FLANGE	Aluminum Alloy 6082 Peraluman	2670 Kg/m3	1.02	1	1.02	
CONE FLANGE IST INTERFACE	Titanium	4460 Kg/m3	0.77	1	0.77	
BOLTS & NUTS	Ergal	2810 Kg/m3	0.0015	36	0.05	
INNER FLANGE_TYPE 1	Aluminum Alloy 6082 Anticorodal	2690 Kg/m3	0.32	4	1.28	
BOLTS & NUTS	Ergal	2810 Kg/m3	0.0015	112	0.17	
INNER FLANGE_TYPE 2	Aluminum Alloy 6082 Anticorodal	2690 Kg/m3	0.37	4	1.48	
BOLTS & NUTS	Ergal	2810 Kg/m3	0.0015	60	0.09	
INNER WALL	Aluminum Alloy 6082 Anticorodal	2690 Kg/m3	1.48	1	1.48	
BOLTS & NUTS	Ergal	2810 Kg/m3	0.0015	204	0.3	CONNECTORS
INNER PATCH PANELS	Aluminum Alloy 6082 Anticorodal	2690 Kg/m3	0.17	4	0.68	
INNER CYLINDER	Aluminum Alloy 6082 Anticorodal	2690 Kg/m3	1.45	1	1.45	
BOLTS & NUTS	Ergal	2810 Kg/m3	0.0015	60	0.09	
TWINAX FEEDTHROUGH (Inner Region) Part 1	Aluminum Alloy 6082 Anticorodal	2690 Kg/m3	0.16	4	0.64	
TWINAX FEEDTHROUGH (Inner Region) Part 2	Aluminum Alloy 6082 Anticorodal	2690 Kg/m3	0.13	4	0.52	
INNER CLOSING FLANGE	Aluminum Alloy 6082 Anticorodal	2690 Kg/m3	0.25	1	0.25	
IPT INTERFACE FLANGE	Titanium	4460 Kg/m3	0.19	1	0.19	
BOLTS & NUTS	Ergal	2810 Kg/m3	0.0015	14	0.02	
PP1 WEIGHT					32.13	
HV - LV CONNECTORS ACT TYPE 94 - FEMALE					112	5.15
INNER REGION					52	2.39
HV - LV CONNECTORS ACT TYPE 94 - MALE					112	5.6
INNER REGION					52	2.6
CONNECTORS WEIGHT					15.74	
TWINAX CABLES 34 AWG-100 Ohm					16780 (1 m of Cable)	18.5
INNER REGION					3805 (1 m of Cable)	4.2
TWINAX CABLES WEIGHT					22.7	
HV - LV CABLES					112 (1 m of Cable)	
INNER REGION					52 (1 m of Cable)	
HV - LV CABLES WEIGHT						
NB. - Medium Weight of Ergal Bolt: 0.0015 Kg						

