EFDA ITER - Goal Oriented Training Program
Port Plug Engineering
-
Maintainability associated to ITER Component Lifecycle
-

8th - 12th of June 2009

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- **Personal Presentation**
- **Introduction of the subject of my training**
  - ✓ Movie of the maintenance sequence
- **Project about the sealing devices of the ports**
  - ✓ Metallic gasket flange
  - ✓ Welded lips
  - ✓ Associated remote handling tools

Training period 06/2009 – 06/2012

- Subject : Life-cycle of ITER's components, maintenance of port plug

Experiences

- Mechanical engineering school (UTC) 09/2003 – 02/2009
  - ✓ Mechanical design

- Internship within the C.E.A. 09/2008 – 02/2009
  - ✓ Study on the maintenance sequence of the equatorial port plug, and the associated remote handling tools

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Maintainability associated to ITER Component Lifecycle

What is maintenance ?

« All actions which have the objective of retaining or restoring an item in or to a state in which it can perform its required function. The actions include the combination of all technical and corresponding administrative, managerial, and supervision actions »

Why we need maintenance ?

✓To have an available experimental equipment

✓To demonstrate that the maintenance of a Tokamak is compatible with an industrial electricity production

Environmental conditions

- ✓ High magnetic fields
- ✓ High energy neutron
- ✓ High heat flux

Consequences

- ✓ The first wall components will suffer strong stress
- ✓ Many parts of this components will have to be replaced or refurbished
- ✓ The maintenance operations will take place in a nuclear environment

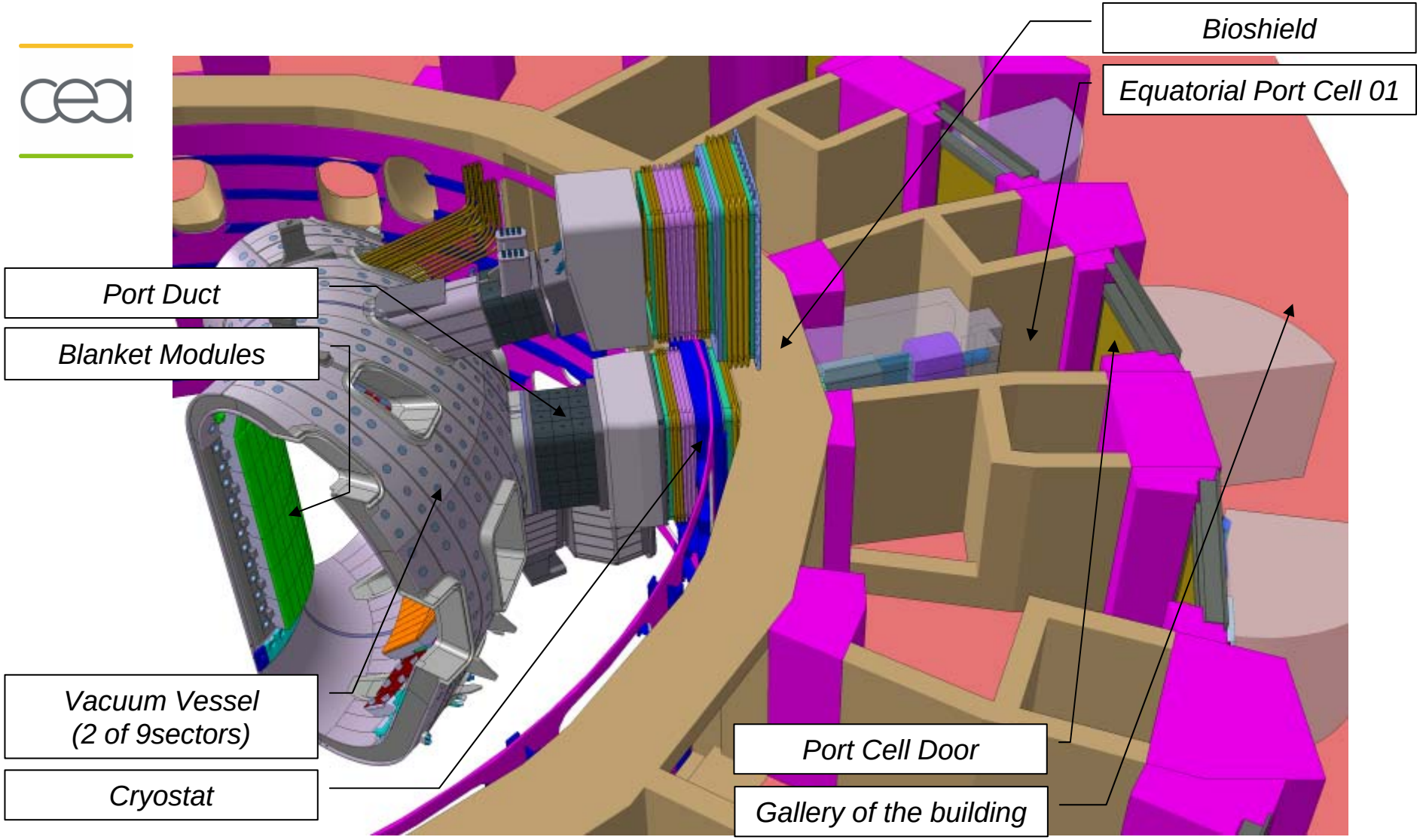
ALARA rules

"As Low As Reasonably Achievable"

