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Detailed analysis of Lorentz's and Maxwell's forces on DEMO segments under normal and off-normal operational conditions

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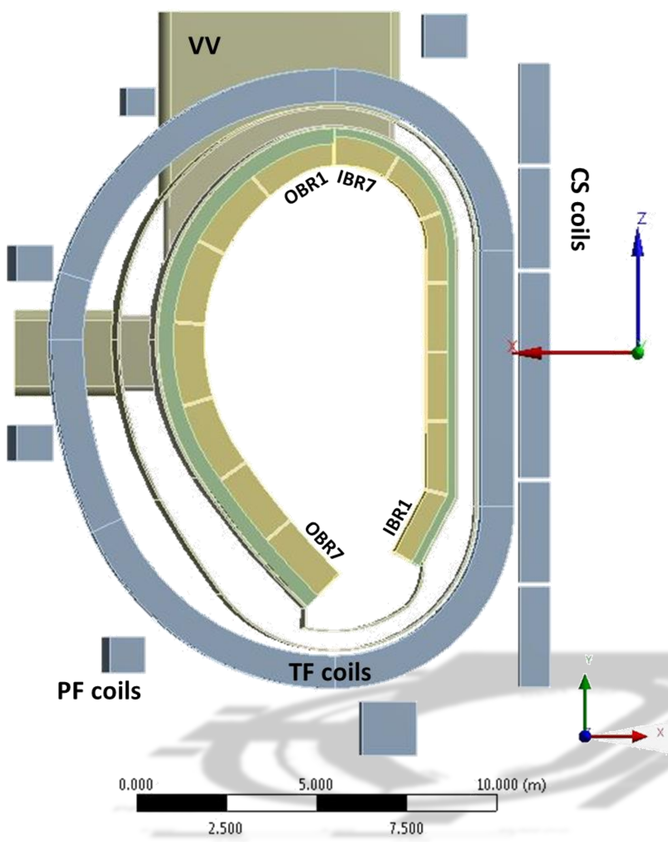
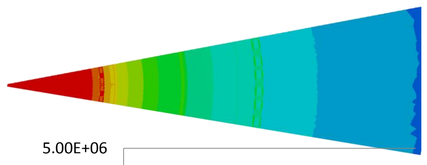
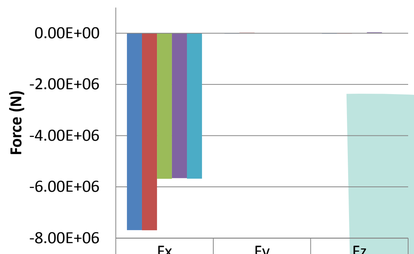
This work is aimed to analyse the EM force distribution on the blanket system (blankets modules and segment back supporting structure) of the EU PPPT DEMO 2015 reactor configuration. Static analyses have been performed using different magnetic source combinations in order to investigate their effect on the Maxwell's forces. Moreover a transient EM analysis, performed using a simplified central plasma disruption with a linear quench time of 77 ms, allows to study the behaviour of Lorentz's forces and identify the most critical loads to be used in structural analyses.
Electrical and structural assumptions used in this work are based on the HCPB blanket design developed at the Karlsruhe Institute of Technology. However the obtained results can give useful information also for the other blanket concepts in the EUROfusion Breeding Blanket Project that are following a similar design architecture.

Static analysis – Maxwell's loads

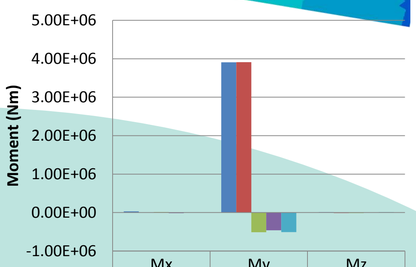


Analytic 1/r toroidal magnetic field

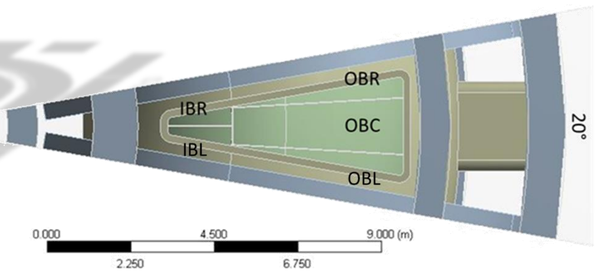




	Fx	Fy	Fz
IBR	-7.69E+06	-1.70E+04	-1.99E+04
IBL	-7.69E+06	1.91E+04	-1.90E+04
OBR	-5.69E+06	-9010	1605
OBC	-5.66E+06	-5868	3.26E+04
OBL	-5.68E+06	8103	1637