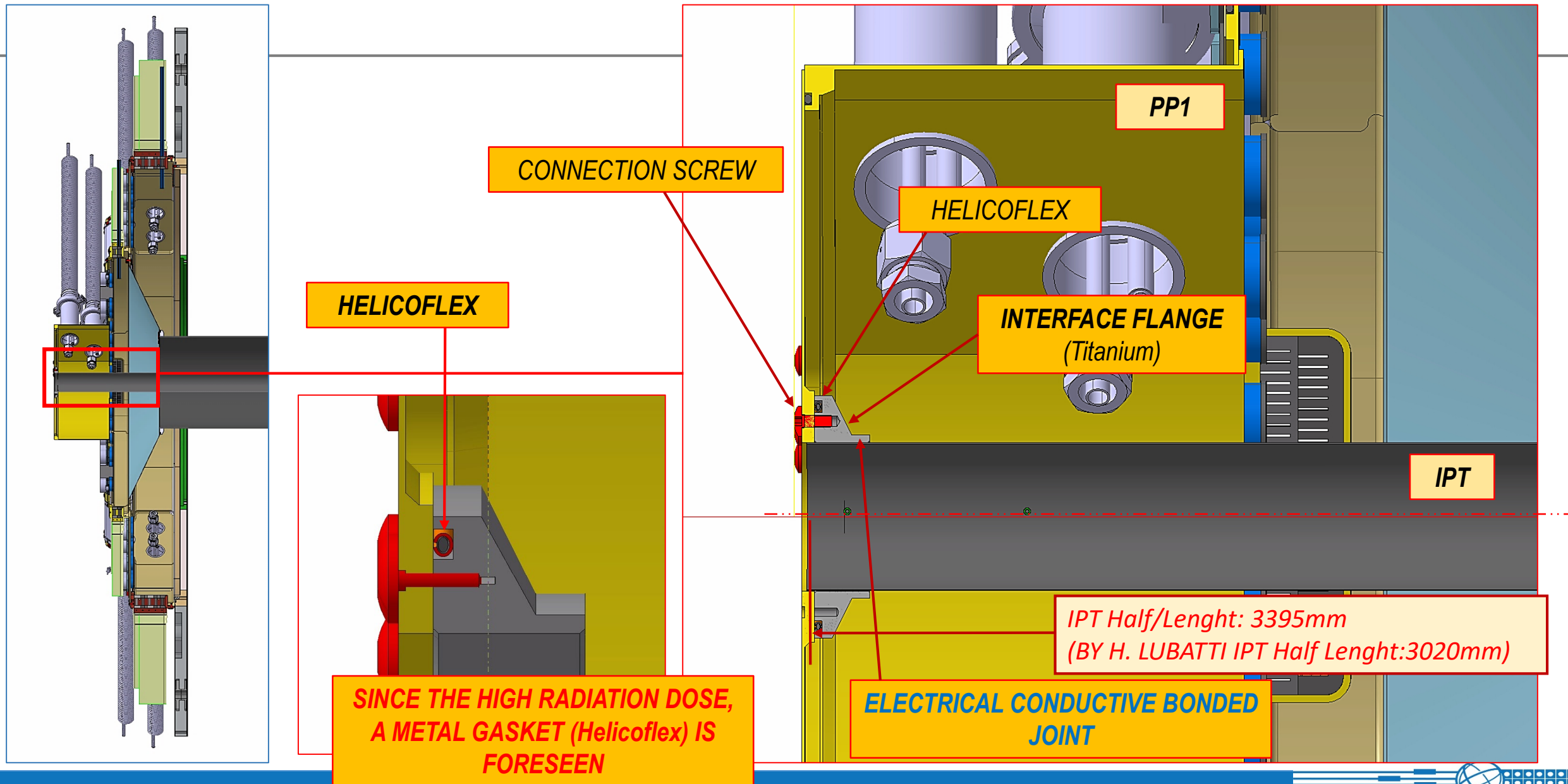
PP1 - BULKHEAD INTERFACE



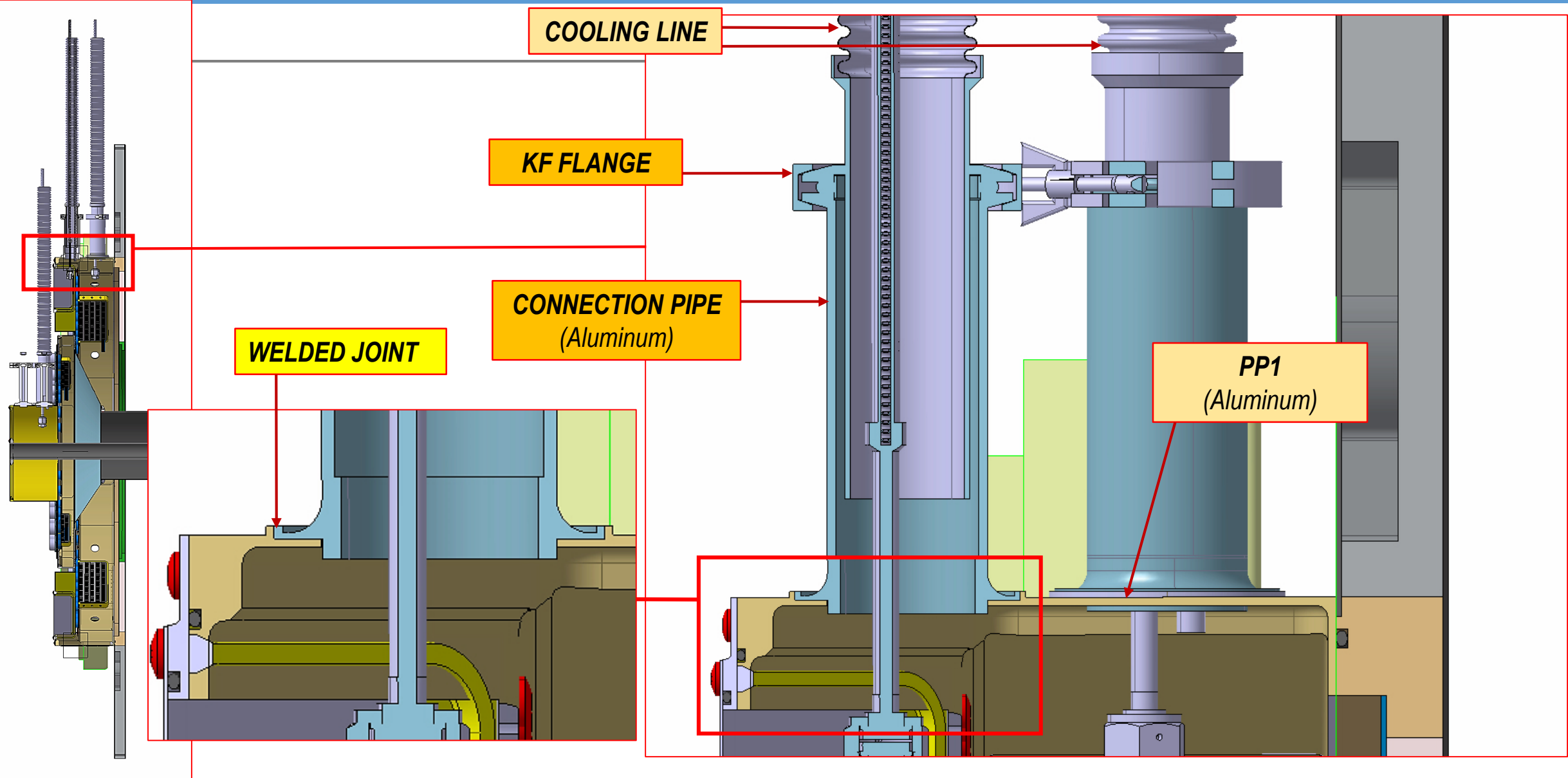
PP1 - IST INTERFACE

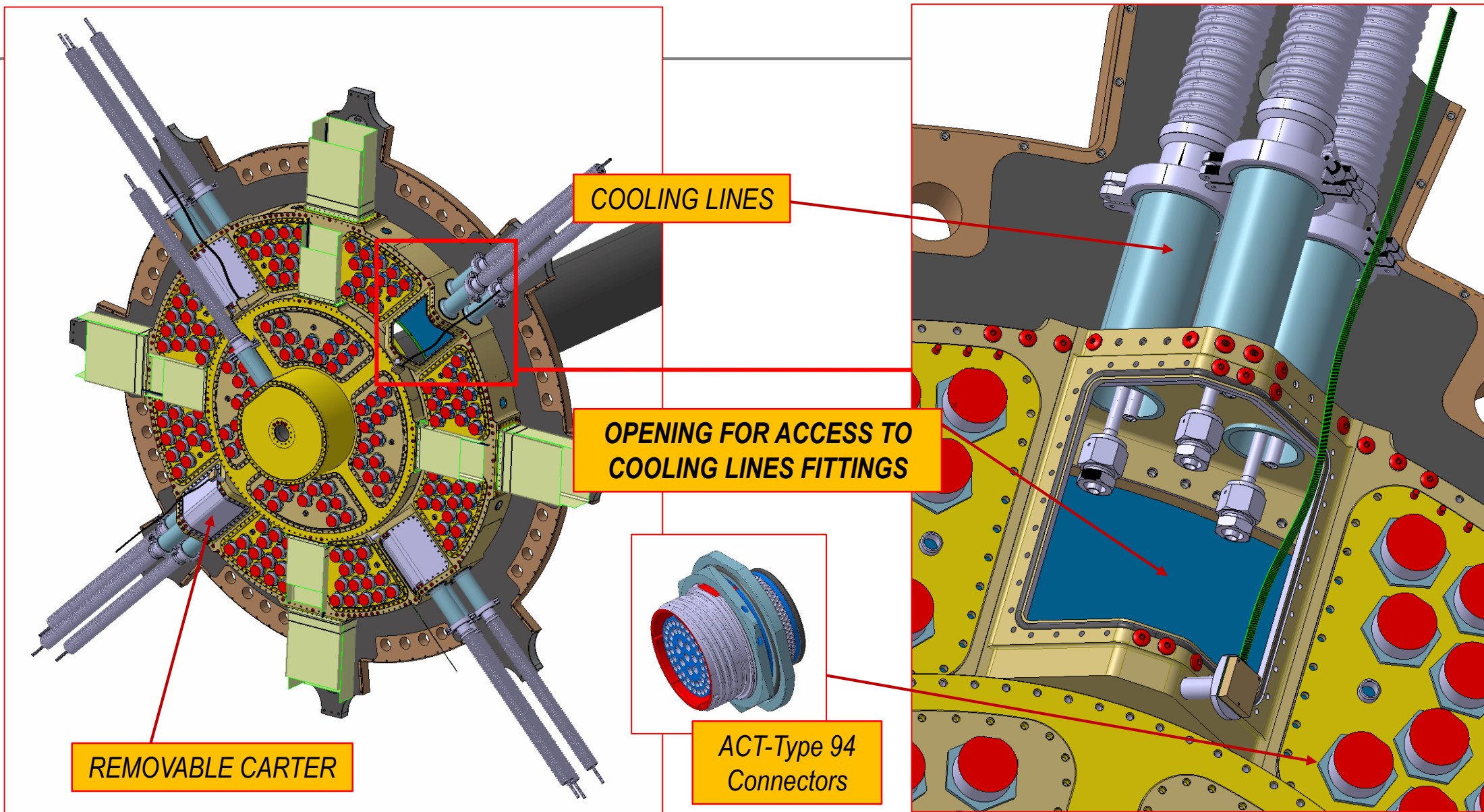