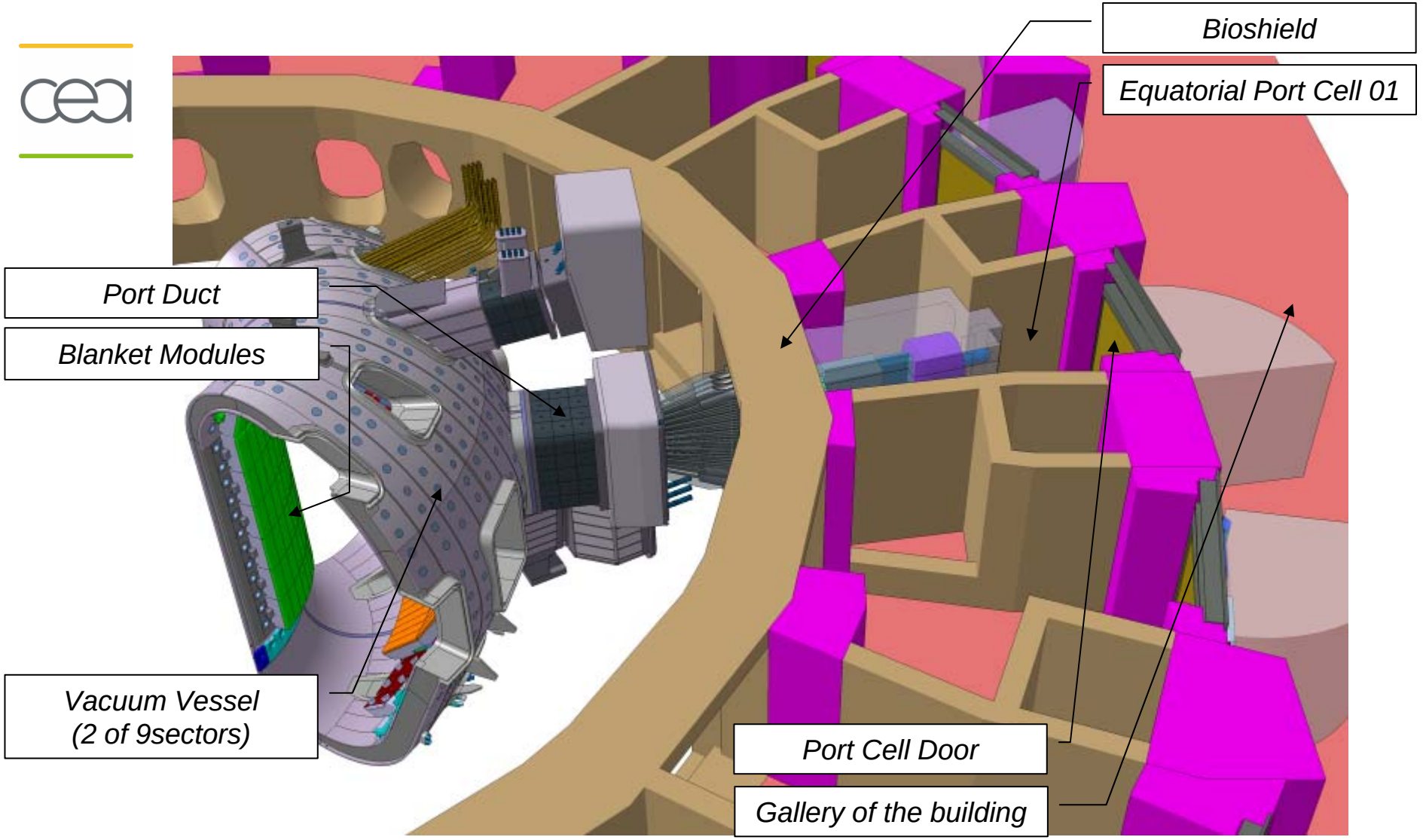
How to work in nuclear environment ?

- ✓ Regulation says :
  - Maximum permissible dose equivalent by year : 20 mSv
  - Maximum permissible dose equivalent by hour : 750 µSv
- ✓ Safety strategies are :
  - to be far
  - to minimize time of exposure
- ✓ Solution is :
  - to use remote-handling tools to operate the first wall components

Overview of the equatorial port plug



Overview of the equatorial port plug



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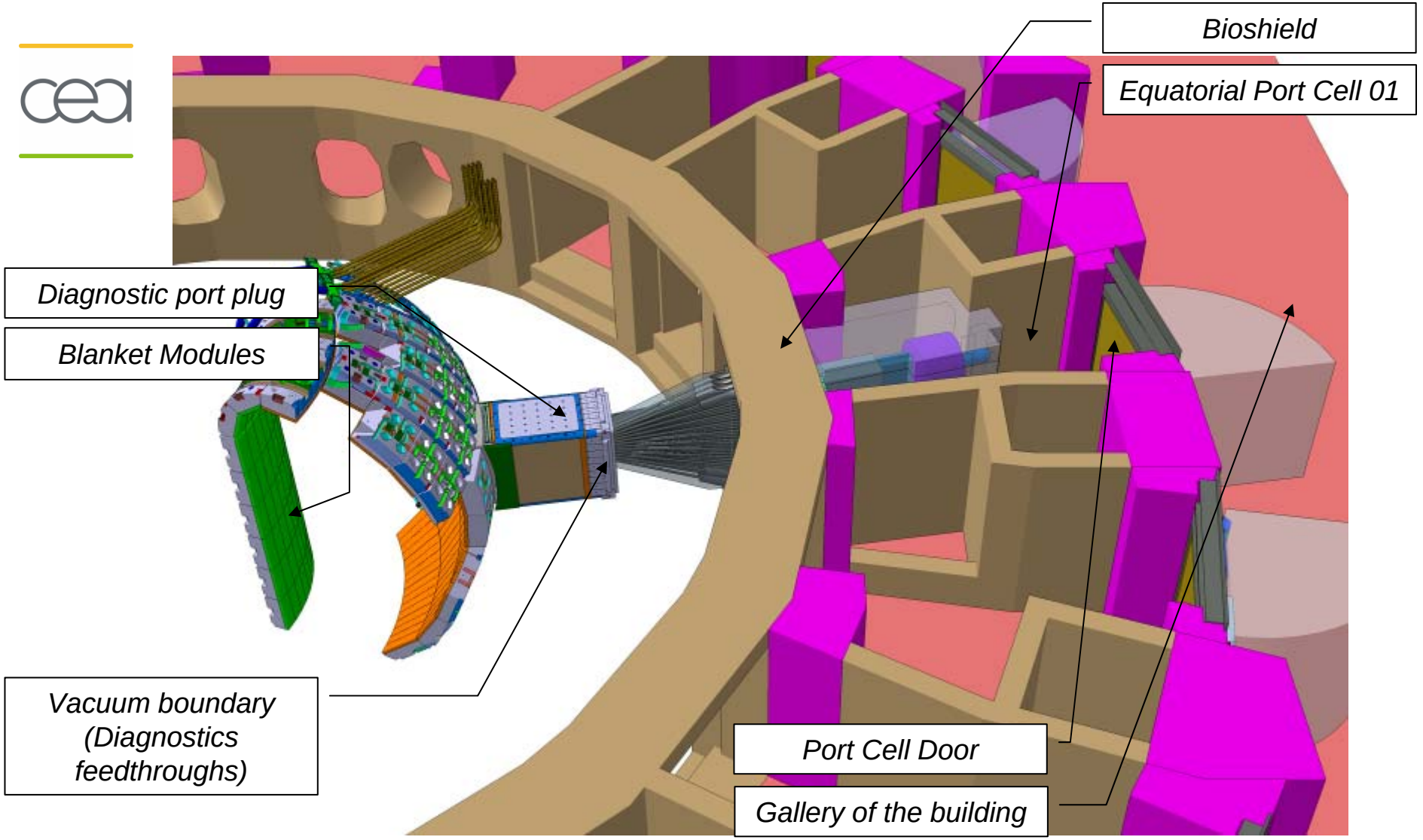