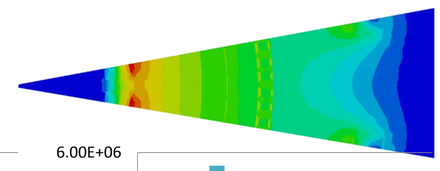


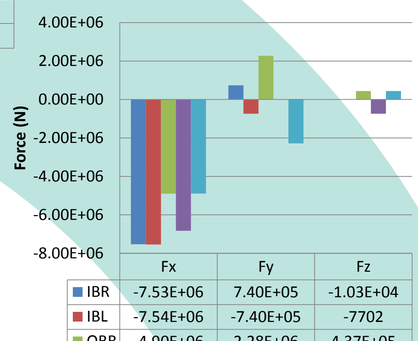
	Mx	My	Mz
IBR	3.06E+04	3.91E+06	9225
IBL	-2335	3.91E+06	-1.41E+04
OBR	1.27E+04	-5.13E+05	-1.42E+04
OBC	-1.65E+04	-4.60E+05	-1098
OBL	5701	-5.10E+05	1.02E+04



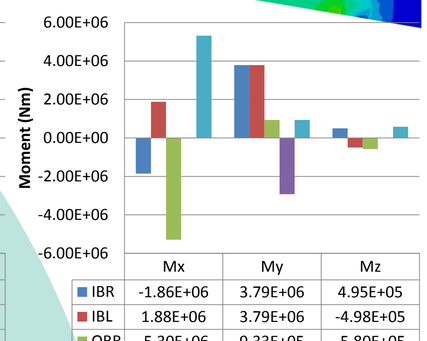
Forces and moments are reported in the coordinate system of each component

TF magnetic field



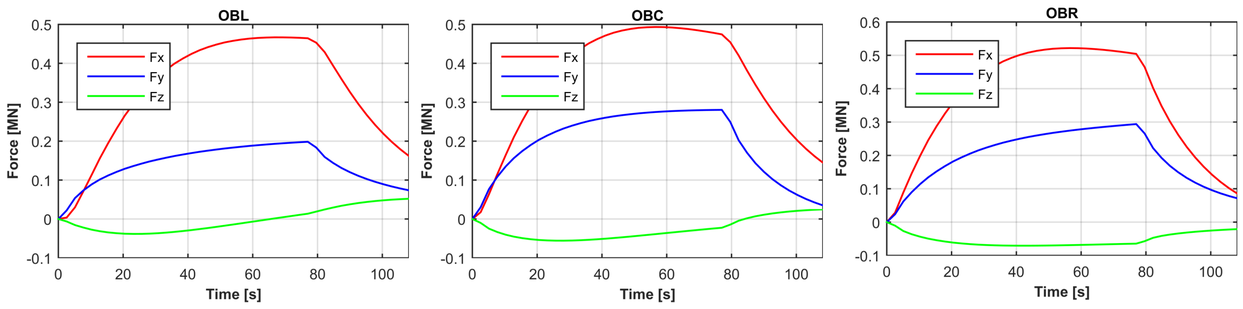


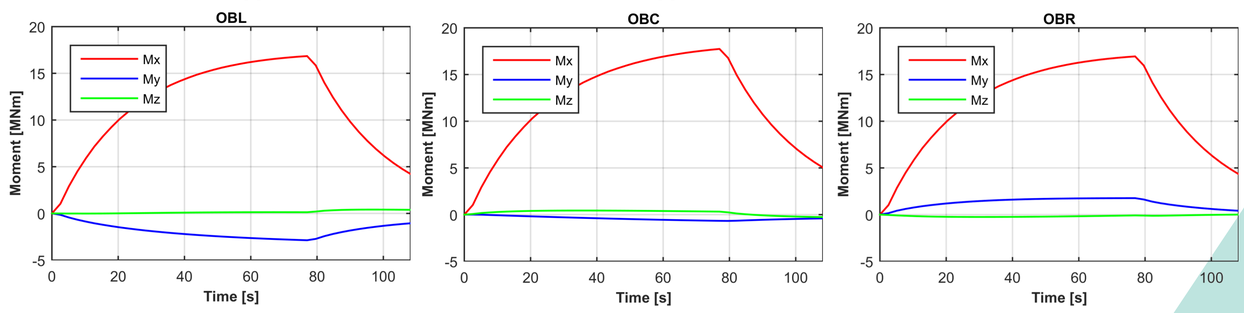
	Fx	Fy	Fz
IBR	-7.53E+06	7.40E+05	-1.03E+04
IBL	-7.54E+06	-7.40E+05	-7702
OBR	-4.90E+06	2.28E+06	4.37E+05
OBC	-6.83E+06	-6918	-7.38E+05
OBL	-4.90E+06	-2.28E+06	4.38E+05