PP1 - IPT INTERFACE

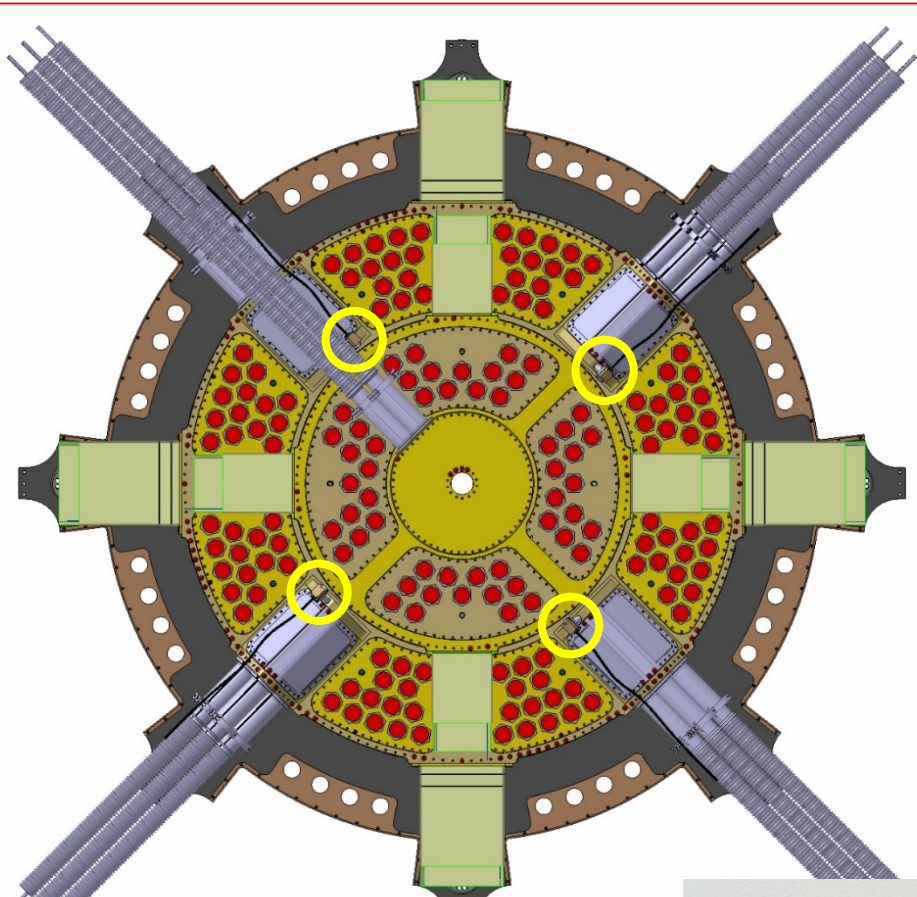


PP1 - COOLING LINES INTERFACE 1/2

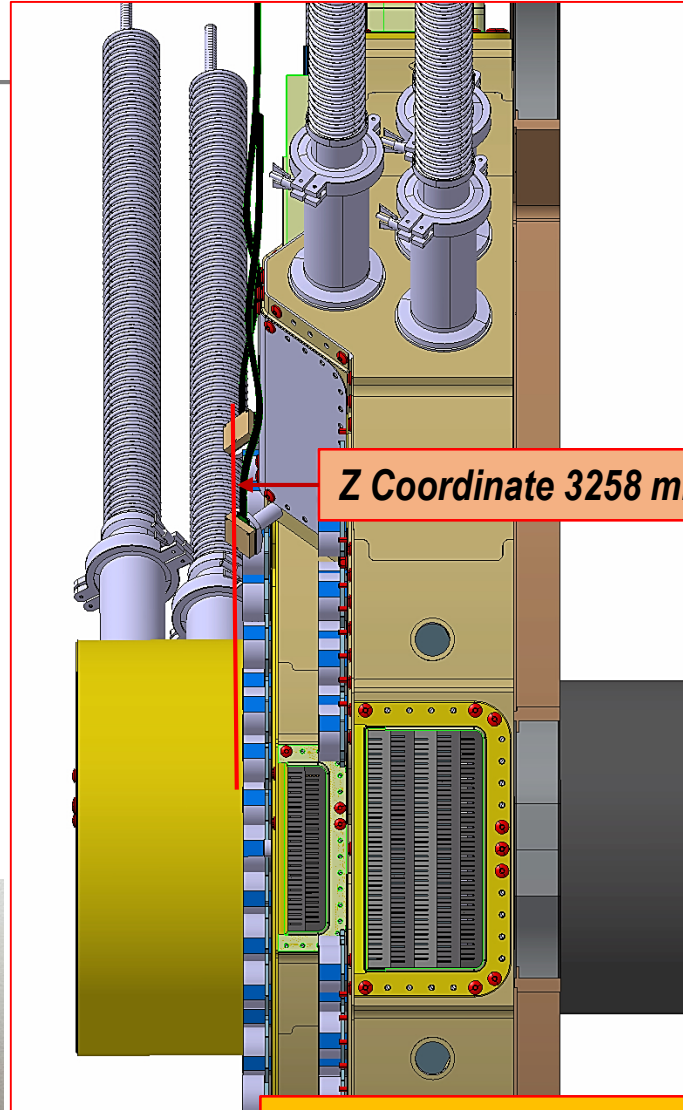
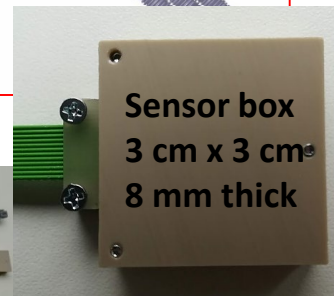