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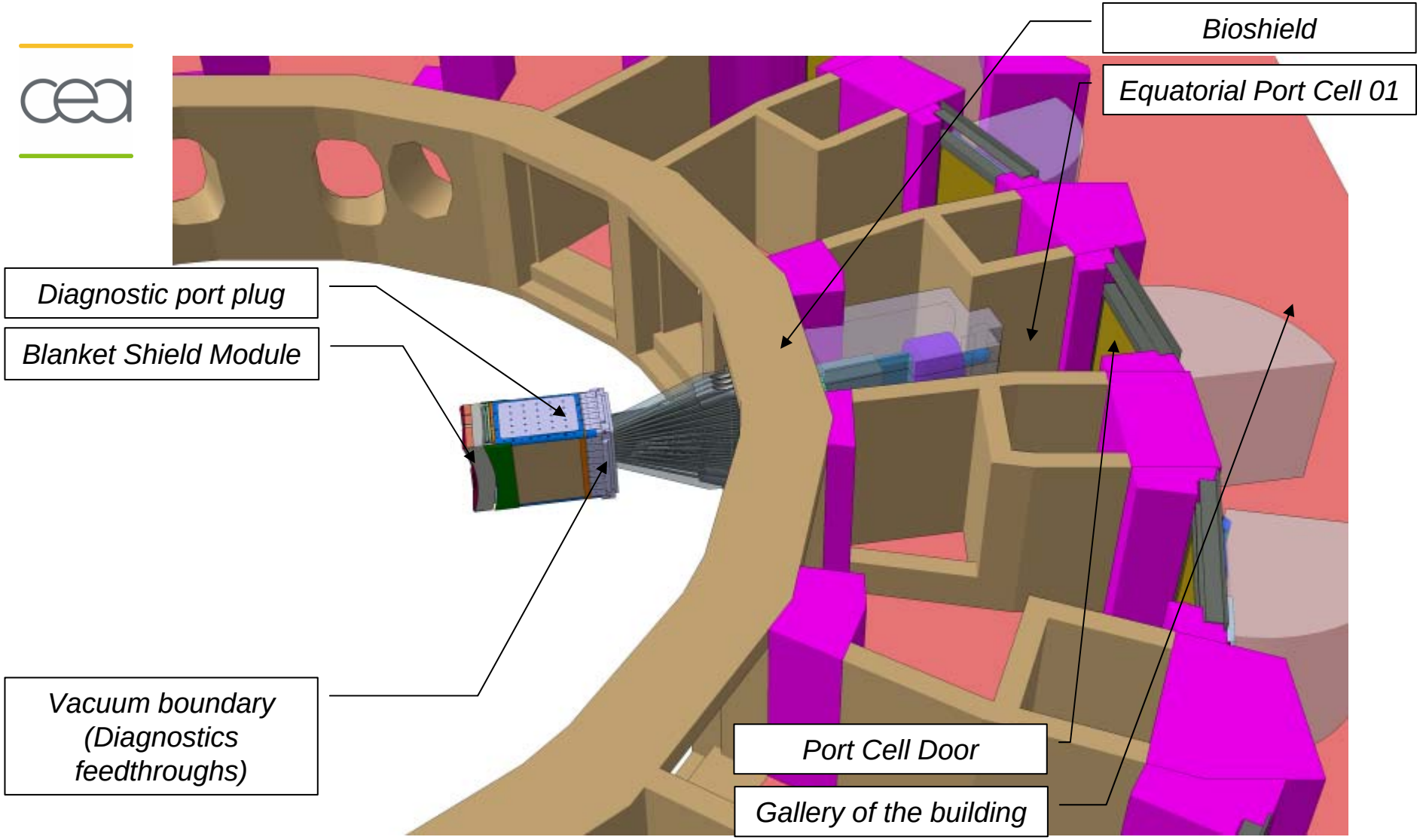