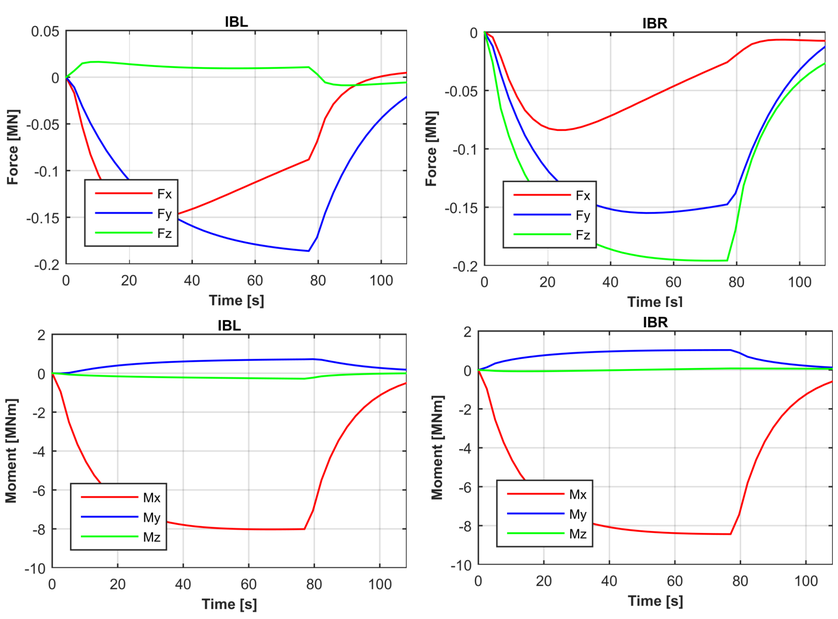


	Mx	My	Mz
IBR	-1.86E+06	3.79E+06	4.95E+05
IBL	1.88E+06	3.79E+06	-4.98E+05
OBR	-5.30E+06	9.33E+05	-5.80E+05
OBC	-1.84E+04	-2.93E+06	63
OBL	5.32E+06	9.37E+05	5.77E+05

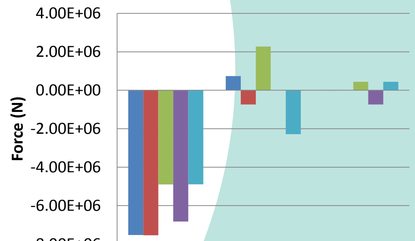
Transient analysis – Lorentz's loads





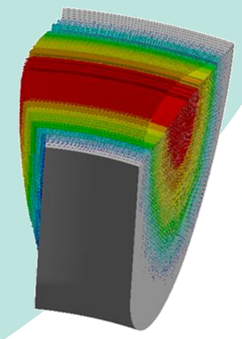


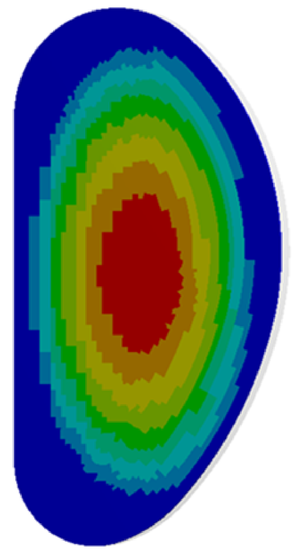
TF + PF + CS magnetic field



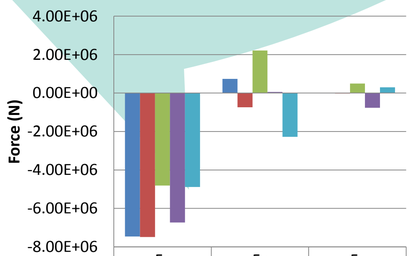
	Fx	Fy	Fz
IBR	-7.53E+06	7.40E+05	-1.03E+04
IBL	-7.54E+06	-7.40E+05	-7702
OBR	-4.90E+06	2.28E+06	4.37E+05
OBC	-6.83E+06	-6918	-7.38E+05
OBL	-4.90E+06	-2.28E+06	4.38E+05

	Mx	My	Mz
IBR	-1.86E+06	3.79E+06	4.95E+05
IBL	1.88E+06	3.79E+06	-4.98E+05
OBR	-5.30E+06	9.33E+05	-5.80E+05
OBC	-1.84E+04	-2.93E+06	63
OBL	5.32E+06	9.37E+05	5.77E+05

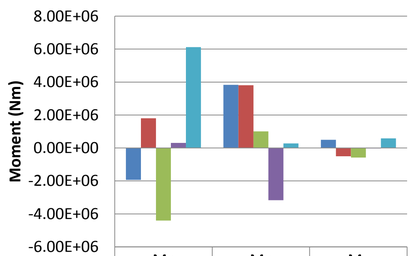




TF + PF + CS + Plasma magnetic field



	Fx	Fy	Fz
IBR	-7.46E+06	7.38E+05	-6705
IBL	-7.49E+06	-7.38E+05	-2.47E+04
OBR	-4.82E+06	2.22E+06	4.92E+05
OBC	-6.74E+06	5.56E+04	-7.66E+05
OBL	-4.89E+06	-2.28E+06	3.01E+05



	Mx	My	Mz
IBR	-1.93E+06	3.83E+06	4.94E+05
IBL	1.80E+06	3.81E+06	-5.00E+05
OBR	-4.41E+06	1.01E+06	-5.80E+05
OBC	3.09E+05	-3.17E+06	-2.19E+04
OBL	6.12E+06	2.73E+05	5.84E+05

KIT – University of the State of Baden-Wuerttemberg and National Research Center of the Helmholtz Association

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