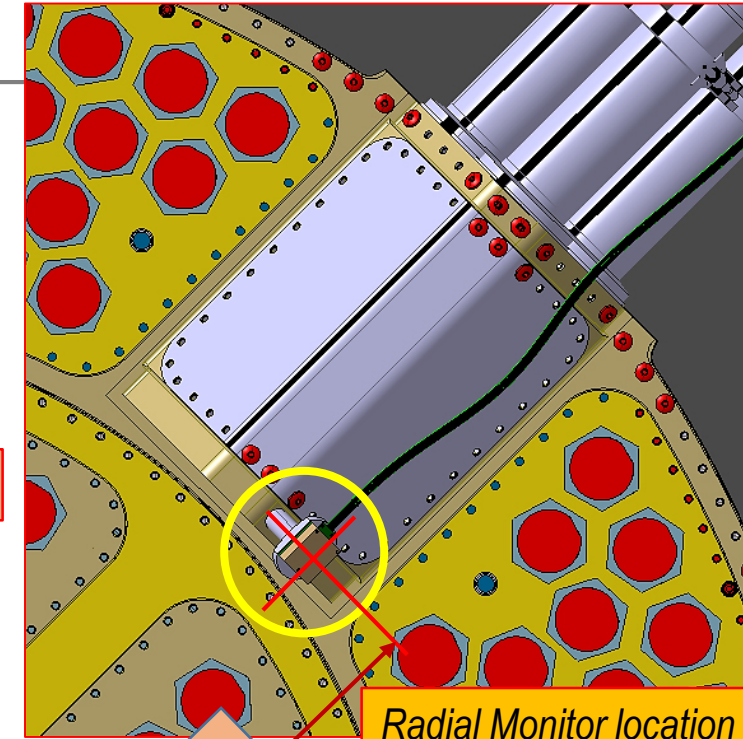
PP1- RAD MONITOR LOCATION



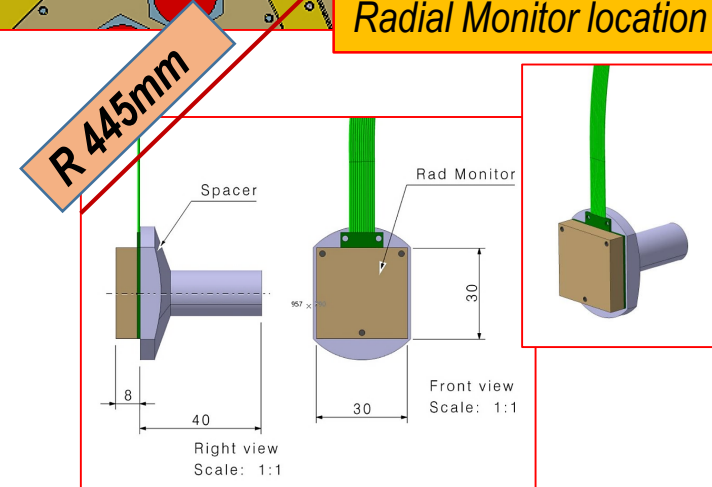
RAD MONITOR LOCATION:
n.4 per Side



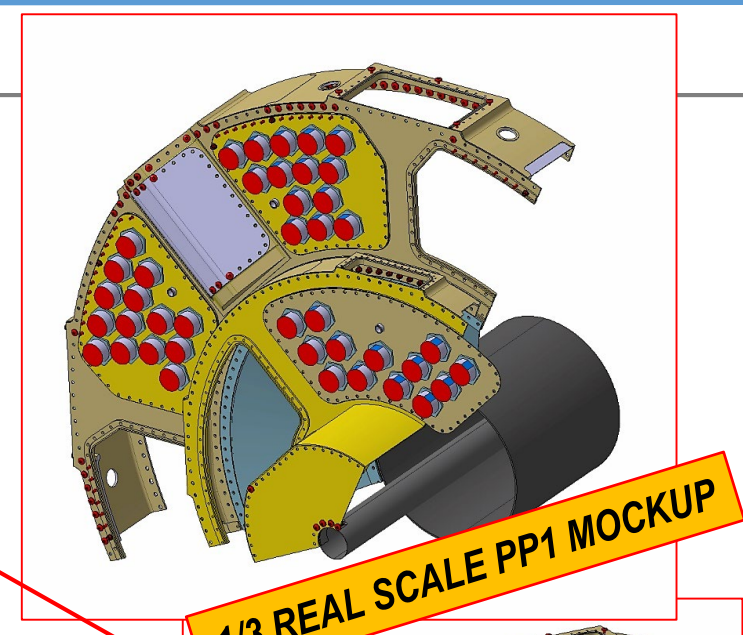
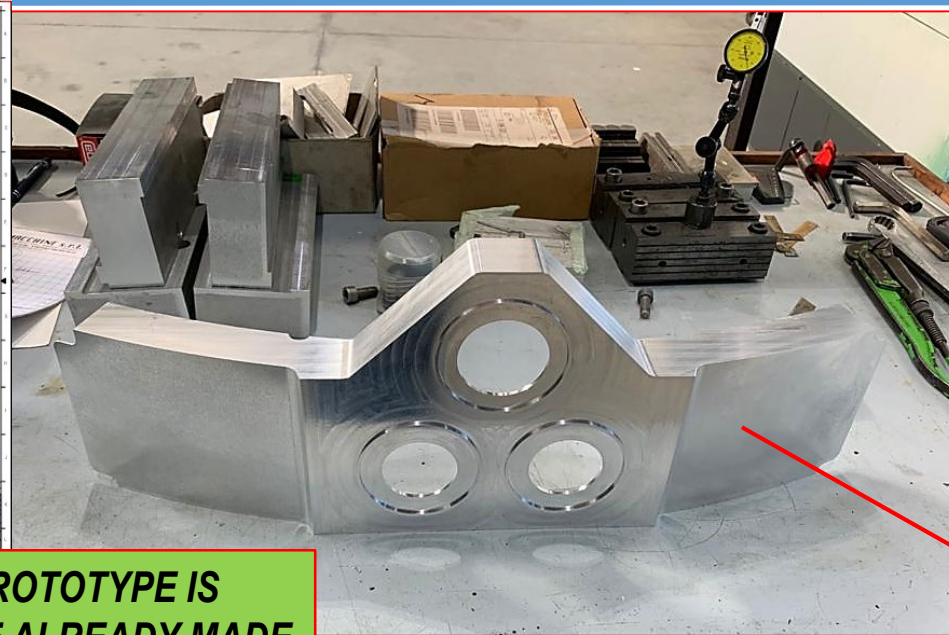
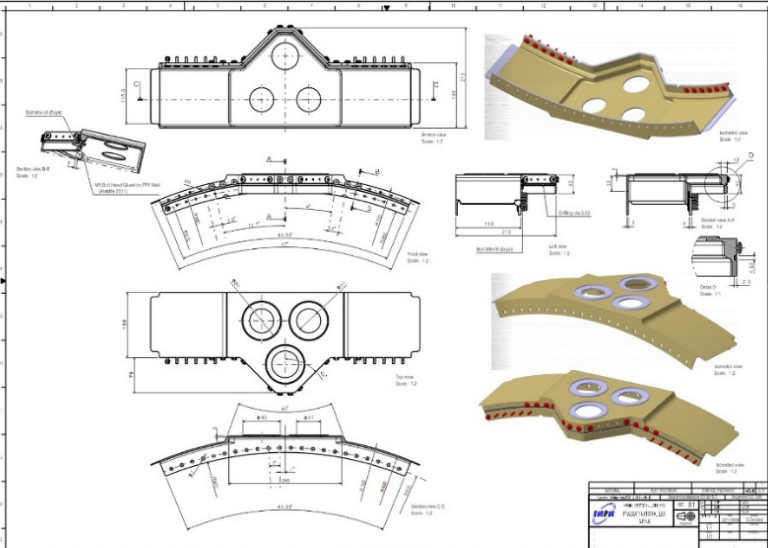
Along Z Axis Monitor location