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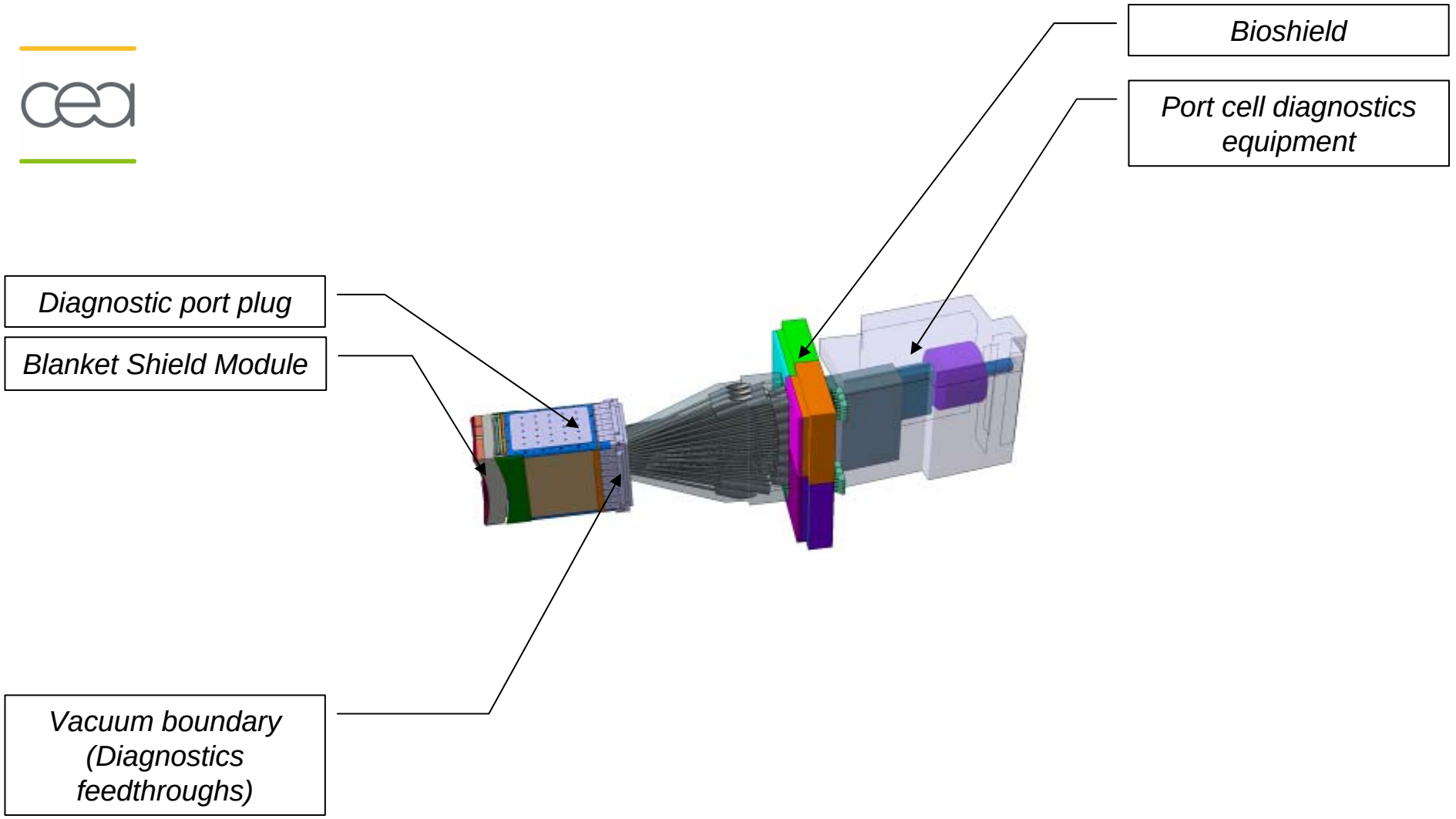