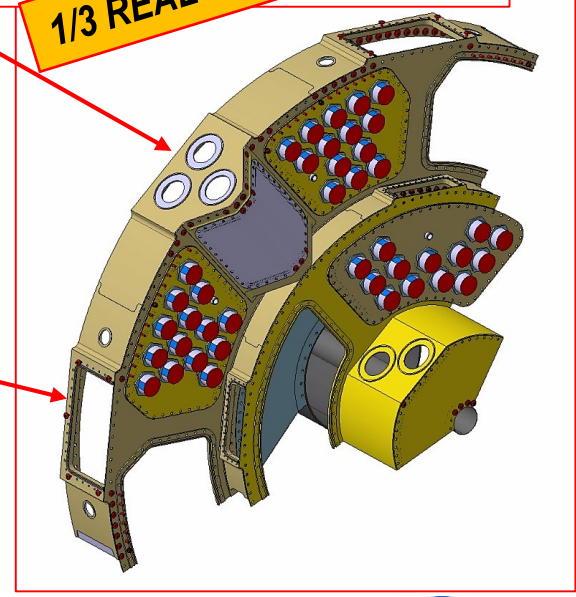
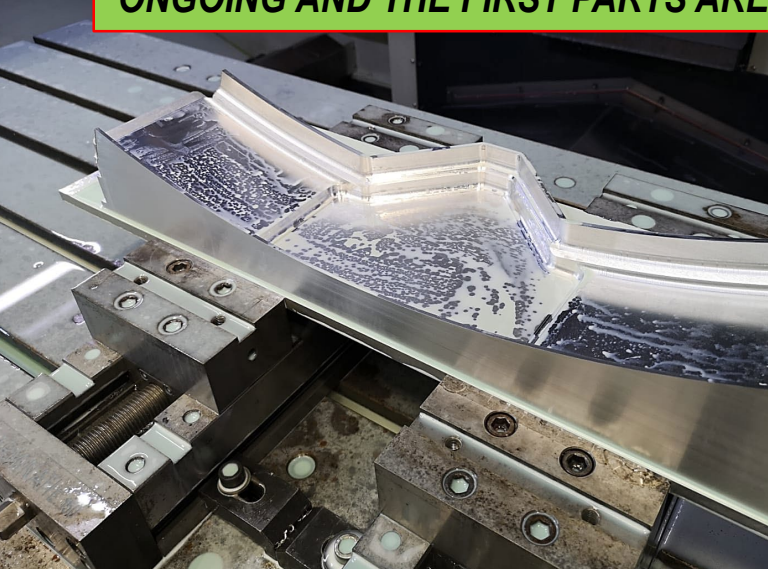
Radial Monitor location



PP1 MOCKUP PRODUCTION



THE PRODUCTION OF THE PP1 PROTOTYPE IS ONGOING AND THE FIRST PARTS ARE ALREADY MADE

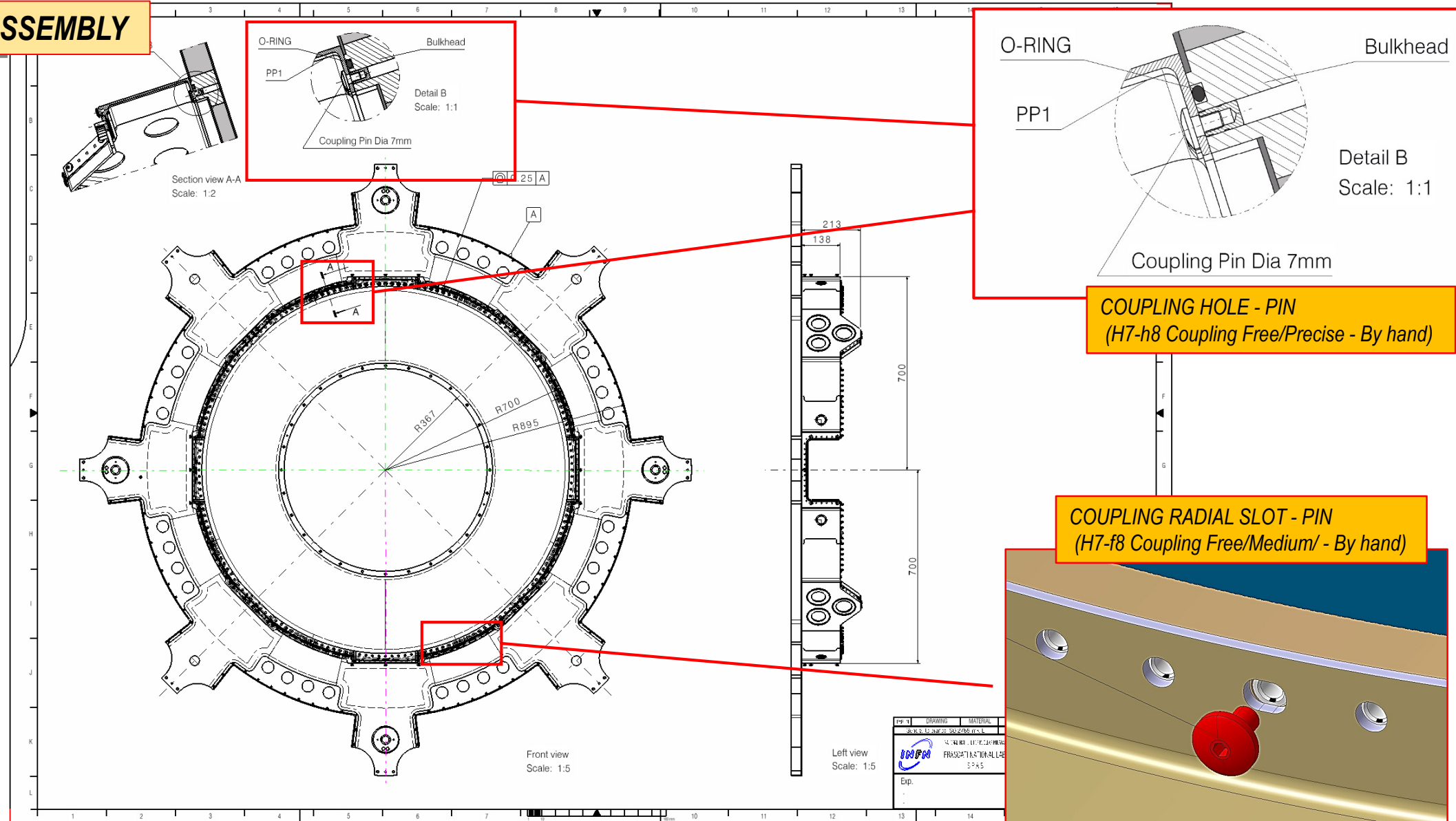


- ***MECHANICAL DESIGN IS COMPLIANT TO THE ENVELOPE, MASS BUDGET AND SERVICE REQUEST***
- ***PP1 MOCKUP IS ONGOING TO VALIDATE THE MECHANICAL DESIGN AND PRODUCTION***
- ***PP1 MOCKUP WILL BE INTEGRATED IN THE “3 CYLINDER PP1 MOCKUP” MAINLY DEVOTED TO CABLES ROUTING TESTS***