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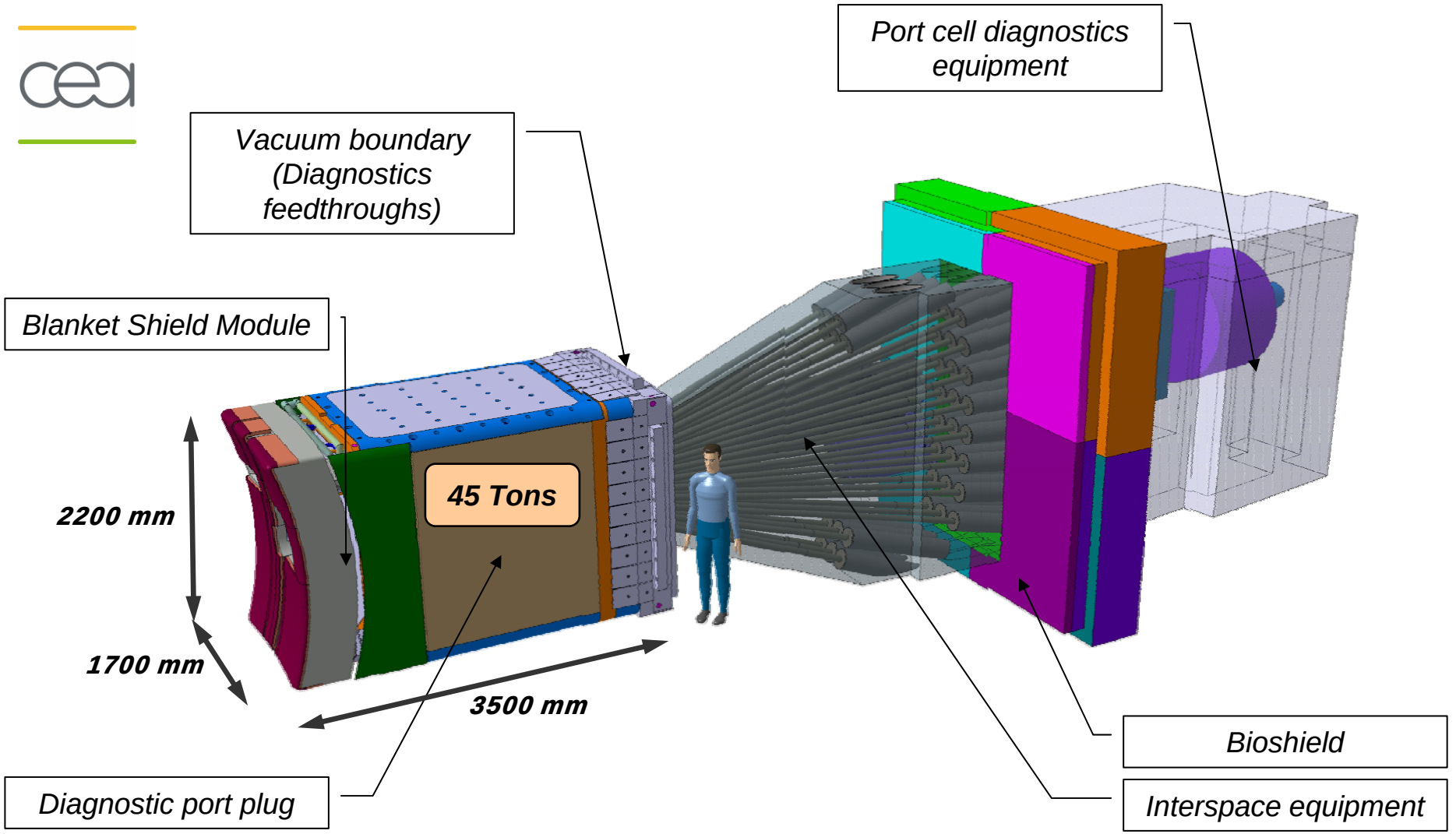
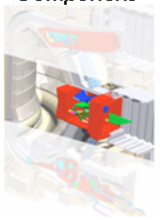
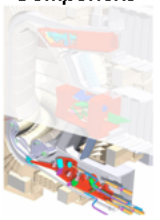
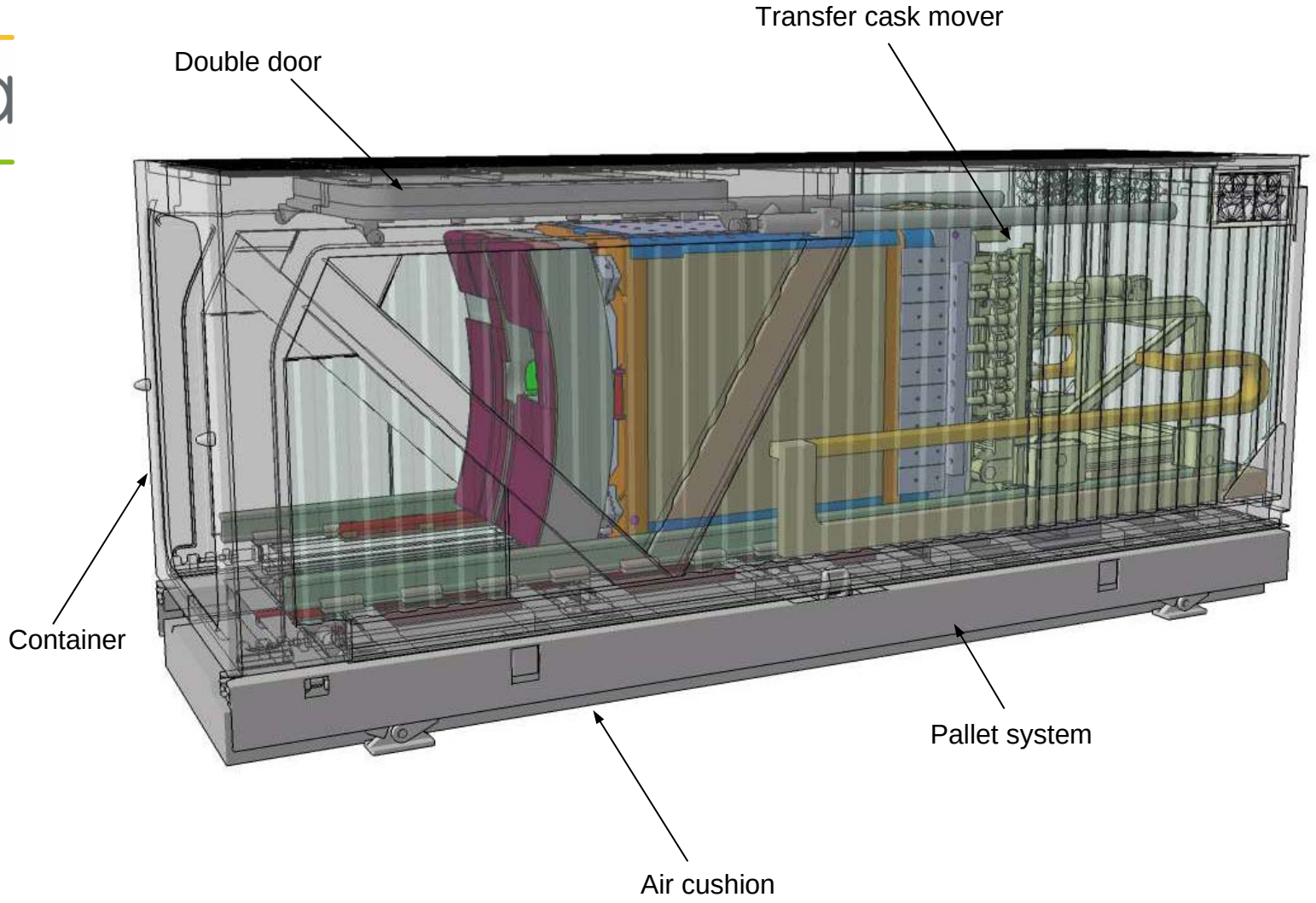