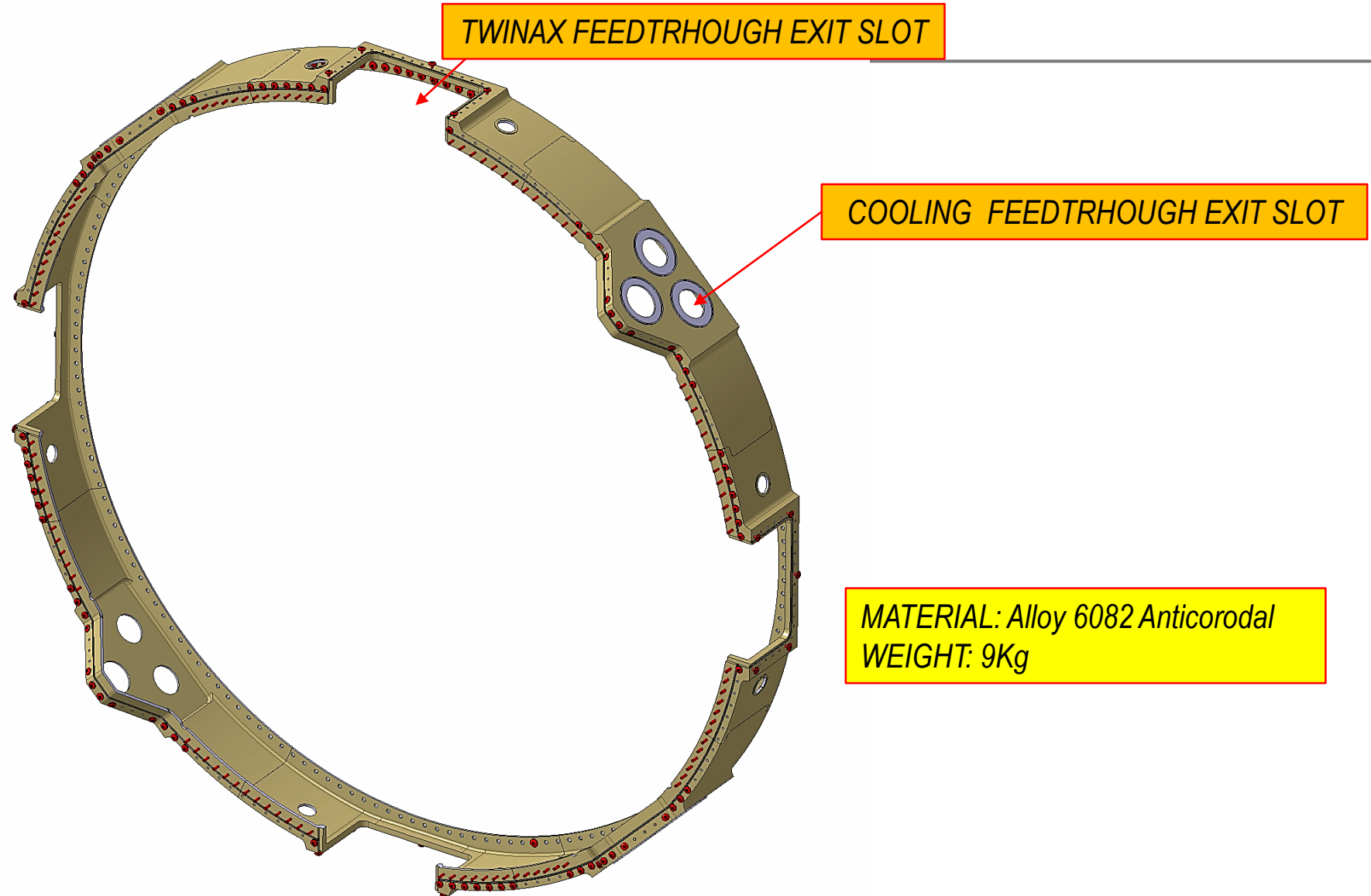
BACKUP SLIDES

PP1-BULKHEAD INTERFACE

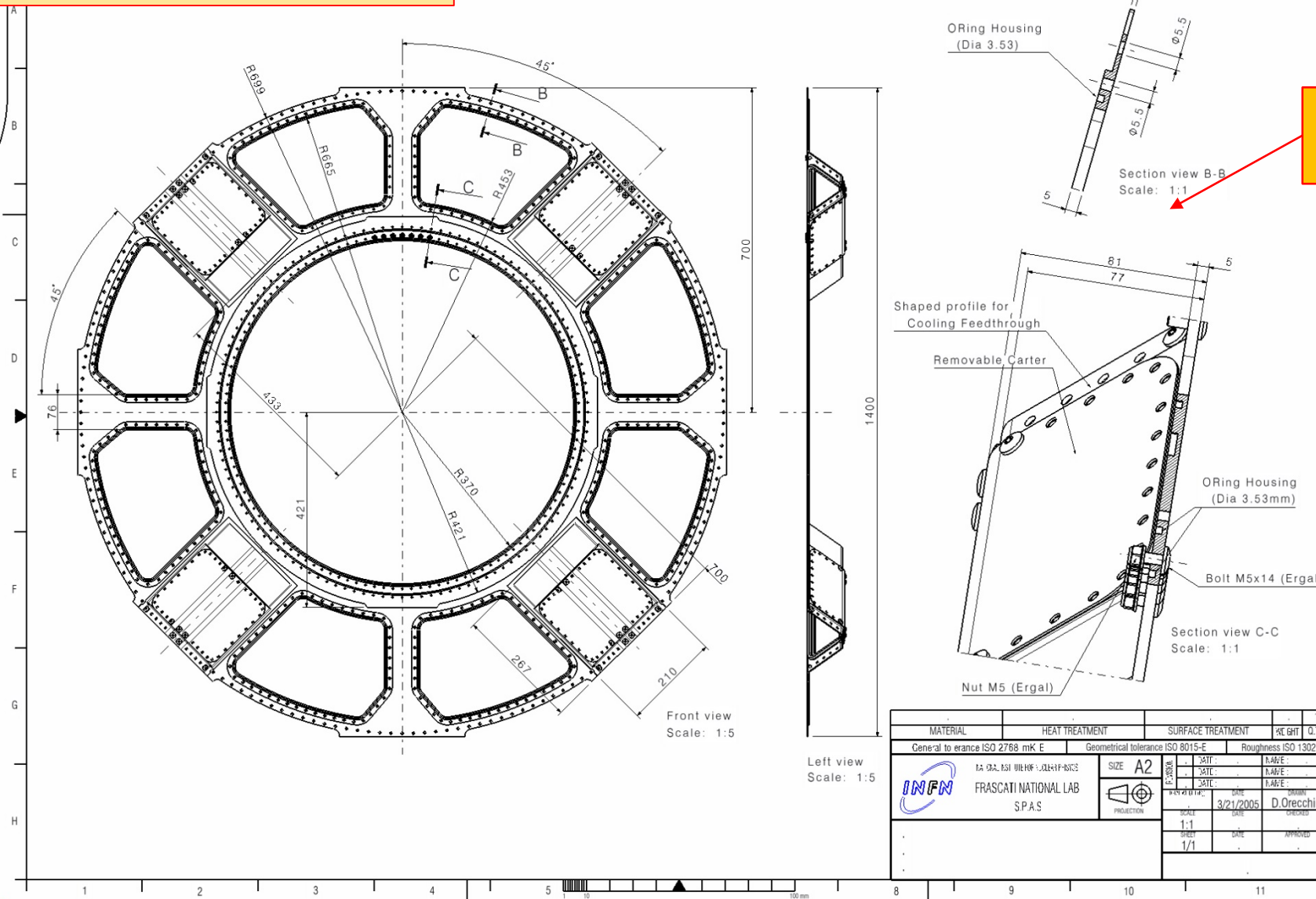
PP1 – BULKHEAD ASSEMBLY



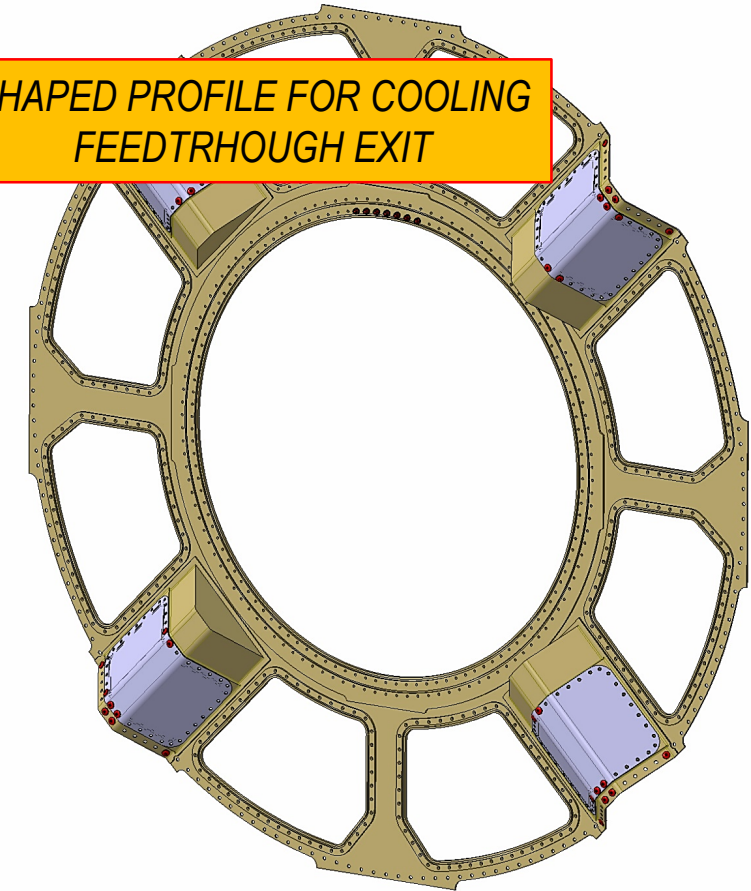
PP1 – OUTER FLANGE



PP1 – OUTER FLANGE



**SHAPED PROFILE FOR COOLING
FEEDTHROUGH EXIT**



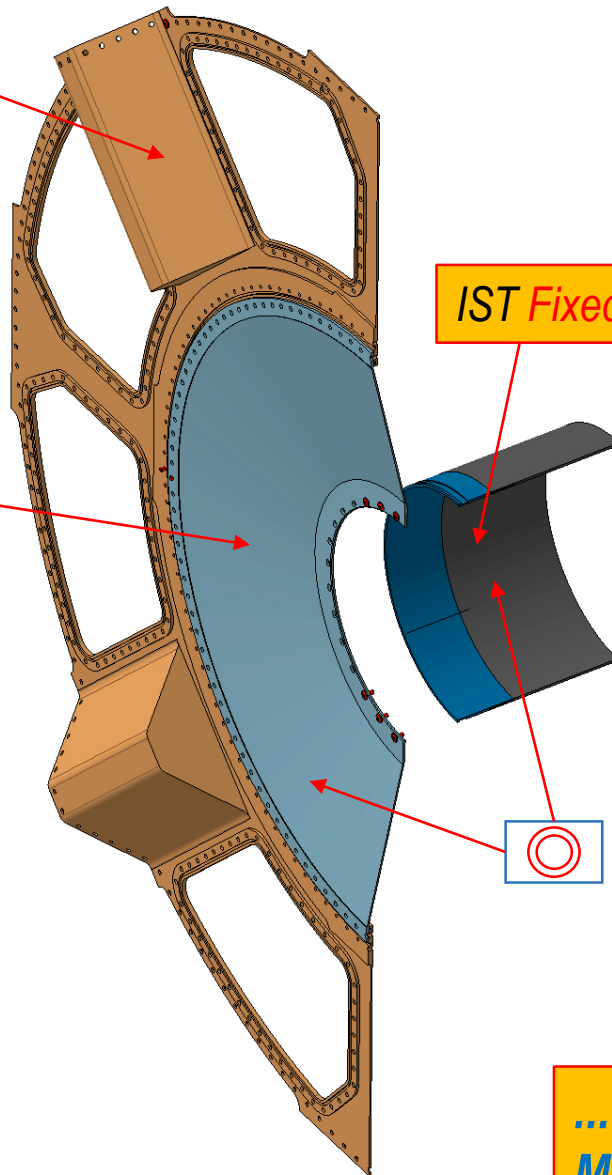
MATERIAL: Alloy 6082 Anticorodal
WEIGHT: 5,4Kg
(Made by Water Cutting & Milling Machining)