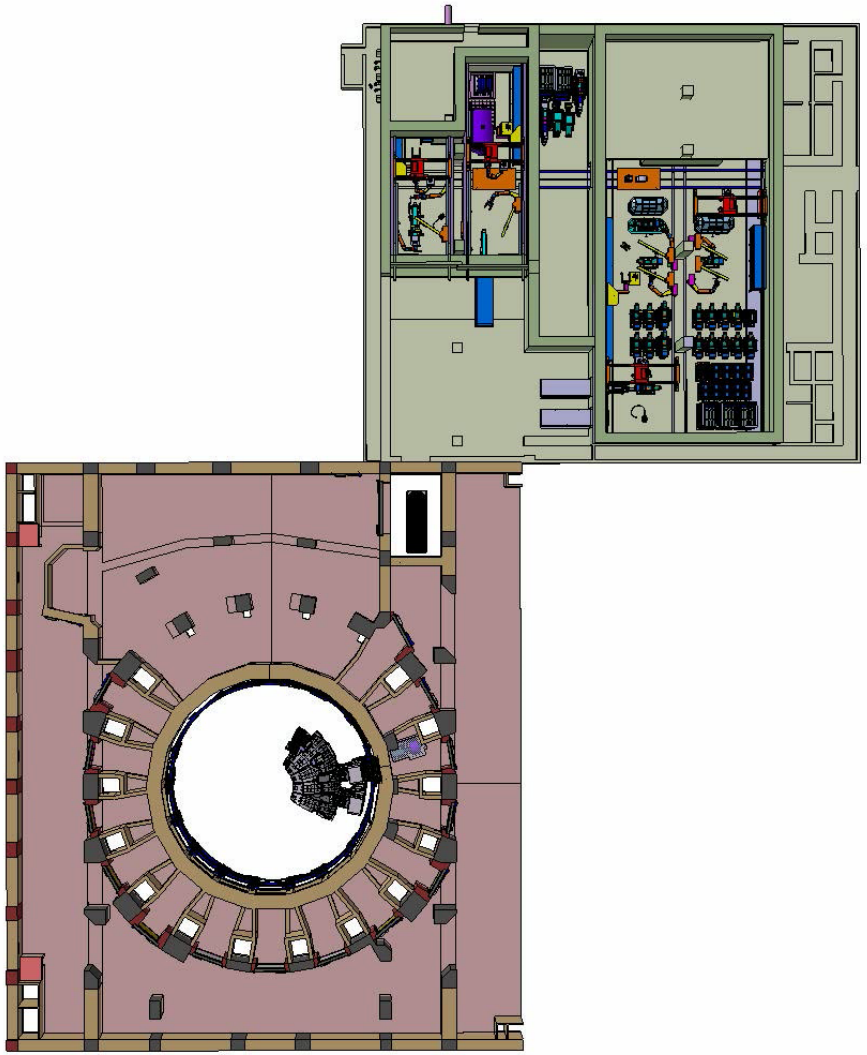
Operation frequency

	Upper level				Equatorial level				Lower Level			
Port N°	Component* 	Number of operations** 1st ass & final removal	Scheduled	Non-Scheduled	Component* 	Number of operations** 1st ass & final removal	Scheduled	Non-Scheduled	Component* 	Number of operations** 1st ass & final removal	Scheduled	Non-Scheduled
1	Diagnostic Plug [2]	2	0	1	Diagnostic Plug [2]	2	0	3	Torus cryopump [2]			
2	Diagnostic Plug [2]	2	0	1	Test Blanket Modules [1]	2	10	0	Diagnostic Racks [1] Divertor Cassettes [1]	2	3 3	0 0
3	Diagnostic Plug [2]	2	0	1	Diagnostic Plug [1] Blanket Modules [1]	2	<5 1	0 0	Cryostat cryopump [3] IVVS Plug [2]			
4	Neutral Beam Cell				Neutral Beam Cell				Torus cryopump [2]			
5									Torus cryopump [2] IVVS Plug [2]			
6									Torus cryopump [2]			
7									Torus cryopump [2]			
8	Diagnostic Plug [2]	2	0	1	Limiter or alternative Plug [1] Blanket Modules [1]	2	<5 1	0 0	Diagnostic Racks [1] Divertor Cassettes [1]	2	3 3	0 0
9	Diagnostic Plug [2]	2	0	1	Diagnostic Plug [2]	2	0	3	IVVS Plug [2]			
10	Diagnostic Plug [2]	2	0	1	Diagnostic Plug [2]	2	0	3	Diagnostic Racks [1]	2	3	0
11	Diagnostic Plug [2]	2	0	1	Diagnostic Plug [2]	2	0	3	Cryostat cryopump [3] IVVS Plug [2]			
12	ECH Plug [2]	2	0	<4	Diagnostic Plug [1] Blanket Modules [1]	2	<5 1	0 0	Torus cryopump [2]			
13	ECH Plug [2]	2	0	<4	ICH Plug [2]	2	0	<4	Torus cryopump [2]			
14	Diagnostic Plug [2]	2	0	1	ECH Plug [2]	2	0	<4	Diagnostic Racks [1] Divertor Cassettes [1]	2	3 3	0 0
15	ECH Plug [2]	2	0	<4	LHH Plug [2]	2	0	2	IVVS Plug [2]			
16	ECH Plug [2]	2	0	<4	Test Blanket Modules [1]	2	10	0	Diagnostic Racks [1]	2	3	0
17	Diagnostic Plug [2]	2	0	1	Limiter or alternative Plug [1] Blanket Modules [1]	2	<5 1	0 0	IVVS Plug [2]			
18	Diagnostic Plug [2]	2	0	1	Test Blanket Modules [1]	2	10	0	Torus cryopump [2]			
Sub-totals		**28**	**0**	**26**		28	54	22		10	24	0
Total		**54**				**104**				**34**		

Remote Handling tool : Transfer Cask system



Sequence of the extraction of the port plug



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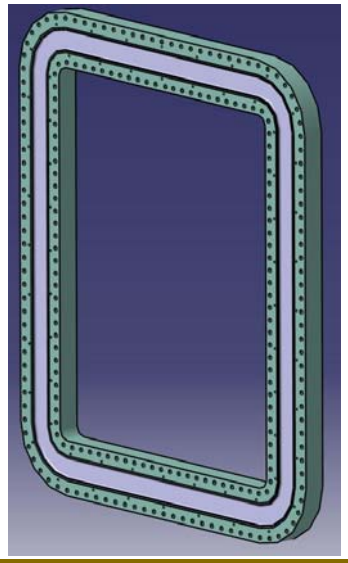
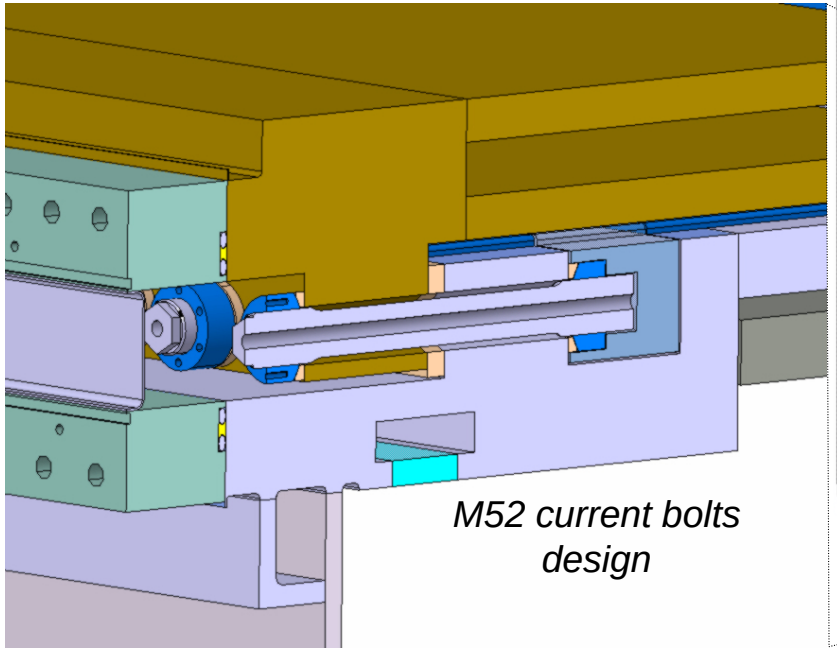
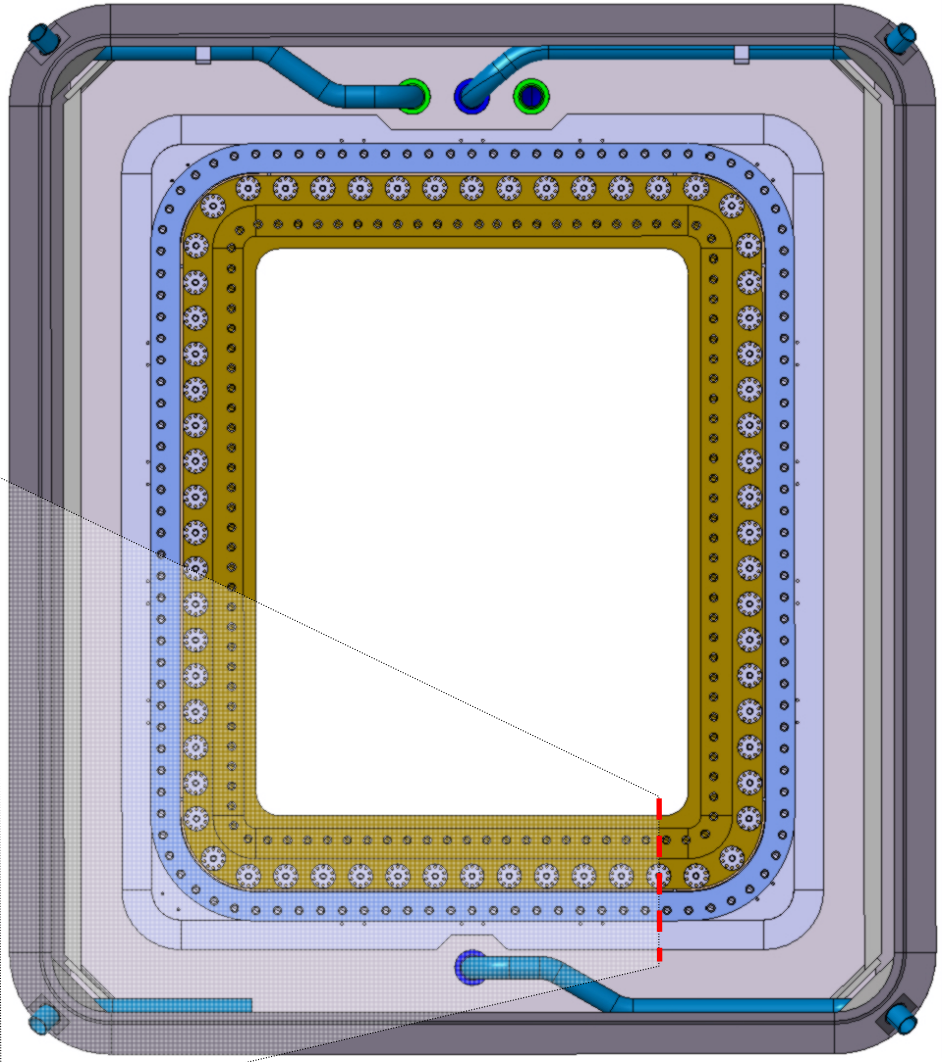
Port Sealing interface current design – Metallic Gasket



Gasket Flange (1000Kg)