IST - PP1 INTERFACE CONSTRAINT ANALYSIS

PP1_Outer Wall
Fixed Part

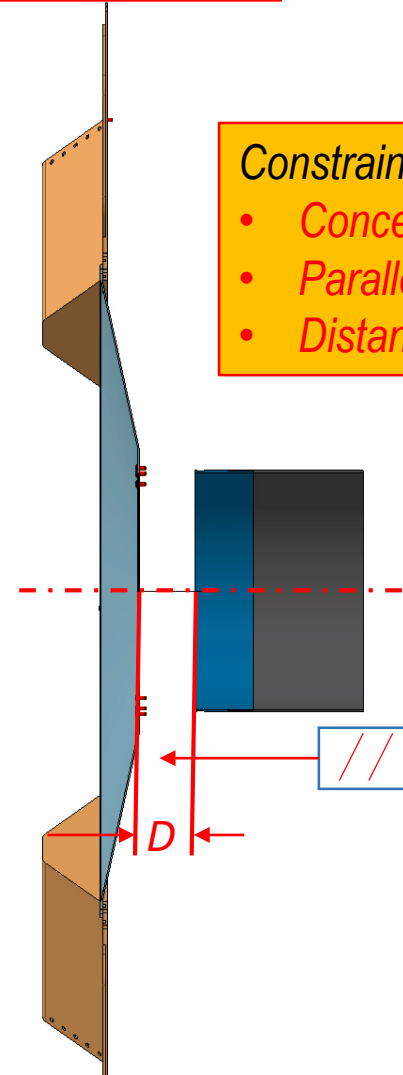
CONE FLANGE
Rigid Part

IST Fixed Part



Constrains between PP1 Outer Wall – Cone Flange

- Concentricity
- Parallelism
- Distance



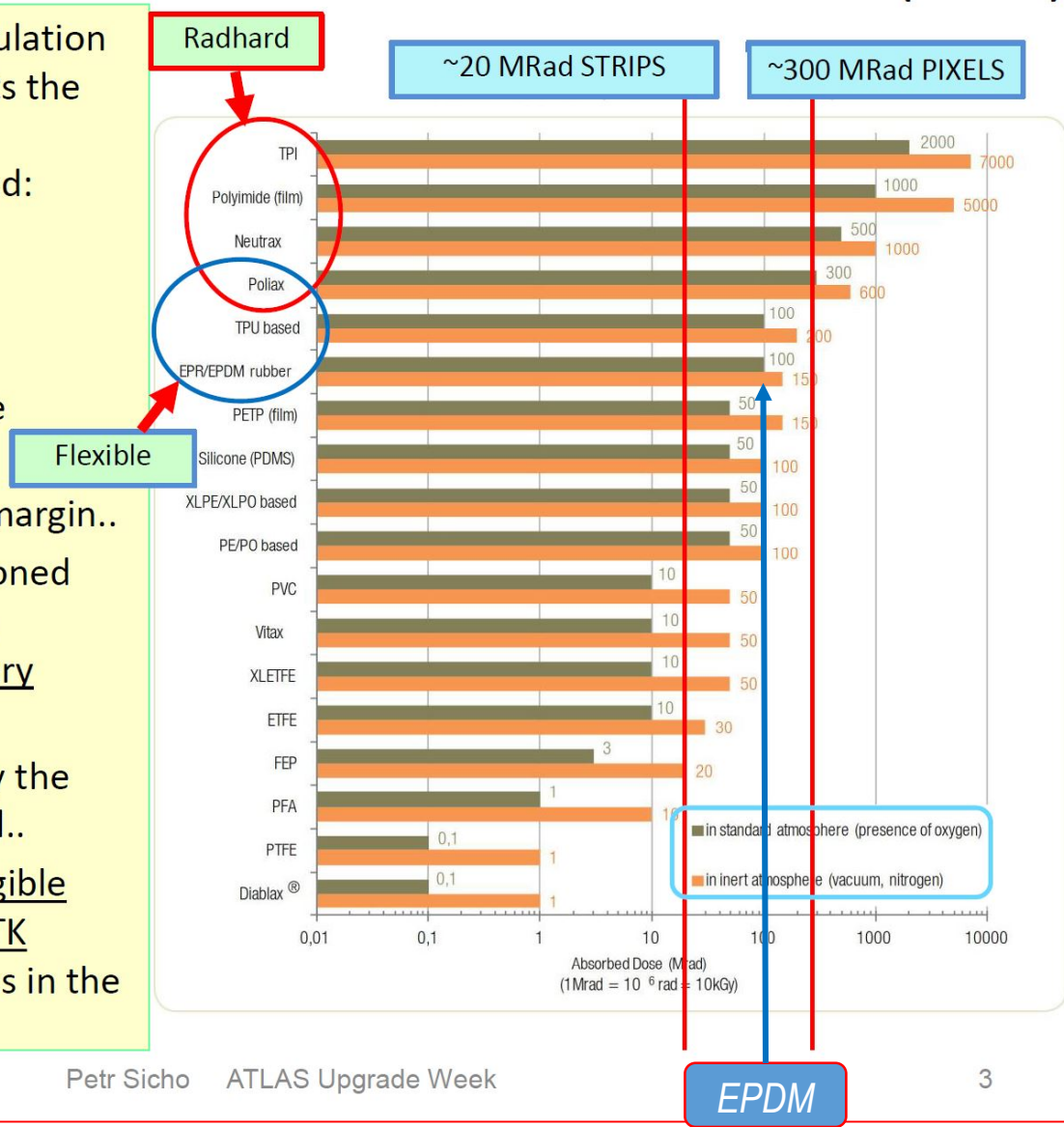
AND MOREOVER

... DUE TO THE AVAILABLE SPACE THE COUPLING COMPONENTS
MUST BE ASSEMBLED AND DISASSEMBLED IN SEQUENCE.

PP1 CHOICE OF GASKETS

Radiation resistance of different insulation materials (Axon)

- Radiation resistance of insulation materials significantly limits the choice. Basically only few materials can be considered:
- **TPI** (extruded polyimide)
- **Polyimide film** (kapton)
- Neutrax (PEEK based)-not recommended (brittle wire insulation).
- **Poliax** - already near the margin..
- Luckily all materials mentioned above are **LSZH** and **flame retardant** 😊 but are **not very flexible** 😞
- TPU (polyurethane) - Likely the only really flexible material..
- Probably we assume **negligible amount of oxygen under ITK endplate** thus higher values in the plot can be considered...



From Petr Slides

11/12/2018

Petr Sicho ATLAS Upgrade Week

3

Carbon Fiber thermal expansion coefficient: Length $m \times \lambda \times C^\circ$ (degrees of temperature increase)

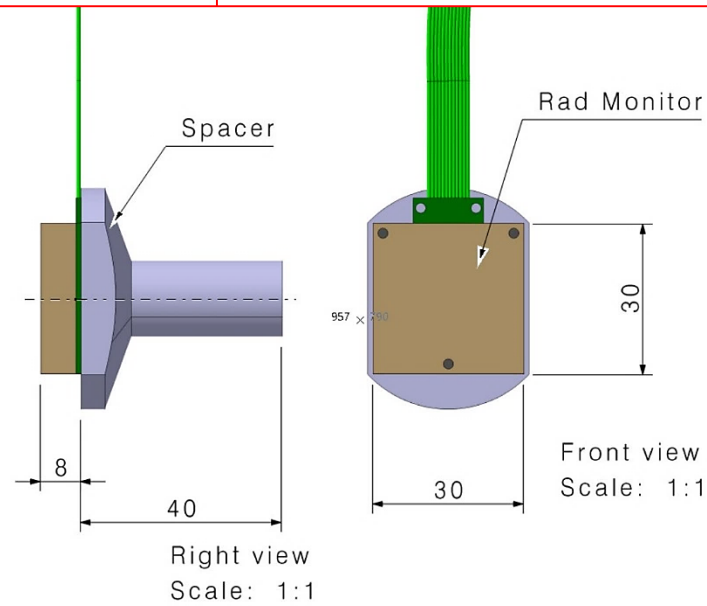
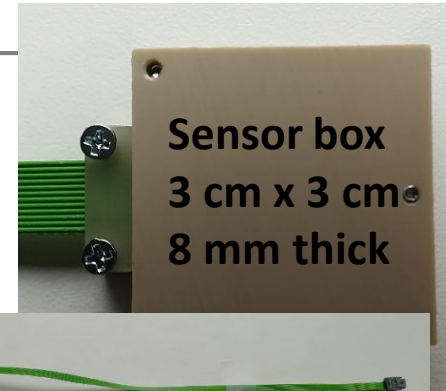
Temperature from 20 ° C to 70 ° C for:

- *Carbon fiber T300: $0,74 \times 10^{-6} / K$ (0,000074)*
- *Carbon Fiber M40: $1,23 \times 10^{-6} / K$ (0,00000123)*
- *- CFRP: 0,000050 (indicative 50 times less Aluminum 0,000023)*
- *- Titanium: 0,0000086*

PP1-RAD MONITOR LOCATION

*Z Coordinate 3258 mm (with a spacer)
(3200mm requested by Igor Mandic)*

Rad Monitor



RAD MONITOR MODEL