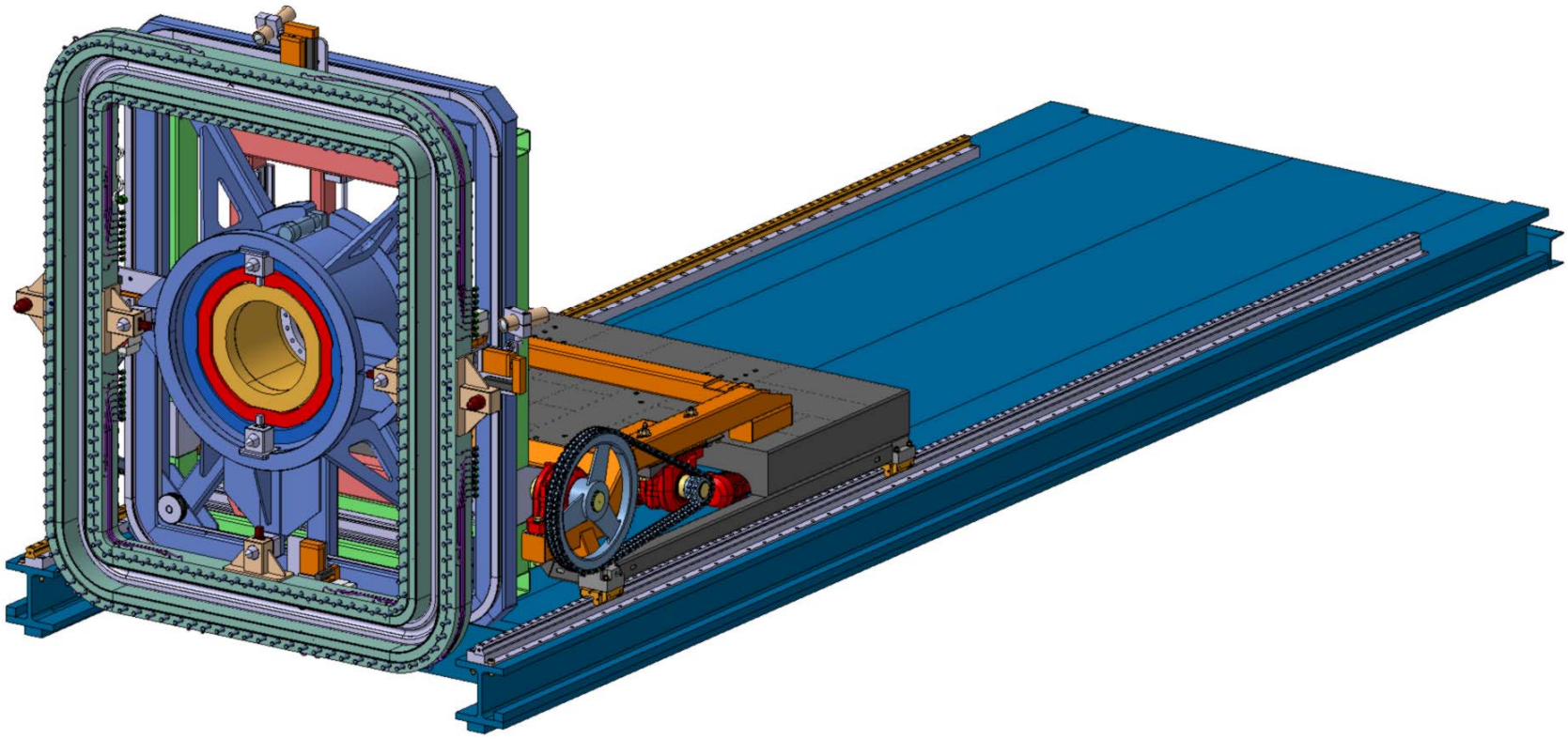
M52 current bolts design

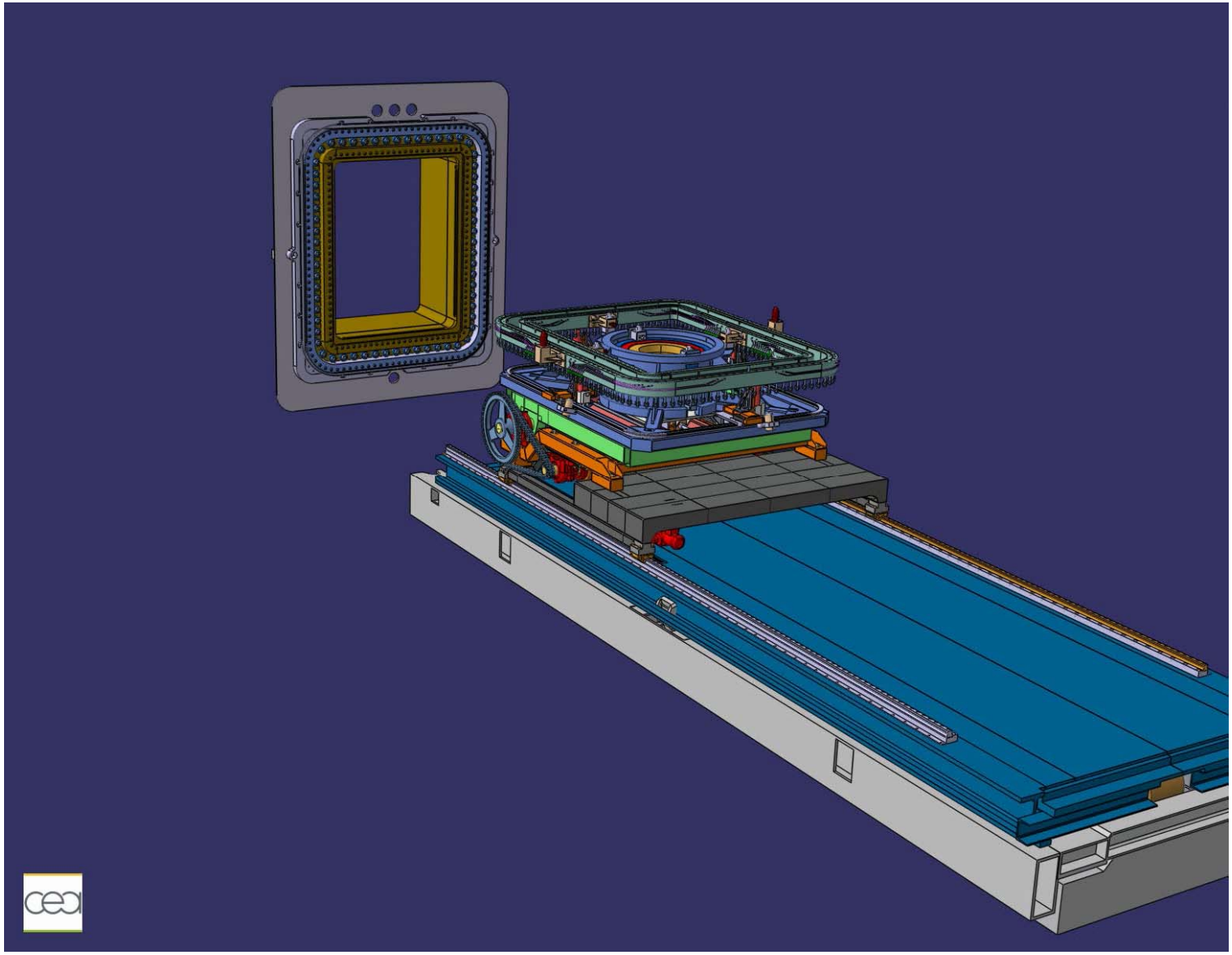


➢ Tooling preliminary conceptual design – *Dedicated tool serial positioning axis*

Design details on the dedicated tool :

✓ *Basic design of the tool already developed by the CEA and used as a base for the current task*





Conclusion

✓***R&D on the ITER port-plug engineering and integration - 10 months***

I should participate to the ITER port-plug engineering and integration projects (diagnostics, TBMs, ICRH antenna), in order to apply his specific skills in maintenance processes in the frame of the project.

- *Technical specification*
- *Components design*
- *Remote Handling impact on design and maintainability*

✓***Development of the port plugs maintenance strategies - 15 months***

For each kind of port plug, their will be common maintenance aspects and specific activities. The trainee will help to identify and detail the operations and associated features:

- *Components Maintenance Procedure and Plan definition (hands-on and remote).*
- *Hot Cells specific equipments. (catalogue of tools)*
- *Standardization of maintenance assembly procedures.*
- *Lifecycle of each kind of port plug*
- *Evaluations of maintenance times*

This development should be done with each partner's involved in the program in order to take benefit of this time to try standardizing the maintenance procedures:

✓*To schedule :*

- *2 months in FZK working on the TBM and ECRH*
- *3 months in HAS working on assembly of diagnostics*
- *3/6 months in ITER working on TCS kinematic*

✓*To organize*

- *Period in industrial partners (AREVA, CYBERNETIX…)*